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1978

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also:

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AC128 18p	BA316 16p	BC182 10p	BCY72 15p	BF179 35p	BFX81 130p	E430 125p	TIP29A 47p	TIP42A 80p	2N2906 18p
AC151 25p	BA316 5p	BC182L 12p	BCY72 15p	BF180 30p	BFX84 25p	MJE340 45p	TIP29C 75p	TIP42B 85p	2N2907 20p
AC153K 40p	BA316 5p	BC183 10p	BD121 85p	BF181 35p	BFX85 30p	MPSA06 22p	TIP30 55p	TIP295 70p	2N3053 20p
AC176 20p	BB105A 35p	BC183L 12p	BD123 100p	BF181 35p	BFX87 25p	OA10 40p	TIP30A 58p	TIP305 55p	2N3054 50p
AC177 35p	BB110 45p	BC184 10p	BD124 85p	BF182 30p	BFX88 25p	OA17 15p	TIP30B 65p	TIS90 25p	2N3055 60p
ADY21 30p	BC108 10p	BC184L 12p	BD131 36p	BF183 30p	BFY50 20p	OA30 6p	TIP30C 80p	TIS91 25p	2N3439 50p
AD149 60p	BC108C 15p	BC205 14p	BD132 36p	BF186 25p	BFY51 20p	OA31 6p	TIP30C 80p	IN914 5p	2N3702 11p
AD161 40p	BC109 10p	BC212 11p	BD133 45p	BF194 10p	BFY90 125p	OA202 8p	TIP31A 58p	IN3754 10p	2N3703 12p
AD162 40p	BC109C 14p	BC212L 12p	BD136 40p	BF195 10p	BR101 35p	OC23 200p	TIP31B 65p	IN4001 5p	2N3704 11p
AD161/2MP 80p	BC113 12p	BC213L 12p	BD137 36p	BF196 10p	BR197 10p	OC25 100p	TIP31C 70p	IN4002 5p	2N3705 12p
AF114 80p	BC117 19p	BC214 15p	BD139 38p	BF198 25p	BR298 35p	OC28 75p	TIP32 60p	IN4003 5p	2N3706 11p
AF115 22p	BC125 20p	BC214L 14p	BD140 40p	BF199 25p	BSX20 20p	OC35 75p	TIP32A 65p	IN4004 5p	2N3711 12p
AF116 22p	BC126 15p	BC258 13p	BD141 40p	BF200 30p	BSY40 25p	OC43 35p	TIP32B 85p	IN4005 5p	2N3712 175p
AF117 22p	BC146 12p	BC294 35p	BD181 80p	BF224 20p	BSY95 20p	OC45 35p	TIP32C 90p	IN4006 5p	2N3819 25p
AF118 30p	BC148 10p	BC303 55p	BD182 30p	BF225 20p	BT100A 80p	OC71 25p	TIP33 100p	IN4007 7p	2N3886 9p
AF125 25p	BC148C 14p	BC317 15p	BD207 70p	BF241 18p	BU105 150p	OC72 30p	TIP33A 105p	IN4007 7p	2N3904 15p
AF139 35p	BC149 10p	BC328 13p	BD233 50p	BF244B 35p	BU133 5p	OC72 30p	TIP33A 115p	IN4148 4p	2N4062 14p
AF239 45p	BC157 10p	BC338 12p	BD263 65p	BF257 28p	BU208 220p	OC75 30p	TIP33C 130p	IS44 4p	2N4126 20p
AS226 40p	BC158 10p	BC347 12p	BDY10 100p	BF258 28p	BY100 20p	OC81 30p	TIP34 115p	2N456A 90p	2N4126 20p
BA114 9p	BC159 10p	BC547 12p	BDY62/01 90p	BF259 30p	BY126 15p	OC81D 25p	TIP34A 118p	2N929 20p	2N5061 35p
BA121 9p	BC167A 12p	BC547B 13p	BF120 50p	BF274 15p	BY127 19p	OC83 50p	TIP34B 145p	2N930 20p	2N5163 35p
	BC167A 12p	BC548 12p	BF121 45p	BF324 30p	BY133 22p	OC84 50p	TIP35 225p	2N1302 25p	2SD234 50p

BZY88
400M.W.
Zeners

OV7 10p
2V4 10p
2V7 10p
3V0 10p
3V3 10p
3V6 10p
3V9 10p
4V7 10p
5V1 10p
5V6 10p
6V2 10p
6V8 10p
7V5 10p
8V2 10p
9V1 10p
10V 10p
11V 10p

BZY88

12V 10p
13V 10p
15V 10p
18V 10p
20V 10p
22V 10p
27V 10p
30V 10p
33V 10p
100 Mixed Zeners 850p
BZY88 Zeners 850p

CA3090AQ 400p

TA A300 150p
TA A350 190p
TA A550 50p
TA A570 220p
TA A861B 140p
TA A700 350p
TAD100 250p
TAD110 200p
TBA120S 125p
TBA120T 125p
TBA340 300p
TBA540Q 400p
TBA550Q 400p
TBA560 400p
TBA641A12 250p
TBA720 230p
TBA800 100p
TBA820 100p
TBA920 250p
TCA270Q 250p
TCA270S 250p

LM301A 65p
LM307N 65p
LM308TOS 130p
LM308 8 DIL 130p
LM309K 180p
LM317K 325p
LM348N 200p
LM380N 110p
LM555 35p
LM710 TOS 60p
LM710 P 65p
LM723 TOS 60p
LM723 14 DIL 75p
LM741 25p
LM748 45p
LM1303N 155p
LM3900 90p
NE555 35p
NE556 100p
NE562B 400p

ELECTROLYTIC CAPACITORS

330/35 16p
330/50 12p
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470/35 18p
470/50 22p
680/25 25p
1000/16 25p
1000/35 50p
1000/10 20p
2000/35 50p
2200/16 35p
2200/100 120p
3300/16 40p
3300/25 42p
3300/63 80p
4700/25 45p
4700/40 50p
4700/63 120p

POLYMER CAPACITORS
Mullard or Erie

001 5p
0022 5p
0033 5p
0047 5p
0068 5p
01 5p
022 5p
033 5p
047 12p
047 12p
1 6p
22 7p
33 7p
47 12p
100/10 6p
100/16 6p
100/25 6p
100/50 6p
100/63 10p
125/15 6p
220/16 10p
220/25 12p
220/50 20p
330/25 15p

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-5 W 1/16 1p
2-2Ω-4-7M 2.5p
1 W 2-2Ω 10 MEG 3.5p

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1K Lin 30p
5K Lin 30p
10K Lin 30p
20K Lin 30p
50K Lin 30p
100K Lin 30p
250K Lin 30p
500K Lin 30p
1 Meg Lin 30p
2 Meg Lin 30p
5K Log 30p
10K Log 30p
25K Log 30p
50K Log 30p
100K Log 30p
250K Log 30p
500K Log 30p
1 Meg Log 30p
2 Meg Log 30p

ROTARY SWITCHES BY LORLIN

1P 12W 40p
2P 6W 40p
3P 4W 40p
4P 3W 40p

MULLARD PPT CORES

LA3 100-500 KHz 75p
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LA5 30-100KHz 100p
LA7 < 10KHz 100p

LA13 FOR W.W. OSCILLOSCOPE 200p

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100 for £9.00
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RED -125 15p
GREEN -125 25p
YELLOW -125 25p
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GREEN -2 25p
YELLOW -2 25p
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CMOS

4000 20p	4023 20p	4055 140p
4001 20p	4024 100p	4056 140p
4002 20p	4025 20p	4060 135p
4005 120p	4028 20p	4068 55p
4007 20p	4027 85p	4069 30p
4009 70p	4028 150p	4071 30p
4011 20p	4029 130p	4072 30p
4012 20p	4030 80p	4081 20p
4013 55p	4032 150p	4082 30p
4015 90p	4043 220p	4082 30p
4016 55p	4046 150p	4510 145p
4017 110p	4047 115p	4511 200p
4018 250p	4049 70p	4516 140p
4020 140p	4050 50p	4518 110p
4022 180p	4054 130p	4528 130p

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1A 50V 25p	V/REG.
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Capacitive discharge
electronic ignition kit

VOTED BEST
OF 8 SYSTEMS
TESTED BY
'POPULAR
MOTORING'
MAGAZINE
OCT 74



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THE KIT COMPRISES EVERYTHING NEEDED

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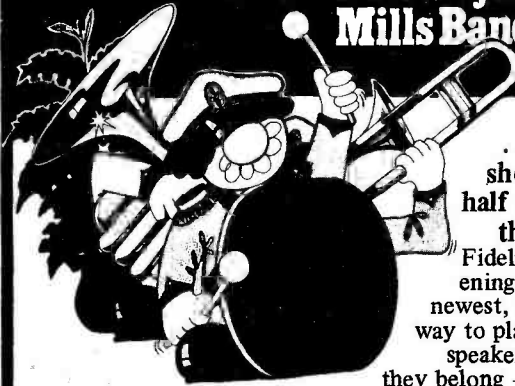
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Name

Address

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★ CARTRIDGES with Diamond Styl. 3 SEPARATE VOLUME CONTROLS for each turntable and Mic.

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Rating RMS Imp 8-15 ohms

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£49.95

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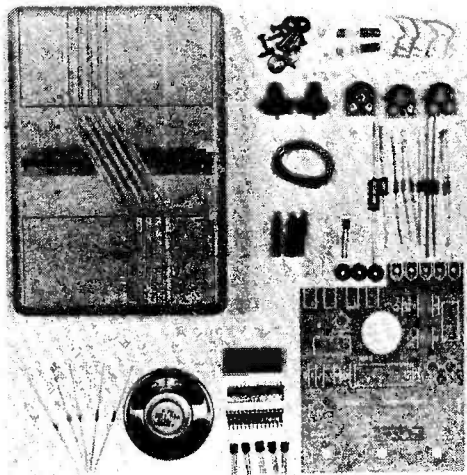
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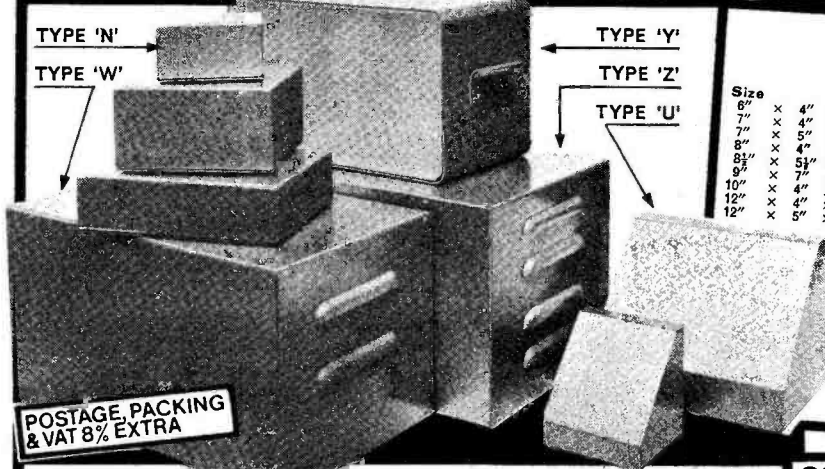
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HY5 Preamplifier

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.

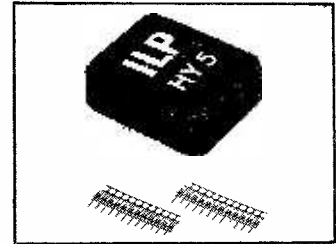
OUTPUTS: Tape 100mV; Main output 500mV R.M.S.

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 £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 £5-22 + 65p **VAT P&P free.**



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

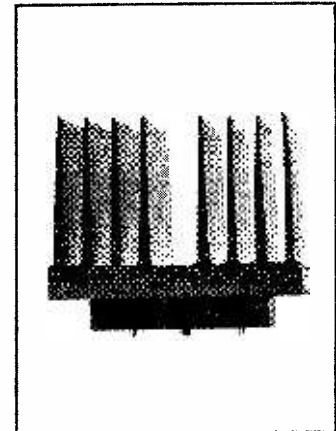
SPECIFICATIONS: **INPUT SENSITIVITY** 500mV

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 £6-82 + 85p **VAT P&P free**



HY120 60 Watts into 8 Ω

The HY120 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 £15-84 + £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

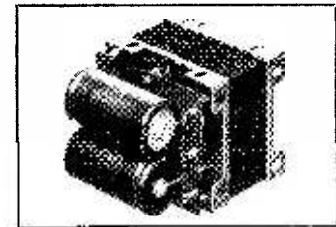
OUTPUT POWER 120W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-05% at 100W

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

\pm 45V

SIZE 114 50 85mm

Price £23-32 + £1-87 **VAT P&P free.**



HY400 240 Watts into 4 Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 Ω ! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

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

Price £32-17 + £2-57 **VAT P&P free.**

POWER SUPPLIES

PSU36 suitable for two HY30's £5-22 plus 65p VAT. P/P free.

PSU50 suitable for two HY50's £6-82 plus 85p VAT. P/P free.

PSU70 suitable for two HY120's £13-75 plus £1-10 VAT. P/P free.

PSU90 suitable for one HY200 £12-65 plus £1-01 VAT. P/P free.

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7408	0.18	74100	1.07
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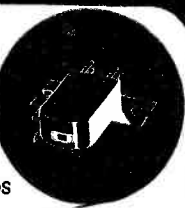
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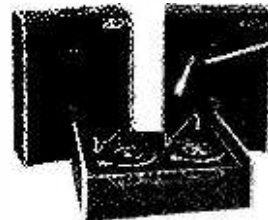
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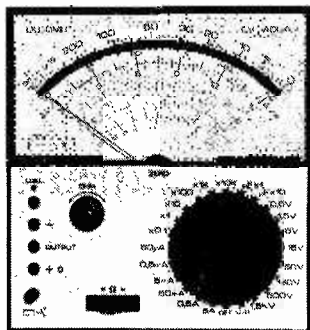
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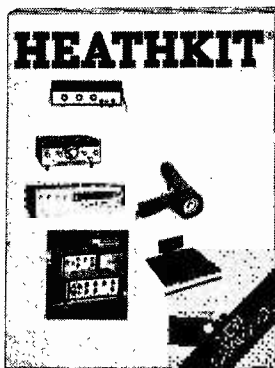
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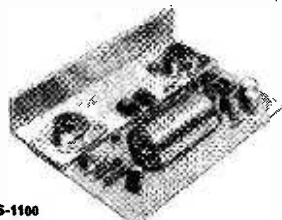
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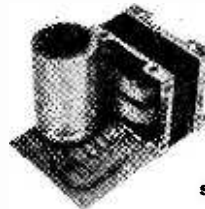
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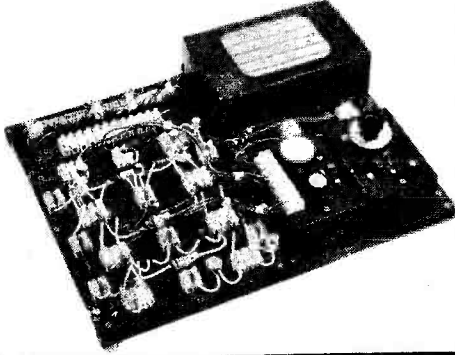
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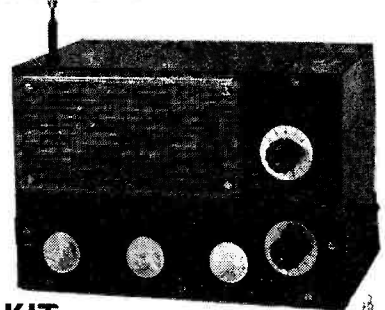
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MULTIBAND V.H.F. AND A.M. RECEIVER. 13 TRANSISTORS AND FIVE DIODES. QUALITY 5" x 3" LOUDSPEAKER. WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with 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 and 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 600mW 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.

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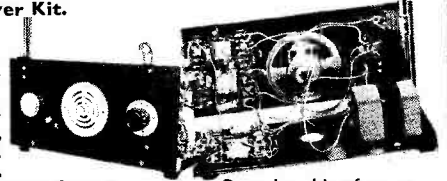


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ELECTRONIC CONSTRUCTION KIT

E.C.K. 2 Self Contained Multi-Band V.H.F. Receiver Kit.

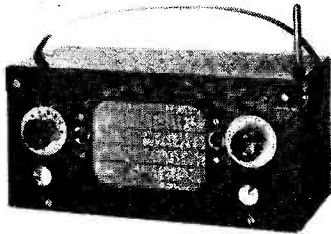
B transistors and 3 diodes. Push pull output. 3in. loudspeaker, gain control, 7 section chrome plated telescopic aerial V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit)



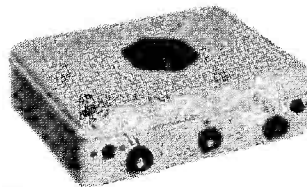
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- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN—PNP
- 4 Transistor Push Pull Amplifier

- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker. Radio MW/LW.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
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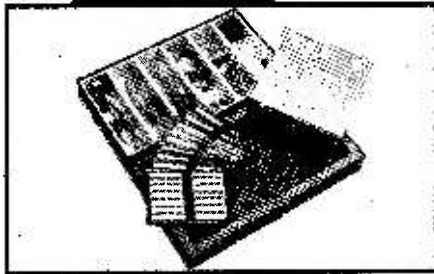
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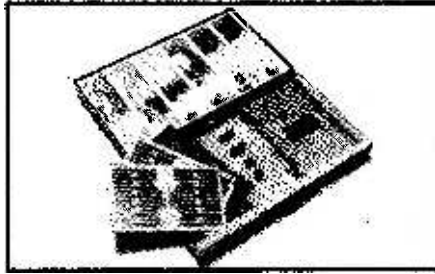
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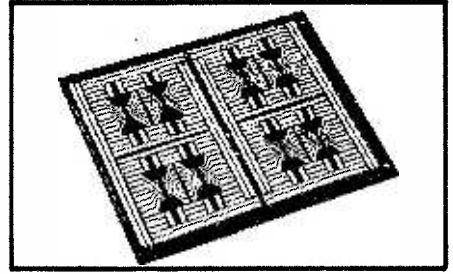
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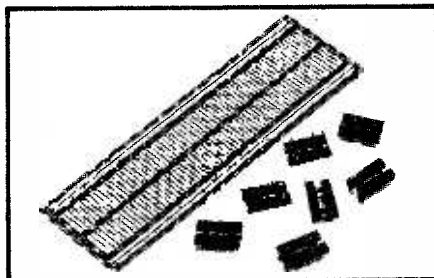
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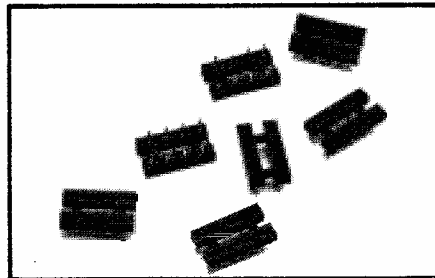
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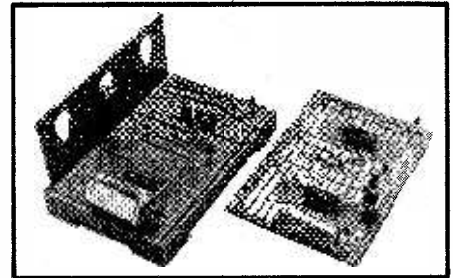
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200	THY600/200	£0.38	800	THY7A/800	£0.92
400	THY600/400	£0.44			

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100	THY10A/100	£0.57	100	THY16A/100	£0.58
200	THY10A/200	£0.62	200	THY16A/200	£0.62
400	THY10A/400	£0.71	400	THY16A/400	£0.77
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800	THY10A/800	£1.22	800	THY16A/800	£1.38

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100	THY3A/100	£0.30	100	THY30A/100	£1.43
200	THY3A/200	£0.33	200	THY30A/200	£1.63
400	THY3A/400	£0.42	400	THY30A/400	£1.79
600	THY3A/600	£0.50	600	THY30A/600	£3.50
800	THY3A/800	£0.65			

5 AMP TO66 CASE			30 AMP TO66 CASE		
Volts	No.	Price	No.	Price	
50	THY5A/50	£0.36	BT101/500R	£0.80	
100	THY5A/100	£0.46	BT102/500R	£0.80	
200	THY5A/200	£0.50	BT106	£1.25	
400	THY5A/400	£0.57	BT107	£0.93	
600	THY5A/600	£0.69	BT108	£0.98	
800	THY5A/800	£0.81	2N3228	£0.70	

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U31	150	Germ. OA70/81 diode	16131	£0.60
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U33	150	Diodes 75mA 1N4148	16133	£0.60
U54	50	Sil rect top hat 750mA	16134	£0.60
U55	20	Sil rect stud type 3 amp	16135	£0.60
U56	50	400mW zeners DO7 case	16136	£0.60
U57	30	PNP trans BC107/8 plastic	16137	£0.60
U58	30	PNP trans BC177/178 plastic	16138	£0.60
U59	25	PNP TO39 2N697/2N1711 silicon	16139	£0.60
U60	25	PNP TO59 2N2905 silicon	16140	£0.60
U61	30	PNP TO18 2N706 silicon	16141	£0.60
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U63	30	PNP plastic 2N3906 silicon	16143	£0.60
U64	30	PNP plastic 2N3905 silicon	16144	£0.60
U65	30	Germ. 0071 PNP	16145	£0.60
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U67	10	TO3 metal 2N3055 NPN	16147	£1.20
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U70	8	3 amp SCR TO66 case	16150	£1.20

Code Nos. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

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Pak No.	Qty.	Description	Order No.	Price
C1	200	Resistor mixed value approx. (count by weight)	16164	£0.60
C2	150	Capacitors mixed value approx. (count by weight)	16165	£0.60
C3	50	Precision resistors. Mixed values	16166	£0.60
C4	80	¼W resistors mixed values	16167	£0.60
C5	5	Pieces assorted ferrite rods	16168	£0.60
C6	2	Tuning gangs. MVJ1W VHF	16169	£0.60
C7	1	Pack wire 50 metres assorted colours single strand	16170	£0.60
C8	10	Reed switches	16171	£0.60
C9	3	Micro switches	16172	£0.60
C10	15	Assorted pots	16173	£0.60
C11	5	Metal jack sockets 3 x 3.5mm 2 x standard switch types	16174	£0.60
C12	30	Paper condensers mixed values	16175	£0.60
C13	20	Electrolytics trans. types	16176	£0.60
C14	1	Pak assorted hardware—nuts/bolts, gromets, etc.	16177	£0.60
C15	5	Mains slide switches ass.	16178	£0.60
C16	20	Assorted tag strips and panels	16179	£0.60
C17	15	Assorted control knobs	16180	£0.60
C18	4	Rotary wave change switches	16181	£0.60
C19	2	Relays 6-24V operating	16182	£0.60
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C23	60	¼ watt resistors mixed values	16188	£0.60
C24	25	Presets assorted type and value	16186	£0.60
C25	30	Metres stranded wire assorted colours	16187	£0.60

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Pak No.	Qty.	Description	Order No.	Price
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S2	6	Slider potentiometers, all 470 ohms	16191	£0.60
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S4	6	Slider potentiometers, all 22kΩ lin	16193	£0.60
S5	6	Slider potentiometers, all 47kΩ lin	16194	£0.60
S6	6	Slider potentiometers, all 47kΩ log	16195	£0.60

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Pak No.	Qty.	Description	Order No.	Price
MC1	24	miniature ceramic capacitors, 3 of each value—22pF, 27pF, 33pF, 39pF, 47pF, 68pF and 82pF	16160	£0.60
MC2	24	miniature ceramic capacitors, 3 of each value—100pF, 120pF, 150pF, 180pF, 120pF, 270pF, 330pF and 390pF	16161	£0.60
MC3	24	miniature ceramic capacitors, 3 of each value—470pF, 560pF, 680pF, 820pF, 1,000pF, 1,500pF, 2,200pF and 3,300pF	16162	£0.60
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ORDER No. 16214		*60p
R3	60 mixed ¼W 10-82kΩ.	
ORDER No. 16215		*60p
R4	60 mixed ¼W 100-820kΩ.	
ORDER No. 16216		*60p
R5	40 mixed ¼W 100-820Ω.	
ORDER No. 16217		*60p
R6	40 mixed ¼W 1-8.2kΩ.	
ORDER No. 16218		*60p
R7	40 mixed ¼W 10-82kΩ.	
ORDER No. 16219		*60p
R8	40 mixed ¼W 100-820kΩ.	
ORDER No. 16220		*60p
R9	60 mixed ¼W 1-10MΩ.	
ORDER No. 16221		*60p
R10	40 mixed ¼W 1-10MΩ.	
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MINIATURE MAINS Primary 240V with two independent secondary windings

No.	Type	Price
2024	MT280 0-8V, 0-8V RMS	£1.38*
2025	MT150 0-12V, 0-12V RMS	£1.38*

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	8V-0-8V 100mA	90p*
2022	9V-0-9V 100mA	90p*
2023	12V-0-12V 100mA	95p*

1 AMP MAINS Primary 240 V

No.	Secondary	Price	P. & P.
2026	8V-0-8V 1 amp	£2.70*	30p
2027	9V-0-9V 1 amp	£2.80*	30p
2028	12V-0-12V 1 amp	£2.90*	30p
2029	15V-0-15V 1 amp	£2.75*	30p
2030	30V-0-30V 1 amp	£3.45*	30p

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Multi-tapped secondary mains transformers available in 1/2 amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V.

Voltages available by use of taps: 4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 50, 25-0-25 V.

No.	Rating	Price	P. & P.
2031	1/2 amp	£3.42*	30p
2032	1 amp	£4.40*	30p
2033	2 amp	£5.45*	30p

AUDIO LEADS

S127	5 pin DIN plug to 4 phono plugs length 1.5m	£1.38*
S128	5 pin DIN plug to 5 pin DIN socket length 1.5m	£1.05*
S129	5 pin DIN plug to 5 pin DIN plug mirror image length 1.5m	£1.05*
S130	2 pin DIN plug to 2 pin DIN socket length 5m	88p*
S131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 length 1.5m	83p*
S132	2 pin DIN plug to 2 pin DIN socket length 10m	88p*
S133	5 pin DIN plug to 2 phono plugs connected to pins 3 & 5 length 1.5m	75p*
S134	5 pin DIN plug to 2 phono sockets connected to pins 3 & 5 length 23cm	88p*
S135	5 pin DIN socket to 2 phono plugs connected to pins 3 & 5 length 23cm	88p*
S138	Coiled stereo headphones extension cord extends to 7m	£1.75*
S124	3 pin DIN plug to 3 pin DIN plug length 1.5m	75p*
S125	5 pin DIN plug to 5 pin DIN plug length 1.5m	75p*
S113	3.5mm Jack to 3.5mm Jack length 1.5m	75p*
S114	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5 length 1.5m	85p*
S115	5 pin DIN plug to 3.5 Jack connected to pins 1 & 4 length 1.5m	85p*

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L.E.D.s

Type	Size	Order No.	Colour	Price
TL209	0-125in	1501	RED	12p
TL211	0-125in	1502	GREEN	25p
TL213	0-125in	1503	YELLOW	25p
FLV115	0-2in	1504	RED	12p
FLV310	0-2in	1505	GREEN	25p
FLV410	0-2in	1506	YELLOW	25p

2nd Grade L.E.D.s

A pack of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for experiments.

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£0.90

L.E.D. CLIPS

Size	Order No.	Price
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0-2in	1508/0-2	18p

Pack of 5
Pack of 5

NUTS AND BOLTS

BA BOLTS—packs of BA threaded cadmium-plated screws, slotted cheese head.

Supplied in multiples of 100

Type	No.	Price	Type	No.	Price
1in 0BA	839	£1.50	1in 4BA	845	£0.51
1in 0BA	840	£0.83	1in 4BA	846	£0.38
1in 2BA	842	£0.99	1in 4BA	847	£0.33
1in 2BA	843	£0.34	1in 6BA	848	£0.30
1in 2BA	844	£0.43	1in 6BA	849	£0.30
			1in 8BA	850	£0.33

BA NUTS—packs of cadmium-plated full nuts in multiples of 100

Type	No.	Price	Type	No.	Price
0BA	855	£0.90	4BA	857	£0.42
2BA	856	£0.60	6BA	858	£0.38

BA WASHERS—flat cadmium plated plain stamped washers supplied in multiples of 100

Type	No.	Price	Type	No.	Price
0BA	859	£0.20	4BA	861	£0.15
2BA	860	£0.15	6BA	862	£0.12

SOLDER TAGS—hot tinned supplied in multiples of 100

Type	No.	Price	Type	No.	Price
0BA	881	£0.42	4BA	883	£0.30
2BA	882	£0.36	6BA	884	£0.30

CASES

INSTRUMENT CASES. In two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
165	8in	5 1/2in	2in	£1.40*
166	11in	6in	3in	£1.80*
167	6in	4 1/2in	2 1/2in	£1.25*
168	6in	5 1/2in	2 1/2in	£1.60*

ALUMINIUM BOXES. Made from bright all, folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5 1/2in	2 1/2in	1 1/2in	£2p*
160	4in	4in	1 1/2in	£2p*
161	4in	2 1/2in	1 1/2in	£2p*
162	5 1/2in	4in	1 1/2in	£2p*
163	4in	2 1/2in	2in	£4p*
164	3in	2in	1in	£4p*
165	7in	5in	2 1/2in	£1.04*
166	8in	6in	3in	£1.32*
167	6in	4in	2in	8p*

BRIDGE RECTIFIERS

SILICON 1 amp

Type	Order No.	Price
50V RMS	BR1/50	£0.28
100V RMS	BR1/100	£0.30
200V RMS	BR1/200	£0.32
400V RMS	BR1/400	£0.36

SILICON 2 amp

Type	Order No.	Price
50V RMS	BR2/50	£0.45
100V RMS	BR2/100	£0.48
200V RMS	BR2/200	£0.52
400V RMS	BR2/400	£0.58
1000V RMS	BR2/1000	£0.68

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0.07*
1 1/2in x 3/4in chassis mounting	507	£0.12*
1 1/2in car inline type	508	£0.15*
Panel mounting 20mm	509	£0.20
Panel mounting 1 1/2in	510	£0.30

QUICK BLDW 20mm

Type	No.	Type	No.	Type	No.
180mA	611	1A	615	3A	619
250mA	612	1.5A	616	4A	620
350mA	613	2A	617	5A	621
500mA	614	2.5A	618	All 5p each	

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2.5A	628
250mA	623	2A	626	3-15A	629
500mA	624	1.6A	627	5A	630

All 7p each

QUICK BLOW 1 1/2in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634
		All 7p each			
Type	No.	Type	No.	Type	No.
1A	635	2.5A	638	4A	641
1.6A	636	3A	639	5A	642
2A	637	All 6p each			

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0.10*
DPDT standard slide	1974	£0.12*
Toggle switch SPST		
1 1/2 amp 250V a.c.	1975	£0.33*
Toggle switch DPDT		
1 amp 250V a.c.	1976	£0.38*
Rotary on-off mains switch	1977	£0.42*
Push switch—Push to make	1978	£0.13*
Push switch—Push to break	1979	£0.18*

ROCKER SWITCH

Colour	No.	Price
A range of rocker switches SPST—moulded in high insulation. Material available in a choice of colours, ideal for small apparatus	RED 1980	£0.22*
	BLACK 1981	£0.22*
	WHITE 1982	£0.22*
	BLUE 1983	£0.22*
	YELLOW 1984	£0.22*
	LUMINOUS 1985	£0.22*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0.50*
Miniature SPST toggle, 2 amp 250V a.c.	1959	£0.55*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0.65*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0.85*
Push button SPST, 2 amp 250V a.c.	1962	£0.65*
Push button SPST, 2 amp 250V a.c.	1963	£0.68*
Push button DPDT, 2 amp 250V a.c.	1964	£0.80*

MIDGET WAFER SWITCHES

Single-bank wafer type—suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactive loads make-before-break contacts. These switches have a spindle 0.26in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	£0.48*
2 pole 8 way	1966	£0.48*
3 pole 4 way	1967	£0.48*
4 pole 3 way	1968	£0.48*

MICRO SWITCHES

Description	Order No.	Price
Plastic button gives simple on-off action		
Rating 10 amp 250V a.c.	1969	£0.20
Button gives 1 pole change over action		
Rating 10 amp 250V a.c.	1970	£0.25

DISPLAYS

Type	Order No.	Price
BDL707 0-3in single	1510	£0.80
BDL747 0-6in single	1511	£1.50
BDL727 0-5in double	1512	£1.80

COLD CATHODE I.T.T. 5087 ST

side viewing indicator tubes. Displays 0-9 and decimal points. Wide viewing angle—operates from 180V with 16kΩ series anode resistors—character height 18-5mm pin connections supplied.

