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NEWS & VIEWS

FOR OUR CONSTRUCTORS

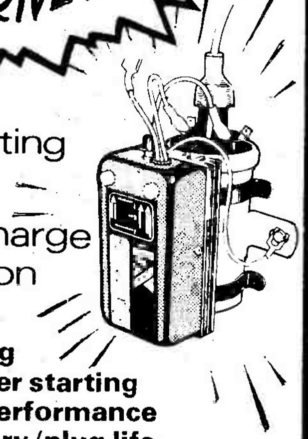
GENERAL INTEREST

Our June issue will be published on 4 May
(for details see page 39)

We regret that part 2 of "Logical Noughts and Crosses" has been held over due to pressure on editorial space

The latest kit innovation! from Sparkrite

Sparkrite – was featured by Shaw Taylor in "DRIVE IN"



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NOTE – Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.85 inc. VAT. post & packing.

Electronic Design Associates, 82 Bath Street, Walsall, WS1 30E U.K. only.

Electronics Design Associates, Dept. PW5
82 Bath Street, Walsall, WS1 3DE. Phone: (9) 614791

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Editor R. N. Wainwright, T. Eng, (CEI), F.S.E.R.T.

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VMOS POWER TRANSISTORS FOR PW WINTON £9.95 pair * 2SK133/J48

FULL KITS FOR THE PW SANDBANKS METAL LOCATOR (should be ex stock)

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TDA1029	DC mode switch	3.50

Radio and Tuner modules

We cannot really list all the details we would like to here - but with advent of the new mark 3 tuner system, the Dorchester and matching AF units, Ambit offers you the widest choice ever, plus hardware and styling that matches the very high standards we have set in this new range.

TERMS etc: CWO please, VAT on Ambit Items is generally 12½%, except where marked (*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays.

At last, DIY HiFi which looks as if it isn't.

That's not to say it doesn't look like HiFi - just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb. A small pic here would be an insult, so send an SAE for details on the kit that looks as if isn't. It's something else.............

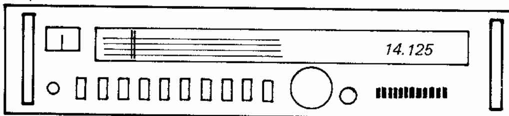
- ★ Exceptionally high performance - exceptionally straightforward assembly
- ★ Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- ★ Various options and module line-ups possible to enable an installment approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- ★ Matching both the style and design concepts of the MkIII HiFi FM tuner
- ★ Hitachi VMOS power fets - characterized especially for HiFi applications
- ★ Power output readily multiplied by the addition of further MOSFETs
- ★ VU meters on the preamp - not simply dancing according to vol level
- ★ Backed with the usual Ambit expertise and technical capacity in audio

The PW Dorchester-LW,MW,SW,& FM stereo tuner

THE DIGITAL DORCHESTER ALL BAND TUNER



With styling and dimensions to fit in with the rest of AMBIT's new range of tuner & audio equipment.

When the new range of OKI digital frequency display ICs was announced, the original prototype of the Dorchester had been made - but since so many of you wanted to use the OKI frequency counterdisplay system with the Dorchester, we quickly designed a unit to incorporate the necessary facilities. The Digital Dorchester is designed in 19 inch form, and forms a perfect match for the other units in the range. If you don't want to go to the expense of the full Ambit DFM1 module, with AM/FM/Time/Timers, then the MA1023 clock module can be used instead -

The Dorchester has been described in PW Dec., Jan. and Feb. issues - but for those of you who may have missed it - it is an All Band broadcast tuner, covering LW/MW/SW and FM stereo in 6 switched ranges. Construction is very straightforward, with all the switching being PCB mounted - and the revolutionary TDA1090 IC used for AM/FM.

The electronics for the radio section of the Dorchester remain unchanged at £33.00, with 12.5% VAT. The hardware package, of case, meter, PSU now costs £33.00 + 8% with the MA1023 available for an extra £5 only.

For the fully digital version, with Ambit DFM1, the price is £56.50 + 8% VAT.

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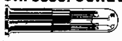

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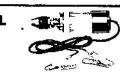

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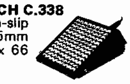

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(Pat. App. For)

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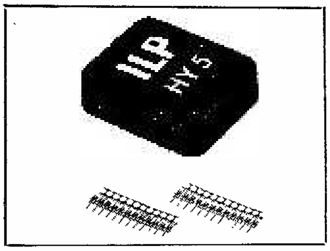
15—240 Watts!

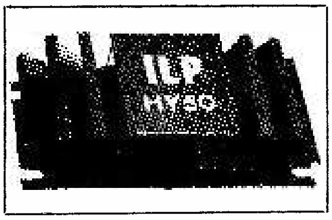
HY5
Preamplifier



The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.
FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.
APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address
SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 47kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.
Price £6·27 + 78p VAT P&P free.

HY30
15 Watts into 8Ω

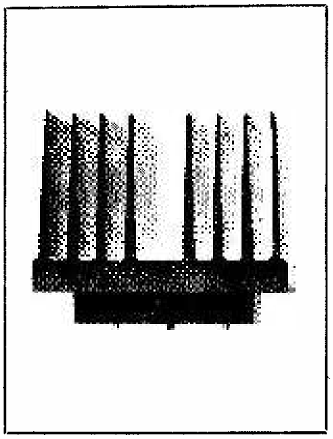
The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier 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 8Ω: DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.
Price £6·27 + 78p VAT P&P free.



HY50
25 Watts into 8Ω

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 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm
Price £8 18 + £1·02 VAT P&P free

HY120
60 Watts into 8Ω



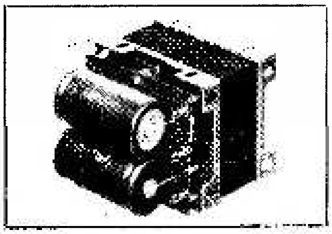
The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.
FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components
APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ
SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm
Price £19·01 + £1·52 VAT P&P free.

HY200
120 Watts into 8Ω

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 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±45V
SIZE 114 50 85mm
Price £27·99 + £2·24 VAT P&P free.

HY400
240 Watts into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! 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 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz – 3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 100 85mm
Price £38·61 + £3·09 VAT P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £6·44 plus 81p VAT. P/P free.
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AUY10	1.70*
BA145	0.13*
BA148	0.13*
BA154	0.09
BA155	0.10
BA156	0.09
BAW62	0.05
BAX13	0.06
BAX16	0.09
BC107	0.12
BC108	0.12
BC109	0.13
BA113	0.12*
BC114	0.13*
BC115	0.14*
BC116	0.15*
BC117	0.17*
BC118	0.10*
BC125	0.16*
BC126	0.20*
BC135	0.14*
BC136	0.15*
BC137	0.15*
BC147	0.09*
BC148	0.08*
BC149	0.09*
BC157	0.09*
BC158	0.08*

BC159	0.10*
BC167	0.12*
BC170	0.11*
BC171	0.10*
BC172	0.10*
BC173	0.12*
BC177	0.15
BC178	0.14
BC179	0.16
BC182	0.11*
BC183	0.10*
BC184	0.11*
BC212	0.13*
BC213	0.12*
BC214	0.15*
BC237	0.09*
BC238	0.12*
BC301	0.25
BC303	0.24
BC307	0.10*
BC308	0.10*
BC327	0.20*
BC328	0.18*
BC337	0.18*
BC338	0.17*
BCY30	1.00
BCY31	1.00
BCY32	1.00
BCY33	0.90
BCY34	0.90
BCY39	3.00
BCY40	1.00
BCY42	0.25
BCY43	0.25
BCY58	0.16
BCY70	0.15
BCY71	0.17

BCY72	0.13
BCZ11	1.50
BD115	0.45
BD121	1.20
BD123	1.20
BD124	1.30
BD131	0.35
BD132	0.38
BD135	0.34*
BD136	0.34*
BD137	0.35*
BD138	0.40*
BD139	0.43*
BD140	0.44*
BD144	2.00
BD181	1.10
BD182	1.18
BD237	0.40
BD238	0.55
BDX10	0.91
BDX32	2.00
BDY20	1.25
BDY60	0.50
BF115	0.25
BF152	0.18
BF153	0.20
BF154	0.17
BF159	0.23
BF160	0.16
BF167	0.20
BF173	0.20
BF177	0.24
BF178	0.24
BF179	0.25
BF180	0.30
BF181	0.30
BF182	0.30
BF183	0.25
BF184	0.25
BF185	0.25

BF194	0.09*
BF195	0.09*
BF196	0.10*
BF197	0.12*
BF200	0.27
BF224	0.20*
BF244	0.28*
BF257	0.24
BF258	0.26
BF259	0.32
BF336	0.20*
BF337	0.30*
BF338	0.31*
BFS21	3.96
BFS28	2.23
BFS61	0.20*
BFS98	0.20*
BFW10	0.65
BFW11	0.65
BFX84	0.22
BFX85	0.23
BFX87	0.21
BFX88	0.21
BFY50	0.26
BFY51	0.26
BFY52	0.26
BFY64	0.26
BFY90	1.25
BSX19	0.21
BSX20	0.20
BSX21	0.20
BT106	1.25
BTY79/400R	3.19
BU205	1.75*
BU206	2.25*
BU208	2.00*
BY100	0.45
BY126	0.14
BY127	0.15

BZX61 Series	0.18
BZY88 Series	0.13
CRS/105	0.45
CRS/140	0.60
CRS/305	0.45
CRS/340	0.75
CRS/360	0.90
GEX66	1.50
GEX541	1.75
GJ3M	0.75
GJ5M	0.75
GM037BA	1.75
KS100A	0.45*
MJE340	0.80
MJE370	1.17
MJE371	0.61
MJE520	0.52
MJE521	0.55
MJE2955	1.25
MJE3055	0.75
MPF102	0.30*
MPF103	0.30*
MPF104	0.30*
MPF105	0.30*
MPSA06	0.24*
MPSA56	0.26*
MPSU01	0.36*
MPSU06	0.46*
MPSU56	0.49*
NE555	0.45
NKT401	2.00
NKT403	1.73
NKT404	1.73
OA5	0.95
OA7	0.55
OA10	0.60
OA47	0.14

OA70	0.30
OA79	0.30
OA81	0.30
OA85	0.30
OA90	0.08
OA91	0.08
OA95	0.08
OA200	0.09
OA202	0.09
OA211	1.00
OAZ200	1.00
OAZ201	1.00
OAZ206	1.00
OAZ207	1.00
OC16	2.90
OC20	2.50
OC22	2.50
OC23	2.75
OC24	3.00
OC25	0.90
OC26	0.90
OC28	2.00
OC29	2.00
OC35	1.50
OC36	1.50
OC41	0.80
OC42	0.75
OC43	2.25
OC44	0.60
OC45	0.55
OC71	0.55
OC72	0.55
OC73	0.70
OC74	0.65
OC75	0.65
OC76	0.55
OC77	1.20
OC81	0.65
OC81Z	1.20

OC82	0.65
OC83	0.65
OC84	0.65
OC122	1.50
OC123	1.75
OC139	2.25
OC140	2.75
OC141	3.25
OC170	1.00
OC171	1.00
OC200	1.50
OC201	1.75
OC202	1.75
OC203	1.75
OC204	2.50
OC205	2.50
OC206	2.50
OC207	1.75
OCP71	1.25
ORP12	0.75
R2008B	1.75*
R2009	2.25*
R2010B	1.75*
T1C44	0.30
T1C226D	1.20
T1L209	0.20
T1P29A	0.41*
T1P30A	0.44*
T1P31A	0.45
T1P32A	0.48
T1P33A	1.69
T1P34A	1.73
T1P41A	0.63
T1P42A	0.70
T1P2955	1.67
T1P3055	0.56
T1S43	1.00
ZS140	0.25*
ZS170	1.21
ZS178	0.54*

ZS271	0.23*
ZS278	0.57*
ZTX107	0.11*
ZTX108	0.10*
ZTX109	0.12*
ZTX300	0.12*
ZTX301	0.13*
ZTX302	0.15*
ZTX303	0.17*
ZTX304	0.19*
ZTX311	0.12*
ZTX314	0.20*
ZTX500	0.13*
ZTX501	0.14*
ZTX502	0.16*
ZTX503	0.17*
ZTX504	0.20*
ZTX531	0.20*
ZTX550	0.16*
1N914	0.05
1N916	0.07
1N4001	0.06
1N4002	0.06
1N4003	0.07
1N4004	0.07
1N4005	0.08
1N4006	0.08
1N4007	0.09
1N4009	0.06
1N4148	0.06
1N5400	0.13
1N5401	0.13
1S44	0.04
1S920	0.07
1S921	0.07
2G301	1.00
2G302	1.00
2G306	1.10
2N404	1.00
2N696	0.25

2N697	0.25
2N698	0.30
2N705	1.20
2N706	0.15
2N708	0.20
2N930	0.20
2N1131	0.26
2N1132	0.26
2N1302	0.35
2N1303	0.35
2N1304	0.45
2N1305	0.45
2N1306	0.50
2N1307	0.50
2N1308	0.55
2N1309	0.55
2N1613	0.25
2N1671	1.50
2N1893	0.25
2N2147	1.75
2N2148	1.65
2N2218	0.25
2N2219	0.24
2N2220	0.18
2N2221	0.18
2N2222	0.18
2N2223	2.75
2N2368	0.17
2N2369A	0.21
2N2484	0.20
2N2646	0.55
2N2904	0.25
2N2905	0.25
2N2906	0.21
2N2907	0.21
2N2924	0.21*
2N2925	0.22*
2N2926	0.14*
2N3053	0.25
2N3054	0.50

2N3055	0.70
2N3440	0.60
2N3441	0.80
2N3442	1.10
2N3525	0.80
2N3614	1.50
2N3702	0.11*
2N3703	0.13*
2N3704	0.13*
2N3705	0.13*
2N3706	0.13*
2N3707	0.13*
2N3708	0.10*
2N3709	0.13*
2N3710	0.10*
2N3711	0.10*
2N3771	1.75
2N3772	2.00
2N3773	3.00
2N3819	0.36*
2N3820	0.45*
2N3823	0.55*
2N3866	0.72
2N3904	0.13*
2N3905	0.13*
2N3906	0.13*
2N4058	0.14*
2N4059	0.10*
2N4060	0.12*
2N4061	0.12*
2N4062	0.13*
2N4124	0.15*
2N4126	0.15*
2N4286	0.20*
2N4288	0.22*
2N4289	0.24*
2N5457	0.35*
2N5458	0.35*
2N5459	0.35*

VALVES

AZ31	1.10*
CBL31	1.50
CL33	2.00*
CY31	1.00*
DAF91†	0.40*
DAF96	1.00*
DF91†	0.40*
DF96	1.00*
DK91	1.05
DK92	1.25*
DK96	1.10*
DL92	0.75*
DL94	1.20*
DL96	1.10*
DY86/7†	0.55*
DY802	0.84*
E88CC†	1.00
EABC80	1.20
EAC91	0.50
EAF42	1.25*
EAF801	1.75*
EB41	2.00*
EB91†	0.40*
EBC33	1.75*
EBC41	1.25*
EBC81	1.10*
EBC90	0.75*
EBF80	0.50*
EBF83	1.25*
EBF89†	0.45*
EBL31	2.50*
ECC40	1.25*
ECC81†	0.50*
ECC82†	0.47*

ECC83†	0.55*
ECC84†	0.60*
ECC85†	0.55*
ECC88†	0.75*
ECC91†	0.55*
ECC189	1.66*
ECF80†	0.60*
ECF82†	0.70*
ECH35	2.00*
ECH42	1.15*
ECH81†	0.55*
ECH83	1.25
ECH84†	0.85*
ECL82†	0.60*
ECL83	1.50*
ECL86†	0.85*
ECLL800	7.00*
EF37A	3.50
EF39†	1.60*
EF40	1.15*
EF41	1.20*
EF42	2.00*
EF50†	0.60*
EF80†	0.50*
EF83	1.75*
EF85†	0.50*
EF86†	0.60*
EF89	1.60
EF91†	0.70*
EF92†	0.75*
EF98	1.25*
EF183†	0.70*
EF184†	0.70*

EH90	1.40
EL32	1.50*
EL33	3.50*
EL34 (Thorn)	1.60*
EL34 (Mullard)	2.24*
EL41	1.25*
EL42	1.75*
EL81	1.10*
EL84†	0.45*
EL86†	0.75*
EL91	6.15*
EL95†	0.80*
EL360	3.50*
EM80	1.10*
EM81	1.00*
EM84	1.00*
EM85	1.25*
EM87	1.50*
EN91†	2.56
EY51†	0.75*
EY86†	0.50*
EZ40	1.25*
EZ41	1.25*
EZ80†	0.50*
EZ81†	0.50*
EZ90†	0.60*
GZ32	1.25*
GZ33	4.00*
GZ34†	1.90*
KT61	3.50*
KT66	5.50*
KT88	6.75*
KTW61	1.75*
KTW62	1.75*
KTW63	1.75*

MU14	1.60*
N78	9.00*
OA2†	0.55
OB2†	0.60
OC3†	0.75
OD3†	0.75
OZ4	1.60
PC86†	0.85*
PC88†	0.85*
PC97	1.20
PC900†	1.00*
PCC84†	0.50*
PCC88	0.65*
PCC89†	1.05*
PCC189†	1.00*
PCF80	1.00*
PCF82†	0.50*
PCF86†	0.75*
PCF87†	1.10*
PCF200†	1.15*
PCF201†	1.10*
PCF801†	0.60*
PCF802†	0.88*
PCF805	1.60
PCF806	1.60
PCF808	1.60
PCL82†	0.80*
PCL83†	0.92*
PCL84†	0.75*
PCL86†	0.85*
PCL805/85†	1.08
PD500	3.60*
PFL200	1.80
PL36†	1.20
PL81	1.20

PL81A†	1.20
PL82	0.60*
PL83†	0.55*
PL84†	0.75*
PL504/500†	1.40
PL508†	1.80
PL509†	3.00
PL519†	3.20
PL801	1.10*
PL802	3.46*
PY33	1.10*
PY81	0.92*
PY82	0.80*
PY83	0.70*
PY88†	0.88
PY500A†	1.80
PY800/81†	0.84
PY801	0.84
QQV02-6	9.90
QQV03-10†	2.00
QQV03-20A†	10.50*
QQV06-40A†	13.00*
R17	1.65*
R19	1.20*
R20	1.44*
U18-20	2.50*
U25	1.16*
U26	1.44*
Z803U	7.90
UA8C80†	0.58*
UAF42	1.25*

UB41	1.25*
UBC41†	1.00*
UBF89	0.60*
UCC84	1.10*
UCC85†	0.55*
UCF80	1.15*
UCH42	1.20*
UCH81†	0.65*
UCL82†	0.75*
UCL83	1.44*
UF41	1.00*
UF80†	0.50*
UF85†	0.65*
UF89†	0.55*
UL41	1.60*
UL84†	0.85*
UM80	1.00*
UY41†	0.75*
UY85†	0.65*
1B3GT†	0.65*
1R5†	0.55*
1S5†	0.40*
1T4†	0.40*
2AS15	10.00
2D21†	0.80
3A5	1.35
3CX100A5	20.00
3S4†	0.75*
3V4†	1.00*
4CX250B	24.81
5R4GY†	1.10*
5U4G	1.52*
5U4GB	2.26*
5V4G†	0.65*
5Y3GT	0.85*

5Z3	1.50*
5Z4G	1.52*
5Z4GT	1.50*
6-30L2	1.80*
6AB7	0.75*
6AC7	0.75*
6AF4A†	0.70*
6AG7	0.75*
6AH6†	0.95*
6AK5†	0.50*
6AK6	0.95*
6AL5†	0.40*
6AM4	2.30*
6AM5	3.85*
6AM6†	0.70*
6AN5	5.32*
6AN8A†	0.70*
6AQ5†	0.85*
6AR5	0.70*
6AS6†	0.80*
6AS7G†	1.50*
6AT6†	0.75*
6AU5GT	4.26*
6AU6†	0.55*
6AV5GT	4.18*
6AV6†	0.75*
6AW8A†	1.00*
6AX5GT	3.10*
6B7	0.75*
6B8	0.75*
6BA6†	0.50*
6BA7	5.12*
6BA8A	3.75*
6BC4	3.71
6BE6†	0.48*

6BH6†	1.20*
6BJ6†	1.20*
GBK4	4.21*
6BL6	85.00
6BL7GT	3.86*
6BN6	0.80*
6BQ7A	1.55*
6BR7	4.00*
6BR8†	1.20*
6BS7	4.00*
6BW6	3.75*
6BW7	1.52*
6BX7GT	4.96*
6BZ6	1.78*
6C4†	0.55*
6CB6A†	0.55*
6CD6GA	4.90*
6CG7	1.72*
6CH6	16.50
6CL6†	0.75*
6CW4	7.24*
6D2†	0.40*
6DK6	2.25*
6DQ6B	3.90*
6EA8	2.21*
6EB8	2.12*
6EW6	1.50*
6F6	1.75*
6F23	1.60*
6F28	1.16*
6H2N	1.05*
6H3N	1.05*
6H6	1.60*
6J4†	1.20*
6J6	0.55*
6J7	0.80*
6K4N	1.25*

6K6GT	1.30*
6K7	1.50*
6K8	1.75*
6KD6	6.16*
6L6G	2.50*
6L6GA	1.50*
6L6GT	0.85*
6L6GC	1.95*
6L7	2.00*
6N2P	1.05*
6N3P	1.05*
6N7	1.50*
6P25	3.60*
6Q7	2.20*
6R7	1.80*
6SA7	1.45*
6SC7	1.50*
6SF7	1.60*
6SH7	1.50*
6SJ7	1.60*
6SK7	1.30*
6SL7GT†	0.70*
6SN7GT†	0.70*
6SQ7	1.30*
6SR7	1.50*
6SS7	1.80*
6U5G	2.00*
6U8†	0.55*
6U8A†	0.55*
6V6GT†	0.65*
6X4†	0.60*
6X5GT†	0.60*
7B7	1.70*
7C5	1.75*
7C6	1.25*

7H7	2.00*
7R7	1.50*
7S7	2.25*
7Y4	1.60*
7Z4	1.85*
12AT6	1.20*
12AT7†	0.50*
12AU6	0.65*
12AU7†	0.47*
12AV6	0.85*
12AV7	3.46*
12AX7†	0.55*
12AY7†	0.85*
12B4A†	1.00*
12BA6	0.65*
12BE6	1.60*
12BH7†	0.65*
12BY7†	0.80*
12E1	7.10
30C15	1.60
30C17	1.60
30C18	1.60
30F5	1.60*
30FL1/2	1.20
30FL12	1.80
30FL14	1.60
30L1	1.00
30L15	1.80
30L17	1.80
30P4	0.92*
30P19	1.20
30PL1	1.32*
30PL13	1.80
30PL14	1.68*
30PL15	1.80
35W4	0.60*
50C5	0.70*