Order no. 1513 Price £0.60

VOLTAGE REGULATORS

Positive Regulators TO220 case	Order No.	Price
MVR 7805 5V	MVR 7815 15V	£1.25
MVR 7812 12V	MVR 7824 24V	£1.25

Negative Regulators TO220 case	Order No.	Price
MVR 7905 5V	MVR 7915 15V	£1.85
MVR 7912 12V	MVR 7924 24V	£1.85

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BACK NUMBERS

We are very glad to announce the re-establishment of a PW Back Numbers Service for our readers. In future back numbers dated from June 1977 only will be available from our Post Sales Department for 65p, which includes postage and packing. Cheques and Postal Orders should be made payable to IPC Magazines Ltd.

Send your orders to:- Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

A Logical Step?

MICROPROCESSORS, as those of you who read our competitor magazines will know, are all the rage. As so often happens with modern developments in electronics (and, to a certain extent, in other fields) much thought has been devoted to finding new applications for this answer to all our problems.

The replacement of electro-mechanical control systems in things like cars, sewing machines, washing machines, etc., is a fairly logical step, giving great scope for improvement in reliability, and some reduction in cost. Other applications, such as the "computerised door-chime" reviewed last month, for things which were simply not practicable before, are also obviously valid.

When we get into the realm of the replacement of ranks of logic packages by a microprocessor and its memory, the advantages become more questionable. On a production line, considerable savings in assembly time are possible, though for the home constructor this is not quite so important. Systems can become more flexible, providing you can afford the memory required to store all the different programs—but what are you going to use this flexibility for? For control systems in a space capsule, or for some of the newer and more interesting TV games, all well and good. But for domestic control systems, I wonder.

If you are talking about central-heating controllers, burglar and fire alarms and the like, most of the cost and complexity is in the input/output devices and the sensors and controls, and these remain the same, by and large, whatever form the central processing unit takes. The idea of one box of electronics in a house, controlling a multiplicity of appliances and systems, doesn't really seem to be the answer. Even some microprocessor experts are now admitting that a separate processor in each application is likely to be a better solution. So what price flexibility? Each appliance and system will contain a single microprocessor chip with the necessary memory built in, dedicated to that one purpose and incapable of doing anything else.

For these reasons, we do not think that microprocessors have much application for the home constructor as yet, though obviously they are of interest, especially for anyone also involved professionally in electronics. We will not be ignoring them; one thing for sure, they aren't going to go away. But what do you, our readers, think about the subject? We would love to hear.

Geoffrey Arnold

PLEASE NOTE

We do not operate a Technical Query Service except on matters concerning constructional articles published in PW. We do not supply service sheets or information on commercial radios, TV's or electronic equipment.

All queries must be accompanied by a stamped self-addressed envelope otherwise a reply cannot be guaranteed.

Catalogue with a Plus

Available now from Plustronics, is their latest catalogue containing all the gen on the latest range of portable radios, radio/cassette recorders, tape decks, headphones, in-car units, digital watches and electronic calculators.

Many of the products in the catalogue are listed under the "Plustron" brand name, including the recently announced MC1500 Music Centre, which is featured on the front cover. Other brand names handled by Plus-



tronics include Fair mate, Roxy, Aiko and Dansk.

For a copy of the Plustron catalogue which is called "A World of Entertainment", contact *Plustronics Ltd., Hempstalls Lane, Newcastle, Staffs. ST5 0SW. Tel: 0782 615131 or call at their London Showroom at 235-241 Regent Street, London, W1.*

Showtime

Aiwa, one of the fastest growing Japanese HiFi manufacturers have recently opened a new London Showroom. Growth of the company has continued since Aiwa were first marketed and distributed by Johnsons of Hendon, and continued growing when Aiwa decided to do their own marketing by opening up a new office,

Practical Wireless, January 1978

warehouse and distribution complex at Leeds.

Well known for their pioneering work in the compact cassette market, Aiwa were first with such innovations as automatic cassette loading; oil-



damped ejection; full automatic stop; synchronised recording between cassette and turntable; and the first full HiFi music centre. Another 'First' by Aiwa, is a unique insurance scheme whereby the company offer, free of charge, insurance against fire, theft and accidental damage on every HiFi separate or music centre sold between November 1st 1977, and October 31st 1978. Insurance cover lasts for two years and costs purchaser absolutely nothing. The full range of Aiwa products can be seen, inspected, heard and whatever else you need to do, at the new showroom which is sited at the New Brunswick Shopping Precinct, a short step from Tottenham Court Road and an even shorter step from Russell Square tube station.

Aiwa Sales and Service (UK) Ltd., 56-58 Brunswick Centre in Bloomsbury, London WC1. Tel: 01-278 2081.

Stocking-up?

As the old saying goes "stock is as good as money", and by the look of the latest stock list published by Watford Electronics, they would appear to be potential millionaires considering the extensive and varied range of components included in the list. Now available to PW readers, this stock list contains just about everything for the electronic enthusiast, is clearly set out with components under headings and listed by

type number. Ratings, where applicable are also shown, together with the type of package and the cost per unit. As the list is about 210 x 300mm, when ordering, please enclose an SAE. *Watford Electronics, 33 Cardiff Road, Watford, Herts. Tel: Watford 40588*

Light work

A new family of Silicon Photovoltaic Cells are now available from National Semiconductors Ltd., and are accompanied by claims of good stability, high efficiency and excellent short circuit current linearity over wide ranges of illumination.

Available in TO18, TO5 and 1/2 inch diameter hermetically sealed packages these cells also feature low leakage currents of 10µA max. when reversed biased by only 1.5V, and fast response rates of typically 8µS. Operating temperature range extends from -60°C to +125°C.

National Semiconductors Ltd., Stamford House, Stamford New Road, Altrincham, Cheshire. Tel: 061 928-3417.

Keep-it-clean!

You've heard what they do to old warships to stop the elements getting to them—they 'mothball' them. Although the 'Mothballing' material differs slightly, you can now protect your records in a similar manner, with a new product called 'Sound Guard'. Originally developed for NASA, as a dry lubricant for the moving parts of space craft, it can now be obtained in a Hi-Fi form which is sprayed onto the surface of records. When buffed up immediately following application it leaves a five-millionth-of-an-inch thin-film solid lubricant of low shear strength bonded to the record groove. Other advantages are that while Sound Guard bonds to record surfaces, it will not bond to itself, so re-application will not cause a build-up of the coating. Also it contains an anti-static property, which all goes towards helping keep the groove clean and free from dust.

Marketed in the UK by Pyser Ltd. a 2oz bottle with a pump sprayer and buffer pad (sufficient for 25 LP's) costs around £4.99.

DIRECT CONVERSION receiver

M.H. TOOLEY B.A. G8CKT



Short wave listening can be an interesting and absorbing pastime. High performance SSB/CW short wave receivers do however tend to be very complex and rather expensive; it is unfortunate that the complexity of a receiver which has all the desirable features can be somewhat daunting to anyone but the most experienced constructor.

The basic receiver described here covers the popular 20m (14MHz) amateur band. This band offers a considerable long distance (DX) potential. This project is equally suitable for the beginner who requires a simple yet effective design, and the experienced short wave listener who requires a second, highly portable receiver. The unit may also be used in conjunction with a 2m converter having an intermediate frequency (IF) of 14 to 16MHz. The receiver will then cover the bottom end of the 2 metre band (144.0 to 144.4MHz) in which there is a great deal of VHF signal sideband (SSB) activity. Component changes and circuit modifications are also provided for coverage of the other amateur bands between 3.5MHz and 30MHz.

Single band design makes for considerable simplicity as regards coil winding and calibration; it also avoids problems associated with multi-band construction. Furthermore, the direct conversion technique ensures that the receiver is less prone to spurious signals, such as image channel interference, which can often be a problem with conventional superheterodyne receivers using single conversion and a low intermediate frequency.

The receiver uses a minimum number of semiconductor devices and is assembled using a single printed circuit board. The receiver may be built for a modest outlay of around £10 to £13 and alignment can readily be carried out using a signal generator or a second receiver.

Why direct conversion?

The vast majority of amateur activity in the HF bands is either single sideband (SSB) or morse (CW). Conventional receiver designs fall into two main categories. These are tuned radio frequency (TRF) and superhetrodyne (superhet). TRF receivers are relatively insensitive and unselective and thus some form of regeneration is needed. A TRF receiver cannot receive SSB or CW signals unless the regeneration is increased to a level which allows the receiver to oscillate continuously. This arrangement lacks frequency stability. The level of regeneration must also be frequently varied according to the strength of the incoming signal.

Superhet receivers, although selective and sensitive, tend to be complex and difficult to align. Further-

more, if SSB or CW signals are to be received using a superhet, it is necessary to incorporate a beat frequency oscillator (BFO) stage and a suitable detector.

The direct conversion receiver is halfway between a TRF receiver and a superhet. The incoming signal is mixed with a local oscillator signal operating on the same frequency. This should be clearly distinguished from the arrangement in a superhet where the local oscillator and signal frequencies differ by an amount equal to the intermediate frequency of the receiver. Thus the direct conversion receiver can be thought of as a superhet receiver with zero intermediate frequency. This may sound rather odd but it simply means that the incoming signal mixes with the local oscillator signal to produce an audible beat frequency. When SSB signals are to be received, the local oscillator is tuned to exactly coincide with the incoming carrier frequency. The result is correctly demodulated audio regardless of whether upper or lower sideband is being used. When a CW signal is to be received, the local oscillator is tuned to a very slightly different frequency from that of the incoming carrier.

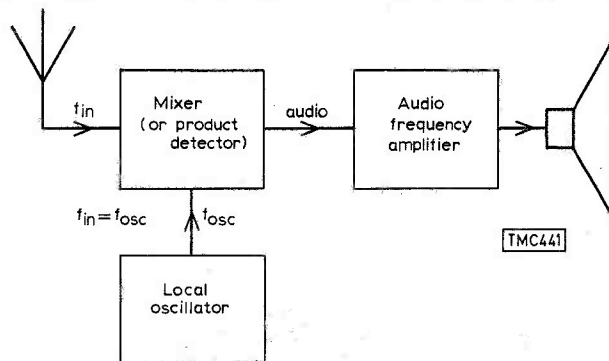


Fig. 1: Block diagram of simplest direct conversion receiver.

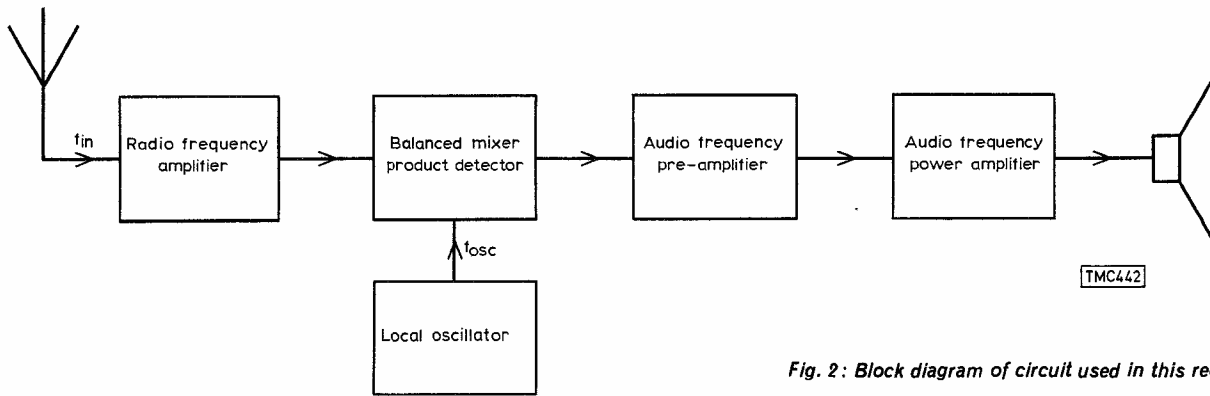


Fig. 2: Block diagram of circuit used in this receiver.

Thus the CW signal is converted to a beat note within the audio frequency range.

The basic form of direct conversion receiver is shown in Fig. 1. This incorporates a separate local oscillator stage. A worthwhile improvement in sensitivity can be achieved by the addition of a radio frequency amplifier stage. This offers the further advantage of providing a degree of isolation between the local oscillator stage and the aerial, thus helping to minimise the amount of local oscillator radiation from the receiver. The block schematic of the receiver is shown in Fig. 2. The AF amplifier has a tailored frequency response and is important in setting the selectivity characteristic of the receiver.

Balanced Detector

There is nothing new in the concept of a receiver which uses a phase synchronous detector. The technique is used in both colour TV receivers and in stereo decoders. In order to provide best results, the local oscillator (or reference) should be phase locked to the incoming signal carrier. This is necessary for the reception of AM signals where even a small phase error can be disconcerting due to the presence of an audio image which is unavoidable when a double sideband signal is demodulated. In advanced receivers, a frequency reference is derived from the signal by means of a threshold gate and PLL but this is not necessary for reception of single sideband and CW signals. Furthermore, provided that the detector exhibits a high degree of linearity, the selectivity of the receiver is determined solely by the frequency response of the audio stages. This eliminates IF filters which are found in superhet receivers.

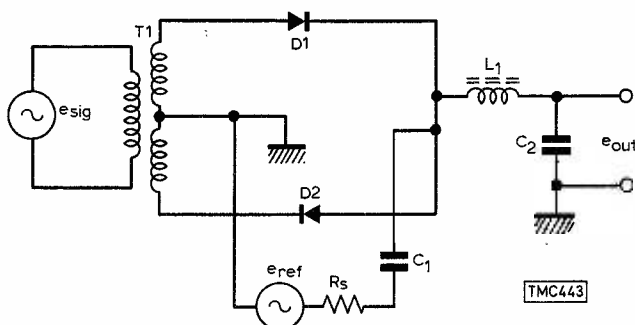


Fig. 3: Balanced detector circuit.

The simplified circuit of the balanced detector is shown in Fig. 3. It should be noted that, in practice, the reference provides a much greater voltage than that of the signal applied to the detector. D1 and D2 are effectively alternately switched "on" and "off"

at the frequency of the reference oscillator. D2 conducts on positive going half cycles and D1 on negative half cycles. R_s represents the source impedance of the reference oscillator circuit amounting to a few hundred ohms. T_1 provides signal voltages which are supplied to D1 and D2 in antiphase. C_1 is chosen so that it has negligible reactance at the reference frequency and a very high reactance at audio frequency and thus behaves as a high pass filter. L_1 and C_2 form a low pass filter preventing both the reference output and signal input from reaching the audio stages.

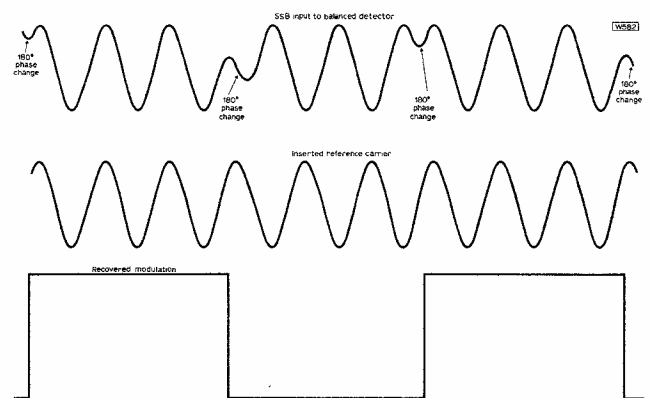


Fig. 4: The upper trace shows SSB signal 100% modulated by a square wave. Note the phase reversals. Without the reference carrier inserted by the receiver local oscillator (middle trace) speech would be received at double the natural frequency and hopelessly distorted. Square wave modulated SSB signals would not be resolved in any form. The lower trace depicts the recovered modulation from the upper trace.

When the signal and reference voltages are in phase, the balance of the detector is preserved and the output voltage after the low pass filter is zero. When a constant phase error exists between the signal and reference voltages the detector no longer remains balanced and a constant DC output voltage is produced. This may be positive or negative depending on the relative phase. When the phase error is not constant but changing, a corresponding alternating output voltage will be produced. Finally, if the signal and reference voltages differ by a constant frequency, say 1kHz, an audio signal is produced at this frequency. Fig. 4 shows a 100% modulated SSB signal applied to the detector.

Circuit description

A dual gate FET is used as the RF amplifier. The gain of the stage is made variable by adjusting the bias voltage applied to gate-2 of the transistor. The input tuned circuit, L_1/C_1 , is damped by means of

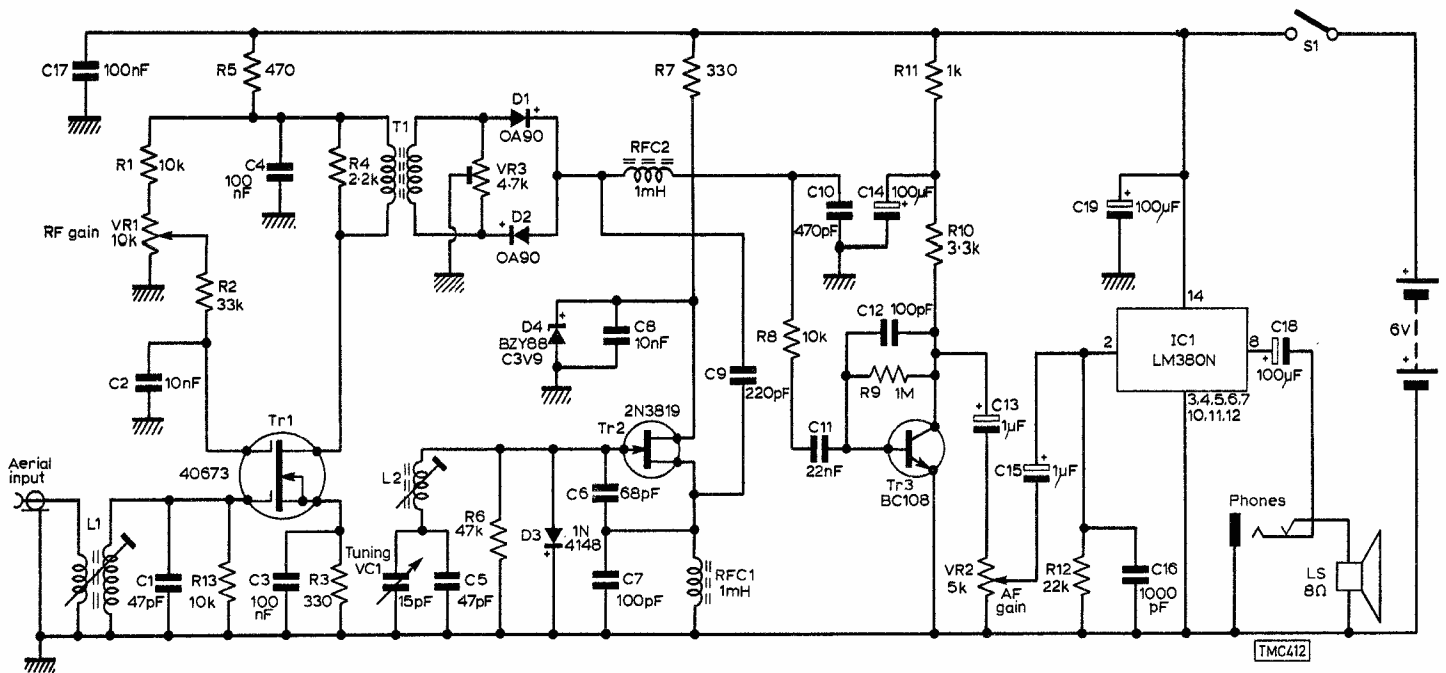


Fig. 5: Circuit diagram.

R13 to broadly tune to the 14MHz band. Its "Q" is however kept sufficiently high in order to reduce strong out of band signals. The RF stage is followed by a balanced detector arrangement using two germanium diodes, D1 and D2. Coupling from the RF amplifier stage to the detector is via a broadband transformer arrangement with damping provided by R4. Adjustment of the balance of the detector stage is provided by RV1. This compensates for any variation in the characteristics of the two diodes and is adjusted for maximum rejection of breakthrough from strong amplitude modulated signals which may otherwise be demodulated in a conventional manner.

The local oscillator uses a junction gate field effect transistor. Silicon diode, D3, provides automatic negative bias for the gate of the transistor. The supply voltage for the oscillator is stabilised by means of the zener diode, D4. The complete circuit diagram is shown in Fig. 5. The oscillator frequency is varied by means of VC1. The initial adjustment of operating frequency is carried out by means of the ferrite dust core of L2.

The demodulated audio signal is passed to the AF pre-amplifier. RFC2 and C11 operate as a low pass filter. C12 and C13 are used to define the operating frequency range of the pre-amplifier stage, Tr3. The audio power amplifier stage is straightforward and uses an LM380. It produces ample output from a 6V supply.

Construction and layout

With the exception of the controls, VR1, VR2, VC1 and S1, the battery holder and sockets SK1, all components are mounted on a printed circuit board. The component layout is fairly important and the use of a printed circuit board is highly recommended. Other forms of construction (matrix board, Veroboard or point-to-point wiring) may give rise to poor performance or instability unless great care is taken. Where a printed circuit board is not used, a good common earth connection to all parts of the circuit is essential.

The input circuit, comprising L1 and associated

components, must be screened from the rest of the circuit. This is accomplished by using a small piece of 20 SWG tinfoil cut out and bent as shown in Fig. 6. The printed circuit board (copperside) is

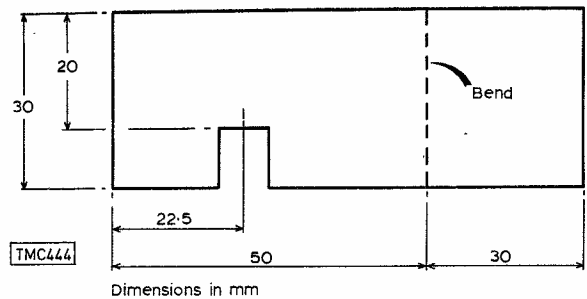


Fig. 6: This screen is essential for good stability.

shown in Fig. 7, the corresponding component overlay is shown in Fig. 8.

Care should be taken to keep all the internal connecting leads short. The leads to the volume control, VR2, should be screened. The loudspeaker is mounted on the lid of the case and, when the lid is in place, care should be taken not to trail the loudspeaker leads across the circuit board. The aerial and converter input socket, SK1, is mounted on the rear panel of the chassis. The tuning capacitor, VC1, is mounted on a small aluminium bracket. The bracket is secured to the front panel of the receiver by means of the same two screws and nuts which retain a vernier drive mechanism. The "live" connection from VC1 to L2 on the printed circuit board should be made using stiff wire, preferably 18 or 20 SWG; this helps improve the frequency stability. The earth tag of VC1 is returned to the common rail on the printed circuit board by means of a short length of copper braid. The outer conductor removed from a short length of 50 ohm or 75 ohm coaxial cable is ideal for this purpose. The lid of the case should also be earthed to the common rail. This prevents hand capacitance effects.

In the prototype, the printed circuit board is held in place by means of four 25mm spacers which are

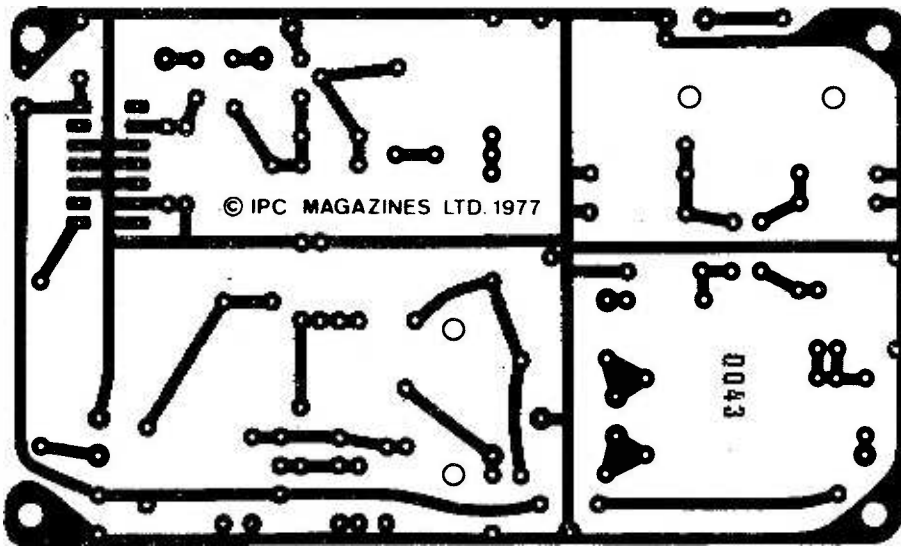


Fig. 7: The printed circuit board shown copper side. People are strongly recommended to use this board layout having been developed and checked with several prototypes. Boards may be obtained from the Readers' PCB Service (p 658) if required, quoting Ref. D043. The price is £1.85 + 15p p & p

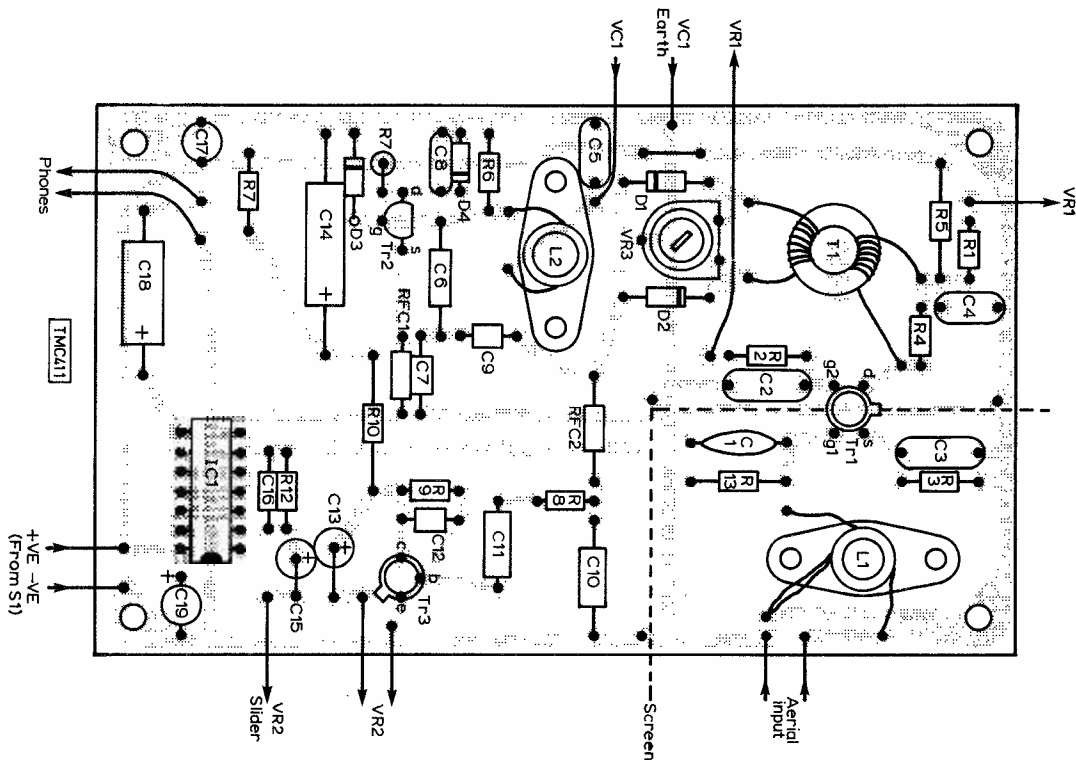


Fig. 8: The PCB overlay showing component locations.

secured to the bottom of the chassis by countersunk screws. The battery holder is made from suitably bent aluminium and then lined with a strip of foam rubber. The battery holder fastens to the back of the case by two nuts and bolts.

Coil winding details

Both coils, L1 and L2, are wound on 7mm diameter coil formers fitted with dust cores. L1 comprises a main tuned winding of 20 turns of 26 SWG enamelled copper wire closewound with an aerial winding of 4 turns 30 SWG enamelled copper wire as in Fig. 9a. A thin layer of PVC tape is used to hold the main tuned winding in place while the aerial winding is completed.

L2 consists of a single tuned winding of 24 turns of

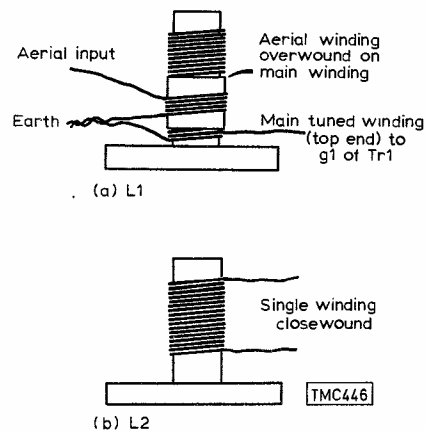


Fig. 9: Coil winding details for L1 and L2.

26 SWG enamelled copper wire closewound as in Fig. 9b. After winding, both coils are liberally coated with a quick setting epoxy resin adhesive. This seals the winding in place and provides a very effective protective coating.

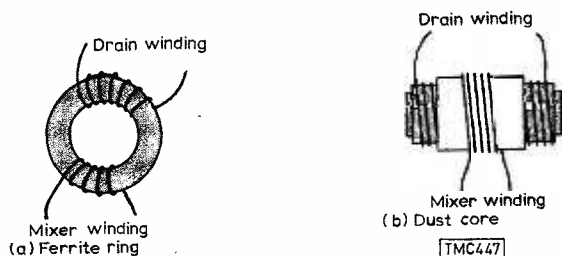
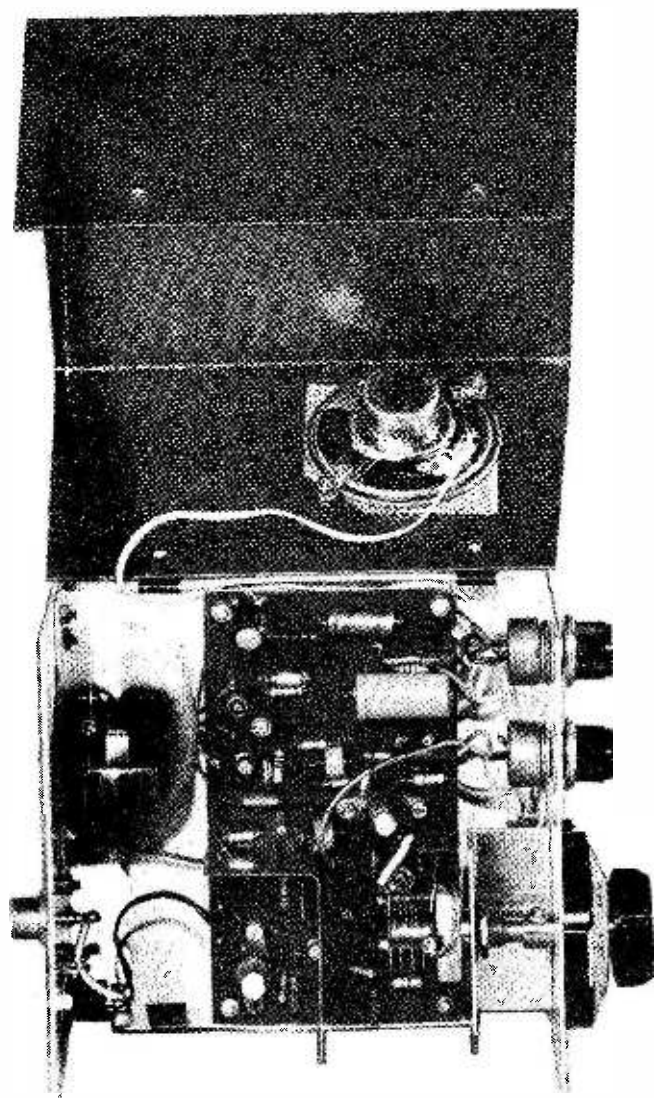


Fig. 10: Details of detector transformer (see text).

The interstage coupling transformer is wound according to Fig. 10. The transformer is wound on a miniature ferrite ring of approximate diameter 12mm. The drain winding (primary) consists of 10 turns 30 SWG enamelled copper wire. The mixer winding (secondary) consists of 5 turns 30 SWG enamelled copper wire. The transformer is similarly sealed with quick setting epoxy resin adhesive. If a ferrite ring is not available, the transformer may be wound using a 17mm x 8mm diameter dust core. The



thread on the core facilitates a guide in which the transformer may be wound. The drain winding (primary) consists of 12 turns 26 SWG enamelled copper wire. The mixer (secondary) consists of 6 turns of 30 SWG overwound in the centre of the core. The transformer should be sealed with quick setting epoxy adhesive. The performance of the receiver is slightly better when a ferrite ring is used for the interstage transformer.

★ components

Resistors

R1 10k Ω
 R2 33k Ω
 R3 330 Ω
 R4 2.2k Ω
 R5 470 Ω
 R6 47k Ω
 R7 330 Ω
 R8 10k Ω
 R9 1M Ω
 R10 3.3k Ω
 R11 1k Ω
 R12 22k Ω
 R13 10k Ω
 All $\frac{1}{4}$ W 5% carbon

Capacitors

C1 47pF
 C2 10nF
 C3 100nF
 C4 100nF
 C5 47pF silvered mica
 C6 68pF
 C7 100pF
 C8 10nF
 C9 220pF
 C10 470pF
 C11 22nF
 C12 100pF
 C13 1 μ F 63V
 C14 100 μ F 10V
 C15 1 μ F 63V
 C16 1000pF
 C17 100nF
 C18 100 μ F 10V
 C19 100 μ F 10V

Semiconductors

Tr1 40673
 Tr2 2N3819
 Tr3 BC108
 IC1 LM380N
 D1 OA90
 D2 OA90
 D3 1N4148
 D4 BZY88 C3V9

Potentiometers

VR1 10k Ω lin
 VR2 5k Ω log
 VR3 5k Ω preset

Miscellaneous

VC1 15pF Jackson type C804. S1 SPDT miniature toggle switch. RFC1, RFC2 1mH RF chokes. T1 miniature ferrite ring or dust core, two coil formers 7mm diameter fitted with dust cores, vernier dia, 50mm, loudspeaker 50mm 8 Ω $\frac{1}{4}$ W. Case 127mm x 152mm x 89mm, 14 pin low profile dual-in-line IC socket, battery holder for 4 x HP7 1.5V cells plus snap connector to suit. Knobs. Mounting pillars. Double sided push fit pins. Coax socket for aerial and jack socket for 'phones.

Initial checks and alignment

After completing the wiring and assembly of the receiver, a careful visual check should be made for any faults. A 6V battery (4 x HP7) should be connected and the current consumption measured. If the receiver is working correctly, the supply current should be approximately 12mA. A slight variation should be noticed when the RF Gain control, VR1, is adjusted.

Alignment of the receiver can be carried out by using either an RF signal generator or an existing short wave receiver. The signal generator should be set for an unmodulated output at 14MHz. The tuning capacitor, VC1, should be set to maximum capacitance. L2 should then be varied until a beat note is heard. Carefully adjust L2 for zero beat (ie: the apparently dead spot at the centre of the two ranges in which an audible beat is heard). Note that it should not be necessary to have the signal generator directly coupled to the receiver for this purpose. Stray coupling, using a short throw-out aerial, should be sufficient to produce a strong beat signal. After locating the zero beat position corresponding to 14.0MHz, re-set VC1 to minimum capacitance. Vary the signal generator frequency until a zero beat is found and note the new frequency. This will be approximately 14.4MHz; it should extend to 14.35MHz if the whole of the 20 metre band is to be covered.

To align the RF amplifier stage, adjust L1. Switch the signal generator to give a modulated carrier at 14.2MHz but leave the setting of VC1 at minimum capacitance (do not search for a beat note). A tone should be heard in the receiver's loudspeaker. If this is not the case, increase the output level of the signal generator accordingly. Note that the tone should not vary in frequency as VC1 is adjusted. Now adjust L1 for maximum loudspeaker output. If necessary, reduce the output level of the signal generator as resonance is approached. Finally adjust VR3 for minimum output—it should be possible to null the tone out almost completely. The alignment procedure should be repeated once again after which the cores of L1 and L2 should be sealed. An antenna may then be connected to the receiver and its "on-air" performance can be checked.

Where a signal generator is not available, the frequency of the local oscillator can be set using a calibrated receiver. The receiver should be set to 14.0MHz and VC1 adjusted to maximum capacitance. L2 is then adjusted until a strong signal is heard in the main receiver, this will of course appear as an unmodulated carrier. The two receivers should be in fairly close proximity for this purpose and, if necessary, a short length of wire can be used to link the two aerial sockets so that sufficient coupling of the local oscillator signal is obtained. If more than one signal is heard on the main receiver (corresponding to two different positions of the core of L2) make sure that the stronger of the two is selected. This phenomenon is due to the image channel of the main receiver. Re-set VC1 to minimum capacitance and find the new local oscillator frequency by re-tuning the main receiver. This should be above 14.35MHz. Next connect an aerial to the unit and adjust VC1 to a signal which is fairly strong and continuous. A teleprinter signal is ideal for this purpose. Carefully adjust L1 for maximum output from the loudspeaker. If necessary, reduce the RF gain control accordingly. VR3 should be set to mid-position, but if break-

through from strong amplitude modulated broadcast signals on adjacent frequencies is subsequently experienced, the pre-set should be adjusted for a null to minimise the effect.

If the local oscillator frequency coverage is found to be too low even after adjustment of L2, C5 should be replaced by a 33pF silver mica capacitor. If the local oscillator frequency coverage is found to be too high, C5 should be similarly replaced by a 68pF silver mica capacitor or alternatively a 15pF silver mica capacitor can be wired directly in parallel with VC1.

If adequate screening is not used between the oscillator and RF circuits, a form of RF instability may occur. This is due to local oscillator radiation entering the RF amplifier and may only manifest itself when the RF gain control is turned fully up. Detuning L1 will usually cure this problem; however, the best solution is to ensure that a screen is fitted and that the lid of the case is adequately earthed (this is usually accomplished by the four securing screws).

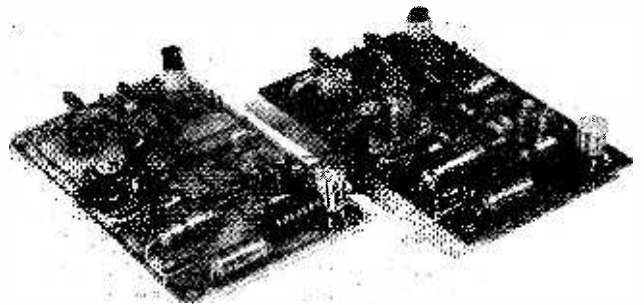
Should audio frequency instability be noticed, particularly when not using the recommended printed circuit layout, a 100nF miniature polyester capacitor in series with a 4.7ohm 1/4W carbon resistor should be wired directly between pin 8 and the integrated circuit holder and the common earth rail. Also, when not using a printed circuit board, C19 should be wired as closely as possible between pin 14 of the integrated circuit holder and the common earth rail.

Instability may also occur which manifests itself as a howling at maximum gain settings when headphones are being used. This can be cured by using an RF choke, consisting of 6 turns 30 SWG (or 8 turns 26 SWG on a ferrite ring) wired directly between the loudspeaker output on the PCB and the headphone jack socket, SK4. However, few problems should be experienced if the recommended layout and printed circuit board is used.

Using the receiver

The performance of any short wave receiver depends greatly on the quality of the aerial system with which it is to be used and on the expertise of the user. This design gives acceptable results with a short "throw-out" aerial (15ft of flexible wire is ideal for this purpose). A good earth may improve performance further. If a dipole is available (this should be approximately 33ft in length and fed in the centre) results should be excellent.

Tuning an SSB receiver often presents difficulties to the uninitiated. The newcomer to short wave listening will however find that his ability to resolve SSB signals will improve considerably with practice. The



signal needs to be slowly tuned through until the speech appears normal. An incorrectly tuned signal will make you think that you are listening to Donald Duck. This is, of course, due to a shift in the frequencies of the speech components. With a little practice, the correct tuning point will easily be found. When incoming signals are very strong, the RF gain control should be backed off. This will assist in resolving signals.

In the first few days of use, and with a very modest aerial, over twenty countries were logged with the receiver. These included DK, EA, EI, F, G, GW, HB, I, K, OE, ON, PA, SM, UA, UB, VE, W, YU. Propagation conditions on 20 metres vary considerably during the day and night. Seasonal variations are also noticeable. Thus do not expect instant long distance (DX) reception! A few days listening will soon tell constructors when and where to listen.

This simple receiver was developed with low cost and portability in mind. It will not outperform a complex communications receiver. However, when used with an efficient aerial system, it gives an extremely good account of itself.

appendix

Table of component changes for alternative frequency coverage

RF TUNED CIRCUIT

Band	Turns on L1		C1
	sec. SWG	pri. SWG	
3.5-3.8 MHz	38 30	8 26	220 pF
7.0-7.1 MHz	30 30	6 26	100 pF
21.0-21.5 MHz	16 26	3 26	22 pF
28.0-30.0 MHz	12 26	3 26	22 pF

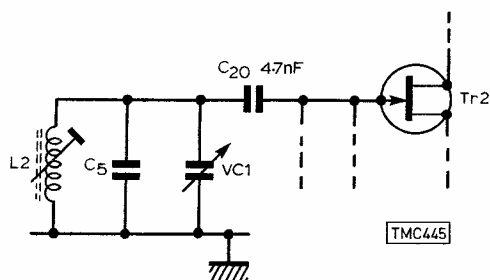


Fig. 11: Oscillator circuit modification for lower frequencies (see note below).

OSCILLATOR TUNED CIRCUIT

Band	Turns on L2	SWG	VC1	C5
3.5-3.8 MHz	30 *see note	30	100pF	220pF
7.0-7.1 MHz	22 *see note	26	15pF	100pF
21.0-21.5 MHz	16	26	15pF	47pF
28.0-30.0 MHz	10	26	15pF	47pF

*Note: Use modified circuit for oscillator shown in Fig. 11. Also increase the primary turns on T1 to 20 (30 swg) and secondary to 15 turns (30 swg). The use of a ferrite ring as the core of T1 is strongly recommended for the 3.5 MHz and 7 MHz bands.

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Apr 76	Auto. Slide Synchroniser	AM0441	2-33+15	<input type="checkbox"/>
June 76	Dig. Freq. Meter (set of 5) A015 and 4x A004		3-17+15	<input type="checkbox"/>
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Aug 76	Cassette Player Power Supply	A001	0-65+12	<input type="checkbox"/>
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Oct 76	Digital Car Clock (set)	A011/012/013	2-58+12	<input type="checkbox"/>
Oct 76	Interwipe	DN8JM	0-80+12	<input type="checkbox"/>
Oct 76	Video-Writer (set)	D002/3/4/6	A007 21-44+50	<input type="checkbox"/>
Oct 76	Hazard Flasher	D005	0-76+12	<input type="checkbox"/>
Nov 76	Low Level Battery Indicator	A016	0-40+12	<input type="checkbox"/>
Nov 76	Electronic Thermostat	A017	1-30+12	<input type="checkbox"/>
Nov 76	Cirtest Probe	A018	0-48+12	<input type="checkbox"/>
Nov 76	Burglar Alarm	A019	0-50+12	<input type="checkbox"/>
Dec 76	Chromachase	A021	5-70+22	<input type="checkbox"/>
Jan 77	Oscilloscope Calibrator	A023	1-25+12	<input type="checkbox"/>
Jan 77	Icelert	A020	1-45+12	<input type="checkbox"/>
Jan 77	Polyphon, motor and main boards	A025/4	7-90+20	<input type="checkbox"/>
	Polyphon, tune disc blank, (SRBP)	A008*	0-90+15	<input type="checkbox"/>
Feb 77	Transistor Checker	A026	1-18+12	<input type="checkbox"/>
Mar 77	FM Stereo Touch Tuner	D023/4/5	7-50+20	<input type="checkbox"/>
Apr 77	Tug 'o' War (set)	A029/030	2-38+12	<input type="checkbox"/>
Apr 77	Gas/Smoke Sensor Alarm	A028	0-65+12	<input type="checkbox"/>
May 77	2-Way Intercom	D019	1-28+12	<input type="checkbox"/>
May 77	Protected Battery Charger	A027	2-38+12	<input type="checkbox"/>
May 77	Seekit Metal Locator	A031	3-38+12	<input type="checkbox"/>
June 77	Reverberation Amplifier	A032	2-38+12	<input type="checkbox"/>
June 77	Versatile AF Generator	A033	2-38+12	<input type="checkbox"/>
June 77	Tele-Games	D029	3-22+18	<input type="checkbox"/>
July 77	20W IC Amplifier	A034	1-38+12	<input type="checkbox"/>
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"/>
Sept 77	Jubilee Electronic Organ	A038	19-00+75	<input type="checkbox"/>
Sept 77	Electronic Car Voltage Regulator	D037	1-25+12	<input type="checkbox"/>
Oct 77	Audio Level Indicator	D039	0-98+12	<input type="checkbox"/>
Oct 77	Sine-Square Wave Generator	D040	2-35+15	<input type="checkbox"/>
Nov 77	Laboratory Power Supply	A039	3-50+12	<input type="checkbox"/>
Jan 78	Proportional Power Controller	DN9JM	0-78+12	<input type="checkbox"/>

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John Thornton Lawrence GW3JGA & Ken McCoy GW8CMY

Before we consider the behaviour of alternating current and voltage in circuits containing inductors and capacitors, we will have a look at the phenomenon of capacitance.

Capacitance

If we place two metal plates close to one another and separate them with a piece of insulating material, we have an arrangement which will store electricity in the form of a charge. The capacitance of the arrangement depends on a number of factors:—

- i. Area of the plates
- ii. Distance between the plates
- iii. The nature of the insulating material occupying the space between the plates (specifically the Dielectric Constant or relative permittivity)

The unit of capacitance is the farad—an uncommonly large unit for the purposes we require—so that the values found in radio work are micro-farads (10^{-6}), nanofarads (10^{-9}) and picofarads (10^{-12}).

Dielectric Constant

If we measure the value of capacitance of two metal plates, separated by a certain insulating material, and repeat the measurement keeping area of plates and distance apart the same but having a vacuum separating them, then the ratio between the two values of capacitance will be equal to the dielectric constant of the insulating material. This constant is usually denoted by the letter K and the capacitance of a capacitor is given by the relationship:— C is

proportional to $\frac{KA}{d}$, where A is the area of

the plates and d the spacing between them.

A capacitor is classified by the material used as the dielectric and the table below shows some types of dielectric used together with their dielectric constants.

Material	Dielectric Constant
Air	1
Dry paper	2.5 approx
Polyester	5 approx
Mica	5.7 approx
Aluminium oxide (electrolytic)	7.5 approx
Ceramic (Lo K)	up to 20
Ceramic (Hi K)	up to 10,000

The Dielectric Strength is the voltage at which the dielectric breaks down and this and its thickness determines the maximum safe working voltage which may be applied to the capacitor.

Capacitor Ratings

The two most important practical ratings of a capacitor are its capacitance and its working voltage

and these are almost invariably marked on the capacitor. The required value of capacitance depends on the purpose for which it will be used and the voltage rating on the maximum voltage that will be present across the capacitor under all operating conditions.

The required accuracy or tolerance of the capacitance value depends on how critical the circuit is to this. For example, the capacitance of an electrolytic capacitor, providing the smoothing in a power supply, could be greater or less by 20 per cent of its stated value without causing any significant change in performance, but a silvered mica capacitor in the oscillator tuning circuit of a communication receiver would cause serious tuning errors if its value was in error by this amount. In some applications therefore, the tolerance is also an important factor.

There are other factors too, such as insulation resistance, temperature stability, physical size, etc., which affect the suitability of a particular type of capacitor for a particular use.

Air Dielectric Capacitors

These are usually in the form of variable capacity tuning capacitors having a set of fixed plates with a set of moving plates that swing into mesh between the fixed plates. This enables the effective area of the plates, and so the capacitance, to be varied.

Air dielectric tuning capacitors for use in receivers, where the maximum voltage may be only a few volts, can have very close spacing between the plates, but types for use in transmitters where high voltages are present, must have significantly greater spacing to avoid voltage breakdown or flashover. The breakdown voltage of air is about 25,000V/cm and the spacing between the plates of a tuning capacitor for a receiver would be about 0.2mm (mainly limited by the mechanical accuracy) and for a 150W HF transmitter about 1.5mm.

Mica Capacitors

The mica capacitor uses thin sheets of mica as the dielectric and offers the best electrical properties possible but for a given capacity it tends to be large and fairly expensive. Mica is a very stable material naturally, after all it has been lying in the ground stabilising for millions of years, so the capacitor using it as a dielectric will also have excellent stability. The mica capacitor is therefore, ideal for use in tuning or other critical circuits.

The silvered mica capacitor has the electrodes deposited as a film of silver on the surfaces of the mica and so enables very thin blades of mica to be used. The blades are stacked with interconnecting foils and are then clamped or riveted together which gives them their characteristically flat "postage stamp" shape. Silvered mica capacitors are available in values from 1pF to about 10,000pF and usually

have a voltage rating of 250 to 500V although higher voltage ratings are available for use in transmitters. They are very suitable for use in RF tuned circuits up to several hundred MHz and will carry appreciable RF currents in transmitter applications.

Some "compression type" trimmer capacitors use mica as a dielectric and in these the mica is sandwiched between spring foil electrodes. The capacitance is varied by squashing the sandwich with an adjusting screw and so changing the dielectric from partly air and partly mica to just mica. These capacitors, which were once seen only in radio receivers are now being used in transistor VHF and UHF transmitters where their very low inductance and low losses make them ideal.

Ceramic Capacitors

Ceramic capacitors are made in various forms, the most popular being the tubular and disc types. The tubular type consists of a small ceramic tube which has silver deposited on the inside and outside surfaces, the capacitance being determined by the area of the surface, the tube wall thickness and the ceramic dielectric constant. The disc type consists of a flat disc of ceramic with silver deposited on each side of the disc. Ceramic dielectric material can be made to have particular characteristics by adjusting the proportions of the ingredients.

The low K ceramic material usually used in the tubular capacitors provides good stability with a fairly low and a predictable temperature coefficient (change of capacitance with temperature) so that in some circumstances they can be used with advantage in a tuned circuit to compensate for the opposite temperature effects in other components in the circuit. Their small physical size and low inductance makes them suitable for use in receivers and low power circuits in the VHF and UHF range.

Tubular ceramic capacitors are also made in a lead-through form for decoupling supplies passing through a screening box or plate and they have a soldering flange or screwed bush for mounting. Variable tubular ceramic capacitors have the internal silvering replaced by a concentric adjusting screw and these are suitable for operation up to several hundred megahertz.

Disc ceramic capacitors are usually of the Hi K ceramic type and have the advantage of very high capacity with small physical size and very low inductance. Hi K ceramic material has a high temperature coefficient which makes these capacitors unstable in value and so unsuitable for use in tuned circuits. They suffer from losses at high frequencies but can be used successfully in bypass and decoupling applications up to 1,000MHz.

Wound Capacitors

Polystyrene, polyester, polycarbonate and paper capacitors are made by winding two strips of metal foil into a roll, insulated by two strips of dielectric film or paper. Connection strips or edges are brought out to form suitable lead-out connections. Polystyrene is a high-grade dielectric having characteristics approaching those of mica; polystyrene capacitors are used in LF, MF and HF circuits where stability is important. Polyester and polycarbonate capacitors are suitable for most LF and MF applications up to a few MHz. Paper capacitors are mainly used in LF applications and for high voltage power supply use where

working voltages up to several thousand volts are available. Capacitors of this type are usually hermetically sealed in a can with special high voltage terminals.

Polystyrene capacitors are available in values from 10pF to 1μF and polyester, polycarbonate and paper capacitors from 1,000pF to 10μF approximately.

Now follows the last major theoretical section, but a very important one, leading up to the resonant tuned circuit, an essential part of every transmitter and receiver.

Inductors and Capacitors in series and parallel

(i) Inductors (not mutually coupled)

Series

$$L_{\text{total}} = L_1 + L_2$$

Parallel

$$\frac{1}{L_{\text{total}}} = \frac{1}{L_1} + \frac{1}{L_2} \text{ or } L_{\text{total}} = \frac{L_1 L_2}{L_1 + L_2}$$

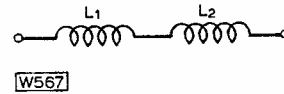


Fig. 20: Inductors in series.

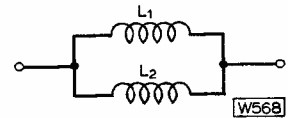


Fig. 21: Inductors in parallel.

The arithmetic is the same as for resistors, in series they add and in parallel the total value is less than the smallest. Whereas for capacitors it is just the opposite, as shown below.

(ii) Capacitors

Series

$$\frac{1}{C_{\text{total}}} = \frac{1}{C_1} + \frac{1}{C_2}$$

Parallel

$$C_{\text{total}} = C_1 + C_2$$



Fig. 22: Capacitors in series.

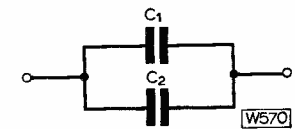


Fig. 23: Capacitors in parallel.

In parallel they add and in series the total value is less than the smallest. We are now in a position to look at the behaviour of resistors, capacitors and inductors in circuits where alternating currents are flowing.

AC Circuits

Resistors in an AC Circuit.

In this case both voltage and current are "in phase" with one another, i.e. they both reach maximum or minimum values at the same instant of time. When calculating current and voltage, the r.m.s. values are used, thus $I_{\text{rms}} = V_{\text{rms}}/R$

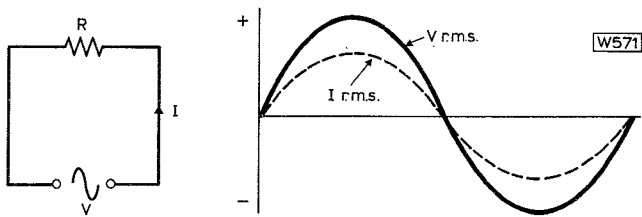


Fig. 24: The voltage and current in a resistive circuit are in phase.

Capacitors in an AC circuit (Capacitive Reactance).

When an alternating current is applied to a capacitor it will charge it, first in one direction and then in the other. The maximum current will be flowing in or out of the capacitor when the applied voltage is changing most rapidly (i.e. as it goes through zero volts) and the current will fall to zero when either peak of the cycle has been reached and the voltage is virtually steady for an instant.

Since the current is at a peak $\frac{1}{4}$ cycle before the voltage it is said to "lead" the applied voltage by 90° (one full cycle being 360° —see section on sine waves). The energy which is stored in the capacitor during the $\frac{1}{4}$ cycle charging period is returned to the circuit in the following $\frac{1}{4}$ cycle. The current flowing is known as Wattless Current as no power is dissipated in the conventional I'R sense.

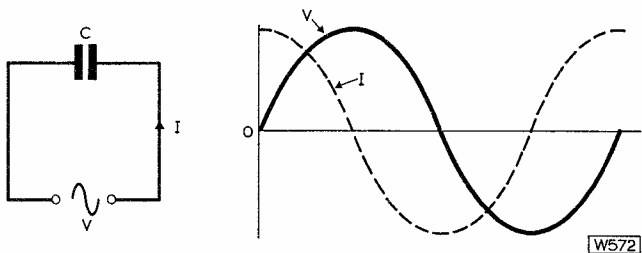


Fig. 25: In a capacitive circuit, the current which flows leads the applied voltage by 90° .

If the relationship between voltage and current is investigated, the frequency of the alternating current must be taken into account, together with the value of the capacitance in the circuit. In fact, the current flowing is proportional to capacitance, frequency and voltage. By arranging these factors we can extract a quantity which is akin to resistance in a DC circuit. This quantity is known as Capacitive REACTANCE and its unit is the ohm.

$$\text{Capacitive REACTANCE } (X_c) = \frac{1}{2\pi fC} \text{ where}$$

f = frequency of alternating current, C = Capacitance and $\pi = 3.142$.

Using Ohm's Law and reactance we can calculate the voltage or current in an AC circuit containing a capacitor:—

$$I = \frac{V}{X_c} \quad X_c = \frac{V}{I} \quad V = IX_c$$

(note that E and I are r.m.s. values)

Inductors in an AC Circuit (Inductive Reactance)

When an alternating voltage is applied to an inductor the resultant current causes a back or induced e.m.f. to be generated which is proportional to the rate of change of the current. In the inductor, as in

the capacitor, the maximum current occurs when the voltage is changing most rapidly (as it goes through zero), except that in the case of the inductor the current "lags" the voltage by $\frac{1}{4}$ of a cycle or 90° .

It will be realised that if the frequency of the alternating current increases, so will the rate of change of current, thus the value of the e.m.f. generated in the inductance will be proportional to the frequency and the current flowing inversely proportional to the frequency. From this we can extract a quantity known as the Inductive REACTANCE, unit—again the ohm.

Inductive REACTANCE (X_L) = $2\pi fL$ where f = frequency, L = inductance and $\pi = 3.142$.

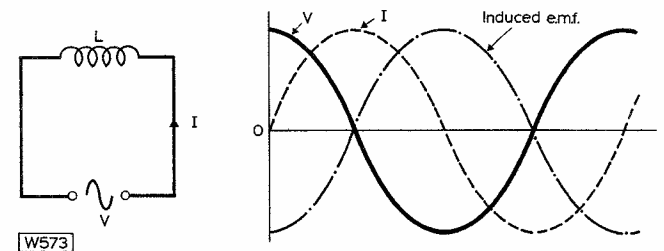


Fig. 26: In an inductive circuit, the current lags the applied voltage by 90° . The induced e.m.f. is in anti-phase (180° different) to the applied voltage.

Again we can use Ohm's Law and calculate current and voltage in the inductive circuit using REACTANCE in the place of resistance:—

$$I = \frac{V}{X_L} \quad V = IX_L \quad X_L = \frac{V}{I}$$

(note that V and I are in r.m.s. values).

Reactances in Series and Parallel

Reactances of the same kind, Inductive OR Capacitive can be treated similarly to resistors:—

Series $X = X_1 + X_2 + X_3$

Parallel $\frac{1}{X} = \frac{1}{X_1} + \frac{1}{X_2} + \frac{1}{X_3}$

Reactances of opposite kinds, Inductive and Capacitive:—

Series $X = X_L - X_c$

Parallel $X = \frac{-X_L X_c}{X_L - X_c}$

This follows because when reactances of opposite kinds are combined in a circuit, the currents lag and lead the voltages, in the inductive and capacitive sections respectively, by 90° and consequently they must first be subtracted from one another to find the total reactance. For this purpose, Inductive reactance is normally considered 'positive' and Capacitive reactance 'negative'.

Impedance

In any circuit containing reactances there will be some resistive element in the wires, for example, in the inductor windings thus when we consider the resistance to current flow presented by reactances we must add that presented by the ohmic resistance of the circuit. When we consider all these elements together, inductive reactance, capacitive reactance and resistance, it is known as IMPEDANCE. The resistive element of the impedance may be either in series or in parallel with the reactance.

Series

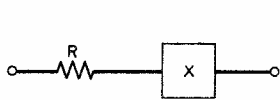
The impedance Z in this case is $Z = \sqrt{R^2 + X^2}$ where $Z =$ Impedance (ohms), $R =$ Resistance, and $X =$ Reactance (inductive or capacitive).

Parallel

$$Z = \frac{R \cdot X}{\sqrt{R^2 + X^2}}$$

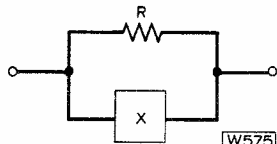
In circuits which contain impedances, Ohm's Law can be applied as follows:— $I = \frac{V}{Z}$ and $V = IZ$

and $Z = \frac{V}{I}$. (use r.m.s. values of V and I).



W574

Fig. 27: Resistance and reactance in series.

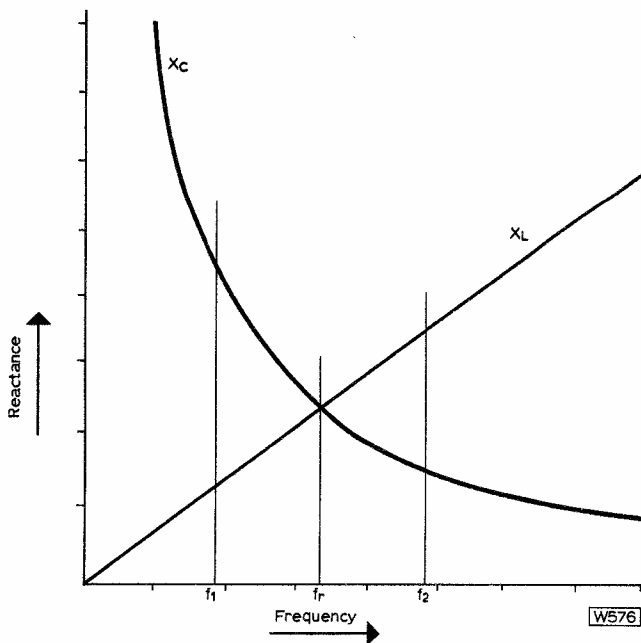


W575

Fig. 28: Resistance and reactance in parallel.

Resonance

The next characteristic of the AC circuit, that we are going to examine, is RESONANCE. This is a most importance effect which is employed many times over in every radio transmitter and receiver. As the AC frequency, applied to a circuit containing inductance and capacitance, is increased, the value of the inductive reactance increases, whilst that of the capacitive reactance decreases, as shown in the graph below:—



W576

Fig. 29: Capacitive and inductive reactance plotted as a function of frequency. At the resonant frequency, f_r , the two reactances are equal in value.

From this it is apparent that at a certain frequency, f_r , the capacitive reactance equals the inductive reactance.

Series Resonant Circuit (Acceptor Circuit)

If the frequency of V changes between f_1 and f_2 then the current flowing in the circuit will rise to a maximum at f_r . The impedance, on the other hand, falls to a value equal to R . To summarise this in an expression:—

$$X_L = 2\pi fL \text{ and } X_C = \frac{1}{2\pi fC}$$

$$\text{at } f_r \quad 2\pi f_r L = \frac{1}{2\pi f_r C}$$

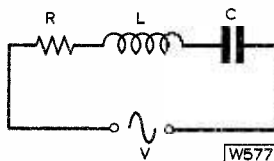
$$\therefore f_r = \frac{1}{2\pi\sqrt{LC}}$$

Where $f =$ frequency in Hz, $L =$ Inductance in henries, $C =$ Capacitance in farads and $\pi = 3.142$.

The value of the current flowing in the circuit is found as follows:—

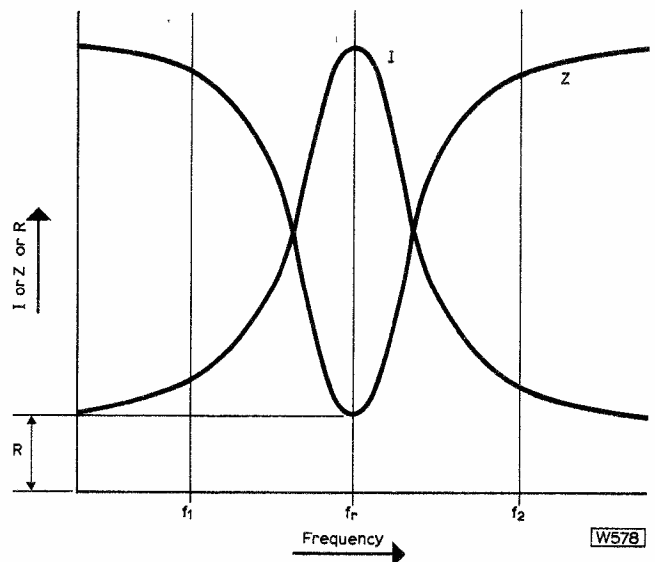
$$I = \frac{V}{Z} = \frac{1}{\sqrt{R^2 + (X_L - X_C)^2}}$$

Thus, at resonance, the impedance of a series resonant circuit is equal to the resistive component R , X_L and X_C having cancelled each other out.



W577

Fig. 30: A series resonant circuit.



W578

Fig. 31: When a series RLC circuit is at resonance, the impedance is at a minimum, and the current is at a maximum.

Parallel Resonant Circuit (Rejector Circuit).