85A2	1.75
90AG	7.96
90AV	7.96
90C1	1.80
90CG	13.68
90CV	13.30
92AG	7.96
92AV	7.96
150B2	2.15
150C2	1.50
150C4	2.30
211	6.00
723AB†	8.00
807†	1.20
811A†	3.80
812A	8.35
813†	10.00
833A	30.00
866A	8.85
872A	13.75
931A	12.24
2050	6.96
5642	5.26*
5654	3.52
5651	1.80*
5670	4.60
5814A	2.60*
6080†	6.85*
6146A	5.12
6146B	5.58
6159	6.00
6442	15.00
6973	3.52*
7586	11.38*
7587	19.60*
7868	3.94*
8068	5.50
8136	2.44*

INTEGRATED CIRCUITS

7400	0.16
7401	0.16
7402	0.16
7403	0.16
7404	0.17
7405	0.16
7406	0.40
7407	0.40
7408	0.20
7409	0.20
7410	0.16

7412	0.26
7413	0.32
7416	0.32
7417	0.32
7420	0.17
7422	0.20
7423	0.32
7425	0.30
7427	0.30
7428	0.43
7430	0.17

7432	0.30
7433	0.36
7437	0.32
7438	0.32
7440	0.18
7441AN	0.85
7442	0.72
7447AN	1.90
7450	0.18
7451	0.18
7453	0.18

7454	0.18
7460	0.18
7470	0.35
7472	0.33
7473	0.36
7474	0.40
7475	0.54
7476	0.40
7480	0.55
7482	0.75
7483	0.90
7484	1.00
7486	0.35
7490	0.52

7491	0.80
7492	0.60
7493	0.60
7494	0.80
7495	0.72
7496	0.80
7497	3.00
74100	1.50
74107	0.45
74109	0.70
74110	0.50
74111	0.86
74116	1.75

74118	1.00
74119	1.50
74120	0.83
74121	0.40
74122	0.60
74123	1.00
74125	0.55
74126	0.55
74128	0.60
74132	0.70
74136	0.55
74141	0.80
74142	2.30
74143	2.50

74144	2.50
74145	0.90
74147	2.00
74148	1.75
74150	1.60
74151	0.85
74154	1.75
74155	0.85
74156	0.85
74157	0.75
74159	2.10
74170	2.30
74172	4.40

74173	1.40
74174	1.50
74175	0.90
74176	1.20
74178	1.25
74179	1.25
74180	1.15
74190	1.50
74191	1.50
74192	1.35
74193	1.35
74194	1.25
74195	1.00

74196	1.20
74197	1.10
74198	2.25
74199	2.25
76013N	1.75*
LM309K	1.50
TAA570	2.30*
TAA630S	3.50*
TAA700	3.91
TBA480Q	1.84*
TBA520Q	2.30*

TBA530	1.98*
TBA540Q	2.30*
TBA550Q	3.22*
TBA560CQ	3.22*
TBA673	2.19*
TBA700	1.52*
TBA720Q	2.30*
TBA750Q	2.07*
TBA800	1.20

TBA920	2.90
TBA920Q	2.99
TBA990Q	2.99*
TCA270Q	2.99*
TCA760A	1.38*

DIL Sockets

8 PIN	0.15
14 PIN	0.15
16 PIN	0.17

BASES

B7G unskirted	0.15
B7G skirted	0.30
B9A unskirted	0.15
B9A skirted	0.30
NUVISTOR	0.55
Int Octal	0.20
Loctal	0.55
8 pin DIL	0.15
14 pin DIL	0.15
16 pin DIL	0.17
Valve screening cans all sizes	0.30

CRT'S

1CP31	31.00
2AP1*	8.50
2BP1*	9.00
3BP1	8.00
3DP1*	5.00
3EG1*	7.00
3FP7	6.00
3GPI	6.00
3JPI*	8.00
3JP2*	8.00
3JP7*	10.00
3KPI*	15.00
3RPI*	35.00

5ADP1	35.00
5BP1*	10.00
5CP1*	5.00
5CP1A	40.00
5FP15A	15.00
5UP7	14.00
DG7-5	25.00
DG7-32	36.00
DH3-91	31.00
DH7-11	68.00
VCR97*	5.00
VCR138*	10.00
VCR138A*	12.50
VCR139A*	8.00
VCR517A*	10.00

VCR517B*	6.00
VCR517C*	6.00
Tube Bases	0.75

*=Surplus
VAT 8%

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A56-120X	45.72	A67-120X	53.61
A55-14X	45.72	A67-150X	54.60

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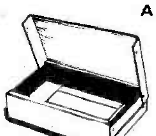
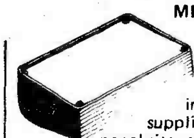
BIMENCLOSURES

ALL METAL BIMCASES



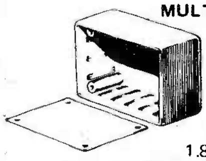
Red, Grey or Orange 14swg Aluminium removable top and bottom covers. 18 swg black mild steel chassis with fixing support brackets.
BIM 3000
(250x167.5x68.5mm)
£14.58

MINI DESK BIMCONSOLES



Orange, Blue, Black or Grey ABS body incorporates 1.8mm pcb guides, stand-off bosses in base with 4 BIMFEET supplied. 1mm Grey Aluminium panel sits recessed with fixing screws into integral brass bushes.
BIM 1005 (161 x 96 x 58mm) £2.18
BIM 1006 (215 x 130 x 75mm) £3.05

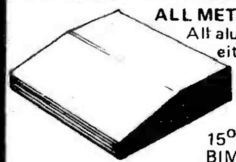
MULTI PURPOSE BIMBOXES

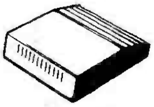


Orange, Blue, Black or Grey ABS with 1mm Grey Aluminium recessed front cover held by screws into integral brass bushes. 1.8mm pcb guides incorporated and 4 BIMFEET supplied.

BIM 4003 (85x56x28.5mm) £1.18
BIM 4004 (111x71x41.5mm) £1.62
BIM 4005 (161x96x52.5mm) £2.19

ALL METAL BIMCONSOLES



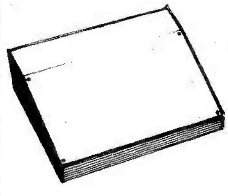


All aluminium, 2 piece desk consoles with either 15° or 30° sloping fronts, sit on 4 self-adhesive non-slip rubber feet. Ventilation slots in base and rear panel for excellent cooling. See latest catalogue for new styles and sizes

Colour Code	Top Panel	Base
A	Off White	Blue
B	Sand	Green
C	Satin Black	Gold

15° Sloping Panel	30° Sloping Panel	
BIM7151 (102x140x51[28] mm)	BIM7301 (102x140x76[28] mm)	£10.67
BIM7152 (165x140x51[28] mm)	BIM7302 (165x140x76[28] mm)	£11.44
BIM7153 (165x216x51[28] mm)	BIM7303 (165x183x102[28] mm)	£12.61
BIM7154 (165x211x76[33] mm)	BIM7304 (254x140x76[28] mm)	£13.82
BIM7155 (254x211x76[33] mm)	BIM7305 (254x183x102[28] mm)	£15.36
BIM7156 (254x287x76[33] mm)	BIM7306 (254x259x102[28] mm)	£16.67
BIM7157 (356x211x76[33] mm)	BIM7307 (356x183x102[28] mm)	£17.58
BIM7158 (356x287x76[33] mm)	BIM7308 (356x259x102[28] mm)	£18.55

LOW PROFILE BIMCONSOLES



Orange, Blue, Black or Grey ABS body has ventilation slots as well as 1.8mm pcb guides and stand-off bosses in base. Double angle recessed front panel with 4 fixing screws into integral brass bushes. 4 BIMFEET supplied.

BIM 6005 (143 x 105 x 55.5 [31.5] mm) £2.37
BIM 6006 (143 x 170 x 55.5 [31.5] mm) £3.08
BIM 6007 (214 x 170 x 82.0 [31.5] mm) £4.12

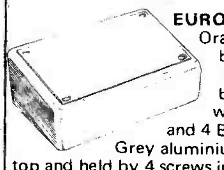
ABS & DIECAST BIMBOXES

6 sizes in ABS or Diecast Aluminium. ABS moulded in Orange, Blue, Black or Grey. Diecast Aluminium in Grey Hammertone or Natural. All boxes incorporate 1.8mm pcb guides, stand-off supports in base and have close fitting flanged lids held by screws into integral brass bushes (ABS) or tapped holes (Diecast).

	ABS		Diecast	Hammertone	Natural
(50x50x31mm)	N/A		BIM5001/11	TBA	£1.02
(100x50x25mm)	BIM2002/12	£0.96	BIM5002/12	£1.46	£1.19
(112x62x31mm)	BIM2003/13	£1.13	BIM5003/13	£1.78	£1.46
(120x65x40mm)	BIM2004/14	£1.35	BIM5004/14	£2.24	£1.82
(150x80x50mm)	BIM2005/15	£1.52	BIM5005/15	£2.84	£2.28
(190x110x60mm)	BIM2006/16	£2.37	BIM5006/16	£3.94	£3.33

Also available in Grey Polystyrene with no slots and self-tapping screws
BIM 2007/17 (112x61x31mm) £1.00

EUROCARD BIMCONSOLES

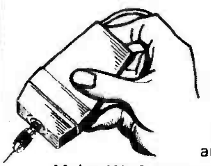


Orange, Blue, Black or Grey ABS body accepts full or ½ size Eurocards, with bosses in the base for direct fixing. 1.8mm wide pcb guides incorporated and 4 BIMFEET supplied. 1mm Grey aluminium lid sits flush with body top and held by 4 screws into integral brass bushes.

BIM 8005 (169x127x70[45] mm) £4.12
BIM 8007 (243x187x103[66] mm) £6.10

BIMTOOLS + BIMACCESSORIES

MAINS BIMDRILLS

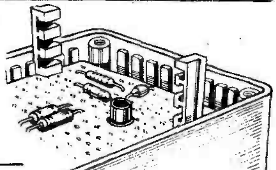


Small, powerful 240V hand drill complete with 2 metres of cable and 2 pin DIN plug. Accepts all tools with 1mm, 2mm or .125" dia. shanks Drills brass, steel, aluminium and pcb's. Under 250g, off load speed 7500 rpm. Orange ABS, high impact, fully insulated body with integral on/off switch £10.53

Mains Accessory Kit 1 includes 1mm, 2mm, .125" twist drills, 5 burrs and 2.4mm collet £2.48

Mains Kit 2 includes Mains BIMDRILL as above, 20 assorted drills, mops, burrs, grinding wheels and mounted points, 1mm, 2mm, 2.4mm and .125" collets. Complete in transparent case measuring 230x130x58mm £22.14

BIMDAPTORS

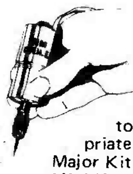


Allows pcb's to be flat mounted sandwich fashion in BIMBOXES, BIMCONSOLES, and all other enclosures having 1.5mm wide vertical guide slots. One plastic BIMDAPTOR on each corner of pcb(s) enables assembly to be simply slid into place. 54mm long, 10 slots on 5mm spacing and can be simply snipped off to length. £1.08 per pack of 25.

BIMFEET

11mm dia. 3mm high, grey rubber self-adhesive enclosure feet. £0.77 per pack of 24

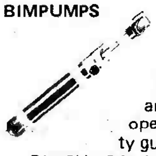
12 VOLT BIMDRILLS



2 small, powerful drills easily hand held or used with lathe/stand adaptor. Integral on/off switch and 1 metre cable.
Mini BIMDRILL with 3 collets up to 2.4mm dia. £ 8.10
Major BIMDRILL with 4 collets up to 3mm dia. £13.60

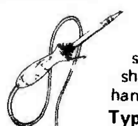
Accessory Kits 1 have appropriate drills and collets as above plus 20 assorted tools. Mini Kit 1 – £15.12, Major Kit 1 – £19.44. Accessory Kits 2 have appropriate drills, collets plus 40 tools and mains-12V dc adaptor. Mini Kit 2 – £34.02, Major Kit 2 – £39.42. Accessory Kits 3 as appropriate Kits 2 plus stand/lathe unit. Mini Kit 3 – £45.36, Major Kit 3 – £50.76.

BIMPUMPS



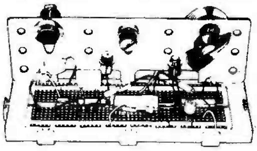
2 all metal desoldering tools provide high suction power and have easily replaceable screw in Teflon tips. Primed and released by thumb operation with in-built safety guard and anti-recoil system.
BIMPUMP Major (180mm long) £7.99
BIMPUMP Minor (150mm long) £6.80

BIMIRONS



Type 30 General Purpose 27 watt iron with long life, rapid change element, screw on tip, stainless steel shaft and clip on hook. Styled handle with neon. £4.05
Type M3 Precision 17 watt iron, quick change tip, long life element, styled handle with clip on hook. £4.43

BIMBOARDS



DIL COMPATIBLE BIMBOARDS

Accept all sizes (4-50 pin) of DIL IC packages as well as resistors, diodes, capacitors and LEDs. Integral Bus Strips up each side for power lines and Component Support Bracket for holding lamps, switches and fuses etc. Available as single or multiple units, the latter mounted on 1.5mm thick black aluminium back plate which stand on non slip rubber feet and have 4 screw terminals for incoming power.

BIMBOARD 1 has 550 sockets, multiple units utilising 2, 3 and 4 BIMBOARDS incorporate 1100, 1650 and 2200 sockets, all on 2.5mm (0.1") matrix.

BIMBOARD 1 £ 8.83
BIMBOARD 2 £21.01
BIMBOARD 3 £29.84
BIMBOARD 4 £38.79

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1, 2, or 3 BIMBOARDS mounted on BIM 6007 BIMCONSOLE with Integral Power Supply (±5 to ±15Vdc @ 100mA and fixed +5Vdc @ 1A) All O/P's fully isolated. Short circuit and fast fold back protection. Power rails brought out to cable clamps that accept stripped wire or 4mm plug.

DESIGNER 1 £55.62
DESIGNER 2 £61.02
DESIGNER 3 £66.42

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*PCC85	1.32
*PCC88	1.12
*PCC89	1.38
*PCC189	1.90
*PCF80	1.36
*PCF82	1.32
*PCF86	1.58
*PCF200	2.46
*PCF801	1.58
*PCF802	1.58
*PCF806	1.44
*PCH200	2.32
*PCL82	1.36
*PCL83	1.58
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*SU61	2.37
TB3-750	59.30
TB4-1250	78.82
TY3-250	59.30
TY4-350	86.57
TY4-400	59.30
TY4-400C	84.78
TY4-500	76.82
TY6-800	150.96
*U50	1.28
*U52	1.90
*U78	0.95
*U142	1.10
*U147	1.15
*U150	1.75
*U151	2.37
*U152	1.00
*U153	1.00
*U193	1.00
*U309	1.00
*UABC80	1.28
*UAF42	1.25
*UBF80	1.10
*UBF89	1.10
*UBL21	1.40
*UCC85	1.10
*UCH81	1.50
*UCL81	0.75
*UCL82	1.66
*UF80	0.75
*UF85	0.65
*UF89	0.75
*UL84	1.44
*UY41	0.95
VR75-30	1.92
VR105-30	1.92
VR150-30	1.92
*W17	0.75
*W77	2.25
*W727	0.80
*X17	1.10
*X727	0.96
XG1-2500	58.35
XG2-500	45.87
XG5-500	30.62
XH3-045	24.66
XL601	19.90
XR1-1600A	22.50
XR1-3200	104.54
XR1-6400A	80.00
*Z77	3.99
*Z719	0.80
*Z729	1.44
Z759	9.05
*ZD17	1.00
ZM1000	4.60
ZM1020	8.55
ZM1040	11.57
ZM1042	11.08
ZM1162	9.75
ZM1550	3.38
ZM1551	3.76
ZP1200	26.25
ZP1210	28.35
ZP1230	32.13
ZP1240	26.60
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ZP1310	12.53
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ZP1481	31.50
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5Z4G	1.12
5Z4GT	1.12
*6/30L2	1.56
*6AB4	1.25
*6AJ8	2.32
*6AK5	2.44
*6AK6	2.33
*6AK8	1.15
*6AL5	0.88
*6AM5	6.00
*6AM6	1.60
*6AQ5	1.12
*6AQ5A	2.82
*6AQ6	1.68
*6AQ8	1.16
6AS6	6.40
6AS7G	1.95
*6AT6	1.25
*6AU6	0.96
*6AV6	1.88
*6AW8	2.20
*6B4G	3.10
*6BA6	0.80
*6BE6	0.98
*6BH6	1.44
*6BJ6	1.00
*6BL8	1.38
6BQ7A	1.55
6BR7	6.00
6BS7	3.84
*6BW6	6.35
*6BW7	1.40
*6BX6	0.80
*6BY7	1.40
*6C4	2.20
*6C5GT	1.10
*6C12	2.32
*6C18	1.36
*6CA4	0.72
*6CA7	2.24
*6CB6A	0.75
*6CH6	1.76
*6CJ6	1.60
*6CK6	1.70
*6CL6	6.44
*6CM5	1.94
*6CS6	1.28
*6CW4	4.72
*6CW7	1.19
*6D2	0.76
*6DA6	1.77
*6DQ5	6.93
*6DJ8	1.68
*6DL5	1.32
*6EH7	1.36
*6EJ7	1.44
*6ES8	1.32
*6F12	3.99
*6F26	0.91
*6F29	1.36
*6F30	1.44
*6F6GB	1.75
*6GA6	1.56
*6GW8	1.58
*6J4	1.50
*6J6	6.58
*6J5GT	4.80
*6L12	1.16
*6L13	0.68
*6L16	1.19
*6L6GA	1.44
*6N7GT	3.00
*6PL12	0.88
*6P15	1.15
*6R3	3.38
*6S2	0.84
6SL7T	2.44
*6SN7GT	1.60
*6SQ7	1.22
*6U8	1.04
*6V4	0.98
*6V6GT	1.24
*6X4	1.08
*6X5GT	1.15
*7DJ8	1.12
*7ES8	1.90
*7FC7	1.38
*8HG8	1.56
*9AQ8	1.32
*9JW6	1.58
*9U8	1.32
*10C14	1.50
10LD12	1.28
*10P18	1.44
*10PL12	1.66
*12AL5	2.15
*12AT7	0.80
*12AT7WA	1.20
*12AU6	1.28
*12AU7	0.68
*12AV6	1.50
*12AX7	0.68
*12B4A	2.56
*12BA6	0.90
*12BE6	1.42
*12BH7	1.50
*12BH7A	1.45
*12BY7A	1.54
12E1	10.17
12E14	32.78
13D3	5.60
13D8	3.75
*14GW8	1.58
*15A6	1.10
*15DQ8	1.44
*16A8	1.38
*17Z3	1.00
*18GV8	1.58
*1908	1.50
*19Y3	1.10
29C1	13.30
*30AE3	1.36
*30C1	1.36
*30FL14	1.44
*30FL2/1	1.12
*30L1	0.84
*30P18	1.58
*30P19	1.00
*30PL12	0.96
*30PL14	1.88
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150C3	1.92
150C4	1.75
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813	51.80
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833A	86.57
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927	10.95
1474B	96.00
1913	6.75
2050A	4.84
5551A	73.25
5552A	99.00
5557	19.15
5559	36.46
5651	1.75
5654	2.50
568	6.34
5696	2.60
5687	59.30
5686	76.82
5894	31.00
5726	9.75
5751	4.00
5763	3.12
6057	2.10
6058	2.10
6060	1.00
6064	1.65
6080	7.00
6084	6.32
6085	5.76
6155	46.60
6158	2.78
6189	7.01
6199	59.00
6201	1.05
6227	5.96
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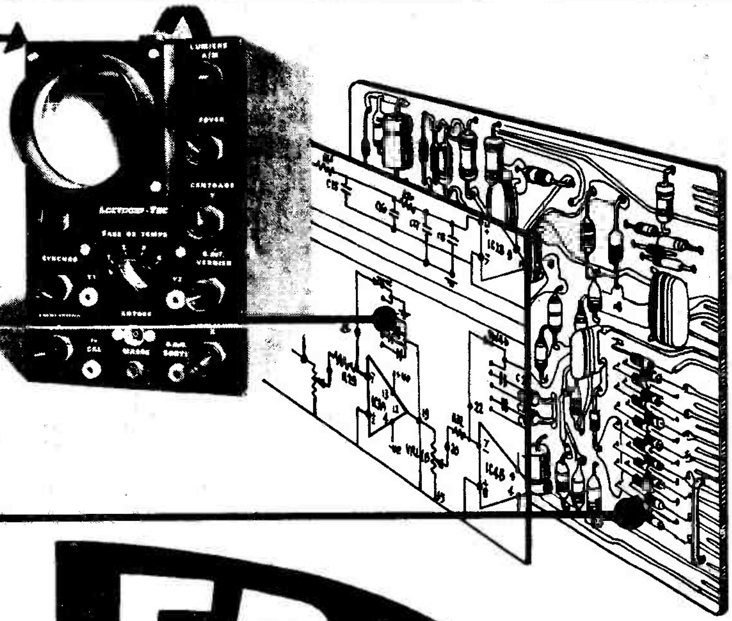

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IN4004 400v	£0·07
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IN4007 1000v	£0·10
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IS30/200 200v	£0·93
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POTENTIOMETERS

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Single gang with wire end terminations, 6mm × 50mm plastic shaft 10mm bushes supplied with shake proof washer & nut.
Tolerance ± 20% of resistance.

1831	1k ohms	£0·26*	1836	47kohms	£0·26*
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1833	4k7ohms	£0·26*	1838	220kohms	£0·26*
1834	10kohms	£0·26*	1839	470kohms	£0·26*
1835	22kohms	£0·26*	1840	1 Meg	£0·26*
1841	2M2	£0·26*			

CARBON POTS (Log Track)

1842	4k7ohms	£0·26*	1846	100kohms	£0·26*
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1844	22kohms	£0·26*	1848	470kohms	£0·26*
1845	47kohms	£0·26*	1849	1Meg	£0·26*
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DUAL CARBON POTS (Lin Track)

These high quality dual gang pots are fitted with wire end terminations and 6mm × 50mm plastic shaft 10mm, bush and supplied with shake proof washer & nut track tolerance ± 20% but matched to within 2db of each other. VC3.

1851	4k7	£0·86*	1855	100kohms	£0·86*
1852	10kohms	£0·86*	1856	220kohms	£0·86*
1853	22kohms	£0·86*	1857	470kohms	£0·86*
1854	100kohms	£0·86*	1858	1Meg	£0·86*
1859	2M2	£0·86*			

DUAL CARBON POTS (Log Law)

1860	4k7ohms	£0·86*	1864	100kohms	£0·86*
1861	10kohms	£0·86*	1865	220kohms	£0·86*
1862	22kohms	£0·86*	1866	470kohms	£0·86*
1863	47kohms	£0·86	1867	1 Meg	£0·86*
1868	2M2	£0·86*			

SINGLE GANG SWITCHED (Lin Law)

These potentiometers are fitted with double pole on-off switches. The switch is incorporated within the rotary action of the pot. Specification of pot is as VC1.
Switch rating 1·5amps at 250v AC.

1870	4k7ohms	£0·65*	1874	100kohms	£0·65*
1871	10kohms	£0·65*	1875	220kohms	£0·65*
1872	22kohms	£0·65*	1876	470kohms	£0·65*
1873	47kohms	£0·65*	1877	1Meg	£0·65*
1878	2M2	£0·65*			

SWITCHED POT (Log Track)

Specification as VC2 but track having (log) law.

1879	4k7ohms	£0·65*	1833	100kohms	£0·65*
1880	10kohms	£0·65*	1884	220kohms	£0·65*
1881	22kohms	£0·65*	1885	47kohms	£0·65*
1882	47kohms	£0·65*	1886	1 Meg	£0·65*
1887	2M2	£0·65*			

DUAL GANG LOG-ANTI-LOG POT

1888 Track specification as dual gang pots VC3 but tracks mounted to log-anti-log action 100kohms **£0·75***

SPECIAL VOLUME CONTROLS

A miniature 16mm type replacement volume control incorporating single pole on-off switch. Resistance value 5kohms. Tolerance ± 20% 1/8watt rating.
1889 **£0·27*** VC8

MINIATURE ROTARY VOL CONTROL

5kohms log law with on/off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.
1890 **£0·54*** VC9

WIRE WOUND POTS

A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shake-proof washer and nut.
VC6

1891	10ohms	£0·80	1895	220ohms	£0·80
1892	22ohms	£0·80	1896	470ohms	£0·80
1893	47ohms	£0·80	1897	1kohms	£0·80
1894	200ohms	£0·80	1898	2k2ohms	£0·80
1899	4k7ohms	£0·80			

PRE-SET POTS HORIZONTAL MOUNTING

Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screwdriver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2·54mm. All tracks are linear law.
VC7

1801	100ohms	£0·09*	1808	22kohms	£0·09*
1802	220ohms	£0·09*	1809	47kohms	£0·09*
1803	470ohms	£0·09*	1810	100kohms	£0·09*
1804	1kohms	£0·09*	1811	220kohms	£0·09*
1806	2k2ohms	£0·09*	1812	470kohms	£0·09*
1806	4k7ohms	£0·09*	1813	1Mohms	£0·09*
1807	10kohms	£0·09*	1814	2M2ohms	£0·09*
1815	4M7ohms	£0·09*			

PRE-SET POTS VERTICAL MOUNTING

Miniature type for transistor circuits. Wiper adjustment is made by a screwdriver slot. Designed to fit 2·54mm pitch board. All tracks are linear law.
VC7

1816	100ohms	£0·09*	1823	22kohms	£0·09*
1817	220ohms	£0·09*	1824	47kohms	£0·09*
1818	470ohms	£0·09*	1825	100kohms	£0·09*
1819	1kohms	£0·09*	1826	220kohms	£0·09*
1820	2k2ohms	£0·09*	1827	470kohms	£0·09*
1821	4k7ohms	£0·09*	1828	1Megohms	£0·09
1822	10kohms	£0·09*	1829	2M2ohms	£0·09
1830	4M7ohms	£0·09*			

ANTEX IRONS

O/Np. 1943. 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit. **£3·80**

O/No. 1947. Replacement element for 1943 iron **£1·90**

O/No. 1944. Iron coated bit 3/32" for 1943 iron. **£0·46**

O/No. 1945. Iron coated bit ⅛" for 1943 iron. **£0·46**

O/No. 1946. Iron coated bit 3/16" for 1943 iron. **£0·46**

O/No. 1948. General purpose 18 watt iron fitted with iron coated bit. **£3·60**

O/No. 1952. Replacement element for 1948 iron. **£1·90**

O/No. 1949. Iron coated bit 3/32" for 1948 iron. **£0·46**

O/No. 1950. Iron coated bit ⅛" for 1948 iron. **£0·46**

O/No. 1951. Iron coated bit 3/16" for 1948 iron. **£0·46**

O/No. 1931. Highly popular X25 25 watt quality soldering iron ceramic shafts to provide near perfect insulation break-down voltage of 1500 volts AC and a leakage current of only 3-5μA and another shaft of stainless steel to ensure strength. **£3·80**

O/No. 1935. Replacement element for 1931 iron. **£1·60**

O/No. 1932. Iron coated bit ⅛" for 1931 iron. **£0·50**

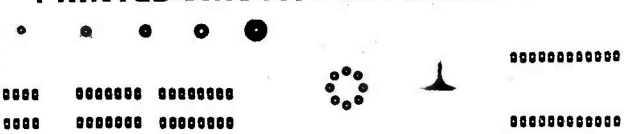
O/No. 1933. Iron coated bit 3/16" for 1931 iron. **£0·50**

O/No. 1934. Iron coated bit 3/32" for 1931 iron. **£0·50**

O/No. 1953. SK1 soldering kit—this kit contains 15 watt soldering iron fitted with a 3/16" bit plus two spare bits, a reel of solder, heat-sink and a booklet 'How to solder'. In presentation display box. **£5·55**

O/No. 1939. ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring, suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean. **£1·50**

PRINTED CIRCUIT PCB TRANSFERS



Draw your own boards with the new BI-PAK etch-resist transfers. Lay the symbols on the board, rub over with a soft pencil. The transfer will adhere to the board. Then complete the circuit with your BI-PAK etch-resist pen.
Each pack contains 11 sheets of transfers 1 of each as shown above.
Illustrations – approx. ½ size.
O/No. TR400 @ **£1·50** p&p £0·10.

BRIDGE RECTIFIERS

Type	Order No.	Price
SILICON 1 amp		
50V RMS	BR1/50	£0·20
100V RMS	BR1/100	£0·22
200V RMS	BR1/200	£0·25
400V RMS	BR1/400	£0·36
SILICON 2 amp		
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

OPTOELECTRONICS

NEW INCREASED RANGE – ALL 1ST QUALITY
LED's (diffused)

O/no.	Type	Size	Colour	Price
1501	ARL209(TIL209)	.3mm(.125)	RED	£0·10
1502	MIL3232(TIL211)	.3mm(.125)	GREEN	£0·15
1503	MIL3331 (OPL212A)	.3mm(.125)	YELLOW	£0·15
1504	ARL4850(FLV117)	.5mm(.2)	RED	£0·10
1505	MIL5251(TIL222)	.5mm(.2)	GREEN	£0·15
1506	MIL5351(MV5353)	.5mm(.2)	YELLOW	£0·15
1509	FLV111	.5mm(.2)	CLEAR (ill., Red)	£0·11

SUPER 'Hi-Brite' Type

1521	MIL32	.3mm(.125)	RED	£0·10
1522	MIL52	.5mm(.2)	RED	£0·10
1514	ORP12 Light dependent resistor			£0·55
1520	OCP71 Photo transistor			£0·35

LED CLIPS

1508/125 pack of 5	125 clips	£0·15
1508/2 pack of 5	2 clips	£0·18

ALL @ 8% V.A.T.

DISPLAYS

DL303 7 segment D.P. left (.30" height)	Common Anode	
RED Single Digit	O/No. 1523	£0·70
DL707 7 segment D.P. left (0.3" height)	Common Anode	
RED Single Digit	O/No. 1510	£0·95
DL527 7 segment D.P. left (.50" height)	Common Anode	
RED Two-Digit Reflector	O/No. 1524	£1·70
DL727 7 segment D.P. right (.510" height)	Common Anode	
RED Two-Digit Light Pipe	O/No. 1521	£2·20
DL747 7 segment D.P. left (.630" height)	Common Anode	
RED Single-Digit Light Pipe	O/No. 1511	£1·70

ALL @ 8% V.A.T.

OPTO-ISOLATORS

Isolation Breakdown – Voltage 1500 – continuous fwd current 100mA

CIL74 Single-Channel 6 pin DIP standard type – optically coupled pair with Infra-red LED Emitter and NPN Silicon Photo Transistor. O/No. 1497 **£0·50**

CILD74 Multi-Channel 8 pin DIP Two Isolated Channels. O/No. 1498 **£1·00**

CILQ74 Multi-Channel 16 pin DIP Four Isolated Channels. O/No. 1499 **£2·20**

ALL @ 8% V.A.T.

2nd GRADE LEDs

A pack of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for amateurs who do not require the full spec.
O/No. 107 **£1·50**

THYRISTORS

Volts	No.	Price
600ma	**TO 18 Case**	
10	THY600/10	£0·15
20	THY600/20	£0·16
30	THY600/30	£0·20
50	THY600/50	£0·22
100	THY600/100	£0·25
200	THY600/200	10·38
400	THY600/400	£0·44
1 amp	**TO 5 Case**	
50	THY1A/50	£0·28
100	THY1A/100	£0·28
200	THY1A/200	£0·32
400	THY1A/400	£0·38
600	THY1A/600	£0·45
800	THY1A/800	£0·58
3 amp	**TO 66 Case**	
.50	THY3A/50	£0·28
100	THY3A/100	£0·30
200	THY3A/200	£0·33
400	THY3A/400	£0·42
600	THY3A/600	£0·50
800	THY3A/800	£0·65
5 Amp	**TO 66 Case**	
50	THY5A/50	£0·36
100	THY5A/100	£0·45
200	THY5A/200	£0·50
400	THY5A/400	£0·57
600	THY5A/600	£0·69
800	THY5A/800	£0·81
5 Amp	**TO 220 Case**	
400	THY5A/400P	£0·57
800	THY5A/600P	£0·69
800	THY5A/800P	£0·81

Volts	No.	Price
7 Amp	**TO 48 Case**	
50	THY7A/50	£0·48
100	THY7A/100	£0·51
200	THY7A/200	£0·57
400	THY7A/400	£0·62
600	THY7A/600	£0·78
800	THY7A/800	£0·92
10 Amp	**TO 48 Case**	
50	THY10A/50	£0·51
100	THY10A/100	£0·57
200	THY10A/200	£0·62
400	THY10A/400	£0·71
600	THY10A/600	£0·99
800	THY10A/800	£1·22
16 Amp	**TO 48 Case**	
50	THY16A/50	£0·54
100	THY16A/100	£0·58
200	THY16A/200	£0·62
400	THY16A/400	£0·77
600	THY16A/600	£0·90
800	THY16A/800	£1·39
30 Amp	**TO 94 Case**	
50	THY30A/50	£1·18
100	THY30A/100	£1·43
200	THY30A/200	£1·63
400	THY30A/400	£1·79
600	THY30A/600	£3·50

No.	Price
BT101/500R	£0·80
BT102/500R	£0·80
BT106	£1·25
BT107	£0·93
BT108	£0·98
2N3228	£0·70
2N3535	£0·77
BTX30/50L	£0·33
BTX30/400L	£0·46
C106/4	£0·60

CABLES

DESCRIPTION	O/No.	PRICE/ Metre
Microphone Cable	3126	£0·10
Twin Microphone	3127	£0·20
Twin Stereo Screened Cable	3128	£0·15
Multicore Standard 4-Core Screened	3129	£0·30
4-Core Individually screened	3130	£0·22
Heavy Microphone Cable	3131	£0·18
Light 3-Core mains	3132	£0·10
Twin Oval Mains	3133	£0·09
Speaker Cable	3134	£0·07
Low Loss Co-axial Cable	3135	£0·22
15 Way Multi Coloured Ribbon Cable	3136	£0·40

BOOKS AND COMPONENTS

BOOKS BY BABANI

BP6	Engineers & Machinists Ref. Tables	40p†
BP14	2nd Book Transistor Equivs & Subs	£1·10†
BP22	79 Electronic Novelty Circuits	75p†
BP24	52 Projects Using IC741 (or Equiv)	75p†
BP26	Radio Antenna Book Long Distance Reception and Transmission	85p†
BP27	Giant Chart of Radio Electronic Semicondictor and Logic Symbols	60p†
BP32	Build Metal and Treasure Locators	85p†
BP34	Practical Repair/Renovation C/TV	95p†
BP35	Handbook of IC Audio Preamplifier and Power Amplifier Construction	95p†
BP36	50 Cicts use Germ/Sil/Zener Diodes	75p†
BP37	50 Projs Using Relays/SCR/Triacs	£1·10†
BP39	50 Field Effect Trans Projects	£1·25†
BP40	Digital IC Equivs and Pin Connection	£2·50†
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BP44	IC 555 Timer Projects	£1·45†
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BP49	Popular Electronic Projects	£1·45†
BP50	IC LM3900 Projects	£1·35†
BP55	Radio Stations Guide	£1·45†
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BP202	Handbook of Integrated Circuits Equivalents and Substitutes	75p†
BP205	1st Book Hi-Fi Speaker Enclosures	75p†
BP213	Circuits for Model Railways	85p†
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BP223	50 Projects using IC CA3130	95p†
BP224	50CMOS IC Projects	95p†
BP225	A Practical Intro to Digital IC's	95p†
BP226	Build Advanced Short wave Receivers	£1·20†
BP227	Beginners Guide to Building Electronic Projects	£1·25†

NEWNES BOOKS — NEW

V.A.T. Zero Rated

ORDER No.	DESCRIPTION	PRICE
	QUESTIONS & ANSWERS:	
216	Transistors 3rd Ed.	£1·00†
217	Integrated Circuits	£1·00†
218	Radio and Television	£1·25†
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234	Guide to Colour TV	£2·25†
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237	Printed Circuit Assembly	£1·80†
238	Transistor Pocket Book	£3·90†
239	50 Photoelectric Circuits	£1·80†
240	Semiconductor Handbook – Part 1	£5·25†
241	Semiconductor Handbook – Part 2	£4·28†
242	Electronics Pocket Book	£3·90†
243	Radio Value & Semiconductor Data	£2·40†
244	Beginners Guide to Integrated Circuits	£2·75†
209	BI-PAK TTL Data Book	£0·50†
	BI-PAK CMOS Data Book	£0·45†

P.C.B. BOARDS

C26 4 pieces 8" × 3½" (approx.) Single-sided fibreglass **80p**

C27 3 pieces 7" × 3½" (approx.) Double-sided fibreglass **60p**

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0·14*
DPDT standard slide	1974	£0·15*
Toggle switch SPST 1½ amp 250V a.c.	1975	£0·33*
Toggle switch DPDT 1 amp 250V a.c.	1976	£0·42*
Rotary on-off mains switch	1977	£0·50*
Push switch – Push to make	1978	£0·14*
Push switch – Push to break	1979	£0·18*

ROCKER SWITCH

A range of rocker switches SPST – moulded in high insulation Material available in a choice of colours ideal for small apparatus.

Colour	No.	Price
RED	1980	£0·30*
BLACK	1981	£0·30*
WHITE	1982	£0·30*
BLUE	1983	£0·30*
YELLOW	1984	£0·30*
LUMINOUS	1985	£0·30*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0·70*
Miniature SPST toggle, 2 amp 250V a.c.	1959	£0·75*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0·80*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0·95*
Push-button SPST, 2 amp 250V a.c.	1962	£0·90*
Push-button SPST, 2 amp 250V a.c.	1963	£0·95*
Push-button DPDT, 2 amp 250V a.c.	1964	£0·20*

MIDGET WAFER SWITCHES

Single-bank wafer type – suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactiver loads make before-break contacts. These switches have a spindle 0·25in dia. and 30° indexing.

Description		Order No.	Price
1 pole	12 way	1965	£0·48*
2 pole	6 way	1966	£0·48*
3 pole	4 way	1967	£0·48*
4 pole	3 way	1968	£0·48*

MICRO SWITCHES	Order No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V a.c.	1970	£0·25

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm × 5mm chassis mounting	506	£0·16*
1¼in × ¼in chassis mounting	507	£0·12*
1¼in car inline type	508	£0·16*
Panel mounting 20mm	509	£0·20*
Panel mounting 1¼in	510	£0·32*

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	6p	1A	615	5p	3A	619	5p
250mA	612	6p	1·5A	616	6p	4A	620	9p
550mA	613	5p	2A	617	5p	5A	521	5p
800mA	614	7p	2·5A	618	6p			

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 1¼in

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
2A	637	3A	639	5A	642

All 6p each

NUTS AND BOLTS

BA BOLTS – packs of BA threaded cadmium plated screws slotted cheese head.
Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1 in 0BA	839	£1·20	½ in 4BA	846	£0·32
½ in 0BA	840	£0·75	¼ in 4BA	847	£0·25
1 in 2BA	842	£0·65	1 in 6BA	848	£0·40
½ in 2BA	843	£0·45	½ in 6BA	849	£0·21
¼ in 2BA	844	£0·52	¼ in 6BA	850	£0·25
1 in 4BA	845	£0·44			

BA NUTS – packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	855	£0·72	4BA	857	£0·30
2BA	856	£0·48	6BA	858	£0·24

BA WASHERS – flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	859	£0·14	4BA	861	£0·12
2BA	860	£0·12	6BA	862	£0·12

SOLDER TAGS – hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	851	£0·40	4BA	853	£0·22
2BA	852	£0·28	6BA	854	£0·22

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	90p*
2022	9V-0-9V 100mA	90p*
2023	12V-0-12V 100mA	£1·12*

MINIATURE MAINS Primary 240V

No.	Type	Price
2024	MT280-0-6V RMS	£1·60*
2025	MT150-0-12V0-12V RMS	£1·60*

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	£2·50*	P. & P. 45p
2027	9V-0-9V 1 amp	£2·00*	P. & P. 45p
2028	12V-0-12V 1 amp	£2·60*	P. & P. 55p
2029	15V-0-15V 1 amp	£2·75*	P. & P. 66p
2030	30V-0-30V 1 amp	£3·45*	P. & P. 86p

STANDARD MAINS Primary 240V

Multi-tapped secondary mains transformers available in ½ 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, 20-0-25V.

No.	Rating	Price	
2031	½ amp	£3·40*	P. & P. 86p
2032	1 amp	£4·40*	P. & P. 66p
2033	2 amp	£5·45*	P. & P. £1·10

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0·60*
113	3·5mm Jack plug to 3·5mm jack plug Length 1·5m	£0·75*
114	5 pin DIN plug to 3·5mm. Jack connected to pins 3&5. Length 1·5m	£0·85*
115	5 pin DIN plug to 3·5mm. Jack connected to pins 1&4. Length 1·5m	£0·85*
116	Car aerial extension. Screened insulated lead. Fitted plug & skt.	£1·25*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0·68*
118	5 pin DIN phono plug to stereo headphone jack socket	£1·05*
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0·2m	£0·90*
120	Car stereo connector. Variable geometry plug to fit most car cassette. 8 track cartridge & combination units. Supplied with inline fused power lead and instructions	£0·60*
123	6·6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1·50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1·5m	£0·75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1·5m	£0·75*
126	5 pin DIN plug to Tinned open end. Length 1·5m	£0·75*
127	5 pin DIN plug to 4 Phono Plugs All colour coded. Length 1·5m	£1·30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1·5m	£0·80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1·5m	£1·05*
130	2 pin DIN plug to 2 pin DIN inline socket Length 5m	£0·68*
131	5 pin DIN plug to 3 pin DIN plug. 1&4 and 3&5. Length 1·5m	£0·83*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£0·98*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1·5m	£0·75*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	£0·68*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	£0·68*
136	Coiled stereo headphone extension lead. Black. Length 6m	£1·75*
178	AC mains lead for calculators etc.	£0·45*

CASES AND BOXES

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

No.	Length	Width	Height	Price
155	8in	5¼in	2in	£1·25
156	11in	6in	3in	£2·12
157	6in	4¾in	1¾	£1·30
158	9in	5¼	2¼in	£1·76

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

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	62p
160	4in	4in	1½in	62p
161	4in	2¼in	1½in	62p
162	5¼in	4in	1½in	70p
163	4in	2¼in	2in	64p
164	3in	2in	1in	44p
165	7in	5in	2½in	£1·04
166	8in	6in	3in	£1·32
167	6in	4in	2in	86p

V.A.T. Add 12½% to prices marked *. 8% to those unmarked. Items marked † are zero rated.
P.&P. 35p unless otherwise shown.

BI-PAK

DEPT. PW5, P.O. Box 6, Ware, Herts.
COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

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TECHNICAL ARTIST
Rob Mackie

ASSISTANT ART EDITOR
Keith Woodruff

SECRETARIAL
Sylvia Barrett
Debbie Chapman

EDITORIAL OFFICES
Westover House,
West Quay Road,
POOLE, Dorset BH15 1JG
Telephone: Poole 71191

ADVERTISEMENT MANAGER
Telephone: 01-261 6671 Roy Smith

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Problems!

COMPONENTS are usually available from advertisers. A source will be suggested for difficult items—So runs the announcement on page 1 of each issue of *PW*. But readers still have problems, and write to us about them, sometimes in the most outspoken terms. And it seems to us we just can't win.

If we know that an item is available from a number of our advertisers, though it may appear only in their catalogues and not in their adverts, we do not quote a source. We have not the room to list all the stockists, and if we quote only one, the others understandably get upset and complain that we are discriminating against them.

Sometimes, an unusual item is used in a project, simply because it will give better results than the more generally available alternatives. Special arrangements are then made for that item to be advertised in the magazine, often by one of our regular advertisers. Occasionally, the supply of complete kits is organised, but even this has recently prompted a particularly vitriolic letter from one reader, accusing us and an advertiser of trying to create a monopoly situation (when in fact none exists) and being intent on profiteering. That reader prefers to shop around, buying each component from the cheapest source. Yet, if a kit is not arranged, other readers write to complain that we are costing them pounds in catalogues, phone calls, postage and packing by forcing them to shop around!

Very often these same readers make life unnecessarily difficult for themselves by not using the information which is available to them. In every issue of *Practical Wireless* there is an Index to Advertisers, usually two pages from the back, listing every advertiser except the smallest Classifieds. Yet we often get letters asking for addresses of advertisers quoted in articles; we even had one peak-rate telephone call from London, from a reader who had looked "everywhere" for an address for a well-known chain of component shops. Everywhere, apparently, except the London telephone directory, which listed no less than 12 branches of the chain.

Knowing where to find relevant information and supplies is basic to the successful pursuit of any hobby, no less than it is for a business. Obviously, there are problems for the beginner, and we try to take account of this, particularly in projects aimed at the less experienced. One of the biggest difficulties for the beginner is knowing where he can make substitutions in components. Will a capacitor with a different dielectric, or even of a different shape, work in a particular circuit position? Is that component value critical, or could it safely be changed by 10 per cent, or even more? We hope to have some articles giving guidance on this sort of problem in the not too distant future.

PW PERSONALITY

Peter Preston—Technical Sub-Editor

During the course of his career, Peter has been involved in the engineering of specialised broadcast equipment, now in operation in various parts of the World, and the preparation of associated technical data and manuals. He joined *PW* just prior to their move to Poole and enjoys this new departure into the world of journalism and the diverse nature of the work.

A keen radio enthusiast and former VK9 licence holder, Peter has great interest in state-of-the-art equipment for the amateur. He has already been responsible for encouraging several new authors, some of whom are very well known in professional circles, to write for the magazine. For relaxation, he enjoys music (wide tastes here) and also holds a private pilots' licence which he claims he can rarely afford to put to use! Peter is also an active member of the Bournemouth Lions, where he serves on the Welfare Committee.