This arrangement is awkward for the purposes of investigating the variation of current and impedance with frequency, so an equivalent parallel circuit is used in which a perfect inductor and a perfect capacitor are in parallel with an assumed resistance, known as the dynamic resistance R_D , R_D being equal to $\frac{L}{C_r}$ at resonance. The expression for the resonant

continued on page 669

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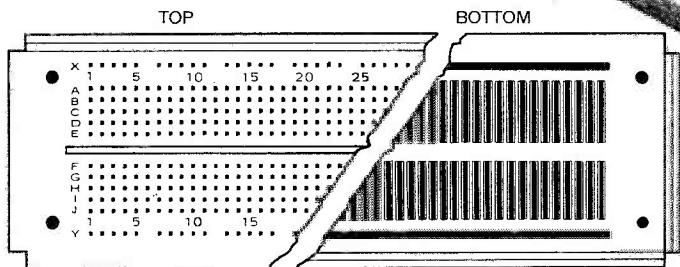
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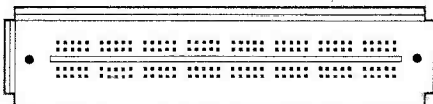


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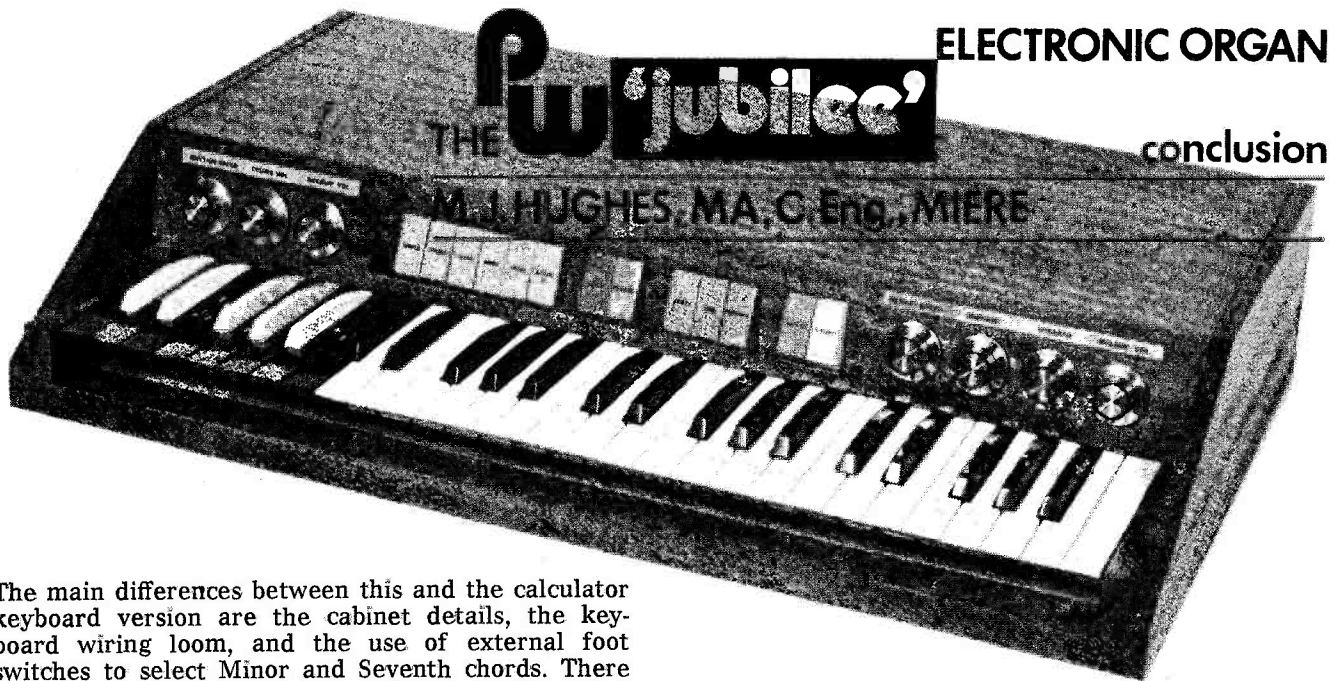
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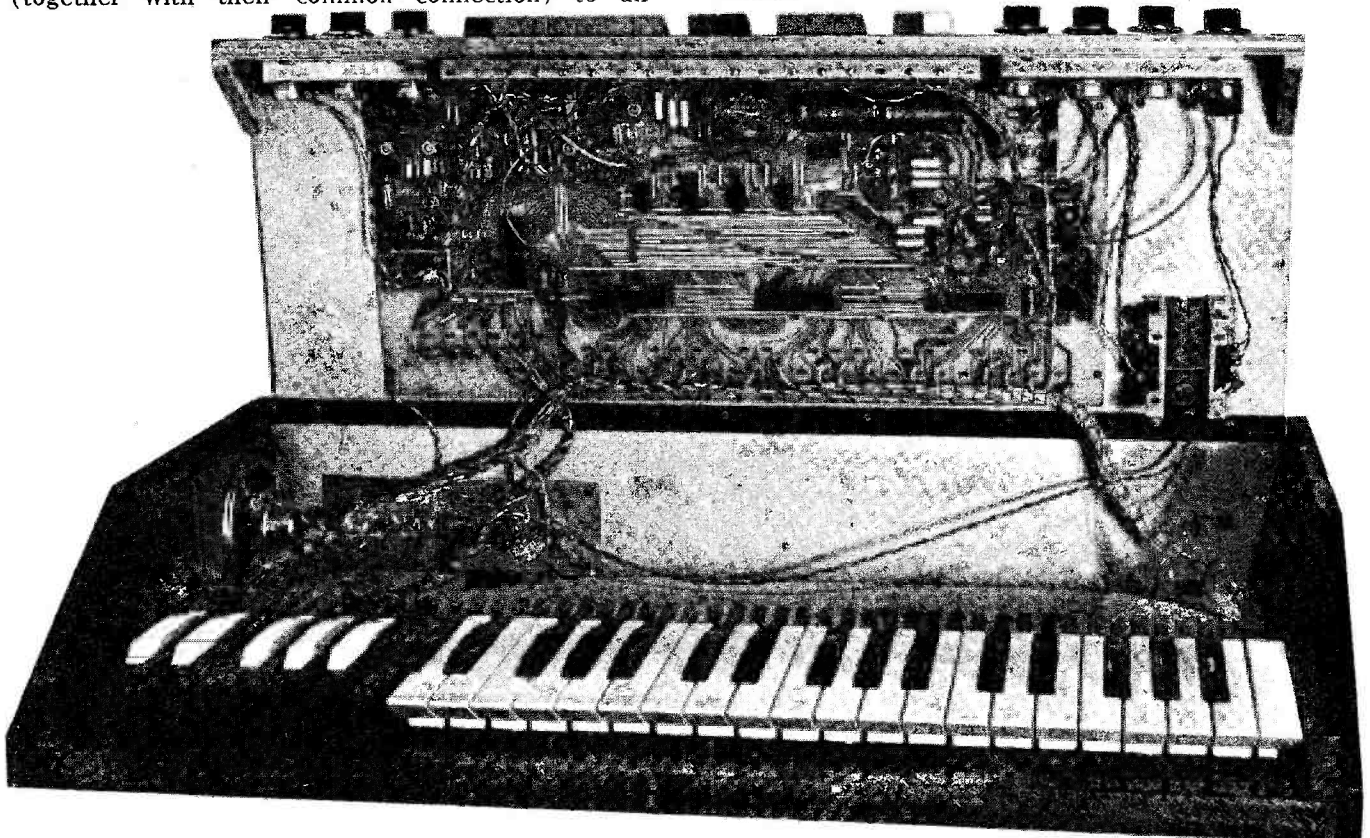
The main differences between this and the calculator keyboard version are the cabinet details, the keyboard wiring loom, and the use of external foot switches to select Minor and Seventh chords. There are one or two minor layout differences.

The accompaniment keys (bottom octave of the 4 octave keyboard) require two separate busbars. One commons together the poles of C, C#, D, D#, E and F while the other commons F#, G, G#, A, A# and B. Use the wiring instructions shown in Fig. 1 to connect between the board pins and the contacts of each key (note) switch—not forgetting the three busbar connections. Use lacing cord to neatly tie the keyboard loom into a bundle.

The rear panel wiring is slightly different from the calculator key version. A stereo jack plug and socket is used to route the Minor and Seventh select wires (together with their common connection) to an

external “push to make” pair of foot switches. Although expensive, an electronic piano “Soft/Sustain” pedal pair worked well.

A single pole toggle switch was put in series with the internal loudspeaker connections so that the internal speaker can be muted. The output for the external Phono lead is connected via an extra stereo jack socket. This enables an external foot controlled volume control (swell pedal) to be used. The wiring is such that the control (which should be 10kΩ log) can be plugged into the jack socket if needed but, if unplugged, the signal is left unaffected at the DIN socket.



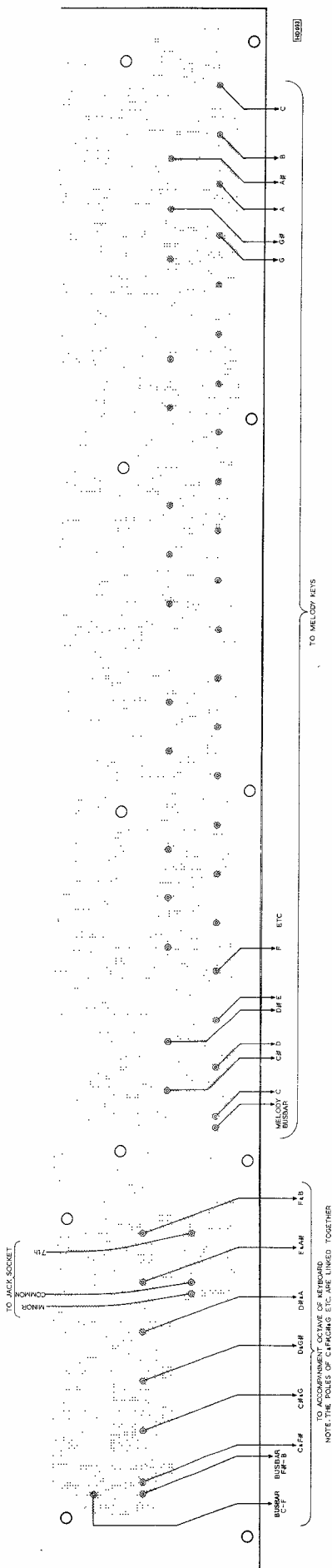


Fig. 1: Wiring between the PCB and an external keyboard.

Adjustments for both versions

The most obvious problem will be caused by constructors trying to get too much out of the internal amplifier. Remember—it is only capable of putting out about 1W (about the same total volume as a portable radio). When playing a single melody note, it is possible to turn up the gain of the melody pre-amp and produce a very loud sound but as soon as you introduce a chord from the accompaniment, the internal amplifier overloads and produces distortion. This is made even worse by the drums—particularly the bass drum. The secret is to turn all the front panel volume controls to maximum and then switch all the voicing switches to their “on” position. Put the vamp switch in the “off” position and select a rhythm—say “Waltz”. With one hand, depress bottom “C” of the melody keyboard and the chord of “G” from the accompaniment. Adjust the preset gains of the three preamplifiers (VR8, 14 and 18) to get a good balance between melody, accompaniment and drums respectively and set the levels so that the sound is as loud as possible *without* distortion. It might be necessary to adjust VR15, 16 and 19 to get the best compromise between level and tonal quality of the cymbals, snare drum and bass drum respectively. Listen, particularly, to the bass drum sound. This is very low frequency and might not be very prominent when heard over a small loudspeaker but it could have a high electronic amplitude driving the drums preamplifier and the internal power amplifier into clipping. Having set the maximum level, do not expect very loud signals if you select the melody string voice unaccompanied.

The “brightest” cymbals sound is heard when VR15 is near its earthy end; likewise for the snare drum control (VR16). The best bass drum setting for VR19 is just before the onset of oscillation; take care, however, not to have too long a decay on the latter otherwise it will sound more like a percussive tone rather than a deep “thump”.

Melody sustain length is increased by increasing the value of C6 by a small amount. Conversely reducing the value shortens the period. If you get no melody sustain, D2 may be short circuit. Check that D2 is in the right way round and the VR5 wiper is making good contact with the track.

Sustain length of the alternating bass is set by C16. Failure of the bass note to cut off completely is an indication that D3 is faulty, the wrong value or inserted the wrong way round.

Chord sustain is set by the value of C20 (which *must* be a polyester type). If the chords do not die away completely Tr5 probably has very low gain and it might be best to replace it. Alternatively you can reduce the value of R44 but if you do this you will have to increase the value of C20 to keep a reasonable sustain time constant. If the chords do not sound at all, D5 may be the wrong way round or Tr5 faulty.

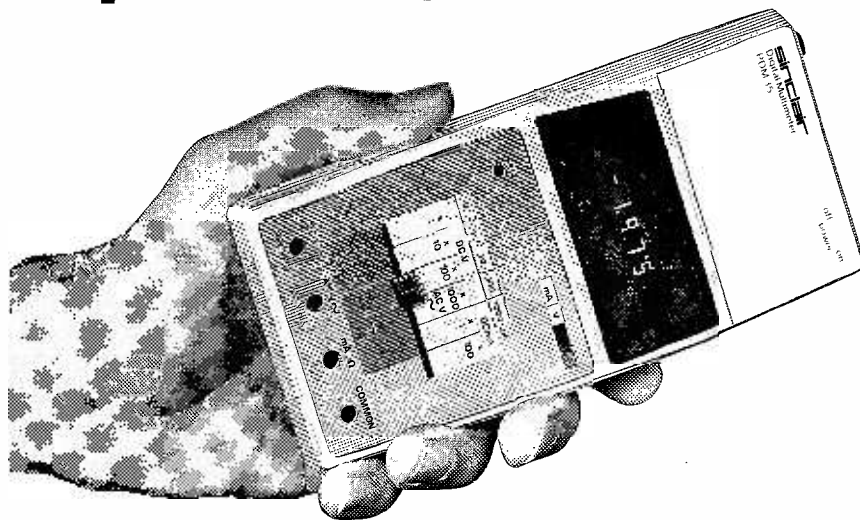
Clicks on the attack of the bass note and melody notes can be removed by careful adjustment of VR10 and VR5 respectively. A hesitation on a cymbal stroke is caused by Tr8 having too high a gain and this can be rectified by reducing the value of R58 to 4.7k.

If you wish to alter the amplitude balance between the cymbals, snare and bass drum without changing their tonal quality (the two parameters are linked to some extent) you can change the values of R61, R75 and R86 respectively. Reducing the value by a small amount will increase the volume for that instrument.

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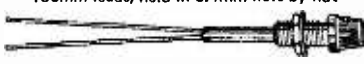
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Trouble shooting

We have already mentioned that the master oscillator operates from a lower supply rail than the dividers and during the constructional tests this was likely to give trouble. Generally the loading on the unbalanced +15V rail—when all the ICs have been inserted—will clear this problem but it is possible, in some instances, that some instability remains (diagnosed by an irregular or distorted quality of some notes. This can be overcome by increasing the value of +15V rail dropping resistor (R93) to 10 ohms. Remember this must still be a ½ watt device!

In the unlikely event of total failure you must check the system carefully in a systematic manner. Total failure is most likely to be associated with the power supply, internal amplifier, or master oscillator. Test procedures have been dealt with in previous issues.

It is difficult to decide whether the AY-1-0212 is faulty (IC2) without using an oscilloscope; if you can be certain that the master oscillator is working with no audio tones from the output pins of this IC, there is a high chance that the integrated circuit is faulty. In the absence of a 'scope there is a simple, but effective, test to check the master oscillator. Place a medium waveband transistor portable radio *very close* (within an inch or two) to Tr1 and Tr2. If you tune over the band, you should hear heterodyne whistles at several points. These may be identified as coming from the master oscillator by turning up the Vibrato Depth control. The whistles turn into chirrups.

Failure of the vibrato oscillator is most likely to be due to incorrect setting of VR2.

As with any printed circuit board project most problems are caused by poor soldering giving rise to dry joints, connections that have been missed—particularly under the large integrated circuits—solder blobs bridging conductor tracks, components put in the wrong holes and components inserted the wrong way round.

It is very unusual for components to be faulty—provided they have not been misused or abused. Remember that it is easy to damage MOS integrated circuits by handling them wrongly. In a complicated design such as the Jubilee Organ, there are bound to be occasions where a component on the extreme end of its tolerance can effect the final performance.

Postscript

Some people might wish to carry out a simple modification which enables the accompaniment section to memorise the last key that was depressed. If this is done, the rhythm and accompaniment sections will continue to repeat the same vamp without the player having to keep his finger on the key. To change the key of the vamp requires a single depression of the next key which is then memorised. Only major chords can be memorised. The modification requires a two pole change-over switch and a break in the printed wiring on the pcb at pins 5 and 35 of IC13 (the Chord Generator). Normally both these pins are strapped to ground 0V. Connecting them to the +15V rail through the switch activates the latch circuitry associated with each chord select key. ●

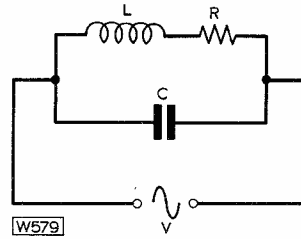
Practical Wireless, January 1978

SO YOU WANT TO PASS THE RAE?

—continued from page 662

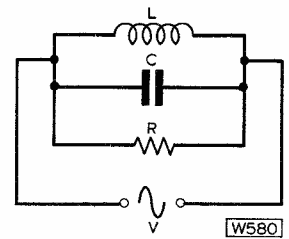
frequency of the parallel tuned circuit is, in practical terms, the same as for the series tuned circuit,

$$f = \frac{1}{2\pi\sqrt{LC}}$$



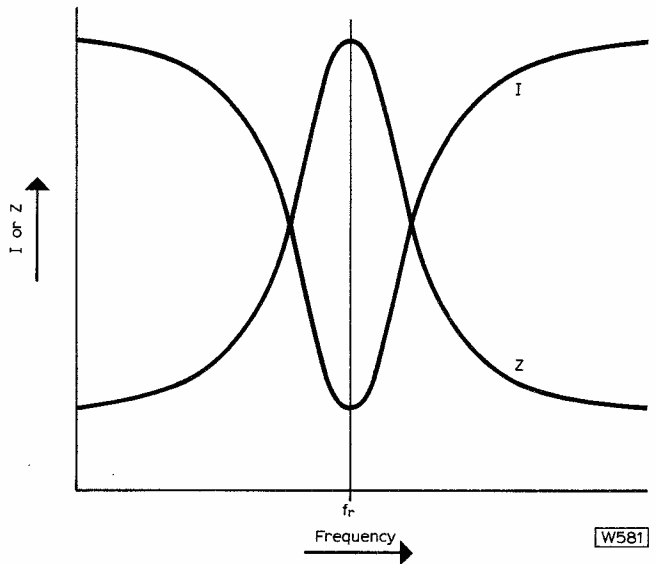
W579

Fig. 32: A parallel resonant circuit.



W580

Fig. 33: The equivalent circuit of Fig. 32.



W581

Fig. 34: In a parallel RLC circuit at resonance, the impedance is at a maximum, and the current is a minimum.

Magnification Factor "Q"

In the circuit shown in Fig. 30, at resonance, the voltage across the inductor (or the capacitor) can be considerably greater than the applied voltage V. As we have seen, the current at resonance is defined by the value of the resistor R, but the voltage across the inductor (or the capacitor) is given by the product of the current and the reactance in question, which is usually very much greater than R. The ratio of the voltage across the reactance to that across the resistor is called the Magnification Factor or "Q" of the circuit.

The "Q" of a practical tuned circuit depends mainly on the quality or "goodness" of the coil as the capacitor normally has very low losses associated with it. A high "Q" tuned circuit has the ability to respond to one frequency whilst rejecting others. In a receiver, this would imply "selectivity", the ability of the receiver to select a wanted signal and reject unwanted ones.

An example of the practical use of a simple resonant circuit is in an Absorption Wavemeter. In this device the resonant frequency of a tuned circuit is used to check the output frequency of a transmitter.

In the next section we will be dealing with diodes, transistors and valves, also block and circuit diagrams.

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

Pocket-it

With "in" words like Teletext and Oracle commonly in the news these days, one tends to be on the lookout for anything new in this field. The most exciting piece of news this month is that a manufacturer is concentrating its efforts on producing a Teletext receiver which will fit into the coat pocket. Although the company (in Germany) has primarily aimed at producing a portable radio size unit, the pocket version is hot on its heels. It is planned that the unit should be complete i.e. you do not need to plug it in or connect it to a TV receiver in any way. The coat pocket version (it is planned) will have its own aerial and tuner, IF amplifier and Teletext decoder. This will feed a display of LEDs (for the mains version) or liquid crystal cells (battery model) and thus avoid using a conventional cathode ray tube. For anyone following the stock market, this looks a good bet—as and when it becomes available.

After remembering using the old PO 3000 type relays for early model control, I am pleased to note that a new DPDT relay, housed in a dual in-line package and standing only 0.38in high, has appeared on the American market. It fits standard 16-pin DIL sockets which is very useful, constructionwise. Even nicer is the extreme sensitivity of these little beasts; the coil requires 200mW maximum to pull in. On the business side, the contacts will switch a resistive load of 1A at up to 28V DC and will carry 5A. It is amusing to note that the manufacturers of this little relay have the address; 100 Relay Road! Clearly an address which should click with those who are really switched on.

Smart alecs!

It seems that we will have to live with the word microcomputer for a while longer—until something even more wonderous takes its place, no doubt. The newest and most interesting development in this field comes from Japan. One of the electronics giants over there is to market a mini-computer-type kit which is aimed at

school children between 12 and 14 years old. With a starting production schedule of producing some 4,000 kits a month, the company seems confident it can sell a large number. The price (converted very roughly) would be around £85—£95. Costly, perhaps, but the kit does contain quite a lot. There's a microprocessor (you know of a home without one?), a random access memory and a read-only memory, arithmetic/logic unit, 8-bit latch, audio amplifier, two static RAM chips, keyboard, displays and drivers, and even a loudspeaker. One of the exercises for users is to become an electronic composer. You can compose a tune and enter it into memory. At the touch of a button your masterpiece will be played back using oscillators (yes, these are included in the kit) Tunes of up to 127 notes are possible and are restricted to a maximum of three octaves. This takes in most if not all of the popular melodies for those who might prefer to stick to known tunes. I can see the time when a hush will descend on the Royal Albert Hall, and the soloist will emerge, tuck a 16-pin DIL under his chin and "give forth". Ah, come back Lionel Hampton, all is forgiven!

Valve size?!

New things are often labelled "best" or "biggest" etc. A new semiconductor just released looks as though it could fairly claim to be the biggest transistor in the world. It will handle a peak current of 200A with voltage rating of 550V. These devices have a gain of 15 at the 50A mark and could doubtless do nasty things to loudspeakers in disco systems where power is all. Transistors have certainly come a long way since those "red spot" semiconductors I bought in the Edgware Road many summers ago (and they cut off at about 800kHz).

Sunset strip

The recent Energy Exhibition in London highlighted (for me) just how sadly inefficient solar cells are. Manufacturers get excited at anything which exceeds 10% efficiency. While it is almost certain that newer and better

materials and techniques will come, there is some work in hand to maximise what is already available. For example, one American company is aiming to get the costs down to fifty cents per watt of power produced. The approach here is to perfect further the technique of "pulling" a ribbon of silicon to get as wide a strip as possible. Up until now, 1in and even 2in wide strips have been produced. Now, the aim is to get 3in widths. The thickness involved is around half a millimetre but by using improved techniques it is hoped to get this down to less than 8 thou.

The strip itself is produced by touching the surface of a molten pool of silicon with a little "seed" bar of silicon. The seed is then very slowly withdrawn. As it rises it "pulls" silicon with it rather like pulling the surface layer of a bowl of hot chewing gum! The cooling length is pulled slowly through a die to form a strip and the silicon allowed to cool at a controlled rate from over 1,200°C down to 600°C. When it is completely cool, it is scribed and broken up into individual cell sizes.

A filter for all occasions

Readers interested in audio filters—particularly electronic music enthusiasts, will find the new SSM 2040 DIL device of interest. It comprises a voltage-controlled monolithic filter and it can be made to synthesize almost any kind of active filter from low-pass to high-pass, band-pass or notch. The manufacturer is offering samples only at the moment and these are quite expensive. Like most things, the price should drop once production increases and the devices would then probably become available to the home constructor. At present, I am waiting further information but it seems possible to use just the one, single filter and to "switch" it to get numerous effects in an electronic musical instrument. Watch this space.



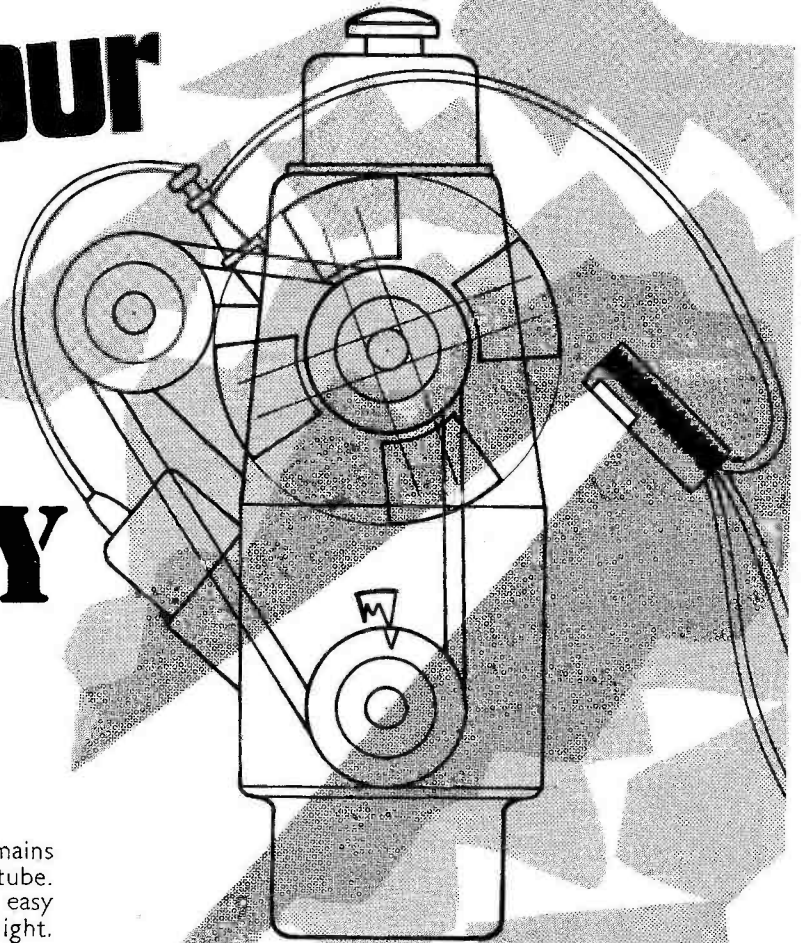
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**ECONOMY
TIMING
STROBE**



A very simple design which uses an a.c. mains power supply to drive the Xenon strobe tube. This provides a really bright flash, allowing easy checking of ignition timing even in full daylight. This unit is suitable for conventional or electronic ignition systems.

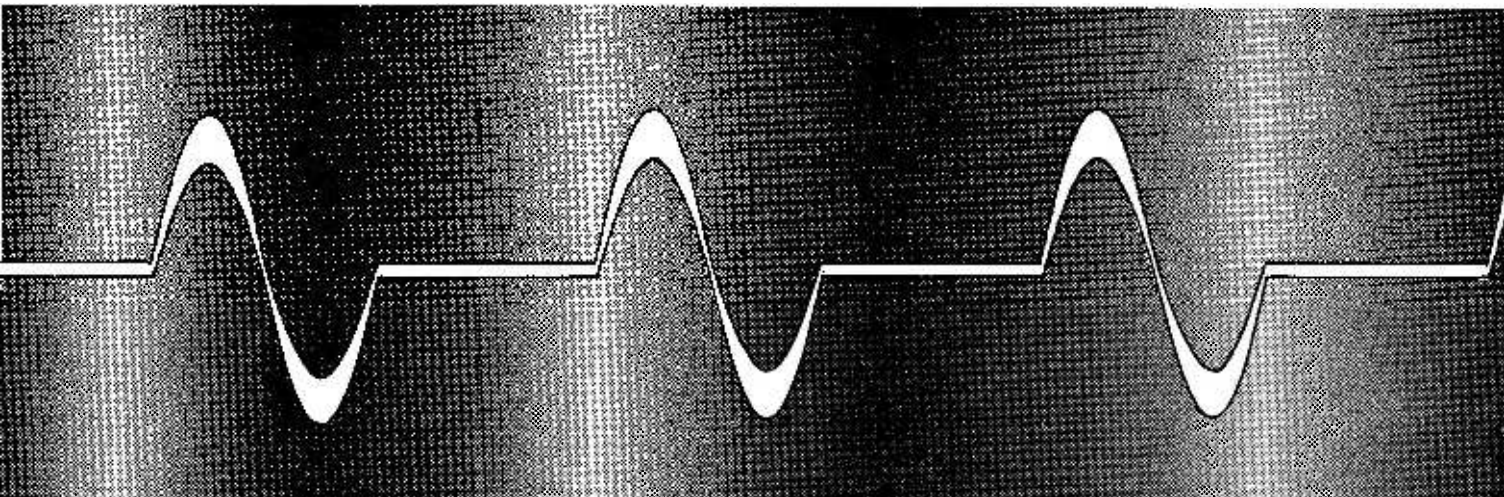
Also:

Active Tone Control

A three-transistor circuit based on the well-known Baxandall tone control, ideal for use in disco or public address systems. A wide variety of source and load impedances can be accommodated.

**Medium Wave
Tuner/Amplifier**

This unit is designed to provide pre-amplifier input facilities plus medium wave AM broadcast coverage for feeding into an existing power amplifier, which also furnishes the necessary power supply. Prealigned IF transformers ease the setting-up procedure.



PROPORTIONAL POW

Due to the ever increasing cost of electricity the need was seen for a reliable and efficient method of controlling an electric fire by reference to temperature. It was thought that the control should be the same, if not better than, that of a gas fire. It should be proportional and automatic, i.e. adjusting to a preset level room heat. When switching large currents of 12-15 amps for up to 3 kilowatt fires, radio frequency interference can be a problem when using thyristors or triacs. With this in mind advantage was taken of the fairly new zero voltage switch integrated circuit, which will give very good proportional control with minimum interference. This is the basis of the circuit shown in Fig. 1.

Zero Voltage Firing

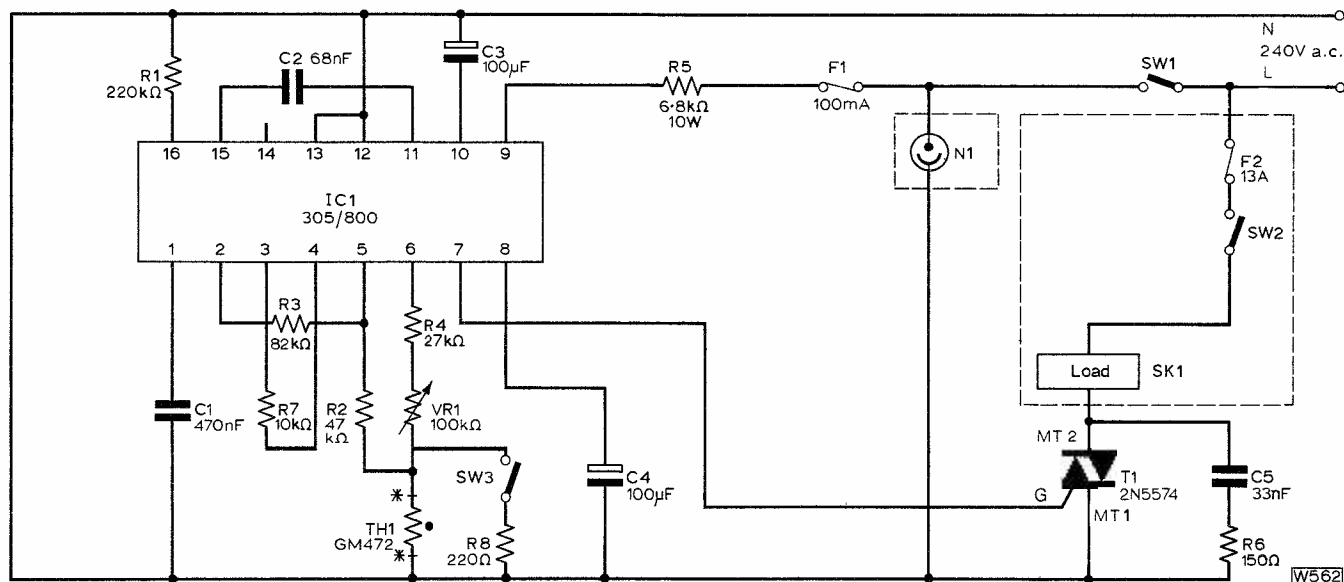
With zero point firing the current in the load is turned on at the zero voltage point; this has the effect of reducing radio frequency interference. The power in the load is controlled by the number of half cycles reaching the load in a given period. This technique

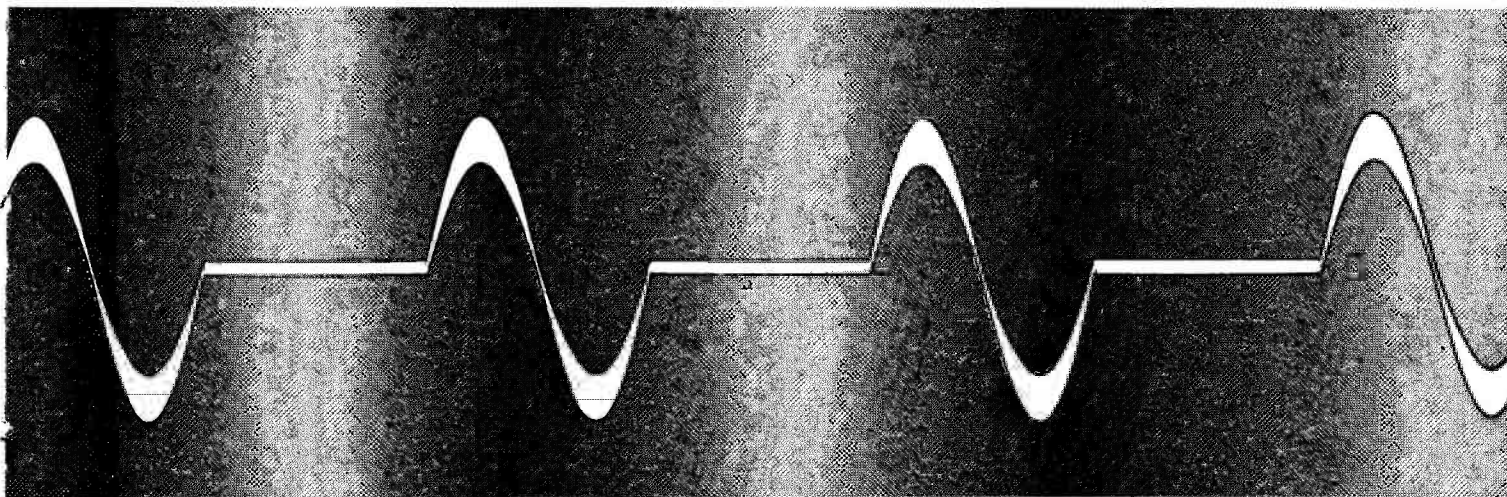
can only be applied to certain loads, but is particularly suited to heater elements, which have a slow thermal inertia. The type of system described allows just sufficient bursts of power to reach the load, to make up system losses. This is achieved by using an internal generated ramp voltage (see Fig. 2 diagram). The result is very accurate control of the power produced in the load and hence, in this case, the temperature of a room.

Circuit Description

The principle of the operation of the zero voltage switch integrated circuit can be seen in Fig. 2. Here a ramp voltage is generated and used to turn on bursts of current in the load at the control voltage which is determined by, and related to, the temperature of the room, detected by the thermistor's resistance. This reference voltage, set up by the control circuitry, is fed into an operational amplifier. R1, R3, R4 and TH1 form the control circuit to give

Fig. 1: The circuit diagram of the power controller.





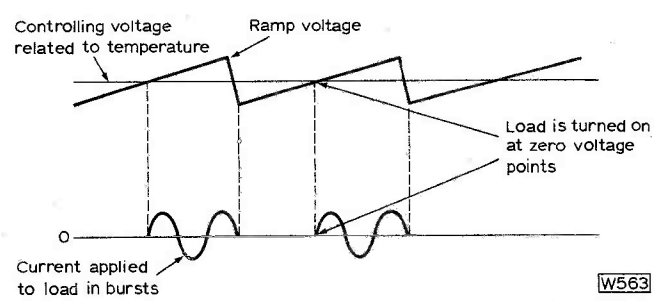
TEMPERATURE CONTROLLER C.TOMS



a means of controlling the related voltage. The width of the ramp voltage is set using the external components R1 and C1. When Pin 2 is at a lower voltage than the bottom of the ramp voltage, the heater is on, and when the voltage is higher than the top of the ramp the heater is off. Therefore voltages lying between the top and bottom of the ramp produce bursts of power to the load thus maintaining the

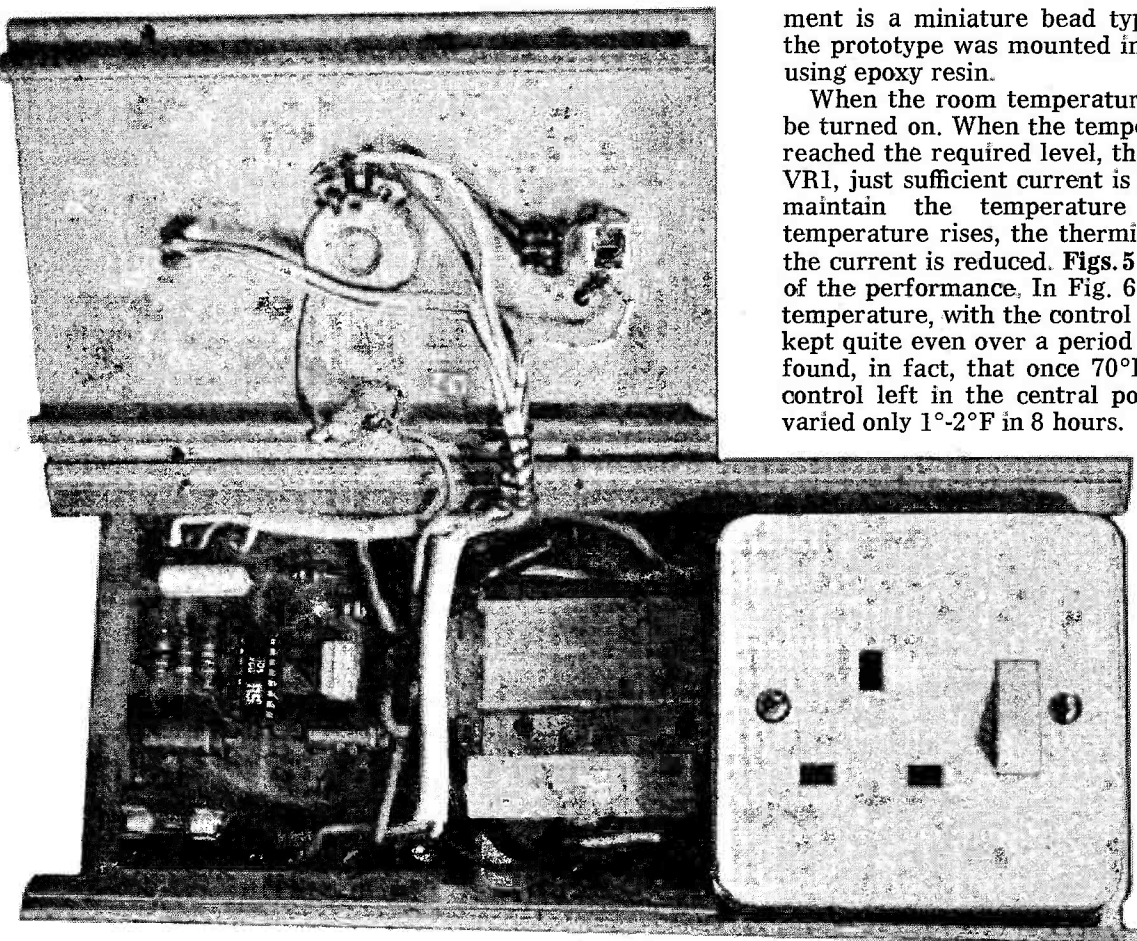
temperature set by the control. The values of VR1, R4, TH1 type, have been chosen to give a temperature range in the region 40°F to 80°F. The output pulse width is controlled by C2, and was chosen to suit the type of triac used, and is therefore fairly critical to ensure that the triac fires correctly. The economy part of the circuit is effected by R8 and S2, R8 being lower in value than the minimum resistance of the thermistor at the high temperature. This ensures a very low load current at low or high temperatures.

Fig. 2: Basic operational principle of the zero-switching device.



Practical Operation

The load can be any electric heater up to 3 kilowatts, with the exception of those using electric motors, i.e. fan heaters. Due to the values of R1, C1, used for good control of an element (bar type), the motor will operate in bursts, and not run smoothly. The 3 kilowatts could be extended using a larger triac and modifications to the gating circuitry. But 3 kilowatts was thought to be adequate. The sensing ele-



ment is a miniature bead type thermistor, which in the prototype was mounted in a miniature jack plug, using epoxy resin.

When the room temperature is low the heater will be turned on. When the temperature of the room has reached the required level, that set by the position of VR1, just sufficient current is applied to the heater to maintain the temperature constant. When the temperature rises, the thermistor value drops and so the current is reduced. Figs. 5 and 6 show some graphs of the performance. In Fig. 6 it can be seen that the temperature, with the control in the mid-position, was kept quite even over a period of some 3 hours. It was found, in fact, that once 70°F was reached, and the control left in the central position, the temperature varied only 1°-2°F in 8 hours.

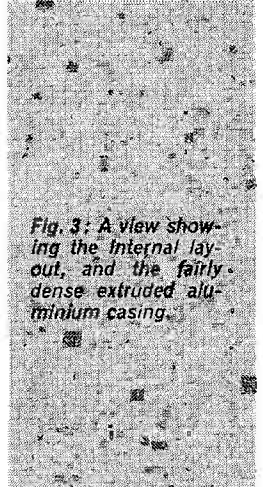


Fig. 3: A view showing the internal layout, and the fairly dense extruded aluminium casing.

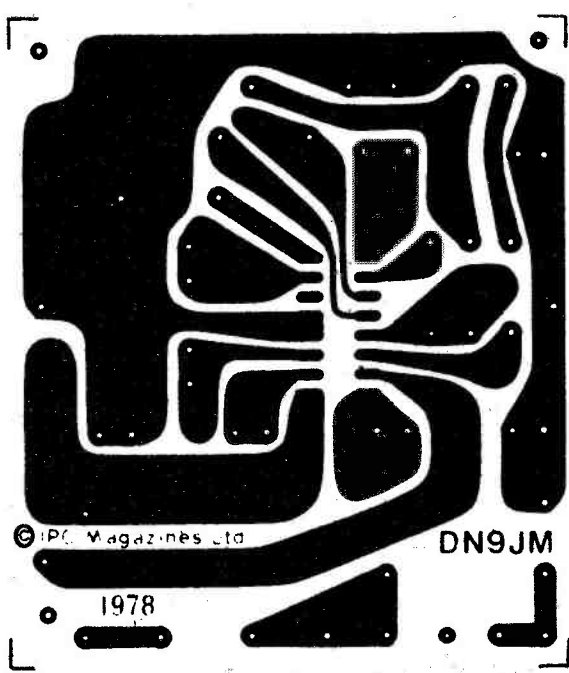
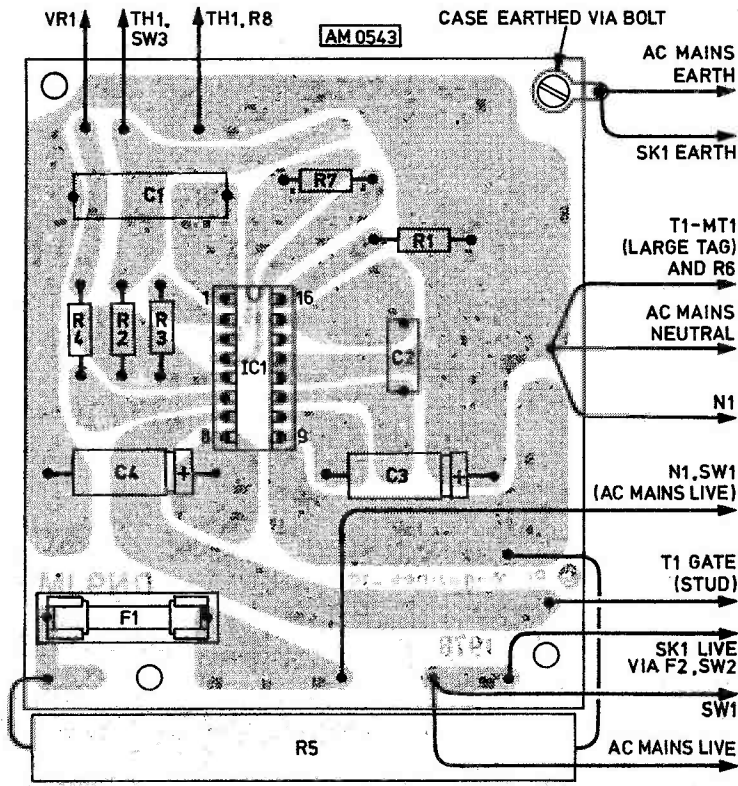
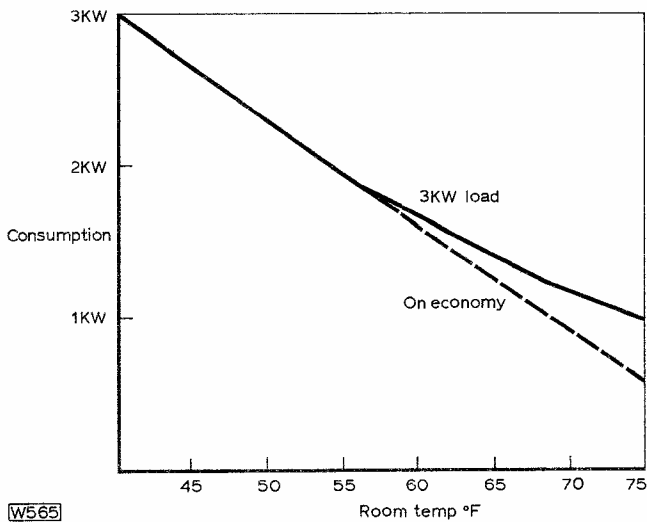


Fig. 4: Details of the PCB and overlay.





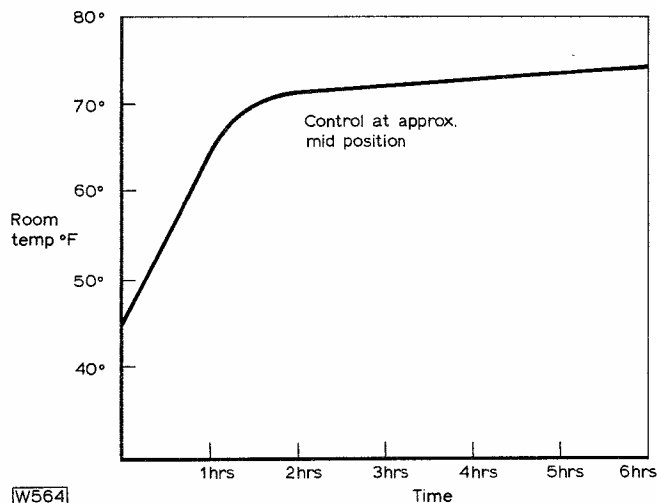
W565

Fig. 5: Graph showing relationship between consumption and temperature.

★ components

Resistors	Capacitors
R1 220kΩ ½W	C1 470nF Polyester
R2 47kΩ ½W	C2 68nF "
R3 82kΩ ½W	C3 100µF 25V electrolytic
R4 27kΩ ½W	C4 100µF 25V electrolytic
R5 6.8kΩ 10W	C5 33nF Polyester
R6 150Ω ½W	
R7 10kΩ ½W	
R8 220Ω ½W	
VR1 100kΩ 1in.	Semiconductors
TH1 GM472	T1 2N5574
	IC1 305/800

Miscellaneous: mains voltage neon, 2 SPST miniature toggle switches, miniature jack plug and socket, 13 amp plug and socket, 13A fuse, fuseholder or fuse clips (20mm), 100mA fuse (20mm), PCB (Readers PCB Service), suitable case.



W564

Fig. 6: Further graph indicating stable temperature level at mid-control position.

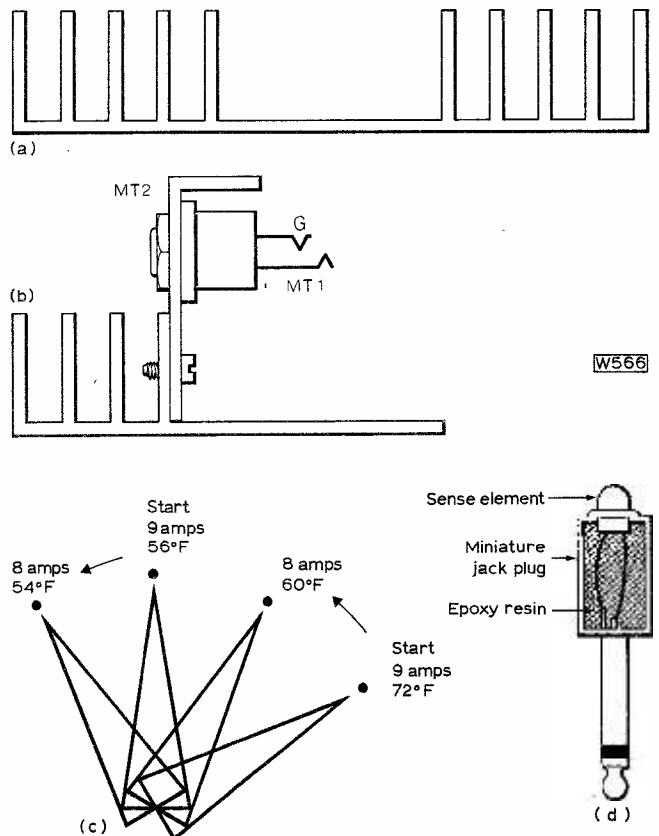


Fig. 7: Details of heatsinking for triac (7a and 7b), method of mounting thermistor (7d), and chart to show the approximate link between current and temperature conditions in the circuit environment (7c). C5 and R6 are mounted on T1, using the shortest possible leads.

Construction

Reference to Figs. 3, 4 and 7 will show the method of construction. First and foremost it must be mentioned that mains voltages are being dealt with and a reasonable amount of care must be taken during construction. To ease the construction it is recommended that the approved P.C.B. is used i.e. Readers P.C.B. services, to minimise wiring errors. The assembly of the P.C.B. should be carried out first. The I.C. should be mounted in an I.C. socket. The case of the prototype was made out of aluminium extrusion, as used in shop fitting work, but any metal box of rigid construction and adequate size could be used. The unit could in fact be mounted flush to the wall, the brickwork giving added heatsinking to the triac. All leads should be kept away from the 6.8k 10 watt resistor. When mounting the triac, it should be fastened to its own heatsink, using the correct insulating kit. Figs. 7a and 7b show the mounting. The sense element was mounted in a miniature jack plug, using epoxy resin, see Fig. 7d. There is no reason why the sense element should not be remote from the unit, say in its own small box. This however could possibly interfere with the fact that the unit is normally a portable accessory to an electric fire. If all the correct components are used there is no setting up of the unit to be done, but emphasis must be made here on checking wiring to the P.C.B. to eliminate damage to the I.C. Short circuits around the triac should be checked for, and also to make sure the case is adequately earthed.

stray signals

by **POINT CONTACT**

Were the summers sunnier, the blooms bigger and life more exciting when you were younger? Was the beer better, were the steaks juicier and the girls prettier? However that may be, I truly believe that the inhabitants of Research and Development Laboratories were more eccentric. In many instances the pranks they got up to were frankly crazy.

In his youth Point Contact spent varying amounts of time in laboratories which were only concerned with electronics in an oblique way, the immediate object of interest being some kind of material, a dielectric or semiconductor for example. Consequently, they were staffed by a motley mixture of Physicists, Chemists and that invaluable oddity, the Tame Mathematician, as well as the occasional Electronic Engineer. PhDs were two a penny, almost every other person had a higher degree except for yours truly and one or two other undergraduates. Whether as vacation students or student apprentices we were privileged for a period to participate in the work of this or that laboratory—and in the play too!



mounting for a specimen, plugging material for pipe-work etc. It was used again and again until it dried out and was thrown away and replaced. If you wanted some you had only to look around and there on the nearest shelf, in the cupboard, on the bench was a lump just waiting to be used. Of course, first of all it had to be well kneaded to make it soft and pliable again—and here care was necessary. The unwary were caught out by the prankster who had carefully fashioned a hollow lump and filled it with water, usually coloured with red ink, before smoothing over the hole and leaving it on the shelf.

Much more spectacular was the party trick of a certain Dr. K., which with a little prompting he would demonstrate. Pouring some liquid air from the Dewar flask of a vacuum-trap into a 50 ml beaker, he would then solemnly take a sip and roll it round and round his mouth. If one held up a smouldering taper he would breathe on it and it would burst into flame. (As liquid nitrogen boils at a lower temperature than liquid oxygen, it boiled off first, so unless replenished from a new delivery, vacuum-trap Dewars usually contained mainly liquid oxygen, as one could see at a glance from the pale blue colour.) He would then spit out the remainder, which vapourised in a flash on hitting the floor. Despite his assurances that it was quite safe if one kept the liquid on the move with one's tongue, I recount this stunt only to illustrate the



Some of the antics which people got up to were relatively harmless, some were fairly hazardous to the prankster and some potentially dangerous to others. In the first category I remember the Plasticene ploy. Plasticene (like Meccano) is a valuable laboratory aid with a thousand and one uses, like instant

statements in my first paragraph. Please DO NOT try it yourself!

Always interested in what components are available and what you can do with them, a colleague drew my attention a few days ago to the RCA fourteen-stage COSMOS ripple counter type CD4020. This divides by up to 2^{14} , so when clocked at 1MHz, produces an output frequency of 10^6 divided by 16384 or 61.03515Hz. A popular proprietary printed circuit board used for bread boarding digital circuits in our laboratory—it has supply rails running round and uncommitted pads for accepting i.c.s with up to 16 pins—accommodates 5 rows of 7 i.c.s. A board full of 35 CD4020s would therefore divide by 16384^{35} , which I am assured is $3.196670156 \times 10^{147}$ (to the nearest 10 significant figures). Clock the board at 1MHz and one cycle at the output would reach completion in $1.01296376 \times 10^{134}$ years.

This is a good bit longer than Point Contact is capable of imagining, in fact if just four CD4020s had been switched on in the year AD0, then given a long-life battery and assuming a rather good MTBF (mean time before failure) for all the components including the 1MHz clock oscillator, there would still be another 305 years to go before the output of the last i.c. clocked over!

The said colleague came back the next day with the further useful(?) information that there is a Motorola device number MC14521 which is a 24-stage ripple counter and that a boardful of 35 of these would have an output period (when clocked at 1MHz) of 10^6 divided by $7.331559403 \times 10^{252}$ seconds or approximately 2.3×10^{239} years. A suitable long-life battery not being available, solar cells wouldn't help much either, he assured me, as the sun is expected to have burnt out in the odd 10^{10} years or so. Figures like these are so meaninglessly incomprehensible that the only thing to be said of them is that they do demonstrate the ample capacity of my informant's all-singing all-dancing scientific pocket calculator. ●

KINDLY NOTE!

Jubilee Organ Part 3—November 1977 issue.

Page 506: In describing the interim keying tests a mistake was made in the text. When the flying lead is connected to the +12V point (positive end of C8) the note is inhibited. It is when the lead is removed from this point that the note will sound and it is under this condition that VR5 should be adjusted. Re-applying the 12V will terminate the tone according to the sustain setting of VR6. When S2 is open the tone burst will occur when the flying lead is REMOVED from the 12V point. The same reversed logic would apply to testing the repeat percussion effect.

next month in

Television

● THIRTY-CHANNEL REMOTE CONTROL

Remote control of channel changing has been a feature of some TV sets for many years, sometimes along with remote control of sound, brightness and colour. More recently however fifteen and thirty channel remote control systems have been featured on some imported sets and some export models. These are based on a set of CMOS i.c.s, and the use of these more elaborate systems is likely to spread in the near future since they can accommodate the functions required for teletext page selection. The operating principles of this type of remote control will be described, and examples of typical peripheral circuitry given.

● DECODER SERVICING

A general guide to the operation of PAL decoders, the faults that occur in them and trouble-shooting procedures, also mentioning some of the more important variations between different designs.

● TELETEXT EYEHEIGHT

What? Well, the transmission of digital teletext signals involves many differences from the well known problems of transmitting and receiving normal TV picture signals. For example, with a conventional TV signal the picture worsens gradually with reduction in signal strength, whereas with teletext reception there is an abrupt transition from correct reception to the decoder producing "scribble". It's important therefore to be able to assess the quality of a teletext signal, and for this purpose the BBC now inserts teletext test signals on lines 20 and 330. These can be scoped, and the eyeheight of the digits observed. Harold Peters explains.

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AERIAL PERFORMANCE TEST SET

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Transmitting and receiving aerial performance is difficult to measure with any degree of accuracy particularly when the operating frequency is low and the aerial is, of necessity, very large. At frequencies as high as 28MHz (10m band) one would find it physically impossible to plot the vertical angle radiation pattern, or indeed the plane polar pattern, with the aerial operating in either vertical or horizontal polarisation mode. At 145MHz (2m band) the problem is eased somewhat since the aeri-als are physically small but even then they need to be mounted very high in order to obtain true "free space" radiation patterns. Further, the transmitted signal source must be a large number of wave-lengths away and/or the receiving point must be at a similar distance if the aerial being tested is radiating.

It is usual to test an aerial under receiving conditions; the final result is the same. The writer has in use a 60ft high mast that can be lowered to half way so that 2m aeri-als for testing can be mounted on a special rotator system that will turn the aerial through 360° as well as from horizontal to vertical mode. The system is remote controlled from the measuring instrument position and the distant transmitters normally used are GB3VHF for horizontally polarised signals and GB3PI, or local amateur stations for vertically polarised signals. Even so, the process of carrying out polar pattern and gain measurements is laborious to say the least, and indeed somewhat hazardous, especially when large beams (a recent one was a 12-element ZL Special) have to be hoisted to a small platform about 30ft above ground before being raised to full height for tests. On new designs there is the added problem of making modifications, so an aerial may have to be hauled up and down several times before the design can be approved.

The Theory of Similar Structures

It is well known that aeri-als scaled down in frequency behave in exactly the same way as they would at the original frequency. At one time the writer used a frequency of 10000MHz to operate a model aerial system capable of obtaining quite accurate polar patterns of both plane and vertical radiation fields. At such a high frequency however, impedance matching, with any degree of accuracy, becomes very difficult indeed.

The "theory of similar structures" is applied in many spheres of engineering. For example, for proving ship's hulls by using scaled-down models in wave tanks, models of aircraft in wind tunnels and models of bridge structures etc. It is readily adaptable to transmitting aeri-als and if we take a dipole for

example, its familiar figure-of-eight radiation pattern is exactly the same whether the aerial is cut to operate on 2MHz or 200MHz, or any other frequency. This applies, of course, to aeri-als of all other configurations and to directivity, gain and polarisation as well.



The author's aerial measurement set-up, with aerial under test mounted on a turntable, plus a pen chart recorder.

Scaling down makes the aeri-als much smaller, easier to construct and handle, reduces the distance between the source of transmission and the aerial being tested, and brings the "free space" position much nearer the real earth. If the effect of earth is required as part of the measurement then a metal ground plane of several square wavelengths extent is no great problem. As mentioned however, if the scale frequency is too high matching the aerial to its feed point becomes a problem and to overcome this frequencies of between 600 and 1000MHz are commonly used.

Some years ago the writer used 800MHz for the original design of the "ZL Special" end-fire beam for operation on 14 and 28MHz and which was described in *PW* recently for 2m operation. At frequencies around those mentioned quite accurate matching is possible, materials for constructing the aeri-als can be scaled down, as can transmission lines, matching stubs and baluns etc. Even "miniature" co-axial cable, with little loss up to around 1000MHz, is readily available.

A Model Aerial System

A system recently built by the writer and described here operates at a frequency of 650MHz and, as with virtually all systems of this nature, aerials being tested are operated in receiving mode. The transmitter is normally placed at a distance of 10 wavelengths, in this case 4.6m, and it is equipped with a three-element (flat plane reflector) beam aerial to concentrate the radiation forward, to provide a sufficiently large illumination area and to reduce reflected signals to a minimum.

The "receiver" consists basically of a simple diode detector to provide a DC voltage from the RF signal picked up by the aerial being tested and which is used (a) to operate a pen chart recorder to obtain either polar co-ordinate or Cartesian co-ordinate plots of radiation patterns or (b) a continuous direct display of a radiation pattern in polar or Cartesian co-ordinates on an oscilloscope screen.

The Transmitter

The transmitter is a simple self-excited oscillator using a Mullard TD1-100A valve to provide an RF output at 650MHz of about 2W. Any similar UHF valve would do and frequency stability is not critical provided drift is not more than a few MHz. Audio tone modulation can be applied for quick checks and for demonstration, in which case the model is made to radiate and the space around explored with a single dipole and diode receiver the signal from this being fed to an audio amplifier and speaker. The transmitter must, of course, be completely screened and its output (loop coupled) matched as closely as possible to the transmitting aerial. The circuit used is shown in Fig. 1 and may serve as a guide to anyone interested in embarking on a similar project.

The Measuring System

This system is rather complex in view of the facilities it provides but could be simplified by using a meter to obtain readings for plotting patterns and checking gain, in which case the receiver need consist only of a diode detector, the DC output from this being fed to a micro-ammeter via a simple attenuator.

One of the most important factors in aerial performance measurement is the "reference" to be used and this is normally a dipole. For example, in gain measurement the dipole is first set up and the signal level from this noted. It is then substituted for the aerial to be tested and the level from this ascertained. If the readings are in terms of voltage then the usual formula $20 \text{ Log}_{10} \frac{V_2}{V_1}$ is used to obtain the gain in dB.

In the system described here a rather more sophisticated reference system is employed, particularly in connection with continuous oscilloscope displays and this uses an "electronic dipole" to be described later.

The block diagram Fig. 2 gives some idea of the complexity of the system, which begins at the aerial being tested, picking up the signal from the transmitter. This is coupled by a rotating loop to the detector and the received signal is rectified, the output being switched to obtain positive or negative (with respect to earth) DC which is fed to a calibrated attenuator. From here the signal goes to a pen-recorder for Cartesian or polar plotting, to a meter

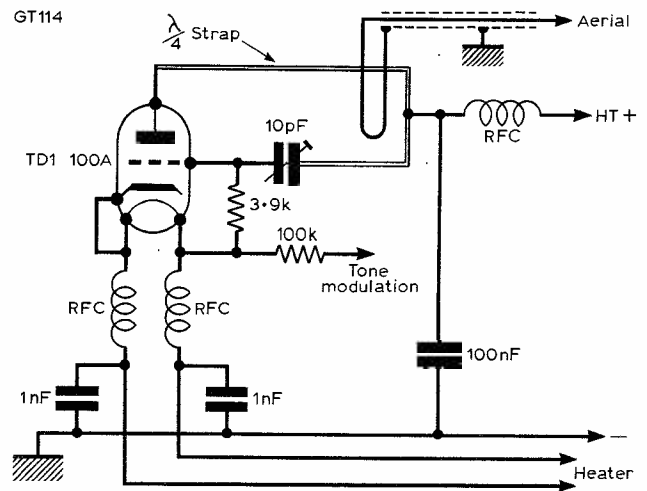
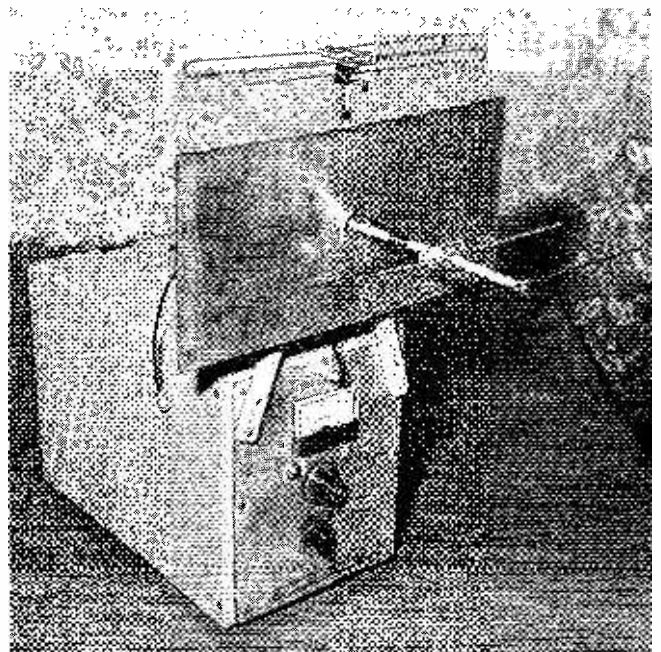


Fig. 1: Circuit diagram of the author's 650MHz transmitter.

for making initial adjustments, or to the oscilloscope DC "Y" amplifier for direct display of Cartesian plots (see various photos). The aerial and polar plotting table are turned by either of two synchronous motors with suitable pulley and/or gear reduction to obtain (a) a slow rotation at about 1 revolution per 30 seconds for pen chart plots or a fast rotation for oscilloscope displays at between 5 and 8 revolutions per second. Directly coupled to the aerial turning shaft are (a) a system for obtaining a sync pulse for each 360° of rotation and pulses for each 10° of rotation which are used for Z modulation (scope "bright up") pulses and (b) the components for generating the electronic dipole signal. The sync and 10° marker pulses are obtained by a light shining through small holes in a perspex disc (painted black)



The 650MHz test transmitter with its 3-element aerial mounted above it.