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

Additions to the Family

Those who said just a few years ago that TTL was dead or dying, were proved yet more wrong by the announcement of two new series by Texas Instruments. Both these third generation designs make use of the Schottky-barrier diode clamp technique.

Advanced Schottky TTL series SN74AS is twice as fast as the SN74S series while maintaining virtually the same power dissipation per gate. Load driving capability is also improved. First types to be introduced will include high-performance gate functions in 20-pin d.i.p., and MSI devices in a new 300-mil 24-pin dual-in-line package offering increased functional density. TI see Advanced Schottky as an alternative to the current ECL family.

Advanced Low-Power Schottky TTL series SN74ALS is more than twice as fast as SN74LS and consumes half the power per gate. ALS-series devices will be available in 14, 16, 20 and 24-pin d.i.p., and will offer direct plug-in compatibility with present LS functions. The improved power performance will make the ALS series a viable alternative to standard CMOS, particularly at higher clock frequencies.

Both lines are expected to become available in the UK during the course of 1979.

New Speak

A new automatic broadcast system has been bought by the Civil Aviation Authority to help airline pilots receive in-flight reports of weather conditions at UK and European airports (Volmet). Designed and developed by Marconi Space and Defence Systems, this new technique automatically converts airport weather reports, which are received every half-hour by telex at the Civil Aviation Communications Centre at Heathrow, into a human voice, and transmits them continuously on a maximum of four frequencies simultaneously.

When this system comes into operation, the voice which will be heard by hundreds of pilots each day, will be that of retired Royal Corps of Signals Officer Colonel John West.

John West's voice, reading standard weather report phrases, words and figures, has been recorded in the Portsmouth studios of Telecomms Ltd., digitised at MSDS and stored in a computer memory.

Incoming Volmet messages are decoded, and this information used to control the speech output from the computer memory.

Many other services can be improved using automatic voice response systems, such as weather and road condition reports, railway time tables and telephone directory enquiries. Announcement-type information services for airports and main-line railway stations can also be provided with standard messages in several languages.

Marconi Space and Defence Systems Ltd., Press Office, Marconi House, Chelmsford CM1 1PL.

Hi-Fi 79

High Fidelity '79 to be held at the Cunard Hotel, Hammersmith, between 24 and 29 April 1979, is proving to be even more popular with the Hi-Fi industry than earlier exhibitions.

Of particular interest is the high number of British companies showing at the exhibition. In recent years the annual Spring Hi-Fi Exhibition has gained a reputation as a most important annual showcase for the British Hi-Fi industry and this year is no exception.

The large number of British companies exhibiting will be supplemented by many of the most famous international names in audio.

As usual, the exhibition will feature a free catalogue and free admittance. The exhibition will be open to the trade and press only on 24, 25 and 26 April, and to the public on 27, 28 and 29 April, between 10am and 8pm excepting the last day, when the exhibition will close at 4pm.

MPUs for hire

Emprise has started a new hire service for microprocessor evaluation and training systems. Intended for "hands on" training and experimentation, the systems come complete with detailed instruction manuals and are ready for immediate use. Types available include: National SCMP; Intel 8080; Motorola 6800; MOS Technology 6500; and Zilog Z80, with others available shortly. Rental is from £4·70 per week.

This inexpensive service enables users to gain "hands on" experience with several systems for much less than the cost of a tuition course or evaluation kit.

As a further aid towards reducing costs, Emprise will help owners of unwanted or "outgrown" evaluation kits and equipment, to sell their units to waiting buyers.

Lists of secondhand equipment are available, which help put buyers in touch with sellers.

For further details contact: *Emprise 76, 25 Carlisle Close, Colchester, Essex CO1 2YT. Tel: (0206) 41773.*

Buzby's New Baby

This latest addition to the Post Office's range of payphones is a version with integral handset. The outer casing of the new model is yellow, the handset and its mounting black and the coin slots and associated mechanism faced with brushed chrome. It is also much smaller than its familiar counterpart, being 300mm wide, 180mm deep and 360mm high and weighs only 12kg, compared with the standard wall-mounted payphone of 25kg.

The additional connection charge for the new instrument is £10 at the time of writing, with a £7 surcharge on the normal quarterly rental for the more usual type.

A portable version is planned for trolley-mounted applications later in the year. This is envisaged as being suitable for hospital beside use and perhaps such locations as service station forecourts.

NEWS... NEWS...

Rally dates

The Spalding and District Amateur Radio Society's annual "Tuliptime" rally will be held at Spalding Grammar School on 6 May 1979.

As well as a variety of trade stands and a "bring and buy" stall, there will also be attractions for all the family. Talk-in will be available on 2m and 70cm.

Further details from: *G. C. L. Parker G4EMK, Kesteven Forest Lodge, Beech Avenue, Bourne, Lincs PE10 9RD.*

The Hull and District Amateur Radio Society will be holding their annual Mobile Rally on Spring Bank Holiday Sunday, 27 May 1979.

Once again the venue will be Hull University and all the usual attractions are expected.

Further details from: *G8EAH (QTHR).*

Britain's First Amateur Spacecraft

Britain's first amateur space satellite is to be built at the University of Surrey. The project is being co-ordinated by the Telecommunications Research Group within, and supported by, the Department of Electronic and Electrical Engineering. It is being carried out in close collaboration with the University's Electronics and Amateur Radio Society (EARS), the international Amateur Satellite Corporation (AMSAT), the Amateur Satellite Organisation of the UK (AMSAT-UK) and the Radio Society of Great Britain. Active support is being given by Britain's electronics, telecommunications and space industries.

AMSAT has been responsible for eight previous amateur satellites in the OSCAR series (Orbiting Satellites Carrying Amateur Radio). These have been built internationally by radio amateurs in the USA, Germany, Canada, Japan and Australia, and their function has been to relay v.h.f. and u.h.f. radio signals, extending the range of transmissions by amateur radio enthusiasts. Each has been given a "piggy-back" launch by NASA when space was available in launch vehicles, because of their educational value.

The new satellite will be Britain's first contribution in flight hardware to the Amateur Space Programme. Its purpose and proposed feature are a departure from the OSCAR series. First, it provides an opportunity for gaining practical experience in developing an inexpensive UK spacecraft programme. Second, its main feature is to be a series of high-frequency beacons, enabling radio amateurs all over the world to study the changing effects of the ionosphere on radio-wave propagation. Third, it is intended to stimulate a greater practical interest in the space sciences in schools, colleges and universities.

The project will be co-ordinated at the University and much of the spacecraft will be built there. It will be constructed in modular form, priority being given to the power, telecommand and other fundamental service systems, followed by the high-frequency beacons. Several other, more complex, experiments are planned, and these will be undertaken later at the University or by other amateur groups in this country until resources, including time, run out.

The design, construction and testing of the satellite will take about two years. It is intended for a polar orbit at a height of 900km, and a possible launch opportunity exists early in 1981.

The cost of the satellite is expected to be around £150 000, and support for the project is being provided in cash and kind by a number of organisations, including: Amateur Satellite Corporation (AMSAT), Amateur Satellite Organisation of the United Kingdom (AMSAT-UK), Appleton Laboratories, British Aerospace, Ferranti, Marconi Space and Defence Systems, M.E.L., Philips Research Laboratories, The Post Office, Racal, The Radio Society of Great Britain and The Royal Aircraft Establishment.

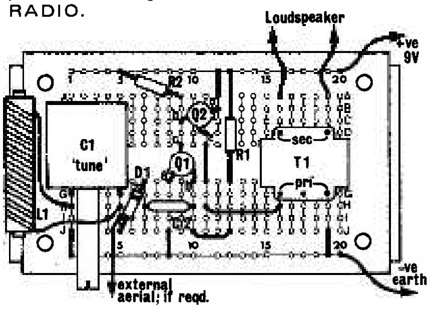
Surrey University's involvement in satellite work has developed as a result of the interest and ability of its student Electronics and Amateur Radio Society (EARS). Since 1974 EARS has played an increasing role in commanding satellites of the OSCAR series, developed by AMSAT, the international amateur satellite organisation. These satellites contain v.h.f. and u.h.f. receivers and transmitters and are intended for use by radio amateurs to extend the range over which their transmissions are received, in the same way as television programmes are relayed around the world.

ELECTRONICS BY NUMBERS FREE PROJECT NO.1

ONCE YOU'VE GOT IT DESIGNED, YOU'VE GOT IT MADE.

ELECTRONICS BY NUMBERS.
TWO-TRANSISTOR RADIO.

Now using Experimentor Breadboards and following the instructions in "Electronics by Numbers" ANYBODY can build electronic projects.
Simply look at the diagram — this has exactly the same type of layout of all EXPERIMENTOR boards. Look at the component list and select the component Q1, this is an NPN transistor type 2N3904, this plugs into holes C10, D11, and B12. Easy isn't it?
Now take C2, which is a .1 uf capacitor, this plugs into holes H7 and H10.
Do the same with all the components, connect a 9 volt battery and you have a perfect working TWO-TRANSISTOR RADIO.



YOU WILL NEED

B1—9 VDC battery
C1—365—pF variable capacitor
C2—.1—uF capacitor
D1—Diode, 1N914 or 4148 or equiv.
L1—Standard broadcast loopstick antenna
Q1—NPN transistor, 2N3904 or equiv.
Q2—PNP transistor, 2N3906 or equiv.
R1—100,000—ohm resistor, ¼ watt
R2—4700—ohm resistor, ¼ watt
S1—SPST switch
T1—500:8—ohm matching transformer
SPKR—8—ohm speaker

Building radios is lots of fun. Here's a loud-speaking crystal set. L1 and C1 form the circuit that tunes the radio. For better performance substitute a germanium diode such as IN34 or IN60.
These projects use components which are readily available from all suppliers and we've made a special effort to design the projects so that in many cases substituting close but wrong component values of different transistors will still result in a working circuit.
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EXP.325. The ideal breadboard for 1 chip circuits.
Accepts 8,14,16 and up to 22 pin IC's.
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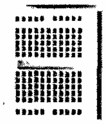
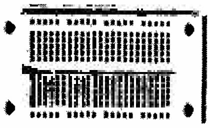
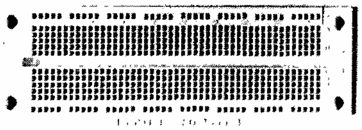


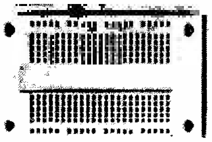
EXP.350. £3.15.
270 contact points with two 20-point bus-bars.



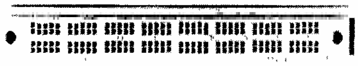
EXP. 300. £5.75.



EXP. 650 for Micro-processors. **£3.60.**



EXP 4B.
More bus-bars.
£2.30.



ALL EXP.300 Breadboards mix and match with 600 series.

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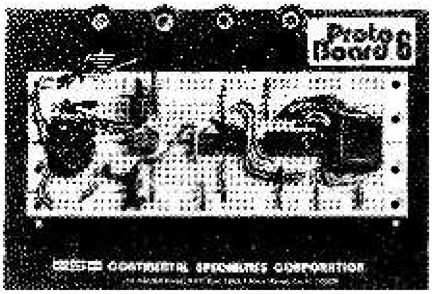
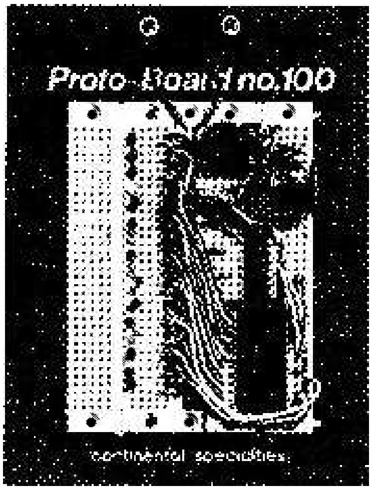


PB.6 Kit, 630 contacts, four 5-way binding posts accepts up to six 14-pin Dips.

PROTO-BOARD 6 KIT. £9.20.



PB.100 Kit complete with 760 contacts accepts up to ten 14-pin Dips, with two binding posts and sturdy base. Large capacity with Kit economy.

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TEST CLIPS			
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PC.16-18.			£ 7.56
PC. 16-18 Dual Clip.			£12.15
PROTO-BOARDS.			
PB. 6.	630	6	£11.01
PB. 100.	760	10	£13.82

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Car Test Probe

G. J. BEARMAN

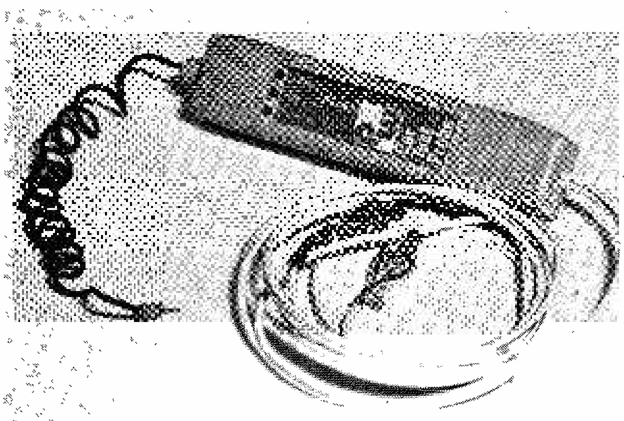
This useful project was designed as a piece of simple test gear to be carried around in the car for fault finding purposes. It can be constructed in various forms to suit the requirements of the user.

The first part of the probe consists of two l.e.d.s which are used to indicate the condition on any electrical connection in the car. With the probe unattached, both l.e.d.s come on to indicate a voltage level which is neither positive or negative. When the probe is applied to a connection with a definite voltage condition on it, the appropriate l.e.d. will light and the other will be extinguished.

Voltage Sensing

The second part of the probe consists of a voltage sensing circuit, using a 741 op. amp. to detect when the voltage across the car battery rises above 12·5 volts, giving a check that the battery is being charged.

It is quite easy to see how the two l.e.d.s D3 and D4 detect the voltage levels. They are connected in series with R4 and R5 as current limiting resistors. When the probe is connected either to a positive or negative voltage one or the other l.e.d. is effectively shorted out, to leave just the other one on.



The completed Car Test Probe ready for use. The label can be cut out from the next page and pasted on to the case

Comparator

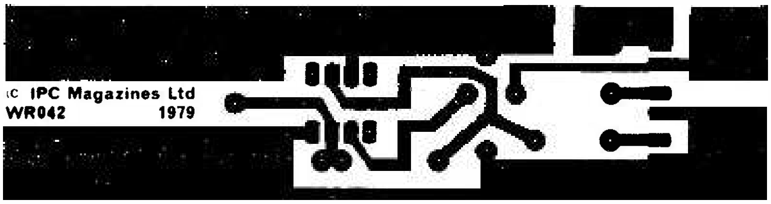
In the second part of the circuit, a 741 operational amplifier i.c. is used as a comparator, changing it's output state when the voltage on one input rises above the other input. A reference voltage is seen across zener diode D1, by the input on pin 3, and the preset is used to set the required voltage on pin 2. When the battery voltage drops, the voltage on pin 2 will drop below that on pin 3, causing the output to go high and lighting the l.e.d. marked "charging" (D2).

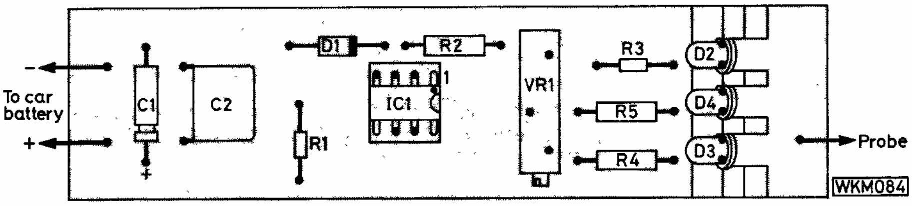
★ components

Resistors		
¼W 5% Carbon		
560Ω	2	R4, 5
2·7kΩ	1	R3
4·7kΩ	1	R1
1·8MΩ	1	R2
Potentiometers		
Cermet multiturn preset		
100kΩ	1	VR1
Capacitors		
Ceramic disc		
0·1μF	1	C2
Tantalum bead		
1μF 35V	1	C1
Semiconductors		
Diodes		
BZY88C6V2	1	D1
Min. l.e.d. red.	3	D2, 3, 4
Integrated circuits		
741 op. amp.	1	IC1

Miscellaneous

Printed circuit board (1), Probe case (West Hyde or Continental Specialities Corp.). Crocodile clips (3). Twin flex cable (1 metre). Extra flexible cable (1 metre). 8 pin d.i.l. socket (1).

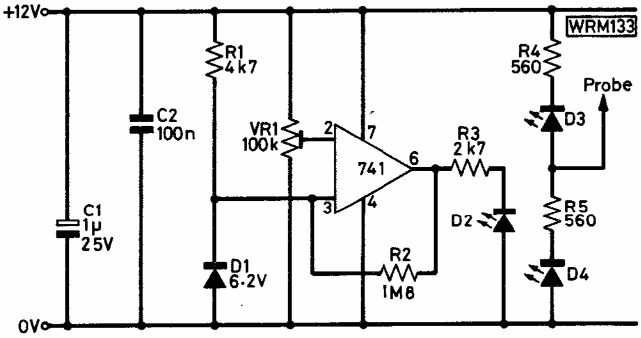


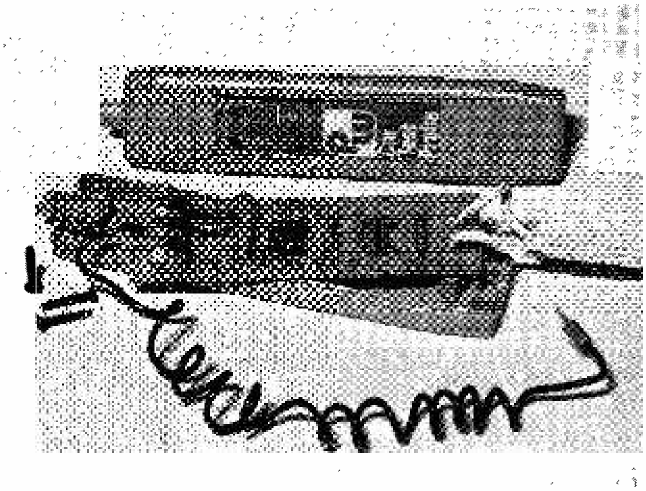


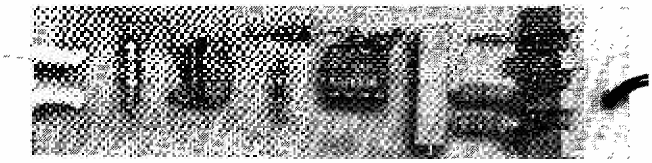
Construction

The probe is constructed on a small p.c.b. which is fitted into a plastic probe case made by Continental Specialities Corporation.

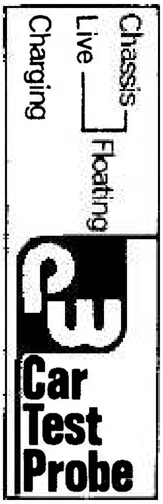
The p.c.b. carries all the components including the three l.e.d.s which are also located into holes in the case. Care must be taken to ensure that the l.e.d.s and the 741 op. amp. are fitted the correct way round. The small front panel can be cut out of the magazine and carefully stuck onto the recessed portion of the case to give easy identification of the state being sensed by the probe.







The printed circuit board copper track pattern is reproduced full size at the top of this page with the component placement drawing below it. The picture above shows the components mounted on to the p.c.b. and also shows the mounting of the three miniature l.e.d.s using the plastic 'bridge' provided with the case. Care must be taken to ensure that the l.e.d.s are correctly orientated. The 'bridge' can be glued to the p.c.b. using one of the rapid bonding adhesives taking care to get it in the correct position to allow the l.e.d.s to fit their holes in the case top. The circuit diagram is shown on the left with a view of the component parts of the probe below

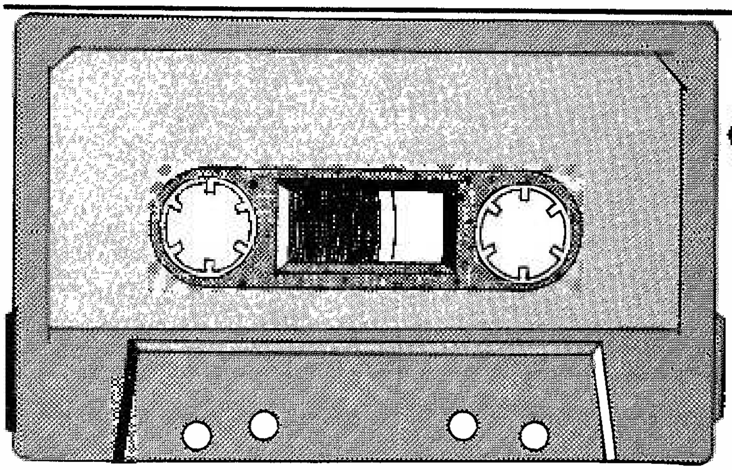


Testing

When the circuit has been built it is tested by firstly setting VR1 to mid travel, and connecting a variable supply and a voltmeter across C2. After switching on it should be found that at a voltage somewhere between 6 and 12 volts the l.e.d. comes on (or goes off). The pre-set is now adjusted so that the l.e.d. just goes out when the supply exceeds 12·5 volts.

Ignition Timing

The test probe can be kept in the car ready for use in case of electrical problems. It can also be used to detect the instant at which the contact breakers open, enabling accurate static ignition timing to be carried out. ●



THE CASSETTE TAPE MEDIUM

pause

Part 2

Gordon J. KING

Spectral Distortion Curves

The collection of curves in Fig. 5 compare the spectral distortion of the *Cr* Super with various other tapes when used in a number of good-quality domestic cassette decks, the curves being the average of the results obtained from a number of such decks.

The lines at the bottom of each graph refer to the noise floors of the tapes, about which more anon. All curves and noise floors in full-line refer to the *Cr* Super.

Graph (a) compares the Super with the Maxell UDXL II, showing that on average the latter yields about 3dB more sheer flux at the low and middle frequencies than the former, but the former having a slight advantage at upper-highs.

The Super at (b) shows almost as much flux at the low and middle frequencies as the recent formulation TDK SA, but less at middle-highs, though gaining, as at (a), at the upper-highs.

At (c) the distribution of BASF regular *Cr* is similar to the Super, but almost 2dB of extra flux is shown by the Super (note: with some machines a greater low- and middle-frequency flux can be achieved when the h.f. biasing can be advanced sufficiently high).

Graph (d) again compares the Super with the SA, but this time based on the average of a different batch of machines. Here there is very little difference between the fluxes over the spectrum, though the tendency of the Super just to take the lead at the upper-highs can be seen; but the differences are small, and on balance the SA would appear to rank the highest.

The Agfa Carat (an *FeCr* formulation) at (e) shows about the same flux at low and middle frequencies as the Super, less at middle-highs, but reaching the level of the Super again at upper-highs. The upper-middle "dip" of the Carat could possibly be attributable to the "partition" effect between the *Fe* and *Cr* layers. Nevertheless, the Carat is a happy tape and well liked by the author. Its noise floor is low—see later.

It must be appreciated that the machines on which the tapes were measured were switched only by the front controls to suit the equalisation and bias requirements. No internal adjustments were attempted in an endeavour to improve the performance of any formulation. In other words, the machines were operated as they would be by the average user.

As supplied, some machines favour certain tapes better than others. Details are given in the handbooks; but these are rarely up-to-date, and tapes not listed have sometimes been proved to perform better than some of those recommended! It might be possible to get better results with a particular formulation by rebiasing; but this generally necessitates internal adjustment, though there are decks equipped with external bias control and internal oscillators, allowing the bias to be set for the best overall frequency response as indicated by the VU meters (the Aiwa AD-6900, for example).

Effect of Bias

As the h.f. bias level is increased, so the distortion falls, and the low- and middle-frequency output rises. If the bias is further increased, the high-frequency output starts to fall, and the distortion may then start to rise a trifle. Further increase pulls back the middle- and then the low-frequency output. The noise is affected less, but there is a bias level where the noise tends to fall to its lowest level. One way of setting the bias is to adjust it first for the maximum 333Hz output, and then to increase it just a shade until the output drops by about 1dB.

Different tapes require different bias levels for the best results. Most ordinary *Fe* tapes require a fairly low level. *Cr* and pseudo-*Cr* formulations require about 50 per cent more, though there are some *Cr* tapes which, for the very best results, require more bias than the average deck is capable of providing. The *Cr* Super, for example, gives a significantly higher low-frequency output (to the 3 per cent distortion threshold) if the bias is increased about the basic *Cr* requirements. *FeCr* formulations require less bias than *Cr* (usually) but more than basic *Fe*. Many decks are equipped with three-position bias switching for basic *Fe*, *FeCr* and *Cr* tapes.

Equalisation

To achieve a "flat" frequency response on replay, the equalisation also has to be switched to suit the type of tape being used. As with f.m. pre- and de-emphasis and gramophone pick-up equalisation, the turnover and roll-off frequencies are indicated by time-constants (a sort of convenient shorthand). The l.f. time-constant is now 3180μs (corresponding to 50Hz turnover), while the upper-frequency time-constant is 120μs for basic *Fe* tapes and 70μs for *Cr*, pseudo-*Cr* and most *FeCr* formulations, corresponding respectively to turnovers of 1·32kHz and 2·27kHz. (Turnover in Hz $=1/2\pi T$, where T is the time-constant in seconds, and time-constant $= 1/2\pi f$, where f is the turnover frequency in Hz.) The equalisation is either separately switchable or ganged to the bias-change switching.

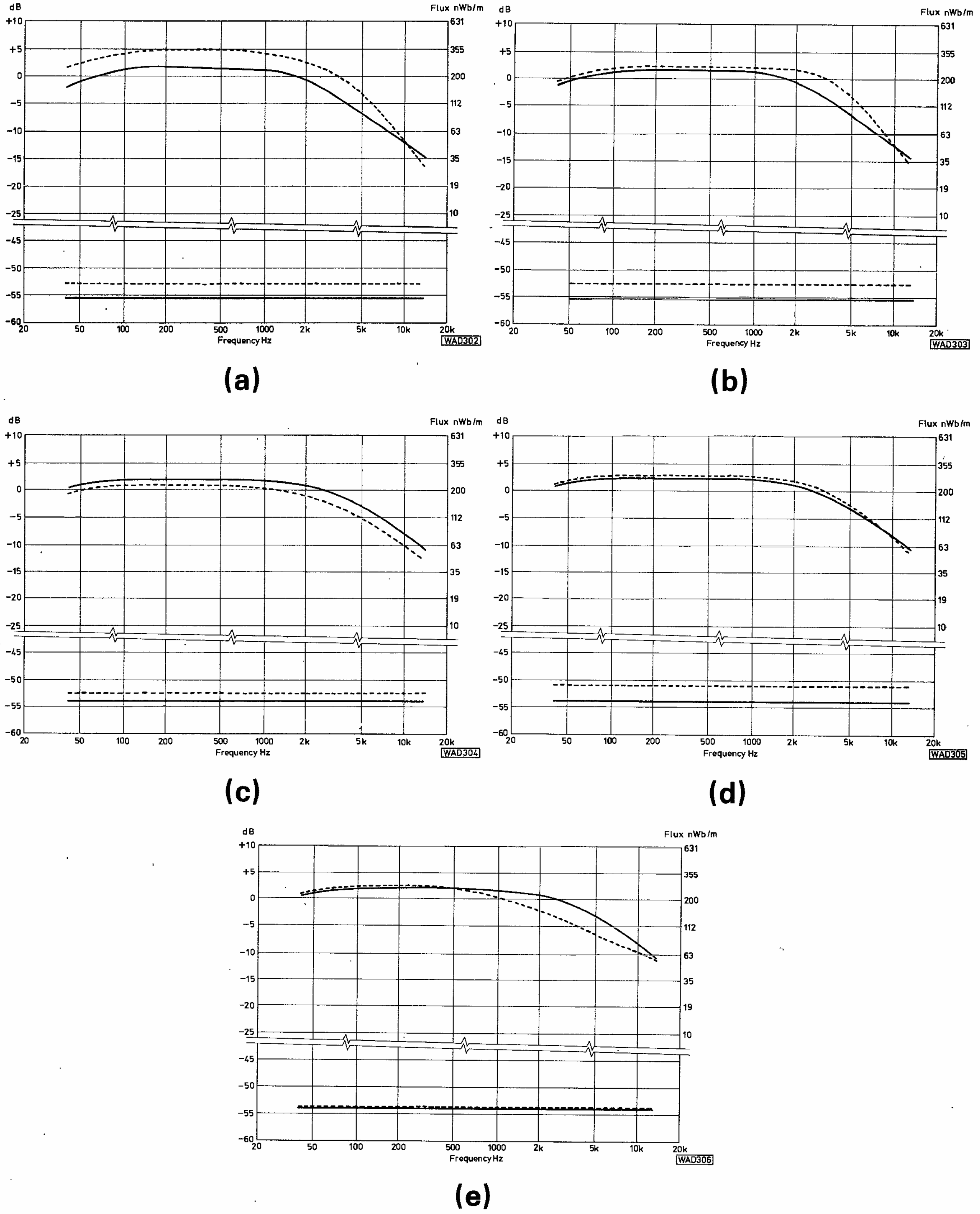


Fig. 5: Graphs comparing the output ref. 3 per cent distortion of the *Cr* Super with various other brands, the results being the average obtained from a number of machines. (a) Super versus Maxell UDXL II. (b) Super versus TDK SA. (c) Regular *Cr* in comparison with *Cr* Super. (d) Super versus TDK SA (using a different batch of machines than the comparison at (b). (e) Super versus Afga Carat. All curves in full line refer to the *Cr* Super. See text for more details

Head Problems

While a fine (short-length) gap is requred by the head for adequately defining (or reading) the short-wavelength, high-frequency signals recorded on the tape, a longer-length gap is better for recording. Where the head is shared between recording and replay a compromise has to be struck, which can give problems related to head saturation at high recording currents, often needed for some of the *Cr* and high-energy formulations. With the higher magnetic force required by such tapes the distortion resulting from head saturation can show up before the flux imparted to the tape has reached the level for 3 per cent distortion. An associated problem is overload of the recording amplifier; but this produces mostly 2nd-order distortion as distinct from the 3rd-order distortion produced by the head and tape. This is where Tandberg's "Actilinear" system gains.

Head saturation problems are less acute where the deck employs separate heads for recording and replay (called three-head machines, the third head, of course, being that for erasure which is often energised by the bias oscillator). Our lab has found that the *Cr* Super, for example, is limited in performance in some machines by head saturation problems (in addition to shortage of bias), the distortion at h.f. then being a function of the machine rather than the tape.

The physical gap of latter-day replay heads is approaching the low 1μm, which is astonishingly small, giving an effective gap length around 1·5μm as the result of flux spread. Such a gap can define frequencies well up to 20kHz. To avoid the compression showing up, the frequency response is measured at a recording level of, at least, 20dB below Dolby (approximately 20nWb/m). A plot shown by the broken line curve in Fig. 4 is then obtained when the biasing and equalisation suit the tape. A deliberate roll-off into a 19kHz notch is common to prevent the Dolby noise-reduction from being affected by 19kHz f.m. stereo pilot-tone signal when radio recordings are made. Too little bias will give upper-frequency lift, and too much bias the converse effect.

Noise Floor and Dynamic Range

The noise floors in the collection of graphs in Fig. 5 are referred to 0dB or 200nWb/m flux level. Excepting circuit noise, most tape noise stems from the technical make-up and parameters of the formulation. For low noise, small particle size and consistent needle shape anisotropy are the basic requirements. The change from 120 to 70μs equalisation yields a noise advantage of about 3·5dB, which is why the background "hiss" from *Cr*, pseudo-*Cr* and *FeCr* is less (when the equalisation is set to 70μs) than from basic *Fe* tapes running with 120μs equalisation. This point should be remembered when comparing noise floors.

The graphs reveal consistently that the *Cr* Super is a particularly low noise tape, several dB better than the comparative brands with the exception of the Carat. An expression of dynamic range is the dB distance between the 3 per cent distortion flux output and the noise floor. At (a) there is not much difference between the pair at low and middle frequencies, but the Super gains at h.f. At (b) the Super is undoubtedly the winner at most frequencies, with the mild exception of the middle-highs. At (c) there is little difference again. At (d) the Super is the outright winner once more. At (e) the Super is a fair challenger, with the Carat not quite making the same grade at middle-highs.

The noise was measured with an average-responding meter via CCIR weighting (e.g., CCIR/ARM), which is a network which emphasises certain frequencies of the noise while attenuating others as a means of obtaining a fair degree of subjective correlation (e.g., so that the annoyance effect of the noise is measured). The effective dynamic ranges are increased by almost another 10dB by the use of Dolby noise-reduction, which means that at the low and middle frequencies, at least, a dynamic range of around 65dB can be achieved with a contemporary tape deck using top-flight tape—a feat which a gramophone record playing system would have difficulty in exceeding!

If the outputs in the graphs were normalised at 0dB to the lowest output tape at low and middle frequencies, then different results would be obtained. It is our opinion that each tape should be exposed in terms of the sheer flux, that it can assimilate up to the 3 per cent distortion threshold, at the different frequencies when used with an "average" cassette deck. The actual level of signal recorded will be shown by the recording level meters; but it is noteworthy that on fast transients the peak of the actual signal arriving at the tape could be 10dB higher than indicated by the meters, owing to the inertia of the pointers. This is where peak-responding light-emitting diodes (l.e.d.s) can be highly advantageous. The dynamic range potential of any tape will only be realised, of course, when the flux is to the upper datum level corresponding to 3 per cent distortion in our graphs.

VU Meter References

Most meters (on Japanese machines, anyway) correspond to 200nWb/m at +3VU, putting 0VU at about 142nWb/m. Some European decks, geared to the DIN standards, have 0VU (or 0dB) corresponding to 250nWb/m, which places the Dolby 200nWb/m point at about −2VU (sometimes even below this). This means that by peaking to 0VU on music there is a greater probability of over-driving the tape on these machines than on the Japanese species.

Requirements

The main requirements of a cassette tape, therefore, are high remanence (and retentivity) for good sensitivity and l.f. output; high saturation for high recording levels reference a given level of distortion; high coercivity for the least self-demagnetisation and for a good h.f. output; and small and consistent particle size for low noise.

Great improvements have been made to cassette tapes over recent years. The current breakthrough is the pure iron particle tape (e.g., Scotch "Metafine"), which has a retentivity of 3400 gauss compared to 1400 for typical *Cr*; a remanence of 0·8 compared to 0·43 for typical *Cr*; and a coercivity of 1000 oersteds compared to 550 for typical *Cr*. These tapes will greatly elevate the performance of the cassette deck, putting it on par with reel-to-reel machines running at much higher tape speeds and using wider tracks. However, in general, the tapes will fail to yield their best on ordinary decks, owing to the need for a higher bias and recording current than most existing machines can provide. A great advantage of the tape is that the 12·5kHz saturation level is 7dB higher than good *Cr* at optimum bias levels. At 5kHz the output is still +4dB and only down to 0dB at 10kHz (based on our 200nWb/m/0dB scaling).

There is no doubt that good things are in store for the cassette enthusiast, and it is hoped that this article has helped to crystallise the scene a trifle. ●

IC OF THE MONTH 75

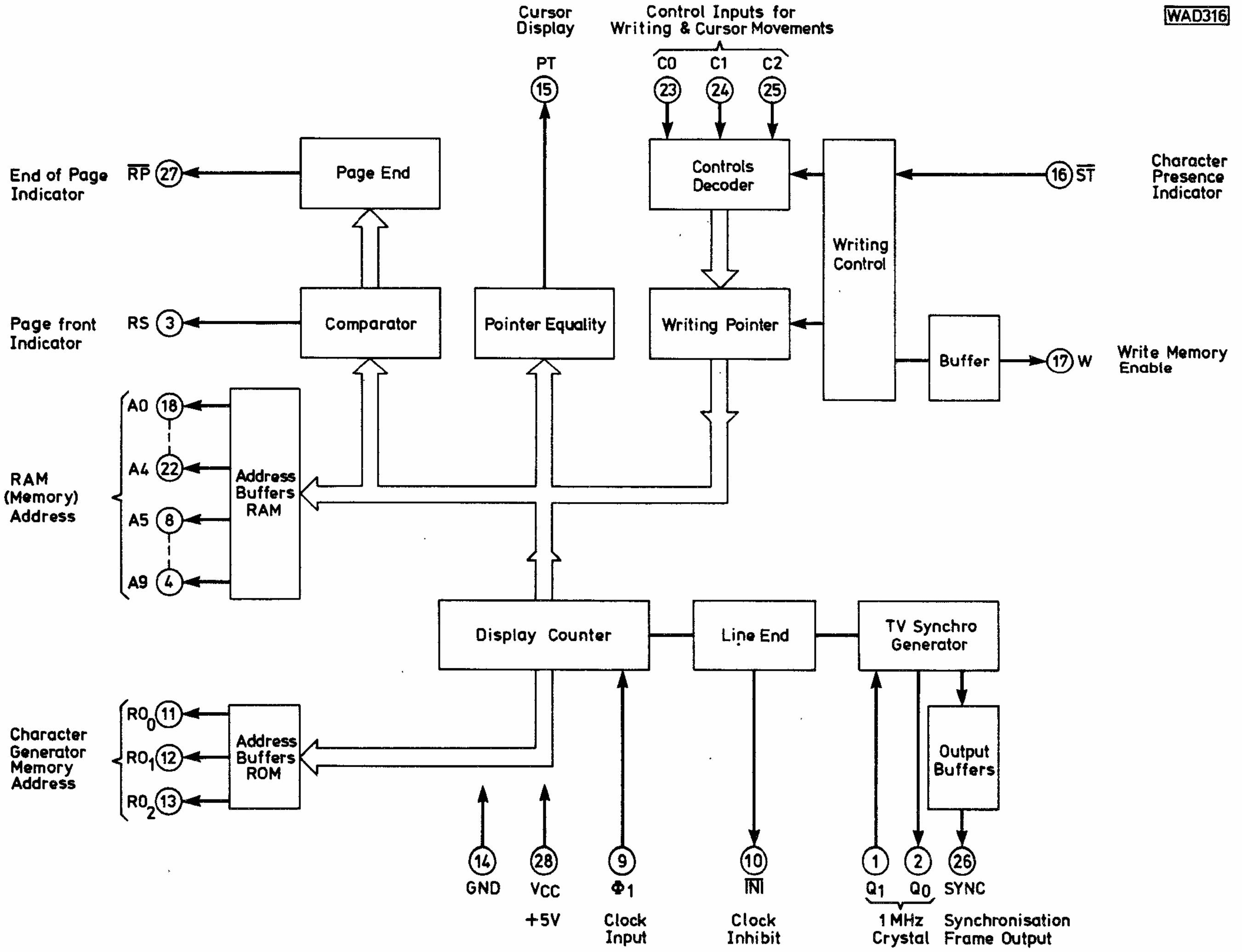
Brian DANCE M.Sc

THOMSON-CSF SF.F 96364

The new SF.F 96364 device from Thomson-CSF of France can be used in a circuit which will convert any television receiver into a visual display unit for use with a computing system or microprocessor. The display can consist of 16 lines of 64 characters per line and is very flexible. Special facilities such as line erasing make the device compatible with any computer or microprocessor system.

When using the SF.F 96364 device, one can link "pages" of the displays, vary the display size or cause the text to move up when an index reaches the end of a page. A cursor which flickers at about 2Hz and which can move in any of the four directions may be used to mark or to draw attention to a particular point in the display. Alternatively certain characters can be displayed with increased brilliance to draw the attention of the user to them.

Fig. 1: The internal circuit of the SF.F 96364 with external connections



Circuit Complexity

The devices covered in *IC of the Month* have usually been relatively simple and are suitable for use by less experienced constructors. However, it must be made absolutely clear that the SF.F 96364 device is highly complex and is intended for use in a relatively complicated circuit. The writer would strongly advise beginners not to start working with such a complex product as the SF.F 96364, but nevertheless the more experienced worker will find that this unique device is extremely powerful in its applications.

The SF.F 96364 itself performs the operations of text refreshment, character writing and cursor management. It must be employed with a 1024 six-bit word size (or greater) static or dynamic memory and a character generator which produces the individual characters (digits, letters of the alphabet, etc.) as a small array of 7 × 5 dots on the cathode ray tube screen.

Cost

The SF.F 96364 is supplied in a 28-pin dual-in-line package, but unfortunately is more expensive than other devices we have covered in these columns. The plastic encapsulated SF.F 96364E is currently priced at about £16·20, whilst the ceramic packaged SF.F 96364K is about £30·24 in small quantities. Both types contain the circuit shown in the block diagram of Fig. 1.

A special board using this device is manufactured under the type number SF.KEX 68364.1.0, which contains a complete display interface, but this board is priced at about £141. All of these prices are exclusive of VAT and packing and postage.

Readers are warned that the SF.F 96364 employs N-MOS silicon gate technology and the device can therefore be damaged by any stray electrostatic charges owing to its high impedance circuits. A well-earthed soldering iron is essential. The connecting pins of the device should be kept in conducting foam until one is ready to use it. Even whilst one is soldering it into a circuit, it is wise to join all pin connections together to prevent the possibility of damage.

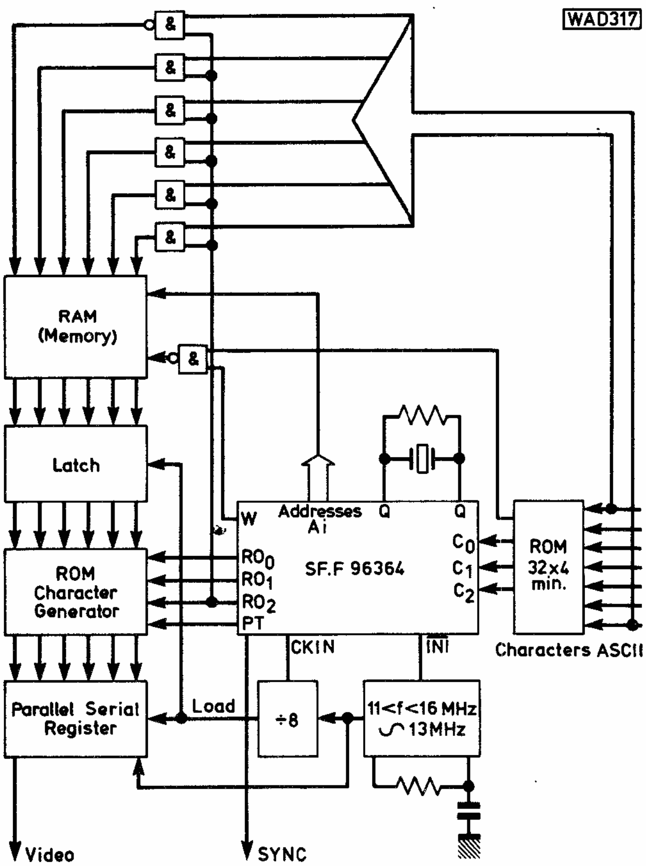


Fig. 2: A simple basic circuit in block form using the SF.F 96364

Table 1

ROM 71301 PROGRAMMING (Positive logic)

Address	O_3	O_2	O_1	O_0
0 at 127	1	0	0	0
128 at 135	0	0	1	1
136	0	1	0	0
137	0	1	1	1
138	1	0	1	0
139	0	1	1	0
140	1	0	0	0
141	1	0	0	1
142 at 153	0	0	1	1
154	1	1	0	1
155	0	0	1	0
156	0	0	0	0
157	0	0	0	1
158, 159	0	0	1	1
160 at 254	1	1	1	1
255	0	0	1	1

Table 2

PROGRAMMED FUNCTIONS FIG. 2

Cursor movement	Key	Codes (Hexadecimal)
Cursor left	CNTRL H	08
Cursor right	CNTRL I	09
Cursor down	CNTRL J	0A
Cursor up	CNTRL K	0B
Page clear and home cursor	CNTRL L	0C
Carriage return and end line erasure	CNTRL M	0D
Erasure of current line	CNTRL Z	1A
Line feed	SHIFT CNTRL K	1B
Home cursor	SHIFT CNTRL L	1C
Carriage return	SHIFT CNTRL M	1D

Other codes are either displayable characters or disable symbols

Voltages

The power supply required by the SF.F 96364 is a nominal 5V between pin 28 (V^+) and pin 14 (ground). This voltage should be stabilised at between the recommended limits of 4·75V and 5·25V. Damage may occur inside the device if the voltage at pin 28 or at any other pin exceeds the absolute maximum of +7V or falls below –0·3V relative to that at pin 14. The typical power supply current is only 50mA (60mA at 0°C).

The input voltages must have a minimum value of 2·2V except for the clock voltage at pin 9 where a minimum of 3·5V is required. The SF.F 96364 is readily compatible with TTL circuitry.