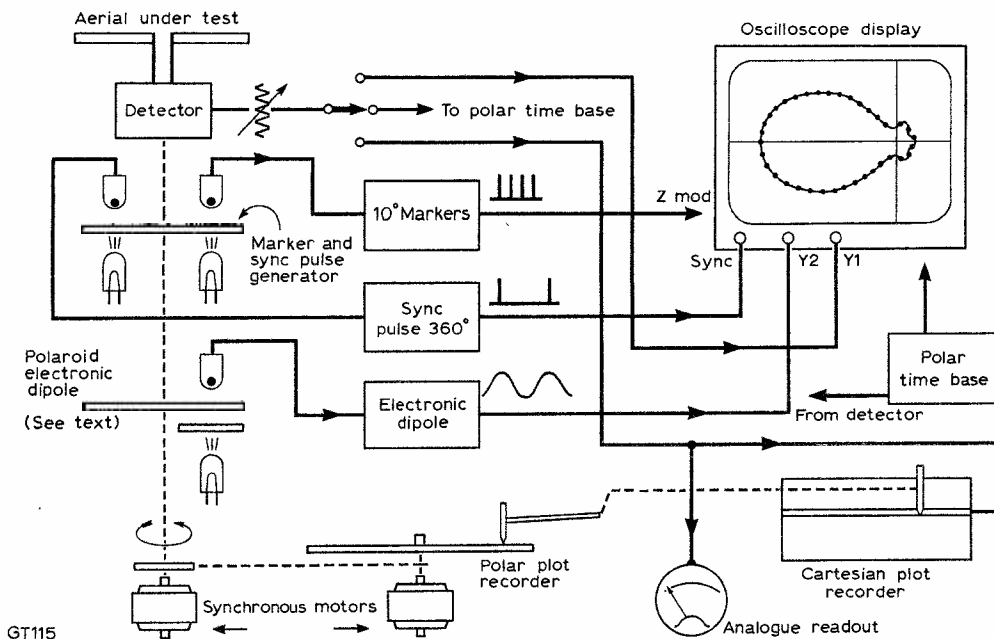


Fig. 2: Block diagram of the performance measurement system.

GT115

on to photo transistors, the outputs from which are amplified and shaped into short duration pulses. The disc contains 36 holes for the 10° markers and one for the 360° sync pulse.

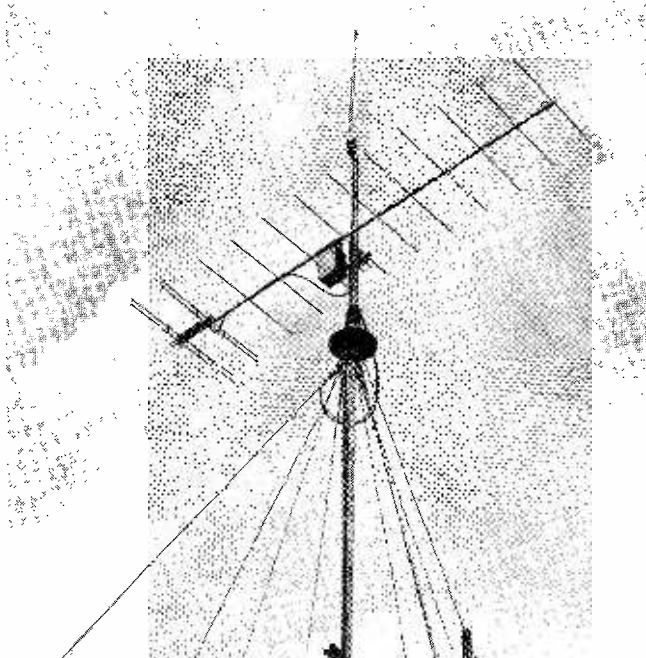
The electronic dipole signal is obtained by shining light through a rotating disc of Polaroid material and a fixed piece of Polaroid simultaneously on to a photo transistor. As the light fluctuates sinusoidally the transistor generates two "sinusoidal" DC voltages per revolution, the equivalent of the radiation pattern from a dipole in Cartesian co-ordinates, see Fig. 3. The signal is coupled to the Y2 DC amplifier on the oscilloscope via an attenuator so that the level can be set against that from a real "reference" dipole and, of course, retained and displayed simultaneously whilst an aerial is being tested.

An additional feature in progress of being developed is to provide the oscilloscope (an Advance model OS250) with a controllable circular time base; controlled, that is, from the aerial signal to provide continuous display of patterns in polar form as depicted in the block diagram.

Examples of Pattern Plotting

First some examples of plots from the oscilloscope in Cartesian co-ordinate and, apart from the dipole, I have taken one or two of the aerials described in my articles in the *PW* July 1976 and May 1977. The pattern from a real dipole is shown in Fig. 4 and, as can be seen, compares very favourably with the "electronic dipole" readout in Fig. 3. Each bright spot represents 10° of rotation, through 360°. Now examine the scope readout, Fig. 5, from the "ZL Special" end-fire beam described in *PW* May 1977, operating in horizontal mode. The two minor rear lobes are displayed to the right and left respectively. Compare this with the polar co-ordinate plot in Fig. 6 taken from the same aerial and with the same equipment.

The $5_8\lambda$ ground plane is a very popular aerial but it is not as efficient as one would suppose due to its high-angle radiation. It is omni-directional and, ideally, maximum radiation should be parallel to the ground. As the vertical angle pattern Fig. 7 shows, maximum radiation is at an angle of about 30° and although some gain is obtained from this aerial over a conventional $1_4\lambda$ ground plane it is wasted in an upward direction. In fact the "gain" on a line parallel to the ground is negative with respect to a vertical dipole. The oscilloscope readout Fig. 8 shows the same pattern in Cartesian co-ordinate.



A 12-element "ZL Special" mounted on the rotator system atop the author's 60ft mast.

Performance Defects

With this system of testing all kinds of defects in performance can be seen readily. Taking again the $5_8\lambda$ ground plane, its normal omni-direction pattern

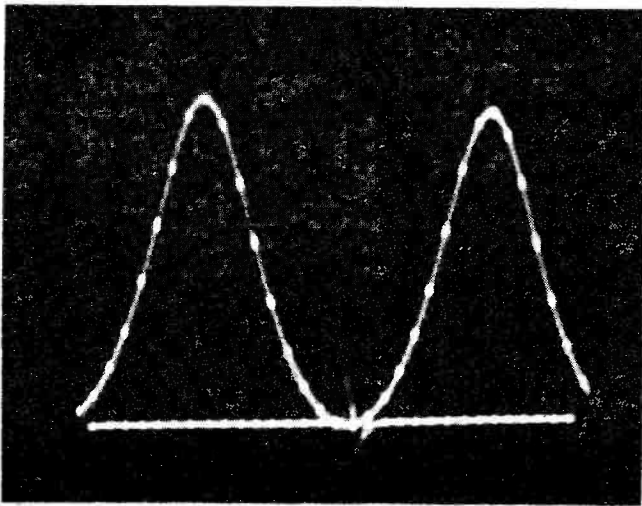


Fig. 3: Oscilloscope Cartesian plot of the "electronic dipole". (See text)

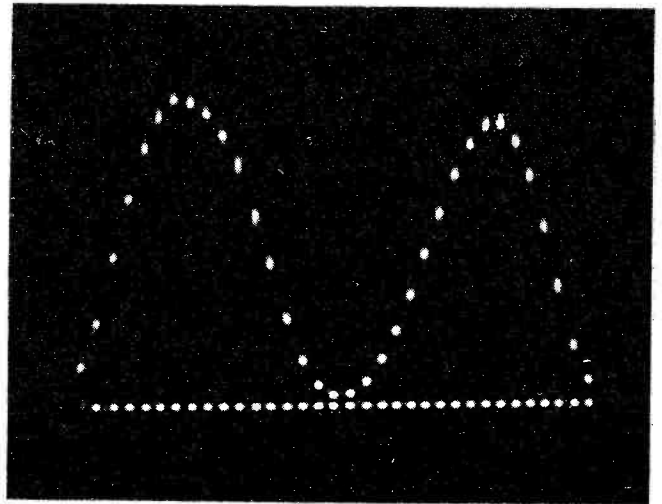


Fig. 4: A Cartesian plot of the response pattern of a real dipole.

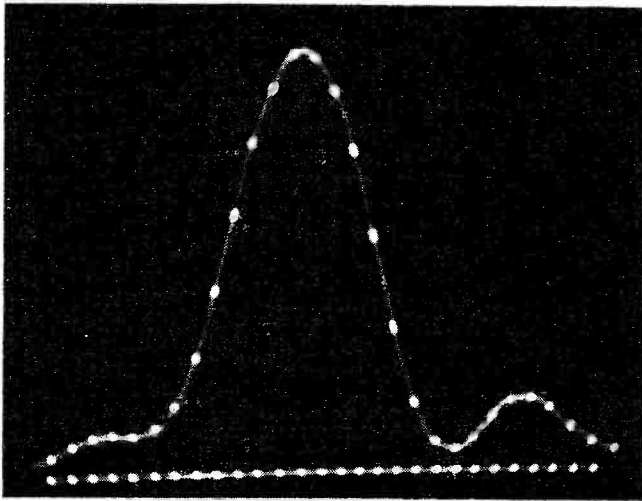
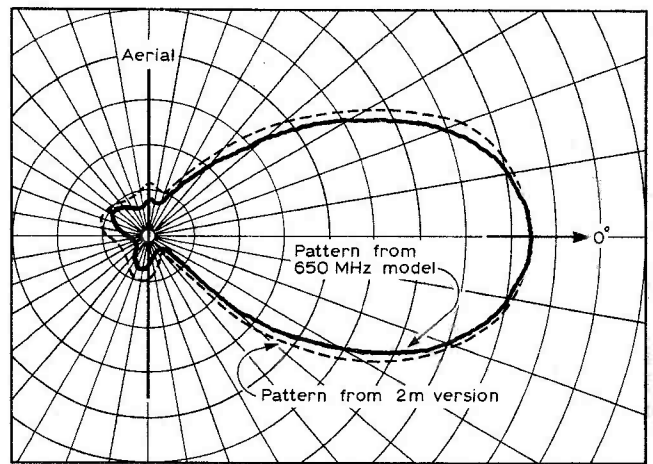
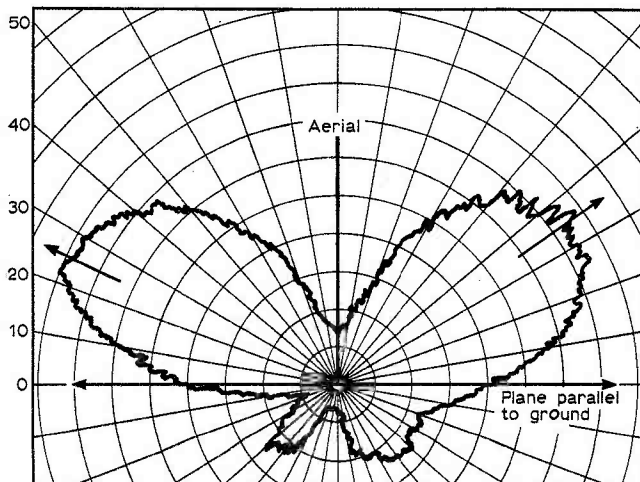


Fig. 5: Cartesian plot of the response pattern of a "ZL Special" array, operating in the horizontal mode.



GT116

Fig. 6: A polar co-ordinate plot of the aerial of Fig. 5, plotted using the pen chart recorder.



GT117

Fig. 7: Vertical radiation pattern of a $\frac{3}{8}$ -wave ground plane aerial.

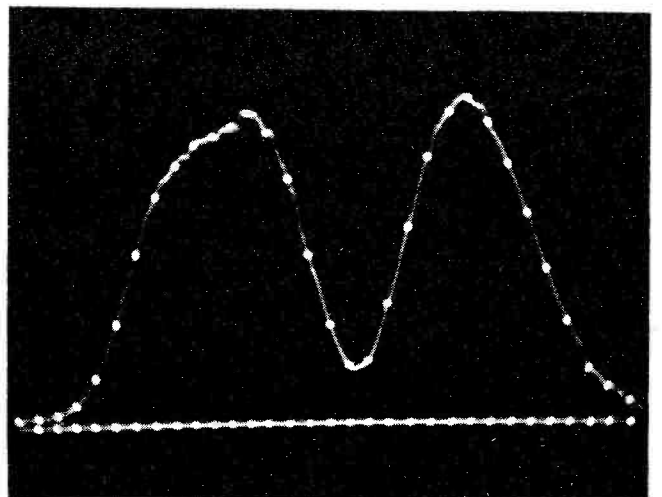


Fig. 8: Oscilloscope Cartesian plot of the response of the aerial of Fig. 7.

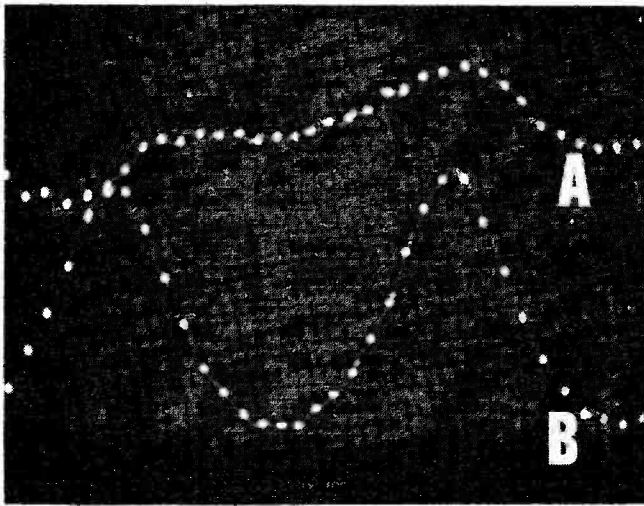
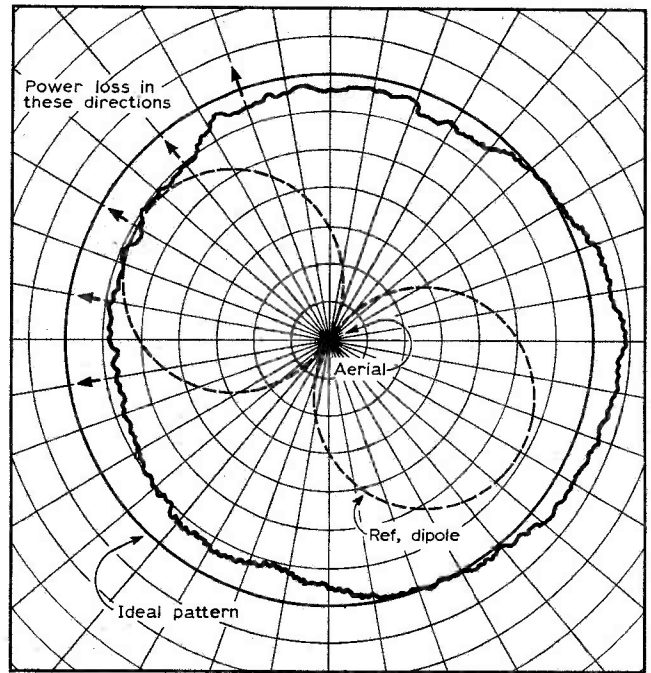
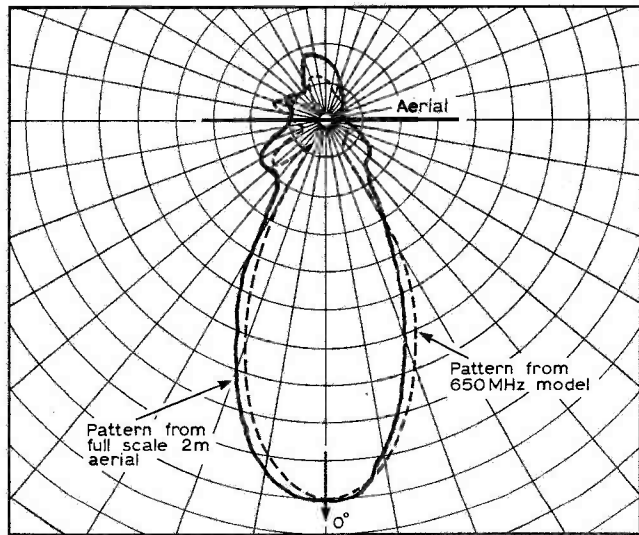


Fig. 9: Trace A shows the distortion of the radiation pattern of an omni-directional aerial due to a nearby resonant conductor. Trace B is a reference dipole.

Fig. 10 (right): The polar co-ordinate plot of the set-up of Fig. 9.

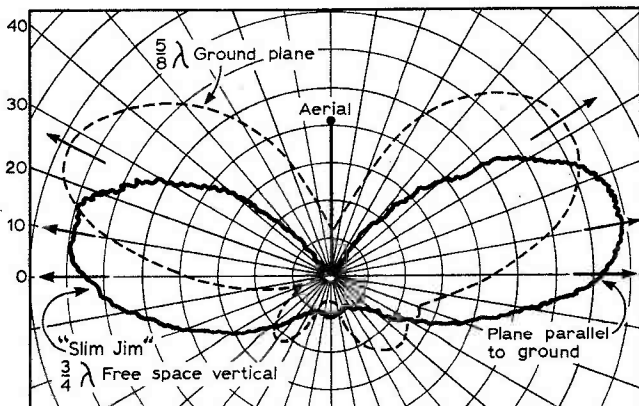


6T118



6T119

Fig. 11: Horizontal radiation patterns of two 12-element "ZL Special" aerials.



6T120

Fig. 12: Comparison of the vertical radiation patterns of a $\frac{5}{8}$ -wave ground plane aerial and the $\frac{3}{4}$ -wave "Slim-Jim".

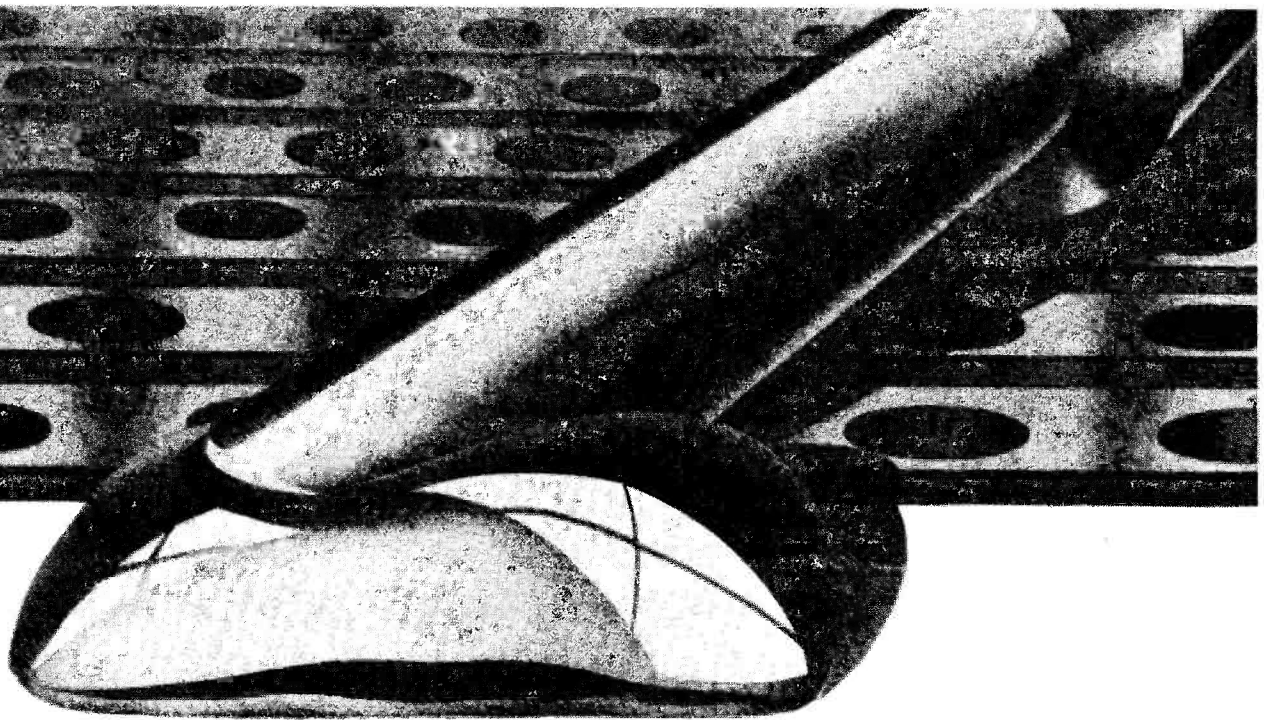
should be a circle if the aerial were behaving perfectly. If a mismatch exists, or the aerial is off resonance, the pattern can become distorted i.e., not a perfect circle. The presence of other resonant conductors will also produce this effect. The oscillogram Fig. 9 shows this quite clearly. The lower trace (B) is a reference dipole pattern. The upper trace should be a straight line, therefore there is a loss of radiated power in some directions. The result is perhaps more clearly illustrated by the polar co-ordinate plot in Fig. 10 of the same aerial with the dipole pattern again for reference.

A 12 element "ZL Special" mentioned earlier, has been developed for operation on 2m and is now operational at G2BCX, the home station. This aerial started out as a 650MHz model and after adjustment and a few modifications to director spacing and length, yielded a gain (over a dipole) of 14dB. The 2m version is physically much smaller than a Yagi array having the same gain. Its radiation pattern, actually plotted operating on 2m is shown in Fig. 11 by comparison with the pattern obtained from the 650MHz model, which is shown dotted.

Slim Jim

Another aerial designed and developed with the aid of the model system is an omni-directional "free space" aerial for 2m known at the moment as the "Slim Jim". It has no ground plane radials and is vastly superior to a $\frac{5}{8}\lambda$ ground plane, due to the radiation being almost parallel to the ground. The vertical angle radiation from the full scale 2m version is shown in Fig. 12. Compare this with vertical angle radiation from a $\frac{5}{8}\lambda$ ground plane shown dotted in the illustration. Details of both these 2m aerials will be published in the not too distant future.

To anyone contemplating setting up a test system of this nature I must emphasise that the task is not an easy one, but the results, if they are reasonably accurate, are highly rewarding.



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DESIGN YOUR OWN PROJECTS

No. 5

Continuity Tester

TOBY BAILEY & BOB WHITAKER

In part one of this series of articles we mentioned that many of the circuits that we would be describing were going to be "one off" affairs. By this we meant that every circuit built to our specification may not necessarily work first time, without some playing about with component values. In fact this is also true of designs which are far more "respectable" than our examples! The audio amplifier in part 4 should work every time whereas the courtesy light extender of the previous month probably needs different values of timing capacitor to cater for the spread in gains of the transistors.

In passing we would recommend that if you don't spend a reasonable amount of time experimenting with simple circuits like this one, then now is the time to start. It's one of the best ways of learning about electronics in practice, as of course is reading this series!

Perhaps it's time now to stop philosophising and get down to business. The circuit for this month stems from the problem of finding which wire is which in wiring harnesses and cables. Wires always seem to end up being coated with nasty mixtures of dust and gunge and usually end in the most inaccessible places. The result of this is that "colour coded" wires can appear identical to one another and that you sometimes need to be a contortionist to hold the meter probes and simultaneously look at the meter needle. To put an end to this ritual we are going to go through the design of an audible continuity tester as this month's project.

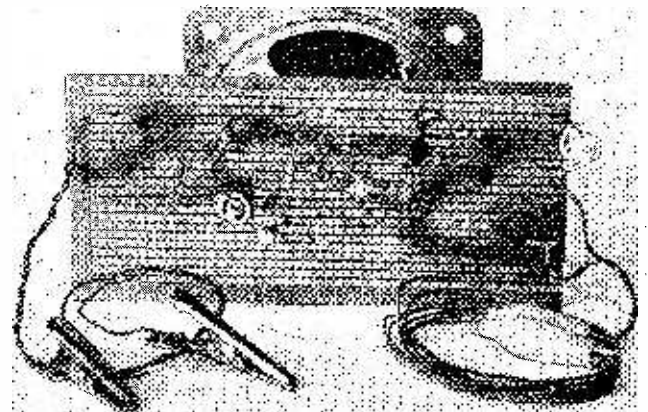
A little while ago we saw a design for such a device which pointed out the merit of using a low testing voltage (about 0.2V) so as to avoid seeing forward biased semiconductor junctions as short circuits. Although this seems a good idea the circuit was implemented with five transistors and a Zener diode—we felt that this was rather excessive so this month we will start from scratch and "design our own".

Specification

We want to use a 4.5/5V supply, so that we can either use batteries or the 5V supply which we use for driving most of the instruments on our test bench. The device should use a low testing current—certainly no more than about 5mA—and should treat a forward biased germanium junction as an open circuit. The standby current should be as low as possible so that when the tester is left on for a few hours/days/weeks it doesn't precipitate a major energy crisis.

Design

The major problem we have to deal with is the



magnitude of the voltages we have to sense. To push three or four milliamps through a forward biased germanium junction is going to need around 0.4V—we realise that the "turn on point" is usually stated to be around 0.2-0.3V but at 4mA it will be a bit more. Now sensing 0.4V is going to be quite difficult and the best solution seems to be to use the sensitivity of a transistor, at the point where it is switching on, to "catch" the small voltages in which we are interested. By far the most convenient way to do this is to work out a way of converting the input signal of a fraction of a volt into a signal of several volts, which we can then use to switch an oscillator on or off.

Early ideas

Initially all our thoughts were directed towards putting the sensing circuit in the supply to the base of the transistor. Fig. 1 shows one of our first circuits.

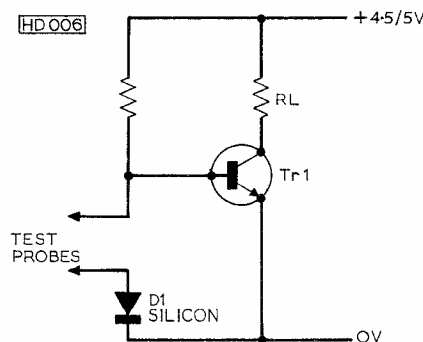


Fig. 1: The start of the design.

The idea is that the diode turns on a little before the transistor so that if the test probes are shorted together then the diode steals all of the base current

from Tr1 and turns it off. If however there is a significant resistance or a junction between the probes then Tr1 will keep its base current and stay turned on.

Now this circuit has all sorts of problems in reality, but the one which caused us to abandon this circuit is that it will gobble up current at an alarming rate during standby. If the collector load resistor R1 is made large so as to reduce the quiescent current then Tr1 will be heavily saturated and hence difficult to switch off.

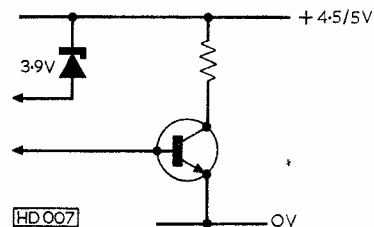


Fig. 2: A possible development using a Zener diode.

An alternative solution is to play around with Zener diodes, which alleviates the current problem (see Fig. 2). We don't like this idea since, by the time you have allowed for the +5% Zener tolerance (+0.2V) and for about half a volt difference between a full battery and a half empty one, the build up of tolerances will produce a bit of a mess.

Anyway, whilst we were thinking about this method, we had a bright idea: why not put the sensing element in the emitter and stabilise the base voltage—which can be done roughly with a couple of diodes? Fig. 3 shows the sort of idea we are getting at—it seems altogether a lot better. The current consumption with

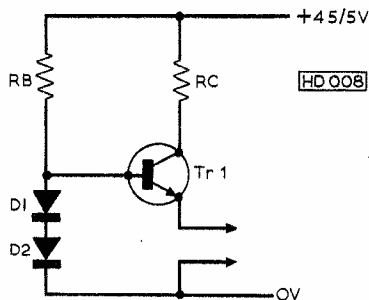


Fig. 3: A more effective modification involving two diodes.

the probes open circuit need be little more than the base current required to turn on Tr1—only a micro-amp or two. We will have to decide about the diodes by experiment but doubtless we can trim up the final circuit with a preset potentiometer. To check that this circuit is feasible suppose that we achieve an emitter voltage of 0.3V and that Rc is say 1kΩ: if we short the probes and ensure that Rb is sufficiently small then Tr1 will saturate, whilst if we connect a 200Ω resistor across the probes then a current of about $0.3/200 = 1.5\text{mA}$ will flow which means that Rc should drop only 1.5V. This all looks very promising.

At this stage in the proceedings we can make intelligent noises about how, since we want voltage gain and aren't particularly fussed about the current gain, a common base circuit (which this is in essence) is going to be at least as useful as a common emitter circuit (which the others were). We feel that whilst this sort of observation may be quite interesting it is not particularly useful and we certainly will not follow the scientific tradition of covering up the luck and inspiration involved by pretending that the circuit was arrived at in this way.

The Oscillator

Having got so far perhaps we should turn to the design of the oscillator. Some sledgehammer solutions spring to mind, such as using a transistor or two to amplify the current available and use this to supply a multivibrator or something. With a bit of thought we can do better than this. What about using the output of Tr1 to control the bias supply to a one-transistor oscillator—something like Fig. 4

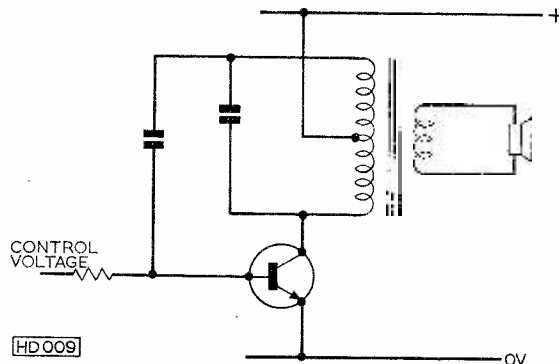


Fig. 4: Here the circuit has grown into a Hartley-type oscillator.

This may well work but we have a solution which we think is even better. The complementary pair type oscillator in Fig. 5 works as follows. Assume that both transistors are turned off—then C will start charging up via R and the speaker. Soon Tr1 will begin to turn on; this turns Tr2 on and the current through the speaker raises the voltage at that end of C.

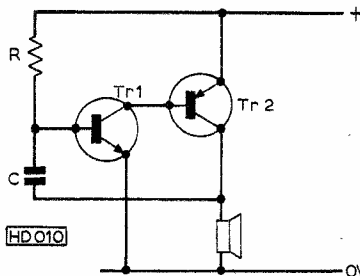


Fig. 5: An oscillator involving a complementary pair.

Now it is one of the fundamental principles of electronic circuitry that you cannot change the voltage across a capacitor instantaneously. This means that the voltage at the other end of C is pushed up even higher and so even more current flows. Eventually the capacitor loses all its charge and the current through the transistors starts to drop. Provided that the component values are within a certain range (which is very wide and we won't worry about it here) the capacitor will drag the base of Tr1 down sufficiently far to turn off both transistors again. The cycle can then be repeated. The current through the loudspeaker, which should be a low impedance type, flows in short pulses but is of sufficient magnitude to make a fair noise.

The major point of interest that this circuit holds for us is that the resistor acts merely as a charging source for the capacitor. If we take the supply-rail end of R and connect it to a variable voltage source, the oscillator won't run when the voltage is zero and will oscillate as before when the voltage is equal to that of the supply rail. Somewhere in between these two extremes it will struggle into life and a little experimentation with the circuit on a T-Dec showed that this occurred with $R = 1\text{M}\Omega$ and $C = 1800\text{pF}$ at around 1.5V.