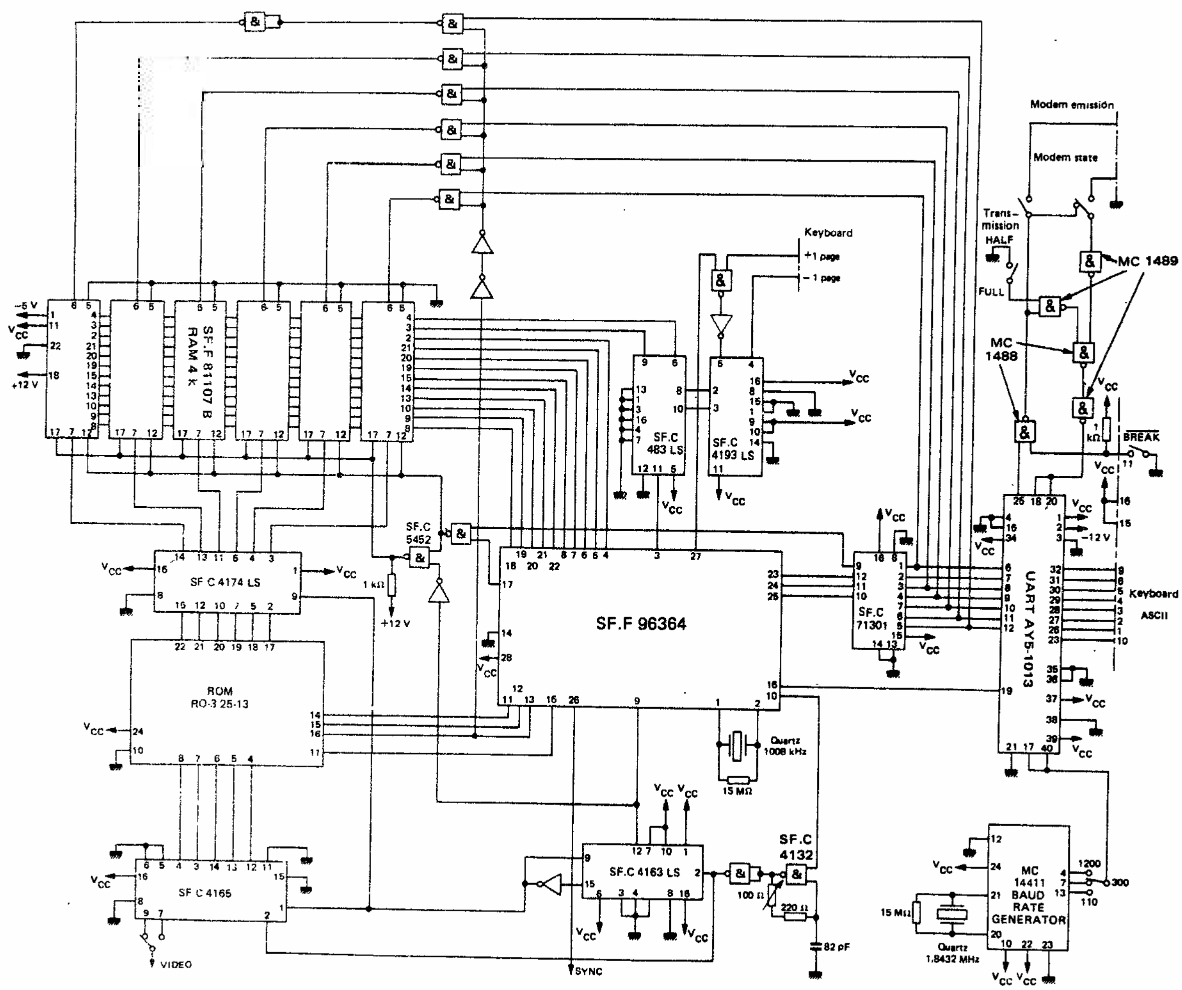


Fig. 3: A circuit for displaying pages which automatically move upwards

A 1·008MHz crystal in parallel with a resistor of a few megohms should be connected between pins 1 and 2 to provide a stable basic frequency for the internal television raster frequency generator. The normal 50 frames per second frequency can be employed to prevent beat frequencies being generated by interaction with the mains frequency. A chip control clock input frequency quite close to 1·6MHz must also be fed to pin 9 of the device.

Access times to the memories are of the order of 200ns.

Simple Circuit

The block diagram of Fig. 2 shows one of the simplest possible circuits for an alpha-numerical terminal providing 64 characters per line on a 16 line page format. (Alpha-numerical displays can show both letters of the alphabet and digits and are much more useful in computing than a purely digital display.)

The control clock frequency used in the SF.F 96364 circuit sets the width of each character and hence the width of each page. A Thomson-CSF ROM (read-only-memory) Type SF.C 71301 may be programmed as shown in Table 1 to provide the special functions to Table 2 using the "ASCII" code. (ASC is asynchronous serial transmission.)

Linking 4 Pages

The circuit shown in Fig. 3 may be used for linking up to 4 pages of displays. A full keyboard using the ASCII coding can be employed to provide a full set of characters. The displayed text and/or digits can be made to continuously move upwards when using this circuit.

Module

The SF.KEX 68364 I-O module can be employed in a system such as that depicted in Fig. 4 to provide a relatively economical computer terminal with a full keyboard system when using an ordinary 625-line television receiver. It can be used with a microprocessor or a computer and may be connected to a telephone line using a suitable modem. The dimensions of the SF.KEX 68364 I-O display module board itself are about 132 × 210mm (or about 144 × 210mm including the connecting strip).

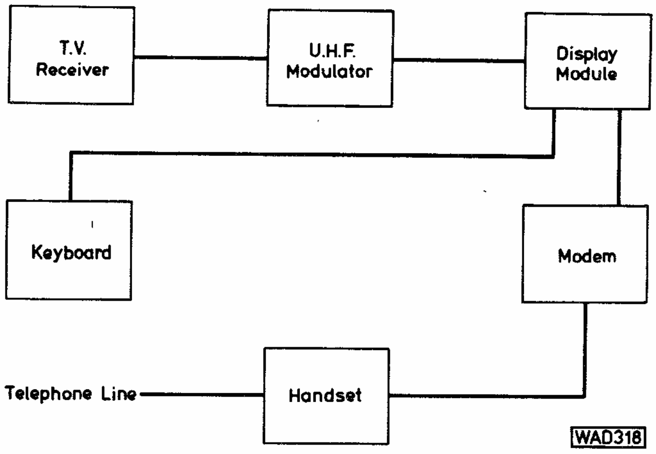


Fig. 4: A system using the SF.KEX 68364 I-O display module

The output of the display module may be connected directly to the video input of any television receiver having such an input. Alternatively the output from the module may be fed to a u.h.f. modulator (as indicated in Fig. 4) and the resulting u.h.f. signal from the modulator can be fed to the aerial input socket of the television receiver.

The SF.KEX 68364 board requires supplies of +5V, 1A; +12V, 100mA and −12V, 100mA. This board provides a very wide range of facilities, including 64 different characters (capitals, digits and special characters, but not small letters). The display can be white on black or black on white, with winking cursor, etc. It can be arranged that the display moves upwards when the 16th line is written.

It can be seen from the circuit of Fig. 5 that the module employs the SF.F 96364 device with various other integrated circuits. Although the circuitry is necessarily complex when compared with many of the circuits with which we are familiar, it is relatively simple for such a complex application. One can even use a light pen with suitable SF.F 96364 circuits for marking positions on a display.

The device is available from Phoenix Electronics Ltd., 139 Havant Road, Drayton, Portsmouth PO6 2AA, at £17·50 including VAT.

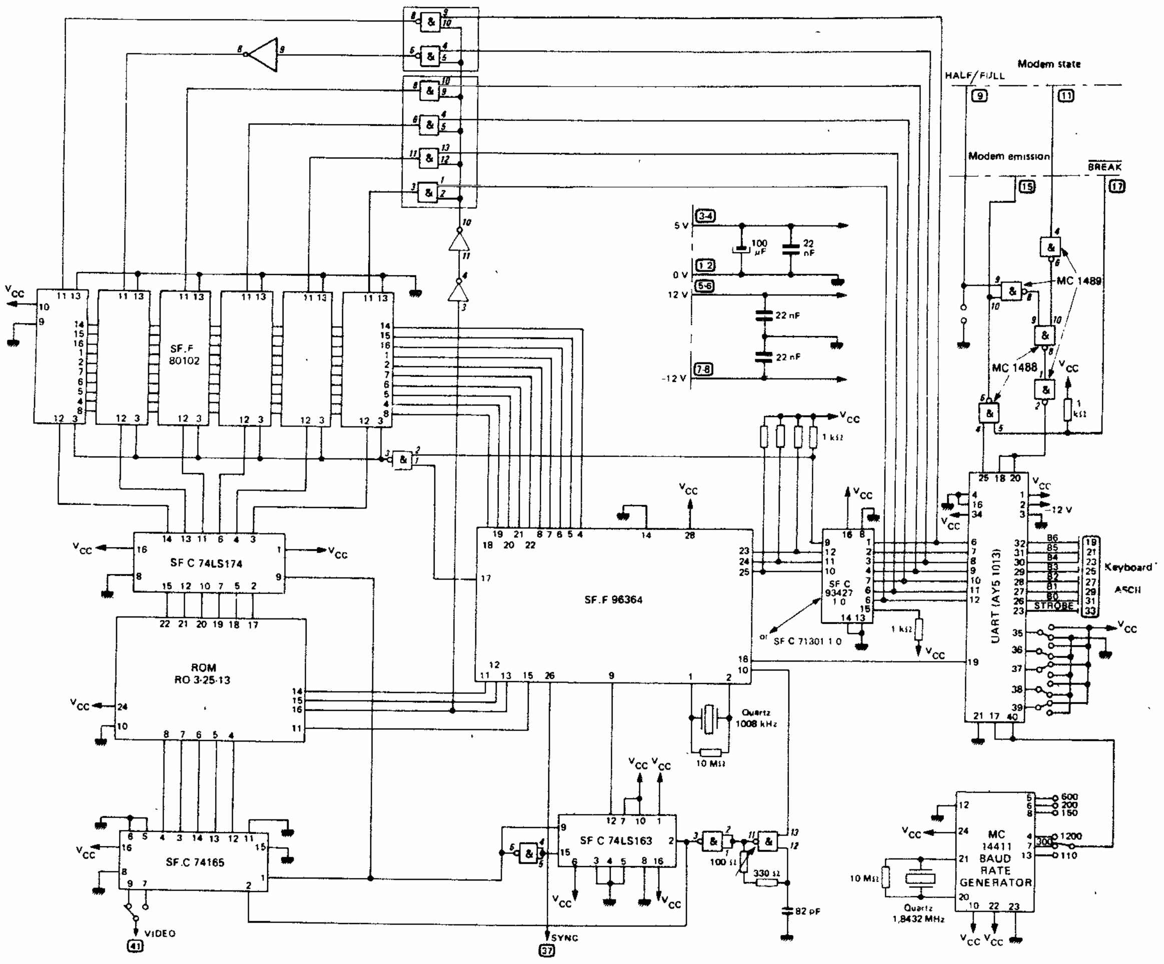


Fig. 5: The internal circuit of the module

VSWR problems at VHF

Fred JUDD G2BCX

Voltage Standing Wave Ratio (v.s.w.r.) is a subject frequently discussed by radio amateurs but somehow it rarely seems to be fully understood. Is a low v.s.w.r. really important and if so what is the maximum ratio tolerable? Often that 1:1 reading, technically a perfect match, may be quite misleading, for reasons which we will consider later in the text.

Many factors determine the loss of radiated power between transmitter and aerial, including poor insulation, non-resonance, aerial too close to others or even the choice of metal from which the aerial is made. Two areas often overlooked are the feeder cable (where inferior construction will cause problems) and the possibility of a mismatch between transmitter and feeder, feeder and aerial, or a combination of all these parameters. All r.f. feeders, such as open lines, exhibit a degree of loss, coaxial cables usually producing the worst effects. This, together with varying degrees of v.s.w.r. often gives rise to ambiguity when determining the effect of the v.s.w.r. itself.

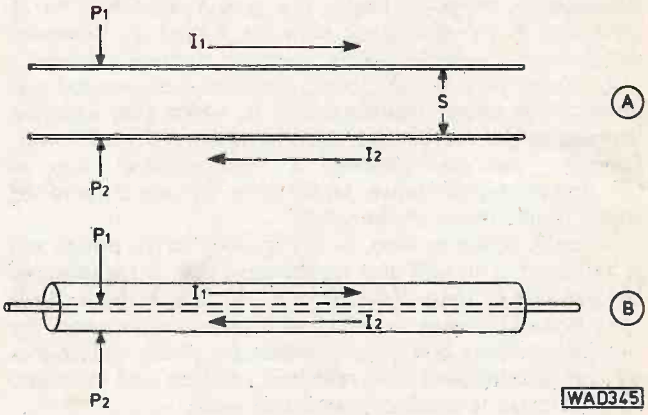


Fig. 1: Configuration of commonly used transmission lines. (A) open wire (B) coaxial. See text for explanation with regard to currents I_1, I_2

Matching

Virtually any cable that carries power from "A" to "B" could be regarded as a transmission line: a pair of wires for instance, from a battery to a lamp. Considering this example further, it will be appreciated that as the length of the "transmission line" increases so does its resistance, and in consequence the lamp grows progressively dimmer.

A similar principle can be applied to the cable connecting a transmitter to an aerial but in this case the source of energy would be high frequency, and not d.c. Therefore the inductive and capacitive properties of the feeder combine to produce an impedance to the transfer of power. This is referred to as the characteristic impedance of the cable, and it remains almost constant, virtually irrespective of frequency.

Purely resistive losses cannot be completely disregarded of course but steps can be taken to prevent radiation loss. If the characteristic impedance of the line equals both the source and load impedance then two conductors can be employed, close enough together for their respective electro-magnetic fields to cancel out.

Transmission lines favoured by amateurs are open line, which consists of two parallel conductors spaced a small fraction of a wavelength apart, and coaxial cable, in which one conductor is effectively shielded by the other whilst electrically behaving as an open two-wire line. The concept is shown in Fig. 1 in which the currents I_1 and I_2 are flowing. If the current I_1 at any point (P_1) along the line has the same amplitude as current I_2 at the opposite point (P_2) the fields thus produced will be equal in amplitude but, as they are moving in different directions, out of phase. This will not necessarily be 180°, so in some instances there may be a small amount of radiation, although for practical purposes it can be disregarded. Certain conditions can exist which will cause an appreciable difference in the phasing of the two line currents however, and in such circumstances far more radiation can take place.

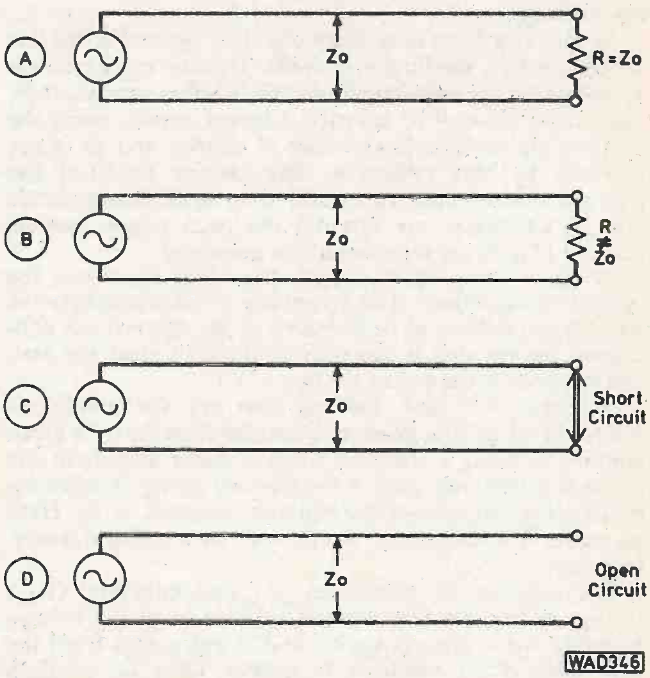


Fig. 2: (A) Line matched to load, R = Z_0. (B) Line partially matched, R greater or smaller than Z_0. (C) and (D) Line with short or open-circuit. See text

Consider Fig. 2(a). Here we have connected one end of a transmission line to a generator of equal impedance, the other being terminated in the purely resistive load R, which has the same ohmic value as the line impedance Z_0. Under these conditions any current travelling down the line will flow into the resistance, which presents itself as an extension of the line. Since a pure resistance has no inductive or capacitive reactance, the line will be perfectly matched and none of the power (I^2Z_0) will be returned to the generator. An infinitely long transmission line would exhibit the same characteristics provided its impedance remained constant, although the power would ultimately be absorbed in overcoming the resistance of the line itself, of course.

Now turn to Fig. 2(b). The resistance of load R does not equal the line impedance in value, and so the power not dissipated is reflected back. The power absorbed by R decreases as the difference between R and Z_0 increases and so under these conditions a greater mis-match exists.

To make the position clearer, the term *incident power* is given to the power transferred to R, whilst that which is returned to the source is referred to as the *reflected power*. Therefore we can produce a mathematical ratio of reflected to incident power which gives an indication of the degree of mis-match in the circuit.

When R becomes zero, as in Fig. 2(c), all the power will be reflected. This will also be the case if R is regarded as an open circuit (Fig. 2(d)). Power will flow in both directions however when a mis-match does occur, and the reflected portion will be dependent on phase differences between the incident and reflected voltages and currents. These interact to produce a *standing wave.*

Standing Waves

The diagrams of Fig. 3 serve to illustrate how standing waves are formed when varying degrees of mis-match are encountered.

In Fig. 3(a) there is an open circuit at the end of the line which prevents the flow of current. The current waveform at this point has zero amplitude and in effect cancels itself, due to the reversal of polarity. Current travels along the line, but the voltage is across it of course, and so is not reversed by this reflection. The electric fields of the forward and reflected waves add up to twice the amplitude and if line losses are ignored the total power can be thought of as being returned to the generator.

When R is a short circuit, Fig. 3(b) illustrates the prevailing conditions. The amplitude of the standing wave pattern can be seen to be the same as for open circuit conditions, except that it has moved along to meet the zero voltage state at the end of the line.

In Figs. 3(c) and 3(d) we can see the conditions produced when R is greater or smaller than Z_0 by a given amount, creating a standing wave of lesser amplitude due to the fact that only part of the forward power is reflected. Finally, Fig. 3(e) shows the situation where $R = Z_0$. Here no power is reflected and the line carries a uniform travelling wave.

The ratio of the maximum (V_{max}) to minimum (V_{min}) voltage of the standing wave is referred to as the *voltage standing wave ratio* (v.s.w.r.) and is calculated from the expression $R:Z_0$ when R is greater than Z_0 or $Z_0:R$ when R is the lesser quantity.

The perfect match, rarely achieved in practice, would have a v.s.w.r. of 1:1. When a mis-match exists, this ratio becomes much larger until, with an obsolute open or short circuit it becomes infinite. Such a situation should be avoided, especially in the case of transistorised apparatus, where high levels of reflected power will almost certainly result in damage unless some form of protection is provided.

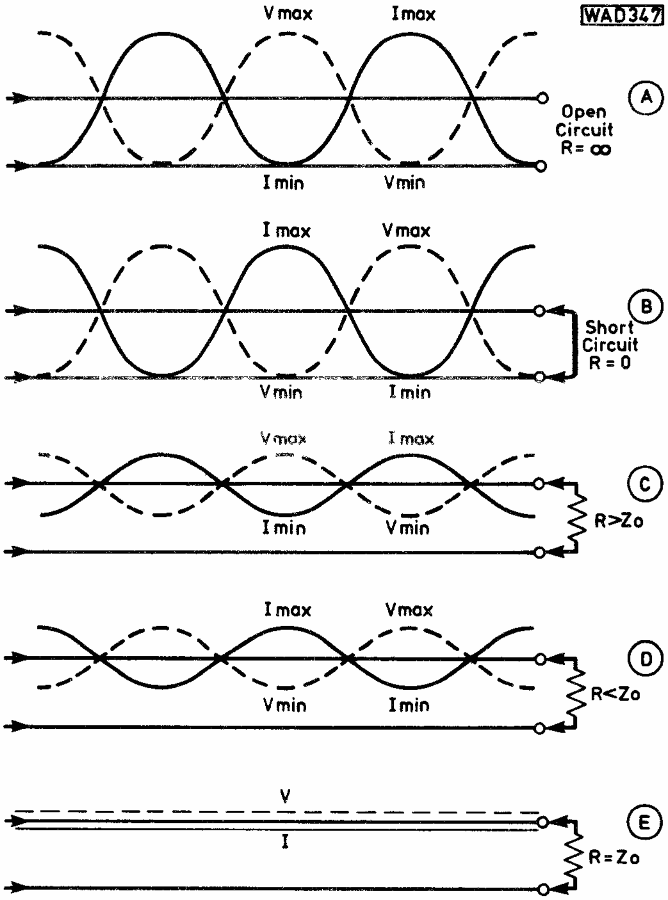


Fig. 3: (A, B, C, D) Voltage and current distribution of standing wave due to mismatch. (E) Line matched: V and I become a travelling wave

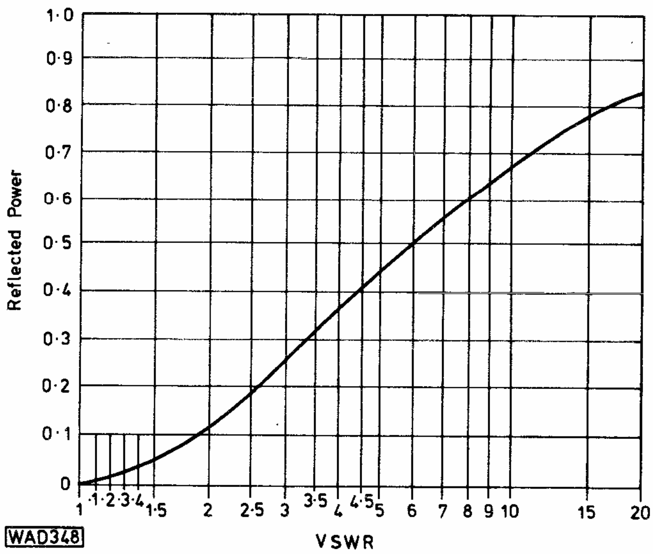


Fig. 4: Reflected power plotted against v.s.w.r. (see text)

The Effects of VSWR

Possibly the loss of power to an aerial due to standing waves on the transmission line may not be as serious as many are led to believe. Provided the line is of low-loss construction the attenuation due to a v.s.w.r. of, say, 2:1 may only be around 0·5dB.

The graph in Fig. 4 shows the percentage of returned power (lost to the aerial) for varying values of v.s.w.r. Some slight discrepancy may occur which must be attributed to the natural losses of the transmission line, and this will affect both forward and reflected power readings. For example, the dotted line in Fig. 5 shows that for a measured v.s.w.r. of 2:1 and a line loss of 3dB along the total length, the true v.s.w.r. is about 5:1, representing a considerable additional loss due to reflected power. This clearly demonstrates the need to use low-loss transmission line.

One should really aim for a v.s.w.r. of less than 1·5:1, especially if the total cable loss is likely to be greater than about 2dB. With around 30m of cable having an attenuation of 2·5dB the additional losses due to a measured v.s.w.r. of 1·5:1 will be less than 1·0dB.

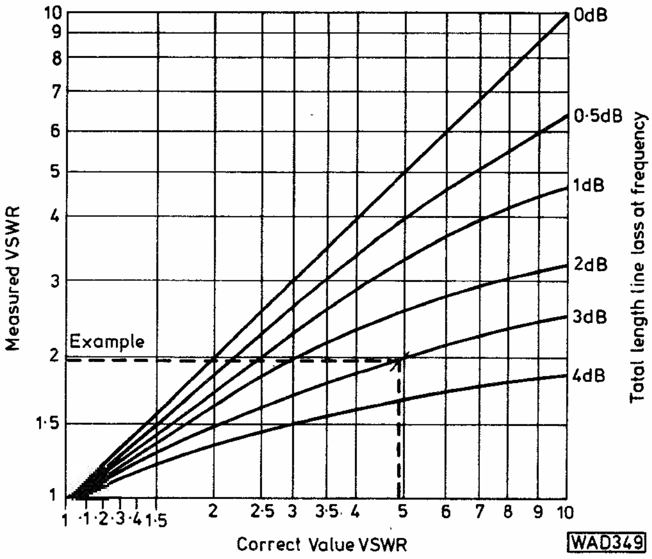


Fig. 5: True v.s.w.r. is dependent on transmission line loss (see text)

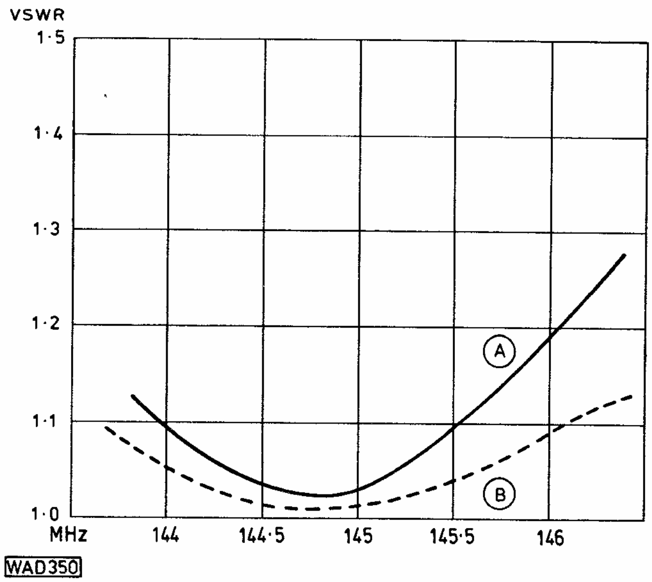


Fig. 6: Typical v.s.w.r. (A) From a well matched line and aerial. (B) Curve flattened due to line loss

When line losses are high, the additional loss caused by standing waves tends to be constant: the amount of power reflected from the aerial is reduced in proportion to the overall attenuation in the feeder. As an example, if the line loss is 6dB only 25 per cent of the applied power will actually reach the aerial. Should the v.s.w.r. at the aerial be 4:1, due to a mis-match, then 36 per cent of the power applied to it would in fact be reflected. However, we have already established that only 25 per cent of the original power has reached the aerial, so the true reflected power is:

$$0{\cdot}25 \times 0{\cdot}36 = 0{\cdot}09\ (9\%)$$

The transmission line characteristics further reduce this by 6dB, so we have

$$0{\cdot}09 \times 0{\cdot}25 = 0{\cdot}02\ (2\%)$$

This represents the actual power arriving back at the transmitter, and would result in a low v.s.w.r. reading at the transmitter end of the feeder—in this case, something like 1·3:1.

On the other hand, with a very low-loss line, a high v.s.w.r. may cause a higher power loss, although the total may be relatively small by comparison with that actually reaching the aerial. A v.s.w.r. of 10:1 (True) on a line having a loss of only 0·3dB would result in an additional loss of about 2dB.

Low v.s.w.r. readings do not necessarily indicate a "Go" situation, and should be closely examined if transmission line losses have not been taken into account. For example, with a 15m length of UR43 coaxial cable having a true v.s.w.r. of 2:1, the reading obtained could be as low as 1·1:1. With old or otherwise inferior coaxial cable exhibiting high loss, virtually no reading at all could occur. On the surface of it, this would suggest a v.s.w.r. of 1:1.

A typical v.s.w.r. readout for a well-matched aerial covering the 145MHz band is given in Fig. 6. With above-average line losses, the response could easily be represented by the dotted curve.

The relationship between transmission line loss and v.s.w.r. can be demonstrated in an alternative way, based on a method of assessing losses in coaxial cable by measuring the v.s.w.r. when the cable is terminated in a short-circuit. *This technique should never be employed when transistorised r.f. power amplifiers are used, incidentally.*

From Example A in Fig. 7 it can be seen that a v.s.w.r. of 1·5:1 would indicate a cable loss of 6-7dB for the total length. This is because the forward power is attenuated in the first instance, and consequently there is a reduction in the quantity of power reflected, which itself is attenuated and results in a low v.s.w.r. reading.

Example B on the same drawing shows that the cable loss is much lower, and the high v.s.w.r. of 4:1 indicates that most of the power travelling along the cable is also reflected. The attenuation of the cable is only a little over 2dB, so this serves to qualify our preceding conclusions.

Ideally, power and v.s.w.r. measurements should be made both at the transmitter and at the aerial, otherwise erroneous readings could be obtained due to other considerations, such as the length of the line in relation to the frequency being used. If the reflected voltage happens to be at or near a minimum at the transmitter end, then low v.s.w.r. figures could be obtained. By the same rule, it is often possible to reduce an otherwise high v.s.w.r. by pruning a short length off the transmission line—or, indeed, by adding to it. This will not effect a cure as such however: it does not remove a standing wave that results from a mismatch.

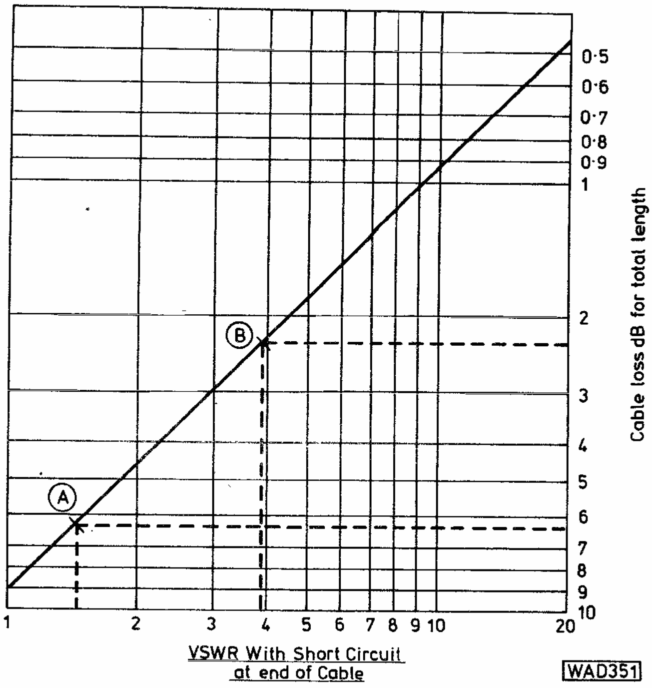


Fig. 7: Attenuation loss in dB for a given length of cable by reading v.s.w.r. into short-circuit termination. See text regarding application of this test

Use of VSWR and Power Meters

Really accurate v.s.w.r. and power meters suitable for v.h.f. applications tend to be on the expensive side, although the model marketed by *Telecommunications Associates* may be considered reasonable. The type of power meter fitted to amateur transmitters and transceivers can rarely be relied on for accuracy. In fact, occasionally some instruments can actually introduce a problem due to poor matching with the feed cable. So also can external r.f. power amplifiers, which incidentally should never be in circuit when first testing an aerial for a match.

Obviously low grade meters should be checked against a known standard and with a dummy load known to provide an accurate match with the transmitter output. In this way a v.s.w.r. approaching 1:1 should be obtained and full output power indicated if the meter is provided with this facility.

Testing a New Aerial

Initially a new aerial should be tested with only a short feeder, to establish that a good v.s.w.r. is possible. A preliminary check with a receiver is also worthwhile, if only to ensure that the aerial is giving some sort of results before applying r.f. power.

Start the tests with fairly low power levels, if possible. This will prevent damage to the transmitter p.a. stage if a serious problem should arise.

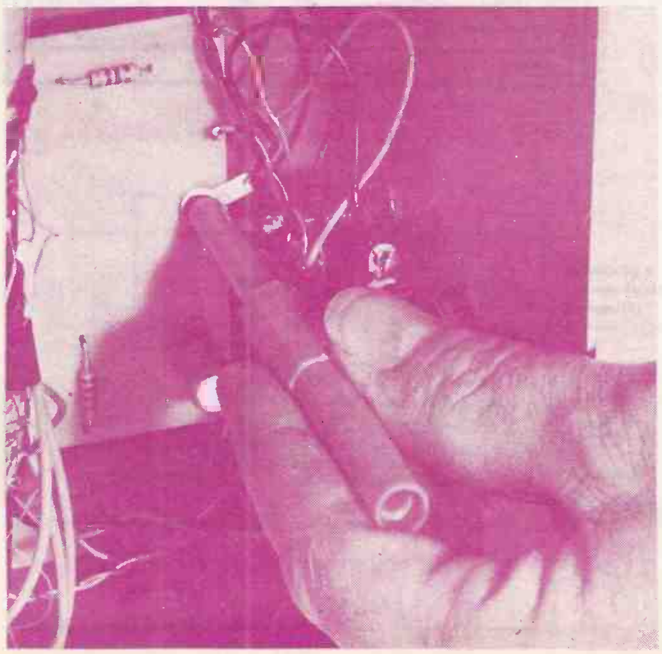
When the aerial is proved, the full length of feeder should be fitted and maximum power applied.

One of the most simple and effective methods of checking for the presence of r.f. alongside an aerial is a small fluorescent tube, of the type often used in caravans. These are usually rated at about 6 watts, and when touched against a *voltage* point on an aerial to which a 10 watt transmitter is attached, should light almost to full brilliance. ●

OK! SO WHAT IS A NUT RUNNER?

Well, it rather comes into the category of "How ever did I manage before I had one of those?"

Traditional methods of getting nuts safely onto screws and studs in inaccessible places include: snipe-nosed pliers; forceps; box-spanners; Sellotape or Plasticine on the end of a pencil or other stick. These can be more or less successful, depending upon the situation. A short length of thick-wall polythene tubing is another method, but since such tubing comes in coils, it naturally isn't straight, and trying to get the nut square-on to the threads can be pretty frustrating!



The Nut Runner in use on our cover subject this month, the PW "Imp"

A nut runner is a purpose-made plastics tube, which has the advantage of being straight, with ends recessed to fit nuts of a given size.

The *PW* Nut Runner, free with every issue this month, is coloured bright orange to help you find it in your tool-box or on the work-bench, and has an eight-sided centre section to stop it rolling away into dark corners. The ends are designed to fit 4BA and 6BA nuts, or any with different threads but similar overall dimensions. Sorry it's only two sizes, but a tube only has two ends!

Using the nut runner is simple, and fairly obvious. There is only one point to make about it really, and that is that the plastics material is fairly soft, so that it can grip the nut, and it won't stand up to too much ill-treatment. Use a box- or socket-spanner to tighten up the nut in the usual way, once you have "started" it on the thread.

The nut runner is also useful for removing nuts safely from threads, in those situations where it is all too easy to drop them into the innards of a piece of equipment. In this case, remember to slacken the nut first with a spanner.

We hope you'll find lots of uses for your *PW* Nut Runner, not only on electronic equipment, but also on the car and on appliances around the house.

Follow-up to PW Gillingham

D.S.COUTTS

1kHz Readout on Medium Wave

It is possible to modify the unit to operate on frequencies up to 2999kHz with 1kHz Readout as follows:

1. Remove IC3 and discard.
2. Link IC3 pin 1 to C on p.c.b.
3. Link B to D on p.c.b.
4. Cut track linking IC4 pin 1 to 0 volts and link IC4 pin 1 to +5 volts.
5. Cut track linking IC4 pin 25 to +5 volts and link IC4 pin 25 to 0 volts.
6. For 460kHz i.f. retain AY–5–8100 for IC4.
7. For 455kHz i.f. use AY–5–8102 for IC4.
8. Remove R23 (decimal point drive).
9. The bottom digit does not read.

The AY–5–8102 is a plug-in replacement for the AY–5–8100 but is specifically designed for a 455kHz i.f. To use the 8102 in the original unit on the s.w. bands:

1. Remove link between pins 2, 3 and 6, 7 of IC3 and link IC3 pins 6 and 7 to 0 volts.
2. Link A to C and B to D on p.c. board.

Use With 1·62MHz i.f.

The original unit can be modified for a 1·62MHz i.f. by the addition of three c.m.o.s. i.c.s. This assumes the receiver has a tunable first local oscillator on the high side of the incoming frequency.

The circuit diagram for the add-on circuitry is shown in Fig. 1. It can be seen that there are five connections between the main p.c.b. and the add-on unit, two power connections (+5V and 0V) and three signal leads.

To modify the unit:

1. Ensure that there are no links on points A, B, C and D on the main p.c.b.
2. Remove link on main p.c.b. between IC3 pins 2, 3 and 6, 7 and link IC3 pins 6, 7 to 0 volts.
3. Build up the add-on unit (see Figs. 2 and 3). As the i.c.s used for the modification are all c.m.o.s. it is advisable to use sockets for them. Double check the wiring and mount the unit on the main p.c.b. using plastic stand-off pillars and self-tapping screws.
4. Connect the two boards together with five wires as shown in Fig. 1.

Circuit Description

Operation of the add-on unit is relatively straightforward. It is required to gate out extra counts to adjust the offset to 1·62MHz. The reset from IC1 pin 12 resets ICs A and B, their outputs go low and ICC pin 2 is

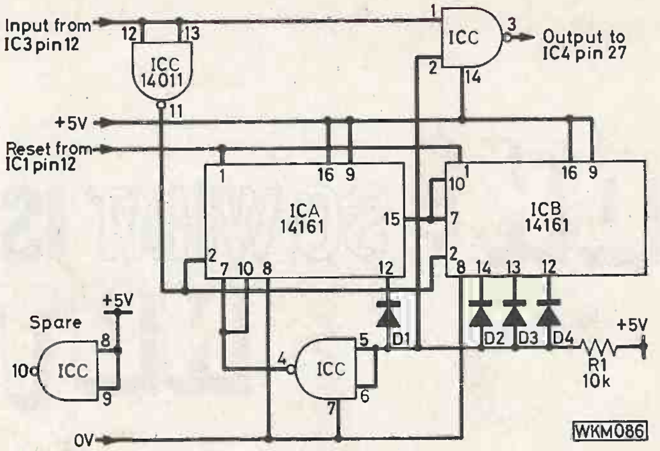


Fig. 1: Circuit of add-on unit for 1·62MHz i.f.

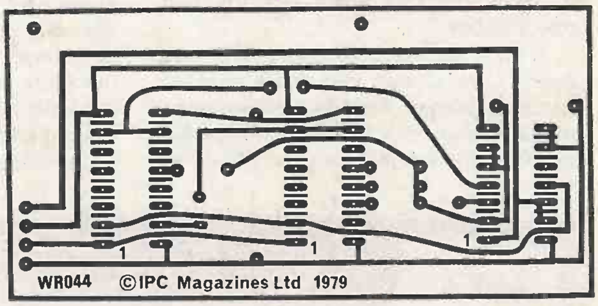


Fig. 2: Full-size track pattern of add-on p.c.b.

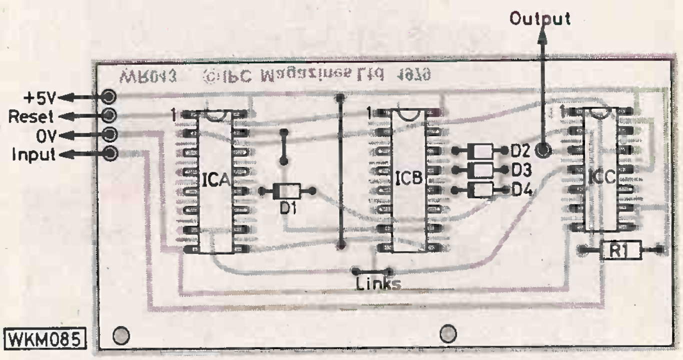


Fig. 3: Component layout and off-board connections

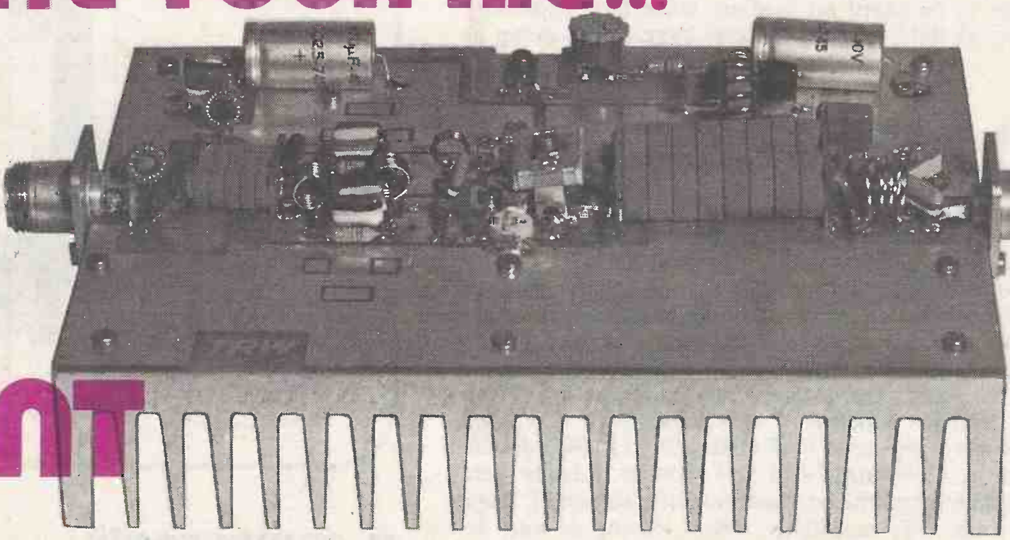
continued on page 61

NEXT MONTH IN...

practical WIRELESS

ON SALE 4TH. MAY

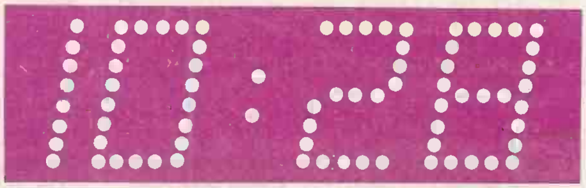
UPRATE YOUR RIG... with the PW TRENT



A 150W solid-state s.s.b. linear amplifier for 2–30MHz, employing the latest broadband technology. This professionally-designed module can be constructed from readily-available European components and requires an input of only 1·5W for full output. The power source is 13·5V d.c. — ideal for mobile applications or for increasing the power output of other small transmitters

ALSO

JUMBO WALL CLOCK



With our Jumbo Wall clock in your kitchen you will know exactly when you should have had your dinner. This unique project uses one i.c. and a host of l.e.d.s for the display to give you the time in 65mm high digits

PASSIVE 10:1 DIVIDER PROBE

This simple, but effective, probe unit has been designed especially for use with the PW Purbeck oscilloscope. It is easily built and will enhance the use of your scope when measuring those interesting waveforms

This construction project is designed for the beginner who wants to build and use his own three waveband receiver, but who doesn't feel experienced enough to tackle a superhet, with i.f.s to align and tuned circuits with padders and trimmers to adjust. This simple transistor set will receive plenty of stations on all three wavebands, once you've picked up the knack of using the reaction control. For this reason it was felt not only worthwhile but essential to incorporate a good slow motion drive, with a pointer and logging scale. Without it, you won't be able to tune your receiver to listen out again for that rare DX (long distance) short-wave station you heard last night.

The article includes a few reminiscences which may interest the old timer and a little theoretical background for the student or the curious. But if all this is beyond you, never mind, just have fun making up the set and then even more fun using it!

For simplicity and long battery life, the set uses headphones. For any serious DX use, you must use 'phones in any case, and don't forget that DX is not confined to the short waves. There are stations from other continents to be heard on medium wave also, especially after most of the European stations have closed down at night.

How the Set Developed

When I was a lad, I was always one for building bigger and better radios. From a very nice early '20s crystal set (alas I no longer have it) given to me by my grandmother, I progressed to a one valver. This used an HL2 battery triode with 2V filament and with the aid of reaction provided both better sensitivity and selectivity than the crystal set. It was succeeded by two and three valve "straight" sets—0V1 and 0V2 we called them in those days—and many others. Eventually came the great leap forward, a mains superhet! 3 wavebands with a Wearite coil pack and a line up of 6K8 mixer, 6K7 i.f., 6Q7 double doide triode, 6V6 output and 5Z4 rectifier. Results were fair to middling and the later addition of a second i.f. stage increased the set's sensitivity whilst leaving it with an intermittent tendency to instability.

More Valves

Other sets followed, including a valve portable with a IR5, IT4, IS5, 3S4 line-up (later revalved with 25mA heater valves of the DK96 series) leading on to transistor portables, etc. But one of the most successful sets of all in terms of results versus complexity was on 0V1 using 0·3A heater valves with UX6 pin bases, salvaged from various pensioned-off prewar imported American radio sets I was given. It had a "77" pentode as leaky grid detector with reaction, a "43" output pentode (if memory serves me well) and the type number of the rectifier escapes me completely.

The whole set was contained in a box made of hardboard, about 5½ inches square by 7 inches high, which with a 5 inch round speaker didn't leave much room. So the heaters were fed from a "line cord" and the reaction control mounted in the middle of the speaker grille! The set covered medium wave only and used a short whip aerial as there were no ferrite rods in those days.

The surprising feature was the great sensitivity and selectivity given by this simple line-up, as long as careful use was made of the reaction control. This was because the reaction could be advanced to the point where the detector was right on the verge of oscillating, but not quite. On tuning off to either side, the circuit would slide gently into oscillation, as evidenced by the appearance of a beat

THE PW IMP 3-Waveband Receiver

COVER PROJECT

★ components

Resistors
¼W 5%

10Ω	1	R8
100Ω	1	R4
330Ω	1	R1
680Ω	1	R7
1kΩ	1	R6
8·2kΩ	4	R2, 3, 9, 10
100kΩ	1	R5

Inductors
Denco Transistor Tuning Coil, Range 3, Blue. L1
Denco Ferrite Rod Aerial MW/LW 5FR. L2A, B
Output transformer 1·2kΩ c.t. to 3·2Ω (LT 700)

Miscellaneous
4p.3w. "Wavechange" rotary switch (1). Stereo jack socket 0·25in (1). Verocase Type 1 (205 x 110 x 140mm) (75–1412K). Slow motion drive unit dual ratio 36:1 and 6:1 with dial Type 4103 (124 x 96mm) (1). 4mm sockets Yellow (1) Green (1). Telescopic aerial. Printed circuit board, "P" clips 10mm dia. (2). Pillars 6BA internal thread 12·7mm long (4). Knobs (2). Nuts, bolts and washers as required. Aluminium sheet 20 s.w.g. 80 x 120mm.