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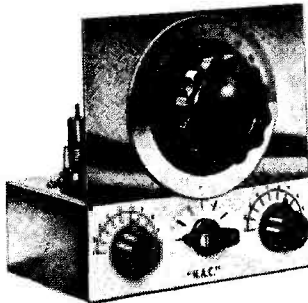
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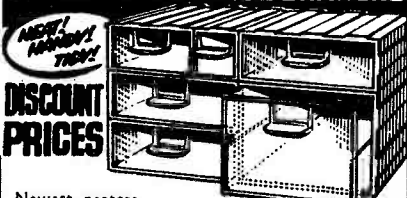
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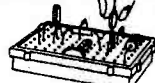


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If we connect R directly to the collector of the sensing transistor in Fig. 3 we will in fact have produced a resistance tester which will make a noise only when we haven't got continuity. Although this works it is not what we wanted when we drew up our specifications. Never mind, we can turn the circuit of Fig. 5 "upside down" if we reverse the polarity of both the transistors—the two circuits can then be fitted together as shown in Fig. 6. We have tapped the resistor to the oscillator from the potential divider of R2 and R3 so that we can arrange for Tr1 to be near saturation before the oscillator switches on. We have also put a preset potentiometer in the base of Tr1 to trim the circuit for maximum sensitivity. We could have put it in series with the probe leads, but let's leave it where it is for the time being.

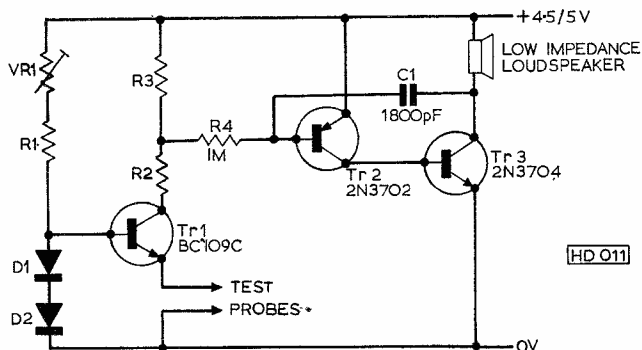


Fig. 6: The "combination" oscillator circuit.

Component values

Perhaps we should justify some of the component values in Fig. 6 which have already been decided. R4 was chosen as 1MΩ because our experiments with the oscillator showed that this value worked well. C1 is 1800pF because this value made a nice noise. As for the transistor types: the 2N3702 and 2N3704 are simply cheap general purpose types and we chose a BC109C for Tr1 because it has high gain which will mean that we need less current in the R1-VR1 circuit and this in turn means lower standby current. What now? Well the best thing to do is to build the circuit on a T-Dec and experiment with the values of the other components.

want more than about 70μA of combined base and diode current. The circuit was then tried without any diodes to make sure that the oscillator oscillated when the probes were shorted and stopped when they were open circuit.

We then experimented with the diodes. It turned out that with one silicon and one germanium diode in series the transistor could not be persuaded to turn on significantly at all, even with the VR1 on minimum. With two silicon diodes in series we couldn't turn the oscillator off when the probes were shorted. This is a disadvantage, as maximum sensitivity is obtained by adjusting VR1 so that the oscillator is just turned

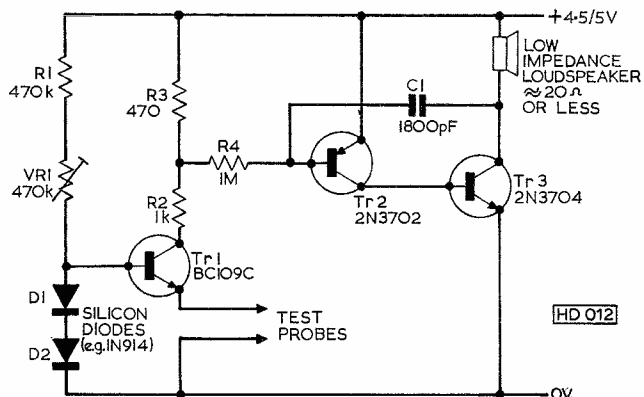


Fig. 7: The circuit of the completed design.

on when the probes are shorted. Increasing the value of R1 to 470kΩ rectified this deficiency.

Having set the circuit to the correct operating point with a 4.5V supply we found that resistances of more than about 20Ω did not register as shorts, neither did a selection of germanium junctions in diodes and transistors. The 20Ω figure was rather better than we dared expect and even when the supply voltage was increased to 5V there was little degradation in performance. The complete circuit diagram is shown in Fig. 7.

Flushed with success we transferred the whole circuit directly from the Dec to a piece of Blob Board. A practical layout is shown in Fig. 8. If the transfer is done component by component then the whole process is very fast and you don't have the problem of

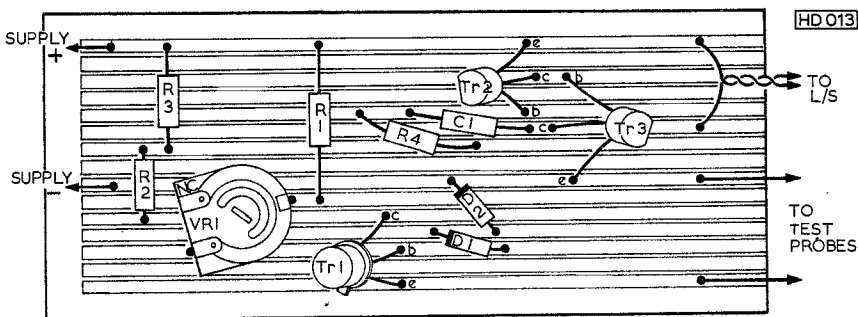


Fig. 8: A practical layout for the continuity tester.

Where do we start? We wanted a sensing current of three or four milliamps maximum so we want R2+R3 to be in the region of 1.5kΩ. We already know that we want about 1.5V drop across R3 when Tr1 is saturated, to drive the oscillator. A little experimentation showed that when R3=470Ω and R2=1kΩ the voltages were about right. Then we dug out a 500kΩ preset and soldered a couple of leads to it so that we could plug it into the Dec. R1 was chosen to be 270kΩ on the grounds that we can't possibly

losing the components among the general chaos of the work bench. We then attached a pair of old probes to the unit along with two leads for the battery.

How you house the finished unit is very much up to the individual constructor, and will depend on whether you want to carry it around in your tool-box or mount it permanently somewhere on the work bench.

POTENTIAL BREAD

OF WRITING FOR PW!



In the January 1976 issue of *PW* we published an article entitled "Want Some Lolly"? which laid down the guidelines for budding authors. The response at the time, and for some time afterwards, was most encouraging so we feel that another similar, but updated, article could be of profit to magazine and readers alike.

First of all, don't imagine that just because you are a genius at developing and constructing electronic circuits you cannot possibly write them up as well. If you go about it in the right way, you can, and get paid for it! You have only to look at any copy of *PW* to see the style we use for technical articles and then copy that. What could be simpler? The secret is to keep an accurate account of what you are doing, from the word "go". Use a notebook and not odd bits of paper which are easily lost or used, inadvertently, for lighting your pipe!

We can sometimes arrange to help an author by providing him with a prototype board, if he can supply a rough foil pattern. A project built on stripboard can be eminently suitable for conversion to a PCB, and, again, we can usually assist. It is, perhaps, pertinent to point out here that we normally accept articles for publication on a "sole rights" basis. That is, *IPC Magazines* retain full copyright in the article on publication and payment of the appropriate fee to the author. Note that this includes the design of any PCB in the article. PCB layouts published elsewhere and possibly already the subject of copyright, cannot be accepted as part of an article submitted for publication.

When experimenting with a circuit you are bound to make voltage or current measurements so put these values on the circuit diagram in your notebook. If using an oscilloscope to check waveforms draw these in at the appropriate points, together with their amplitudes, if these have been measured.

If you think that your brainchild is likely to be of interest to the readers of *PW* then drop a line to the Editor with a brief resumé of what it is and what it does. If its appearance is important then a colour snapshot of it can be very informative to the Editor. **DO NOT SEND THE PROTOTYPE UNTIL REQUESTED!**

Assuming that an article is requested what does the Editor want to receive from you? Briefly, the manuscript (MS), components list, plus circuits and constructional drawings. So let us look at these requirements in detail.

1. The MS. This should start with a brief introduction describing how the project came into being and what it achieves. If a technical specification is warranted put this on a separate sheet of paper. Next, a description of the circuit/s and how they work, with references to components linked to the circuit diagrams. Adequate constructional information comes next and this should not be skimped. Refer to your drawings as necessary, remembering that we shall be adding our own photographs to assist the reader. Finally, information on the alignment or adjustments that are needed to get the project working properly, together with any notes on snags that may have arisen.

To get a good, clean and presentable MS it is imperative to write it all out beforehand, checking and correct-

ing it as necessary before typing it. A lot of work? Maybe, but then, that's what you are going to be paid for, you hope! Type the MS using double line spacing with wide margins at both sides. Here's a useful hint. Type out a whole line from a technical article in *PW* (September 1977 onwards) and use that as a guide to the length of a line when typing the MS. Type on one side of the paper only and number the pages. Add a cover sheet with your name and address, name of article and approximate number of words.

2. The Components List. This is very important and it must be accurate. Component values and references must agree with the circuit diagrams. All components should be readily available to the home constructor, but any "difficult" ones should have at least one source of supply quoted. Look at *PW* to see the required form of the components list. When working on a project see if the relatively unimportant components, such as decoupling components, cannot be rationalised to reduce the number of different values used. Because you have used odd values from your junk box these should not be carried on into the components list. In a big project, a reader can save money by buying similar values of resistors, capacitors etc. in bulk. When you come to reference the components as R1, C1 etc. start at the left and work across to the right. Look at *PW* for our style of numbering and, in particular, note that an IC may be split up on the circuit diagram and shown as IC2a, IC2b and so on but in the component list IC2 is sufficient.

3. The Drawings. All circuit diagrams, constructional drawings, graphs and the like must be on sheets of paper separate from the MS. Circuits only need to be clear and accurate and not works of art. We re-draw them anyway, so don't waste time on unnecessary elaboration. Avoid small, crabby circuits with hard-to-read component values. Naturally, circuits should agree with the working prototype but if you do make any last minute alterations don't forget to amend the circuits! If you are not too happy about your draughtsmanship then try using graph paper, it can be a great help, though sometimes poses problems when photo-copied.

Comes the day when all the bumph is ready but there is just one more very important job to do! Get it all photo-copied! The Editor, or whoever is handling the article, may, almost certainly, want to raise a point or two at some time or other but it will be a waste of time if you haven't got a copy of everything. When you post it to the Editor it is a good idea to send it Recorded Delivery.

General notes

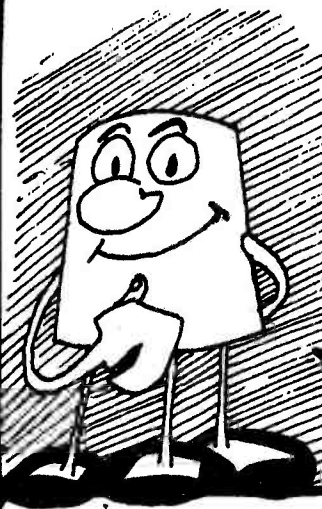
If you don't want to have your name shown on the article when published then tell the Editor in your covering letter and suggest a nom-de-plume. If you happen to have a string of letters after your name don't be modest, we like to print them. It's good for our ego!

Ah, yes, payment! When the Editor gets the first copies of the issue containing your epic he will sit down and assess all the contributions for payment. In a couple of weeks you will get a docket to sign and return to our Accounts bods. When they get it they will issue a cheque in payment and suddenly you will realise that it has all been worthwhile. In the meantime, of course, you will have been working on yet another project for *PW*!

When working on the MS avoid the use of colloquial expressions such as "7 megs" (7MHz), "mike" (microphone), "amp" (amplifier) etc., it is much better to spell them out properly.

Measurements should be in the Metric System but it helps to put the equivalent Imperial figures in brackets, especially for items such as boxes, cabinets and the like. There are many people around who, understandably, have not yet been able to come to terms with the Metric system.

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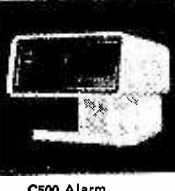
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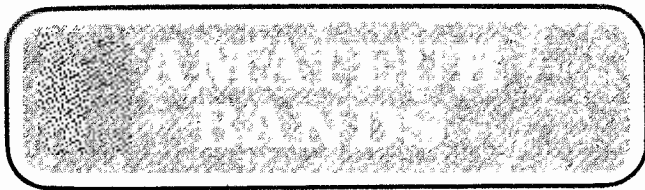
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by **Eric Dowdeswell G4AR**

Quite a few reports have accumulated since last month but pride of place must go as usual to a reader who has just got his nice new callsign. **Andrew Work** of Beverley, E. Yorks, often wrote to the column as A9091 but now he is G8NPT and has already been on the air on 2m with some borrowed gear. Regretfully, Andrew has quite rightly decided to forget the code test until his "O" level exams are out of the way next year. Andrew is full of praise for our new RAE series in PW and feels sure it will bring on a new batch of licencees in due course.

Chas. Mason, subject of my November editorial is now GW4GJD and active with a KW Vanguard on CW using a 132ft wire, plus an AR88. Chas. is in a very isolated spot in Pembroke, W. Wales, so the DX potential ought to be excellent. **Simon Robinson** (Stocksfield, Northumberland) was on holiday on the Isle of Mull where he met local GM4EHB. Simon's DX is still not too good, being stuck with an inside aerial around the lamp fittings!

Alan Doherty BR34968 of Portrush, Co. Antrim has not had too much time for DXing but nevertheless found something on all the HF bands. WB6NCO/VQ9 on Diego Garcia was a good find on 15m and FK8CR on Noumea (Box 544) on 20m will be hard to beat. From Farnham, Surrey, **Paul Pasquet** reports that fellow listener Iain is now radio cadet with BP and away on a course, but Paul seems to have managed quite well on his own! Weirdest call of all time was 4079WARC which turned out to be in YU-land! Another of Paul's weirdies was Z44N reported to be on an island near ZC4. A more familiar prefix was KS6 in the shape of KS6FL a pretty good catch on 15m SSB.

It was good to hear from **Dave Peck** BRS37621 of Cambridge once again with a short list of his RTTY finds on 20m. Dave happened to find out that his neighbour is an Ex-RAF radio op so Dave can now do about 12wpm! Better get him into the local club OM! In Braunton, N. Devon, **Paul Bradbeer** now has a new FRG7 to feed from his V-3jr vertical aerial. Wisely, he has added earth radials rather than rely upon the natural earth. His favourite band is 15m although 20m and 40m get their share of his attention. First time writer **John Stephen** of Glasgow recently bought a Hallicrafters SX140 and is very pleased with results so far but would like to get hold of a manual for it, so if anyone can help write to John at 74 Shakespeare Street, Glasgow G20 8TJ.

Up in Dringhouses, York, some CW has been copied by **John Hague** but he hopes to do better soon with a DX160 which is on the way. John mentions that he is taking his code test very soon but I am not sure that this is very wise. As far as I know the code test certificate is only good for a year so unless John gets his RAE in that time

he might have to take the code test again. With the astronomical rise in the cost of taking the code test and the RAE it behoves every candidate to make quite sure that he is 100% ready for the exams before entering.

An interesting letter from 16-year-old **Kevin Jones** in Nuneaton, Warks, who is shortly entering the Navy as an electrician. He has been busy on communications in the Sea Cadet Corps where he has been able to play around with some of the gear. From Rotherham comes a first letter from **Neil Clarke** who has succeeded in copying SSB on 40m with two domestic receivers, using one as a BFO! Anyway I think that the bug has bitten Neil hard enough to ensure that he will be getting a set soon that is better suited to the job in hand! One callsign, a G8, caused Neil to ask why he was operating on 40m as he thought G8's were confined to VHF and up. Well, this G8 was G8RY, an old-timer licenced around 1937/38, the other G8's have three letters popularly known as G8+3's. Similarly, my own call G4AR was issued in January 1939, the new licencees are G4+3's.

Old-faithful **Robin Bayley** keeps going up in Shropshire with his EC10 and long wire aerial. Even in summer he still logs DX like HK0 and FP8 on 80m and a VK9 on 40m, with KH6 on 20 and 15m. From Redruth in Cornwall, **Bill Caulfield** tells me he has been reading PW for years but only now has taken the plunge and bought some gear for the SW bands. It is only what I would call a "glorified" domestic receiver but, like Neil Clarke mentioned earlier, I hope it will lead to better things before long. Bill admits to being 58 which gives him plenty of time to get his ticket and settle down to the greatest of all hobbies!

CLUB NEWS A new radio club for those of you in Devon, namely the Exmoor Radio Club which meets on the second and fourth Thursday each month at the South Molton Community College. They plan to start RAE courses based on the new PW series. Thanks for the compliment, hope it leads to a lot of new tickets. Contact Chairman Dave Stone, 47 Oakford Villas, North Molton, Devon or Secretary Ted Bruns, Loughrigg, East Street, South Molton, Devon.

Log extracts

R. Bayley:— 80m AP2AD CT2AP EA9CR FP8DA HK0COP 40m DU1DBT FP8DH JA1JRK JW7BK VK9XI 20m KH6BB TG9AD 15m HK0CAT KH6PP TG9TL

P. Bradbeer:— 20m VP2DLF VP8PM 15m HM1JA HR3JJR KG6SS P29JS VP2GAH YB3KA 5T5JD 10m FM7AV VP8NO 8P6FX 9J2BO

A. Doherty:— 80m JA6BSM 5Z4NI 8P6GN 9G1ARS 40m KA2BAY TU2EF 20m FK8CR KS6FL KX6BU ST2SA VP8MX VS5XU YB7AAA ZK1DR 3B8DS 15m P29JW WB6NCO/VQ9 (Diego Garcia) ZD7PV 7P8BC

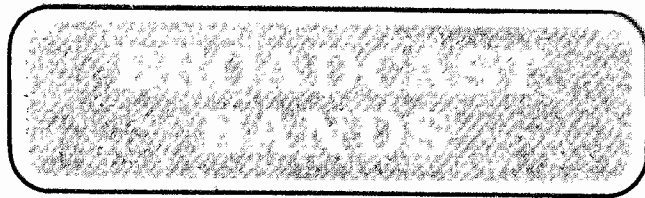
P. Pasquet:— 20m KA6KN 9N1MM 15m J28AM KS6FL VP8NO ZD7SD 8Q7AD (Maldives)

D. Peck:—RTTY 20m A9XCC EA8IY EA9FJ FP8DF KH6FKG LU9CN PY2BXA SL6A VE3FQD YV7DU 7X4MD

J. Stephen:— 20m CP1BP HR3JJR TR8JVC TU2GO 15m VP2SAG

B. Harrison:— 80m VP2LDD 20m KC6BS 15m S88TH VR4DN 8Q7AD 10m VP8CZ VP8LP

All reports are SSB.



MEDIUM WAVE DX

by Charles Molloy G8BUS

A useful log of MW DX comes from **John McFadden** of Belfast who has recently acquired a Yaesu FRG-7 communications receiver. When connected to a 35ft longwire aerial it pulled in CJCH in Halifax, Nova Scotia on 920kHz, CJYQ (ex-CJON) on 930 and three broadcasts from New York City, WINS on 1010, WNEW on 1130 and WQXR on 1560, all heard between 0100 and 0230 GMT. Other DX logged includes Ain Beida in Algeria on 529 at 0014, Istanbul on 1016 at 0216 and an unidentified CBC Radio discussion programme on 630 at 0205. This could be CFCY in Charlottetown, Prince Edward Island which is occasionally heard in the UK. Although privately owned, CFCY may well have been relaying a programme from the CBC (Canadian Broadcasting Commission). Privately owned stations do this, a practice which can easily mislead the DXer.

John says he is interested in US medium wave stations and asks if it is a good idea to concentrate on one area or just to browse around for anything that happens to be on. Surprise and the unexpected await those who browse around the medium waves. New stations are always appearing and propagation is sometimes favourable to quite unexpected parts of the world. On the other hand, DXing North Americans has an attraction of its own.

There are large numbers of stations, over 4000 in the United States. There is no trouble with identification or language and the majority of stations will QSL. Propagation as usual is the deciding factor on the medium waves. The North American specialist will sometimes find the band alive with stations that interest him while at other times not a single North American will be heard. When this occurs he will have to "browse around" or pack in DXing until the North American path picks up again.

Neal Cartwright (London) who uses a Ecko A239 valve receiver, would like to know how to immobilise its AGC (automatic gain control). Locate the AGC line and connect it to the chassis via a switch. The AGC can then be switched on or off as required. Although the AGC is useful when turning across the band, as it prevents the receiver from being overloaded by strong signals, it can be a disadvantage when one is trying to listen to a weak station that is close to a strong one. The AGC will respond to the strong signal, reducing the receiver gain and the weak station now appears to be weaker than it really is.

The usual technique to use when the AGC is ON, is to set the RF gain control to maximum and adjust the volume by means of the audio gain control. With AGC switched OFF then a different procedure is called for. Adjust the audio gain for a comfortable volume from the loudspeaker and follow the signal with the RF gain control, backing it off on strong signals to avoid overloading and crossmodulation.

Is there a book giving details of radio stations in North and South America including powers of transmitters, call signs, identifications and addresses, asks **John Faulkner** from Mansfield. The World Radio and TV Handbook, published annually and distributed in the UK by Billboard Publications, contains this information for the majority of broadcasting stations on the long, medium and short wave bands, throughout the world. The 1977 edition cost £5.50. John already possesses a copy of the World's Short Wave, Medium and Long Wave, FM and TV Listing which covers 1500 medium wave stations in the

United States and another 300 in Canada. This paperback, which is published by Babani, costs 60p and is available from bookshops in the UK.

John does his DXing with a Trio 9R59D communications receiver, a Codar PR40 preselector and a 100ft longwire. North Americans heard with this set-up are CFRB in Toronto on 1010kHz, KMOX St Louis on 1120, WHAM Rochester NY on 1180, Ft Wayne Indiana on 1190 and WOAI San Antonio Texas on 1200. DX from other parts of the Americas include ZDK St Johns in Antigua on 1100, Rio de Janeiro on 1180 and Radio el Mundo in Buenos Aires on 1070.

Jim Robinson of Selby in Yorkshire is building a loop aerial. He has an unmarked variable capacitor and asks if it is possible to find out its value. An indication of the value can be obtained by substituting it for one of known value in a tuned circuit, such as the tuning capacitor in a radio receiver, though this may not be too easy to do in practice. The unknown capacitor will be lower in value than the known one if the tuned circuit resonates at a higher frequency than before, with the vanes fully meshed.

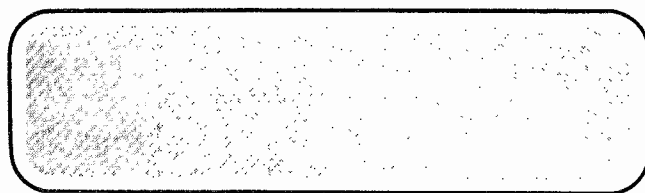
Why not try the unknown variable on the loop? With the vanes unmeshed, adjust the number of turns on the loop so that it resonates not lower than 1600kHz. When the vanes are fully closed the loop should tune to 540kHz. If it tunes to a higher frequency then the capacitor is too low in value. It can be increased by using a fixed capacitor (try 220pF) in parallel via a switch, and the band can now be covered in two ranges. DXers who find it difficult to cover the whole band even when using a 500pF variable, should try this method.

Harold Emblem (Mirfield, Yorkshire) has been busy during the evening with his Eddystone 730/4 and loop. Stations heard include Riyadh in Saudi Arabia on 597kHz at 2145, Ouagadougou, Upper Volta on 746 at 2330, Enugu in Nigeria on 1320 at 2240 and Conakry, Guinea on 1403 at 2245. No need to stay up late to DX on the medium waves!

Harold mentions that all the stations in the CJON network, (610, 670, 680, 930, 1350) are now using the call CJYQ which is abbreviated at times to "CJ Radio". He has sent a reception report to St John's (930) which increased power recently to 50kW and the reply should indicate whether the call sign too has been changed from CJON to CJYQ.

Robin Harvey of Halesworth, Suffolk has heard the medium wave outlet of Mebo 2 under the Spanish station on 733kHz. It is on the air nightly between 1900 and 2300, in parallel with 6205 in the 49m band. Announcements are in English between non-stop music and the broadcast is from a ship anchored in the harbour of Tripoli in Libya. During the day it relays the programmes of Libyan Radio. Reception was with a Telefunken TS101 portable and a telescopic aerial.

T. Cridge of Farndon, Cheshire recently purchased a CR100 and has a great deal of pleasure from it. "I have been experimenting with different aerials and at present have a half folded dipole. I don't really know what I am doing but it is great fun finding out". A loop is now under construction which should give some direction to the experiments!



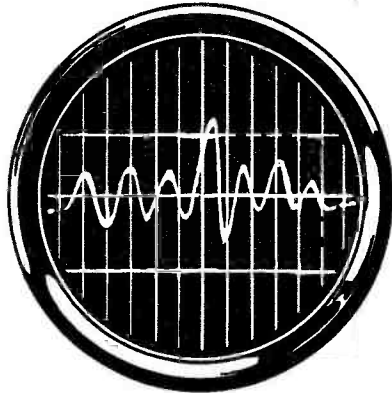
SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

The reference in the October issue of *Practical Wireless* to Radio Australia's transmission on 21570kHz in the 13m band has brought an interesting reply from **George Hew-**

LOOK! Here's how you master electronics.

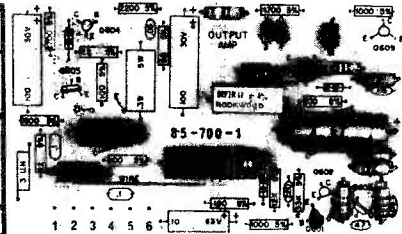
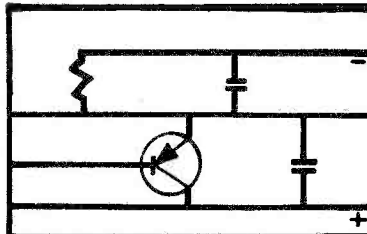
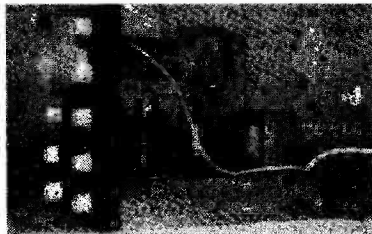
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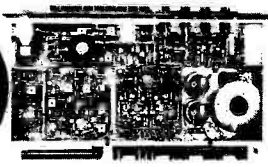
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lett of Torquay who is a Monitor to the Broadcasting Branch of Telecom Australia (Radio Australia and VNG). He refers to the antenna bearings which appear in Radio Australia's transmission schedule and in the World Radio Handbook. For British listeners, bearings of 308 and 325, both across the short route, offer the best reception while 110, 118 and especially 128 give the best reception over the long route across the Pacific. Reception of transmissions on other bearings can occur but are more difficult with much depending on time of year and day.

George refers to the Australian Time and Frequency station VNG which can be heard on 12.0 and 7.5MHz between 0600 and 0800 and on 7.5 and 4.5MHz between 1600 and 2000. Reception is possible throughout the year, the morning times being latest and the evening times earliest, in mid-winter. Station announcements are given a few seconds before each hour, quarter hour, half hour and quarter to the hour. The transmission on 4.5MHz, which appears 30 minutes later than the one on 7.5 should be of interest in Tropical Band DXers as an indicator of propagation conditions across S.E. Asia.

The International Short Wave Club is offering to send a free sample copy of their monthly bulletin to readers of *Practical Wireless*. The bulletin presents news and highlights of the short wave world and there is also a section covering the amateur bands. The October issue gives details of the well known ISWC short wave station popularity poll. The voting, for 1977, favoured Radio Nederland in all six continents. Request should go to the President, Jim Malone, 19 Seventh Avenue, Manor Park, London E12 and return postage, although not asked for, would no doubt be appreciated.

Brian Steele (Sheffield) has recently purchased a Sony ICF 5900W receiver with which he pulled in the Voice of Turkey on 9515 and 11880kHz, Radio South Africa on 11900 and Radio Canada on 15325. Brian is very pleased with his new receiver which has a military style cabinet, a crystal calibrator and has DX/Local, BFO and band-spread controls.

Harold Emblem (Mirfield, Yorkshire) has been trying his Eddystone 730/4 on the short waves and he reports hearing Trans World Radio, Bonaire on 15275kHz (19m band) at 2215, Sri Lanka on 15425 at 0400, AFRTS on 15430 at 2255. On 16 metres he logged WINB Red Lion on 17720 signing off at 2000 with announcement of this frequency which is not listed in the WRH, and WYFR Family Radio on 17845 at 2025. **Harold Brodribb** (St Leonards) has been busy again on the higher frequencies with his CR100 and longwire. On the 11m band he heard Radio Israel in Russian and Yiddish on 25605kHz between 1430 and 1630. On 13 metres, Radio RSA was heard on 21535 at 1435, Radio Australia on 21570 at 0840 with DXers Calling (also on 9570), Radio Israel on 21625 at 1640, BBC World Service on 21710 at 1403 and Radio Norway with Listeners Choice on 21730 at 1345.

Derek Taylor (Preston, Lancs) has been trying out his new Yaesu FRG-7 on the short waves. When connected to a 30ft longwire via an aerial tuning unit, it pulled in Radio Pyongyang on 9420 at 2000, The Voice of Vietnam on 10040 (out of band) at 1820, Bangladesh 11650 at 1830, ELWA Liberia on 11950 at 0625, Tokio, Japan on 15310 at 0610 and Kinshasa, Zaire on 15350 at 2115. **John Hill** (Swindon) has a Realistic DX160 receiver which he uses either with a 40ft longwire or connected to the bedspring (not to be recommended with a mains operated receiver!) Stations logged include Radio Australia on 9570kHz at 0830. John, who is new to the short waves is not sure whether his conversion from MHz to kHz is correct. It is very easy to do, just shift the decimal point three places to the right; 9.57MHz is the same as 9570kHz.

Newcomers to the short waves may be confused by the reference to "bands" which are expressed in metres and to individual frequencies which are in kHz or MHz. The conversion between the two is simple, especially if a pocket calculator is available. Divide 300,000 by the frequency in kHz to obtain the wavelength in metres, and vice versa

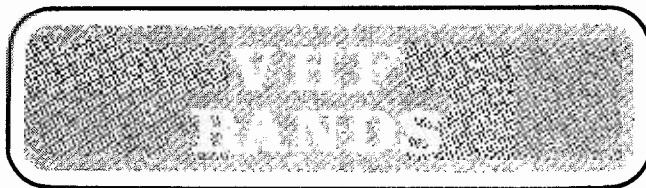
e.g. Radio Australia on 9570kHz has a wavelength of 31.35 metres. The limits of the international short wave bands are:-

49 metre band from 5950kHz to 6200kHz		
41mb	7100	to 7300
31mb	9500	to 9775
25mb	11700	to 11975
19mb	15100	to 15450
16mb	17700	to 17900
13mb	21450	to 21750
11mb	25605	to 26095

and this table should help readers whose receiver is marked in metres, to locate stations mentioned in this column which are in kHz.

Roy Patrick (Mackworth, Derby) sends news of WYFR Family Radio who expect to start testing the first 100kW transmitter from the new transmitting site at Okeeshobee, Florida soon. The Scituate station will continue to broadcast until the middle of 1978 when it is scheduled to close down and all Family Radio programmes will then come from Florida. Roy used a Joystick antenna with ATU connected to a Trio 9R59D or a National 1400 portable. With this set-up he logged Radio Rumbos on 4970kHz at 0600, Malta on 5990 on Saturdays only, Radio Nova (Mebo 2) on 6205 with test transmissions in the evening, Radio Andorra on 6280 in French during the morning, the Voice of Iran 9022 from 2000 to 2030 in English, Voice of Turkey on 9515 at 2200 with DX tips nightly at 2230, WYFR on 11805 in Spanish at 1800, Kuwait on 12095 with a good signal from 1800 onwards, WINB 15270 with a good signal at 2130 and the Voice of Greece on 17780 in English at 1200. Thanks Roy for a very useful log.

The last word this month is from **John Faulkener** of Mansfield who mentions that the World DX Club has its own weekly programme in Adventist World Radio, broadcast over the 100kW station at Sines in Portugal. The programme is on a Sunday from 0835 to 0945 on 9670kHz on the 31m band and was received by John at a SINPO rating of 55555 with his Trio 9R59D receiver and 150ft longwire.



by **Ron Ham BRS15744**

Despite many overcast periods, **Cmdr, Henry Hatfield**, Sevenoaks, continues to produce valuable information about the sun's behaviour with his spectroheliograph and his radio telescope. Frequently, during the latter part of September, **John Smith**, Cranleigh, Henry, and myself recorded radio noise from "active" events on the sun which were no doubt responsible for the widespread ionospheric disturbance, reported by the BBC World Service on the 24th, the auroral openings on the 22nd, 24th and 26th observed by **John Branegan**, Saline, Fife, and **Charlie Newton**, G2FKZ, London, and the good 10m conditions.

Henry identified 3 sunspot groups on October 2, 4 groups on the 3rd and 5th, witnessed 6 bright plages on the 2nd, a spray of gas and a pillar prominence on the 5th, 2 "Enormous" filaments on the 9th, and 4 plages and 16 filaments on the 18th. In view of this it is not surprising that John Smith, Henry and myself often recorded strong solar noise, (136MHz), from the 1st to the 15th and severe noise on the 16th, 17th, and 18th. An ionospheric disturbance was reported by the BBC World Service during the early hours of the 19th.

During the auroral events, John Branegan heard 2m

signals from DL, EI, GM, GW, LA, and the UK beacons from Lerwick, GB3LER, to Cornwall, GB3CTC. Like other observers in the UK, confirmed by G2FKZ, RSGB auroral co-ordinator, John uses GB3LER, 144.955MHz, for early auroral warning. Readers reports will be passed on to G2FKZ and Ron Livesey, Co-ordinator for the British Astronomical Association.

It's good to hear the DX from both hemispheres on 10m again. On October 5, **Henry Hatch**, G2CBB, told BBC World Radio Club listeners that VK stations were currently being worked from the UK and at 0930 on the 8th I heard YB0ACP, and VK8CC/M. During the early mornings of the 10th and 14th I received strong signals from Japanese stations working into Europe. John Branegan heard stations from Italy, Portugal, South Africa, South America, Japan, both coasts of the USA and the USSR on the 8th and 9th, and at 1600 on the 9th the US Citizens Band was wide open and tuned to 27.155MHz, USB, John heard signals from Brazil, California, Louisiana, Nova Scotia, Ontario and Texas.

Harold Brodribb, St. Leonards-on-Sea, **Nigel Golds**, BRS 36910, West Chiltington, Sussex, **Lawrence Hobden**, Brighton, and myself frequently heard strong signals from the Cyprus beacon, 5B4CY, 28.220MHz, between the 8th and the 18th. At 0843 on the 10th I heard, amid QSB, the Bahrain beacon, A9XC, 28.245MHz, and on the 11th, 14th, 16th, 17th and 18th I received signals around 28.330MHz from an experimental propagation beacon ZE2JV. On the 13th, Lawrence Hobden heard the Florida beacon, N4RD, 28.207MHz, on his 1937 receiver which is still going strong, and Nigel heard several VP stations.

Around 1600 on September 27 and 28, **Anthony Mann**, Applecross, Australia, heard strong signals from the Bahrain beacon on 10m and on October 2 there was a strong opening toward UK and western Europe. During the early morning of October 4, and on several days after, the 10m band was open between Australia and the USA and some of the American CBers on 27MHz were almost at local strength.

Frank Luman, **Donald Bassnet**, **John Thorburn**, **John McCarra**, from Glasgow and **Fred Dinning**, Dunlop, have formed a club called, The Scottish VHF AND SW DXers, and currently meet every first and third Saturday afternoons at Frank's home, 2, Ormonde Drive, Netherlee, Glasgow. New members are welcome, enquires to Frank Luman. Frank, Donald and Fred have an early warning arrangement which was used on September 22 when 7 Norwegian stations, some in good stereo, were heard in Band II via what may have been the last event of the 1977 sporadic-E "season".

While on a hill some 600ft ASL Nr Dumfries, using a beam aerial 16ft AGL, **Mark Deutsch**, G3VJG, Kettering, could not make any contacts on 2m SSB, so he moved down the hill, about 1 mile away, at 250ft ASL and worked G2HFC, Wigan, via the Welsh repeater, GB3MP, with a 5/8 whip aerial on his car. Mark could also hear the Central Scotland repeater, GB3CS, where there was no trace of its signals at the 600ft level.

Congratulations to **George Zitterstein**, G8ITS, who, from his difficult location in the City of London, with his beam aerial fixed south on his balcony, has received his Four Metres and Down Certificate from the RSGB for 70cms. His achievement includes contacts with stations in northern G and his best DX was GW8CFQ, Wrexham. George now plans to do the same on 23cms.

On September 21, **Alf Lee**, G4DQS, Brighton, worked a G8 station on 2m via the Bristol repeater, GB3BC, from his car in Haywards Heath car park. At 0930 on the 30th, **Alan Baker**, G8LGQ, Newhaven, heard F1CIX working DC1WO via the German repeater, DB0UT.

Around 0800 on October 12 the atmospheric pressure began a gradual rise reaching 30.2in by noon on the 13th and at 0400 on the 14th it started to fall. True to form, a tropospheric opening occurred which lasted until late afternoon on the 15th when the AP was levelling off at 30.05in. The event covered a wide range of frequencies. **Derek Knight**, Storrington, and **Harold Brodribb**, both reported co-channel interference on UHF-TV and that both

the BBC and IBA warned their viewers about the prevailing disturbance.

From midday on the 14th to mid-morning on the 15th I received strong signals from the Sutton Coldfield, GB3SUT, and Emley Moor, GB3EM, beacons on 70cms, a good picture on Channel 8, 189MHz, from Lichfield, and several continental broadcast stations in Band II, with only dipole aerials feeding the respective receivers. At 2035 on the 14th, **Harold Brodribb**, using a 2 element beam into his Bush VHF-80 heard French and Dutch stations in Band II and at noon on the 15th he counted 20 French stations between 88 and 101MHz, strong enough to obliterate the BBC signals.

During the morning of the 14th, **Alan Baker** worked several German stations on 2m via the Stuttgart repeater, DB0WR, and F1CIX, ON5QL/M, and DJ2HH/M via DB0UT on R7 while located on Beachy Head where both repeater signals were consistently 58. At 1700, **Alan** called on **Ern Hoare**, G8BDJ, Brighton, and they both watched Kojak on French TV via Ern's 70cm beam. Around 0200 on the 15th, **Alan** worked G8LCK, London, via both the Birmingham, GB3BM, and Hampshire, GB3SN, repeaters on R5, at the same time. **Alan** suddenly realised what was happening when the Birmingham repeater signal faded out and he could still hear the 1½ watt signal coming from G8LCK. At 1600 he heard the signal from a GM/M through the Kent repeater, GB3KR, and during the event he worked DC6TY, Cologne, about 500km on 2m SSB.

From 1800 until midnight on the 14th, **John Heys**, G3BDQ, Hastings, proved the value of a morse key and worked a host of DMs, 3 SPs, 4 OEs, 1 OZ, and in a half hour stint between 1935 and 2005 he contacted 6 OKs on the trot, all on 2m. His best DX was more than 1000km, on a mainly overland path with OK3CDI/P. **John** said it was his best evening for 20 years and looks forward to another tropo-opening when he can go for YU, YO, HA, and I1.

During the August leg of the RSGB 3cm Cumulative Contest, **Sam Jewell**, G4DDK, Stone, worked G8AXE/P on Winter Hill, Bolton, from Brown Clee, Shropshire, a distance of 124km with torrential rain at both ends which had little effect on the signals. Several days later, encouraged by this, G8AXE and G8AFC wanted to try for their Microwave Awards by working over 150kms. **Sam** set up his gear on the Long Mynd, Shropshire, and G8AXE, G8AFC, G3SMU and G4BBU climbed to the top of Fair Snape Fell in the Calder Fells, Lancs, to establish their stations. The two groups used their TR2200s for talk-back over the 151km path.

A signal on 3cms was received quickly from G8AXE/P but only a weak signal was received from G4DDX. The contact began at 1930, and as the sun set around 2045, a temperature inversion occurred and the signals came up at both ends allowing them to complete the formalities in relative comfort. On October 2, G8AFC and G4DDK set up their 3cm equipment on Axe Edge in the Derbyshire Peak District and exchanged signals over a 149km path with GW4BRS/P on Pumlumon Fawr, near Aberystwyth.

My thanks to you all for your fascinating reports, best wishes for Christmas, and let us look forward to another interesting year above 28MHz.

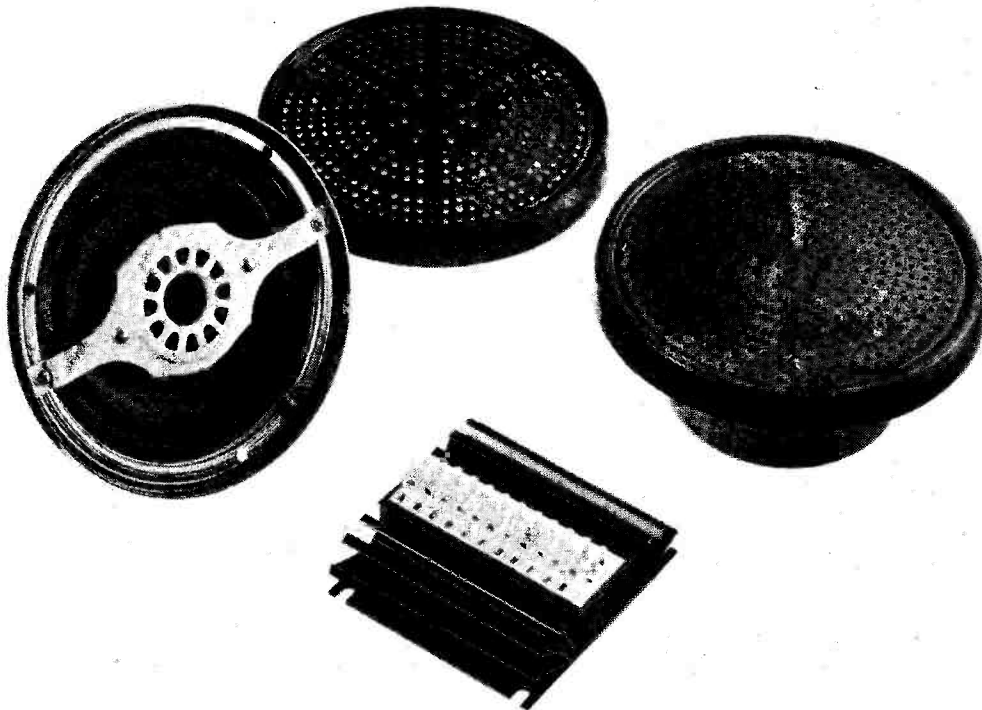
Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-

AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands must be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

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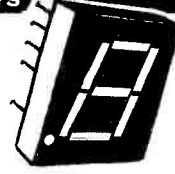
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4010	-62*	4070	-22*	7472	-22*
4011	-18*	4071	-22*	7473	-27*
4012	-21*	4081	-22*	7474	-27*
4013	-53*	4082	-22*	7475	-40*
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4015	-97*	4511	-1-54*	7485	-78*
4016	-58*			7486	-27*
4017	-97*			7489	2-32*
4018	-97*			7490	-38*
4019	-58*			7492	-41*
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4021	-97*	7401	-16*	74107	-27*
4022	-88*	7402	-16*	74121	-27*
4023	-19*	7403	-16*	74123	-49*
4024	-78*	7404	-17*	74141	-41*
4025	-18*	7408	-19*	74145	-63*
4026	-1-76*	7410	-16*	74181	-49*
4027	-58*	7413	-27*	74154	-85*
4028	-87*	7420	-18*	74174	-72*
4029	-1-18*	7427	-28*	74192	-86*
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FRG-7



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Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30°C. Special snip this month £3.00 post and VAT paid.



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Rated at 5 amps 250 volts. Ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 for £1.00, VAT and post paid.



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Easiest way to fault find, traces signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube twin stetho-set £3.00 VAT and postage incl.



MICRO AMPLIFIER

Ex behind the ear deaf aids, complete with volume control £2.16.



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Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3.45 including post & VAT. Made up model £1.00 extra.



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Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £7.95 plus 95p VAT & Postage.



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Wiring dig supplied for complete house protection—'Keep Those Robbers Away'. 13" x 10" = £1.85 24" x 18" = £2.33



MULTISPEED MOTORS

Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is 3/8" diameter and approximately 1 1/2" long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2" dia. x 5" long. Price £2.00 including Post & VAT.



MAINS RELAY

With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one screw fixing, ex unused equipment 60p each, 10 for £5 post and VAT paid.



SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 1.5, 2.5, 2.9, 3.1 metre bands. Kit contains chassis front panel and all the parts £1.90—crystal earphone 55p including VAT and postage.



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American made by Ranco, their 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.



8 POWERFUL BATTERY MOTORS

For models, Meccano's, drills, remote control planes, boats, etc., etc. £2.00.



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Self priming, portable, fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodible, use to suck water, oil, petrol, fertiliser, chemicals, anything liquid. Hose connectors each end. £2.00 Post Paid.

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Bank of 7 Mercury cells type 625 which are approx. 1/2" diameter by 7/8" 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.



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6 photo sockets and d.p. changeover slide switch all mounted on insulating board. Glossy black finish size 2" x 8 1/2" approx.—silly price 35p, or £1 for six.

THIS MONTH'S SNIP

is a miniature sealed relay 12v dc operated with two sets of change over contacts. The unique feature of this relay is its heavy lead-out wires, these provide adequate support and therefore the relay needs no fixing; on the other hand there is a fixing bolt protruding through one side so if you wish you can fix the relay and use its very strong lead outs to secure circuit components—an expensive relay; but we are offering it for only 87p each. Don't miss this exceptional bargain!

MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output £1.50 including Post & VAT. Model 1172 1W, power output £1.85 including Post & VAT. Model EP9000 4 watt power output £2.90 including Post & VAT. EP 9001 twin channel or stereo pre-amp. £2.90 including Post & VAT.



TANGENTIAL HEATER UNIT



A most efficient and quiet running blower-heater by Solatron—same type as is fitted to many famous name heaters—Comprises mains induction motor—long turbo fan—split 2 kw heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct onto base of say kitchen unit—price £4.95 post £1.50 control switch to give 2kw, 1kw, cold blow or off available 60p extra

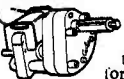
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For camping—car repairs—emergency lighting from a 12v battery you can't beat fluorescent lighting, it will offer plenty of well distributed light and is economical. We offer Philips inverter for 12" 8 watt miniature tube for only £2.75 with tube and tube holders as well.

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 polishing; in fact there are no ends to its uses. Normal mains operation. £4.32 including Post & VAT.

TERMS:

Cash with order—prices includes VAT and carriage unless stated but orders under £6 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 previous lines.

Starlet 9" T.V. Mains Battery Model time based tested and in our opinion repairable. Complete except for small knobs, telescopic aerial and plug for mains/battery input. Price £16.87 each + post and special packing £2 + 12p.

Spare for Starlet. Tuners £3.50p, loud speaker £1.50p complete power unit (base unit) £6, printed circuit board panel £4. EHT Unit £4.50p.

9" T.V. Tubes for the Rigonda Starlet. £9.00. Post and special packing £2.75p.

12 Volt Heavy Duty Relay. Plug in type has three pairs of 10 amp change over contacts. Transparent dust cover. Price £1 + 8p. Suitable 11 pin base 27p + 2p. 4 Changeover Mains Relay. Upright mounting with perspex type dust cover, the really interesting feature is 4 sets of 10 amp changeover contacts. Price £1.62p + 12p.

12 Volt Pump. Designed we believe as a bilge pump, this is 12 volt AC/DC motor coupled by a long enclosed shaft to a submersible pump. Suitable for water or most any fluids. Price £11.75p. Post 80p.

Just Arrived. Fruit Machines—working order—very impressive, choice of several but very heavy so you must collect. £50.

High Load 24 Hour Clock Switch. Made by the famous AEG Company for normal mains but with clockwork reserve has load capacity of 80 amps at 240v 50Hz. Therefore suitable for dealing with large loads of say shop lighting, water heating, storage heaters etc. Has triggers for on and off once per 24 hours but extra triggers will be available. Price £1.50p per pair. Size of clock approximately 8" x 5" x 5", totally enclosed but has lift flap for ease of altering switching times. Price, new and unused £10.65p or used but guaranteed o.k. £6.50p.

Enclosed 24 Hour Clock. With contacts for breaking 10-12 amps at 240 volts. This one has two sets of on/off per 24 hours. Price £7.60.

Smiths 24 hr. Timers—Heart only with over-ride similar to those used in the auto set etc. £4.75p + 38p.

Ditto but in grey plastic wall mounting case, with leads ready for attaching to plug and socket. price £6.98.

Light Dimmer. Our timer module with small mods makes an excellent light dimmer. Contains a 4 amp 400V SCR so it should be suitable for loads approaching 1kw. Price of module with variable resistor and instructions £2.25p.

Push Pull Solenoids. For mains operated solenoid which will push as well as or instead of pull. Very heavy duty, we estimate this at 20lbs push or pull. 1 1/2" x 3 1/4" x 4" made by Magnetic Devices Co. £7.50.

Flashing Lights, chasing lights, random flashes, strobe effects etc. etc. can easily be achieved using our disco switches and with Christmas just around the corner you can do something special for your home or business.

These switches are offered at approximately one-fifth of their proper price, are ex-equipment but guaranteed perfect and supplied with an adaptor suitable for mains working. To get some idea of the loading number, each switch is 10 amp which is approx. 2 1/2 kw so the 6 switch model could handle over 12 kw's. For the light pipe or Catherine Wheel effect we suggest 12 switch model, interconnecting the switches to give fastest speed. 6 Switch model £5, 9 Switch Model £9.75, 12 Switch model £6.20. Also add 50p per switch. If you want the light pipe diagram please request this.

Always in Stock. Turntables with pick up lift, ideal for disco's at £11.95, post £2.25. We are also exporting some professional belt drive type at £25. Call or ring us for more information.

Reed Switches, standard 60 watt glass type. Normal open contacts glass lengths 2" diameter 3/16", 10 for £1 + 8p, 100 for £8 + 64p, 1000 for £65 + £5.20p.

Flat Reed Switches for stacking, greater quantity in confined space. Price 50p each + 4p.

F.M. Tuner and Decoder—two very well made (Japan) units—nice reproduction—£9.95 the pair.

Single Ended Types for jobs where it is not easy to bring a lead to each end. 75p each.

All these switches are normally open but can be biased to a normally closed position by fitting a magnet adjacent. The reed switch would then be opened by a magnet of opposite polarity being brought up to it. Ceramic Magnets suitable for operating reed switches, central fixing hole. 10 for £1.62p.

Music Centre Transformer 12-0-12 at 1 amp and 9 volt at + amp. Normal primary, upright mounting, impregnated and varnished for quiet operation. Price £2.95p. Post 54p.

W Shaped Fluorescent Tubes for porch light, box signs or where you want light evenly spaced over a confined area of approx. 10" x 10", 30 watts, made by Philips price £1.62p. Post 54p.

Plinth for BSR Record Player still available at the record price of 95p + 12p. This is excellent value but unfortunately being a bulky and delicate item the postage has to be £1.50p + 12p so this is obviously only a bargain for callers.

(2) A similar model also available at the same price, this is somewhat larger and has a cut out for an amplifier.

Our Smokey Cover can be used with the above plinths, four small locating pins are fitted to the motor board. Size approx. 12 1/2" x 14 1/2", price £2.50p + 32p. Post £2.00 + 16p.

Extension Speakers 8 ohm 4-5 watts handling power. We have 3 or 6 different models in stock, cheapest being the Partytime at £3.95p each, again only really a bargain for callers as postage is £1.50p per speaker.



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- That your letter is correctly addressed to the advertiser.

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Receivers and Components

BARGAIN SUPPLIES

- New PCB's Long Lead Components includes Thyristors, Plastic Power, TO3 Power Transistors 4 for £1.50
 - Mains Transformers
12v-0-12v 100mA 4 for £5.00
1 for £1.40
 - U11 Type re-chargeable Ni. Cad. cells 3 for £2.00
 - TO3 Power Transistors 7 for £1.00
 - Push to make switches 4 for £1.00
 - Amplifier/tuner cases 25p for details
- Terms. Prices inclusive P&P 20p per line extra.

R. JONES SUPPLIES
3 CENTRE VALE CLOSE
LITTLEBOROUGH, Lancs OL15 9EZ

PACKS FOR DIY ENTHUSIASTS. Resistors 100 £1. Mixed semiconductors large bag £1.20. Capacitors various £1.10. Thyristors 0.8A 100V £1. Rectifier Bridges 3A 50V 6 £1. 741 OP Amps 5 £1. Many other items. SAE with enquiries please. CWO under £2. Add 20p. ELECTRONIC CENTRE (STOCKPORT) LTD., 45 Lower Hillgate, Stockport. Tel: 061-480 9791.

BRAND NEW COMPONENTS BY RETURN.

Electrolytic capacitors 16V, 25V, 50V.—0.47, 1.0, 2.2, 4.7 & 10mfd.—5p, 22, 47—5p, (50V—6p), 100—7p (50V—8p) 220—8p, (50V—10p) 470—11p, (50V—16p) 1000/16V—15p, 1000/25V—18p, 1000/50V—22p.

Subminiature bead tantalum electrolytics—0.1, 0.22, 0.47, 1.0, 2.2 @ 35V, 4.7/25V—11p, 10/25V—13p, 22/16V, 47/6V, & 100/3V—15p.

Mullard miniature ceramic E12 series 2% 63V, 10pf. to 470f—3p, 56pf. to 330pf.—4p.

Vertical mounting ceramic plate 50V, E12 series 22pf—1000pf, E8 series 1500pf—47000pf.—2p.

Polystyrene E12 series 63V horizontal mounting, 10pf to 1000pf—3p, 1200pf. to 10000pf.—4p.

Mullard polyester 250V vertical mounting E6 series, 0.01 to 0.1—4p, 0.15, 0.22—5p, 0.33, 0.47—8p, 0.68—11p, 1.0—13p, 1.5—20p.—2p ea.

Mylar (Polyester) Film 100V vertical mounting, 0.001, 0.002, 0.005—3p, 0.01, 0.02—4p, 0.04, 0.05—4½p.

Miniature resistors Highstab E12 series 5%, Carbon Film 0.25W 1Ω to 10MΩ, (10% over 1MΩ)—1p, Metal Film 0.125W, 0.25W & 0.5W 10Ω to 2MΩ.—1½p. Metal Film 1W, 27Ω to 10MΩ.—2p ea.

1N4148—3p, 1N4002—5p, 1N4006—7p, 1N4007—8p, BC107/3/9, BC147/8/9, BC157/8/9 & BF194 & 197—8p, Fuses 20mm, glass, 1½" glass & 1" ceramic, 2½p. Post 10p. (Free over £4.00) Prices inclusive of VAT.

THE C. R. SUPPLY CO.
127, Chesterfield Rd., Sheffield S8.

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BARGAIN BOARDS. Pack 1 includes 28 transistors, 130 assorted components, £1; Pack 2 includes 45 transistors, 220 components, £1.50. Add 15p P&P. POs to Autoquip, 191 Upper Richmond Road West, East Sheen, London S.W.14.

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Receivers, valves, components, service data, historical research, books, magazines, repairs and restorations. A complete service for the collector and enthusiast of vintage radio.

S.a.e. with enquiries and for monthly newsheet. Full 1977 catalogue, 70p post paid.

TUDOR REES (Vintage Services), 64, Broad Street, Staple Hill, Bristol, BS16 5NL. Tel. Bristol 565472.

RECEIVER UNIT—small personal type battery operated covers 500Kc to 18Mc/s in 4 bands uses 5 miniature valves in superhet circ. with BFO, requires 1.5 and 67.5 volts d.c. has o/p for earphone, uses single 4 way plug in coil unit, has 25:1 ratio dial cal 0 to 100 & supplied with copy of cal chart & circ., size 6½ × 3½ × 1½in. req. ext. batteries made for use by Army. Price £10.80 inc. VAT & post. SAE for enquiry or List 18.

A. H. SUPPLIES

122 Handsworth Road, Sheffield
S9 4AE. Tel: 442278 (0742)

TEST METER PANELS, £2. Ex-GPO pliers and cutters, 75p each. Transistor Amplifiers, 75p each. P&P 50p per order. ARCHER, Box 139

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I.C.s TTL, C/Mos. Linear. Capacitors. Resistors. (E12) SIL/Rectifiers. Diodes. LED. Thyristors. Zeners. Voltage Reg. DiL Sockets. Bridge Rectifiers. Potentiometers. Presets. Triacs. Diac. Plugs. Sockets. Cable. Vero. Carefully selected range, excellent despatch service Same day turn round. S.A.E. List. Suppliers to A.E.R.E. U.K.A.E.A. Governments Dept. Schools. Universities. Manufacturers. Accounts opened for trade and amateur. Join the professionals. Phone by 4 p.m. Goods out 1st class by 5 p.m. Try us and prove it!

ORCHARD ELECTRONICS
Flint House, High Street, Wallingford,
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TOUCH CONTROLLED LIGHTING KITS

These KITS replace conventional light switches and control 300W of lighting. No mains rewiring required. Insulated Touch Plates. Easy to follow instructions. TSD300K—TOUCHSWITCH & DIMMER combined. ONE touch plate to switch light on or off. Brightness controlled by small knob—£5.20. TS300K—TOUCHSWITCH. TWO touch plates ON and OFF—£4.00. TSA300K—AUTOMATIC. ONE touch plate. Light turns off after preset delay—£4.00.

LD300K—LIGHT DIMMER KIT—£2.80.

400V TRIACS	BULK OFFERS	CMOS
3A Plastic	BC148	4001 18p
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16A	8A/400V Triac	4015 91p
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80p	555 3p (for £1)	4040 97p
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LED display, triac, switches, box, pcbs, etc. £16.25

AY-5-1230 CLOCK APPLIANCE TIMER KIT £4.85

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Add 8% (*12½% VAT + 25p P&P. Mail Order Only to:
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SIMPLIFIED TV REPAIRS. Full repair instructions individual British sets £4.50, request free circuit diagram. Stamp brings details unique. TV Publications (Ause PW), 76 Church Street, Larkhall, Lanarkshire.

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by R. F. C. Stephens.

This book is a must for the keen home constructor. Latest technology DIY speaker designs. Contains full plans for infinite baffle and reflex designs for 10-100 watts, also unusual centre-bass system for those who want hi-fi to be "Heard and not seen". £1.95 (£2.20 post paid. 5% Overseas).

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WILMSLOW
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YOU CAN'T HELP BUT MAKE MONEY. If you follow the planned and detailed information on how to start your own business rewinding Armatures, set out in the new manual which is profusely illustrated and leads you through easily understood stages of fault diagnosis, taking data, test procedures, laying down new windings, where to obtain work, how to cost jobs etc. NO PREVIOUS ELECTRICAL KNOWLEDGE REQUIRED. Complete instruction manual, £4, plus 30p P&P. CWO. Copper Supplies, 102 Parrwood Road, Withington, Manchester 20. Dept. PWB.

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50 Projects using IC CA3130 (R. A. Penfold)	£1-05
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50 Projects using Relays, SCR's & TRIAC's (F. G. Rayer)	£1-20
How to build your own Metal & Treasure Locators (F. G. Rayer)	£0-95
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4 CHILWORTH ROAD, WICKHAM RD, BUCKINGHAM, KENT BR3 2BW

Ladders

LADDERS. Varnished 20ft 9in extd., £28, carr. £2.40. Leaflets. Also alloy ext. up to 62ft 6in. Ladder Centre (WLS2), Halesfield (1) Telford. Tel: 586644. Callers welcome.

Practical Wireless, January 1978

Service Sheets

SERVICE SHEETS - COLOUR TV SERVICE MANUALS

Service Sheets for Mono TV, Radios, Record Players and Tape Recorders 75p. Please send large Stamped Addressed Envelope. We can supply manuals for most make of Colour Television Receivers by return of Post.
B.R.C. PYE ECKO PHILIPS ITT/KB SONY G.E.C. HITACHI SAIKI ULTRA INVICTA FERGUSON H.M.V. MARCONI AND MANY MORE
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G. T. TECHNICAL INFORMATION SERVICE
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BELL'S TELEVISION SERVICES for Service Sheets on Radio, TV, etc., 75p plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 Kings Road, Harrogate, N. Yorkshire. Tel: (0423) 55885.

SERVICE SHEETS for Radio, Television, Tape Recorders, Stereo, etc. With free fault-finding guide, from 50p and SAE. Catalogue 25p and SAE. **HAMILTON RADIO**, 47 Bohemia Road, St. Leonards, Sussex.

SERVICE SHEETS, Radio TV, etc., 10,000 models. Catalogue, 24p, plus SAE with orders, enquiries. Telray, 154 Brook Street, Preston PR1 7HP.

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MULTIBAND RADIOS. 12 band . . . Marine, Aircraft, LPSB, HPSB, UHF (430/470), SW1/4, MW, LW, FM, RF gain. BFO. £150. **GRUNDIG SATERLITT** £199. BFO Units, £16-50. **SHARP MW/Aircraft**, £13. Langtons, High Street, Rochester, Staffordshire. SAE lists.

For Sale

NEW ISSUES of "Practical Wireless" available from April 1974 edition up to date. Price 65p post free. Bell's Television Services, 190 Kings Road, Harrogate, N. Yorkshire. Tel: (0243) 55885.

Wanted

WANTED. New Valves, Transistors. Top prices, popular types. Kensington Supplies (C), 367 Kensington Street, Bradford 8, Yorkshire.

SURPLUS??? Turn it into cash. Phone 0491 35529 (Oxon).

WANTED. Rank Bush mono cassette recorder model TP 66. Working P.C.B. case, manual. Denis, 749 3524 after 6 p.m., or write 103 Fitzneal Street, W12 0BA.

WANTED NEW Valves, transistors, I.Cs, amplifiers, receivers, televisions (Anything Useful) any quantity. Stan Willetts, 37 High Street, West Bromwich. Tel: 021-553 0186.

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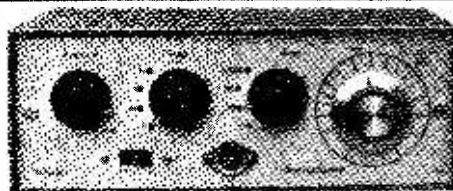
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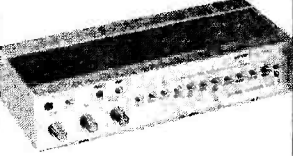
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Flairline Supply	688			Xeroza Radio	cover ii
				Z. & I. Aero Services	712

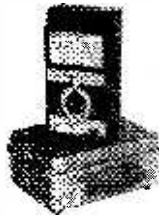
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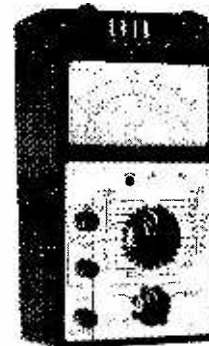


TYPE	U4312	U4313	U4315
Sensitivity D.C.	667 o.p.v.	20,000 o.p.v.	20,000 o.p.v.
Sensitivity A.C.	667 o.p.v.	2,000 o.p.v.	2,000 o.p.v.
D.C. Current	300 μ A-6A	60 μ A-1.5A	50 μ A-2.5A
A.C. Current	1.5mA-6A	0.6mA-1.5A	0.5mA-2.5A
D.C. Volts	75mV-900V	75mV-600V	75mV-1000V
A.C. Volts	300mV-900V	15V-600V	1V-1000V
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

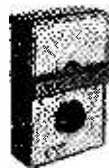


TYPE U4341

Sensitivity:
16700 Ω /V D.C.,
3300/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-
3-30-60-150-300-
900V
A.C. Voltage: 1.5-7.5-
30-150-300-750V
Resistance: 2-20-
200k 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)

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NO OVERLOAD PROTECTION IS INCORPORATED IN THESE INSTRUMENTS



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.)

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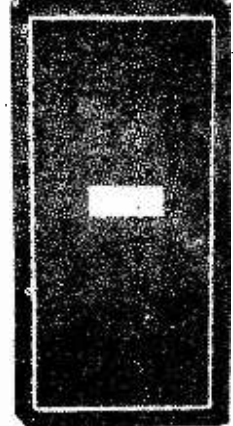
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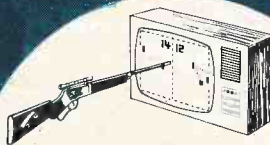
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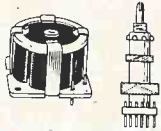


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