Semico
Transisto
BC10
BC21

Potenti
4·7kΩ

Capacit
Polystyre
220pF
470pF
1200p

Ceramic
100p
1nF
22nF
0·1µF

Electroly
50µF
100µF

Variable
365pF

THE

PW IMP

3-Waveband Receiver

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Ian HICKMAN

★ components

Resistors
¼W 5%

10Ω	1	R8
100Ω	1	R4
330Ω	1	R1
680Ω	1	R7
1kΩ	1	R6
8·2kΩ	4	R2, 3, 9, 10
100kΩ	1	R5

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Semiconductors
Transistors

BC109B	3	Tr1, 2, 3
BC214	1	Tr4

Potentiometers

4·7kΩ (Lin.)	1	VR1 (with switch)

Capacitors
Polystyrene

220pF	1	C4
470pF	2	C1, 2
1200pF	1	C3

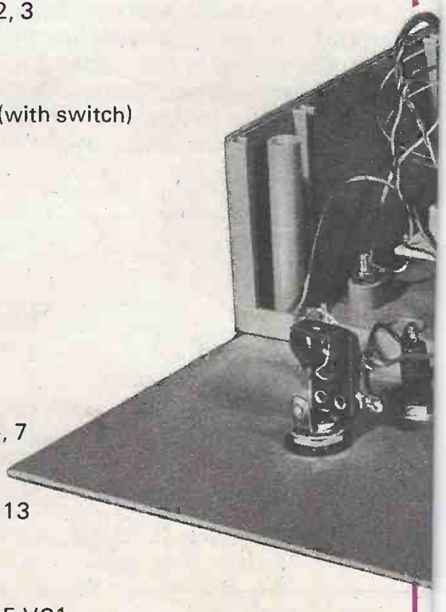
Ceramic

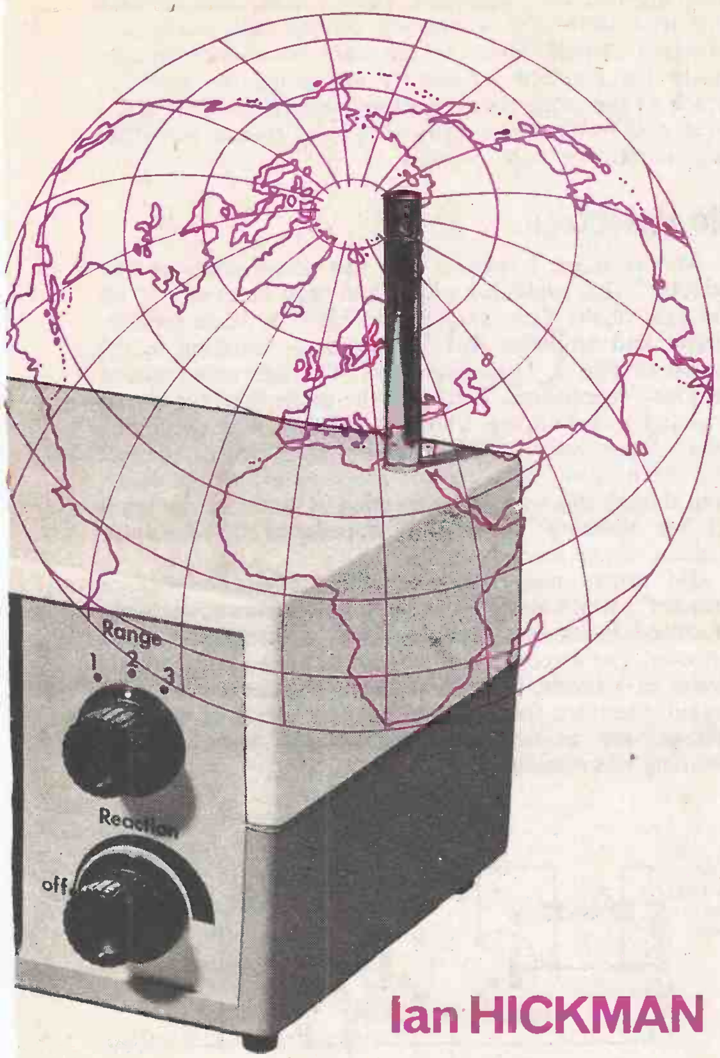
100pF	1	C8
1nF	1	C9
22nF	1	C10
0·1µF	3	C5, 6, 7

Electrolytic (p.c.b. type)

50µF 10V	2	C12, 13
100µF 10V	1	C11

Variable
365pF single gang Jackson 0–1–365 VC1





Ian HICKMAN

note with the received carrier, but on tune the damping due to the received signal prevented oscillation. If the reaction was advanced further, the circuit would oscillate, but phase locked to the incoming carrier—homodyne reception. Application of even more reaction would then actually reduce sensitivity as the received signal was capable of exerting less and less influence on the oscillating circuit.

Reaction Backlash

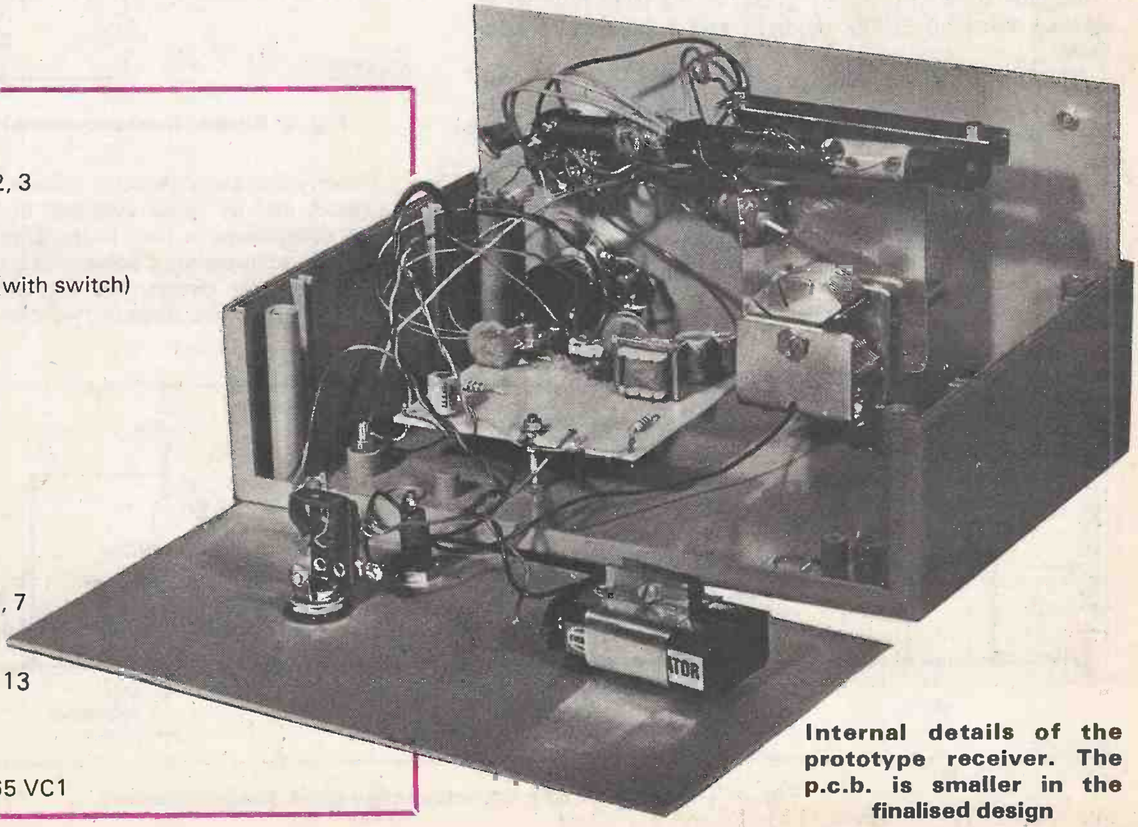
Many times since, I have tried to obtain comparable sensitivity from a transistor set with a single tuned circuit. Always the same snag—reaction backlash—has appeared to a greater or lesser extent. On winding up the reaction to increase gain, the circuit plops into oscillation and won't stop until the control has been wound so far back that there is then no benefit at all.

We have radios enough at home and don't need another, especially one with a reaction control, but the problem posed an intellectual challenge which just had to be accepted. So over the Christmas holiday, while the rest of the family was recovering from a surfeit of seasonal fare, I crept away to my laboratory.

It soon became evident that with reaction applied to a single transistor stage with any of the conventional bias stabilisation schemes, once the circuit commenced to oscillate the net gain would rise, as the collector current rises more on one half cycle than it falls on the other.

This is a consequence of basic transistor theory, which states that the transconductance "gm" is directly proportional to collector current. Therefore, the amplitude rapidly builds up and the transistor biases itself back towards Class C. When the reaction is reduced to the point where oscillation ceases, the transistor is left in a lower gain condition until the base coupling or emitter by-pass capacitor discharges to its normal potential.

ıductors		
rs		
9B	3	Tr1, 2, 3
4	1	Tr4
ometers		
(Lin.)	1	VR1 (with switch)
ors		
ene		
:	1	C4
:	2	C1, 2
F	1	C3
	1	C8
	1	C9
	1	C10
	3	C5, 6, 7
ic (p.c.b. type)		
0V	2	C12, 13
10V	1	C11
single gang Jackson 0–1–365 VC1		



Internal details of the prototype receiver. The p.c.b. is smaller in the finalised design

Long-tailed Pair

The obvious step was to change to a circuit configuration in which the gain does not rise with increasing input. Such a circuit is the long-tailed pair shown in Fig. 1. Note that the input must provide a d.c. connection, otherwise Tr1 will not conduct. When acting as a small-signal amplifier, the "tail" current provided by R2 will (ideally) divide equally between Tr1 and Tr2.

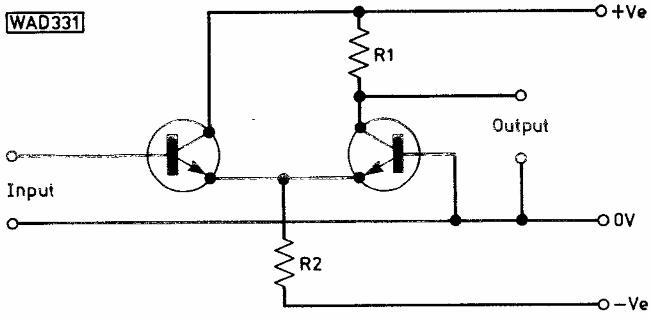


Fig. 1: Basic long-tailed pair circuit

When driven by a large signal, the current (and hence the transconductance) of one transistor rises, and that of the other falls. Consequently the gain is at a maximum for small signals. This circuit was arranged as a m.w. receiver as in Fig. 2. Reaction was applied through a small fixed capacitor, the amount depending on the setting of potentiometer, which was used in place of R1 in Fig. 1. (The arrow across the wiper indicates clockwise direction of rotation.) A couple of r.f. decoupling capacitors were fitted across the supplies as good standard practice. An output was taken from Tr2 collector (via a 15kΩ resistor to avoid r.f. loading) to a laboratory amplifier or "squawk box", an apt name when the reaction is turned up too far!

Results were surprisingly good, with a large number of stations received during daylight and a host more after dark.

There was still, however, a slight tendency to backlash on the reaction control and this made it difficult to receive the weakest stations. Tr1 and Tr2 had not been selected for equal base emitter voltage and it was therefore likely that there was an offset between them resulting in the tail current not dividing equally. Once oscillation commenced, would the voltage swing at Tr1 base, being large compared to the offset, result in a rise in gain and hence backlash? This was indeed proved to be the case by providing separate tail resistors for each transistor and coupling them together via a capacitor. The d.c. conditions for each transistor were now completely defined individually and backlash virtually absent. Weak stations could be brought up to the required volume by advancing the reaction, which at the same time, increased selectivity. Only if the weak station were very close to a local station was there any interference from the latter.

No Detector!

At this stage, I realised that the circuit contained no detector! This explained why it had been necessary to set the gain of the Lab. amplifier so high. A diode detector circuit and amplifier was incorporated, resulting in the circuit of Fig. 3. Disappointment! Considerable reaction backlash reappeared. Evidently the diode detector circuit imposed less damping when the receiver was oscillating than when it wasn't. This would not be helped by the fact that the BC214's base current was supplied via the diode, even though this was only a fraction of a microamp, but it set me thinking about high impedance detectors for minimal circuit loading.

Old timers may remember the "infinite impedance detector", which despite the slight exaggeration, certainly produced much less damping than a thermionic diode detector. The detection was performed by the grid/cathode circuit of a triode, the cathode being bypassed at r.f. The output therefore followed the positive crests of the grid voltage, but as negligible grid current flowed, circuit damping was minimal.

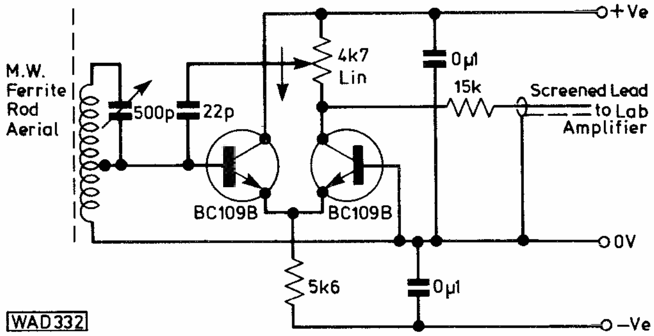


Fig. 2: Simple medium-wave receiver circuit

Exactly the same detector circuit works a treat with a transistor and by direct coupling to Tr2 collector we can save a component or two. In the final circuit of Fig. 4, Tr3 is the infinite impedance detector, rectification occurring in the base/emitter circuit, but with nearly all the rectified current being drawn from the positive rail rather than Tr2.

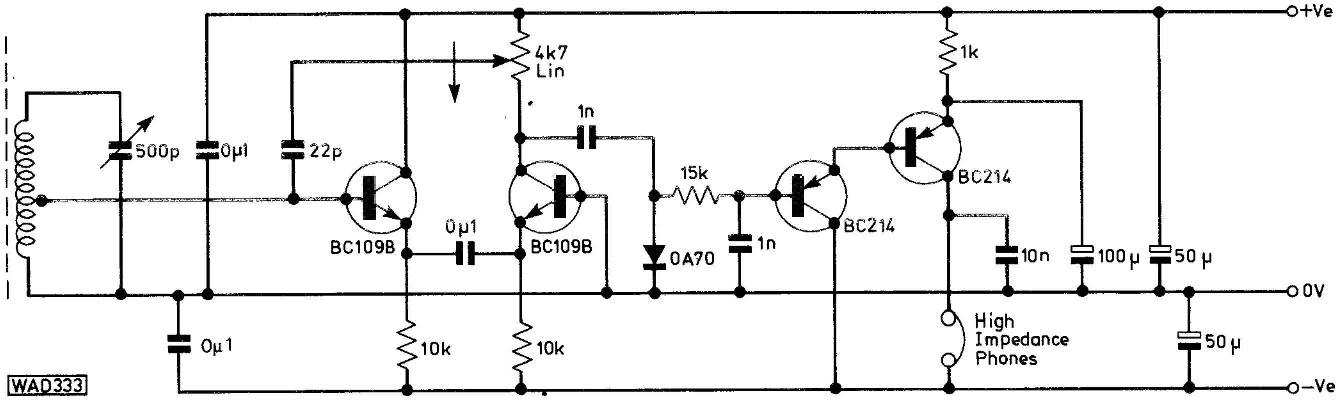


Fig. 3: The addition of a detector stage gave disappointment

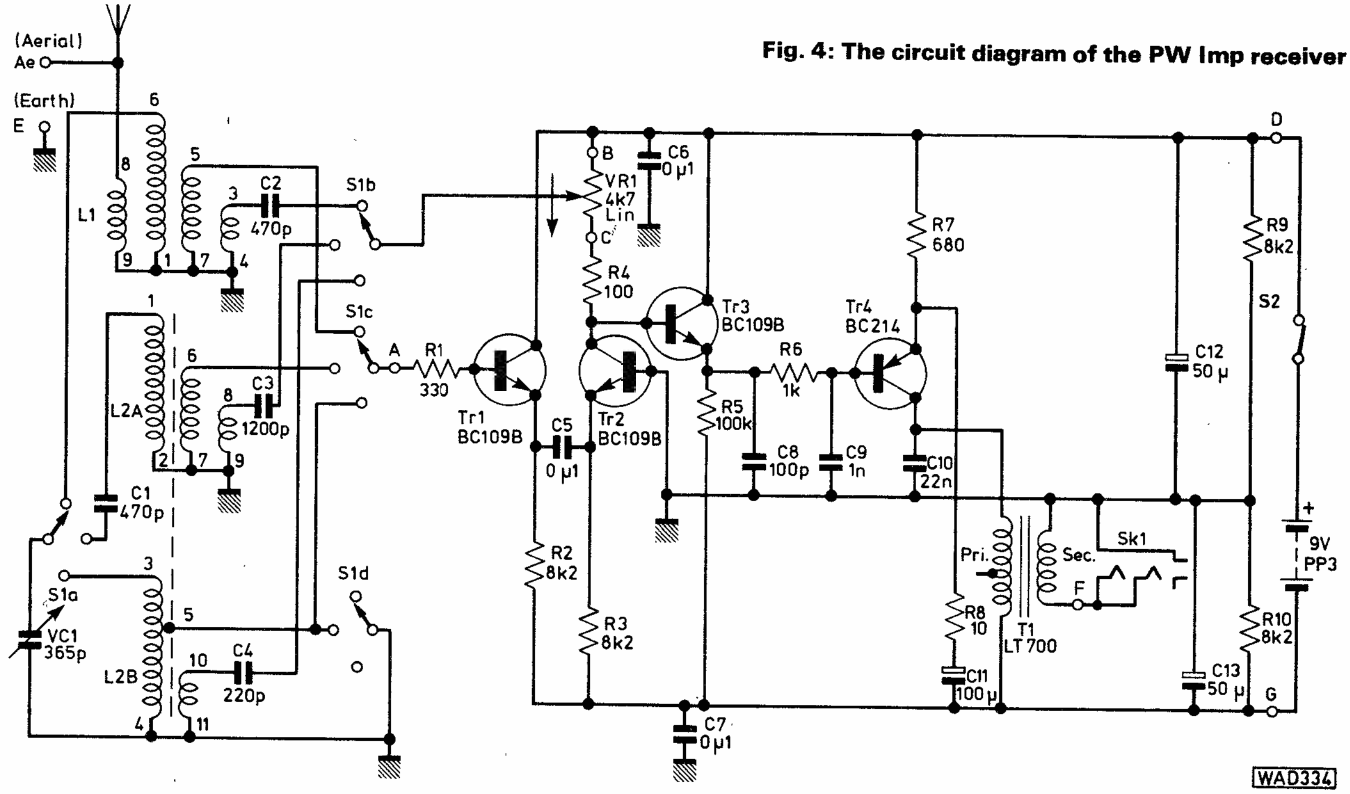


Fig. 4: The circuit diagram of the PW Imp receiver

A little negative feed back has been introduced into the emitter circuit of the output stage Tr4 to reduce the background hiss and minimise distortion at maximum volume. The circuit is designed for low impedance headphones such as the Author's very comfortable stereo headphones bought at a Boot's store, so a matching transformer is included. If high impedance 'phones (usually about 2kΩ impedance, though the resistance is lower than this) are used, T1 should be omitted, the phones being connected between Tr4 collector and the negative rail.

Construction

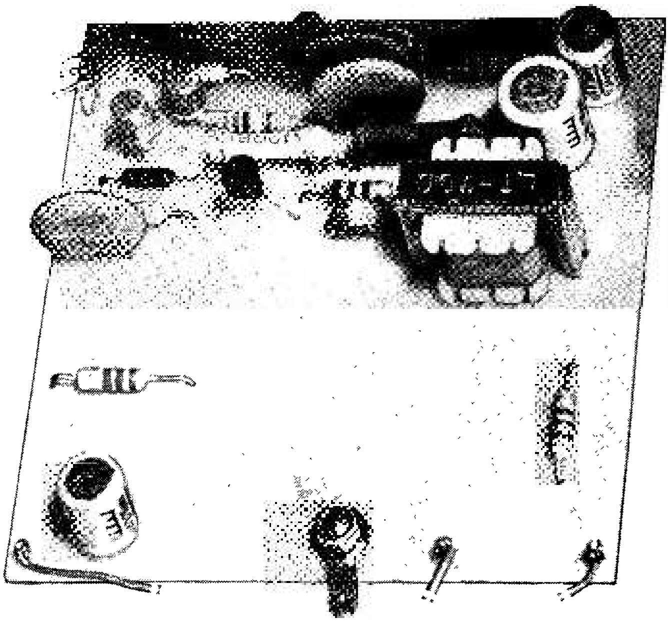
The set was built in a plastic Verocase with metal front and back panels. The slow motion dial frame needs about 1mm filed off of the top and bottom edges to allow it to fit between the top and bottom edges. Use the aluminium plate supplied with the dial to mark out the front panel for the drive mechanism.

It is recommended that the circuit be constructed on the printed circuit board shown and that metalwork dimensions and wiring layout be as in the diagrams and photographs.

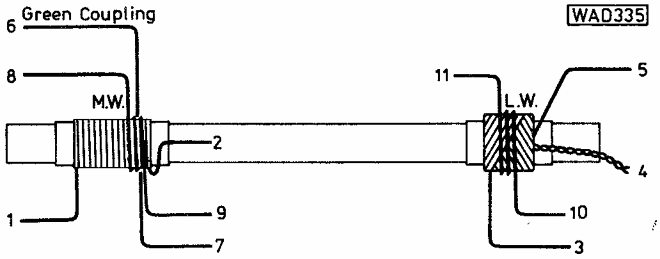
The p.c.b. is mounted on pillars screwed to the bottom of the case, while the telescopic aerial uses a 4BA screw in the case bottom locked into place with a nut, under which is the solder tag for the aerial connection. A hole in the top of the case, exactly over the 4BA bolt, holds the aerial in a vertical position.

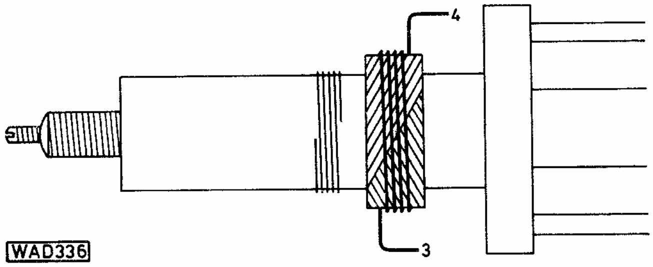
Winding his own coils is the easiest way for the beginner to go wrong, so the well-known Denco range have been used. These are however not designed with receivers using reaction in mind, so additional windings have to be added, as in Fig. 6. On long- and medium-wave bands, a ferrite rod aerial is used and is connected differently from the circuit supplied by Denco. On short wave a Denco transistor coil, Range 3, Blue, is used, with a telescopic aerial and provision for an external aerial and earth. Fig. 4 shows the circuit diagram, Fig. 7 shows the printed circuit board layout, copper side, and Fig. 8 shows the component layout.

When complete, double check all the wiring, set S1 to l.w., VR1 fully anticlockwise and plug-in low impedance headphones and a PP3 battery. With the tuning capacitor about half in mesh Radio 2 should be heard and turning up the reaction control VR1, which also does duty as a volume control, should increase the volume. If turned up too far, the circuit will oscillate, resulting in a whistle or beat note if the set is not exactly on tune. Check the m.w. and s.w. ranges also, noting that the position of the reaction control for best results will be quite different on the three wavebands. Indeed, the position will vary somewhat over any given band.



The prototype p.c.b. The final version is only half this size

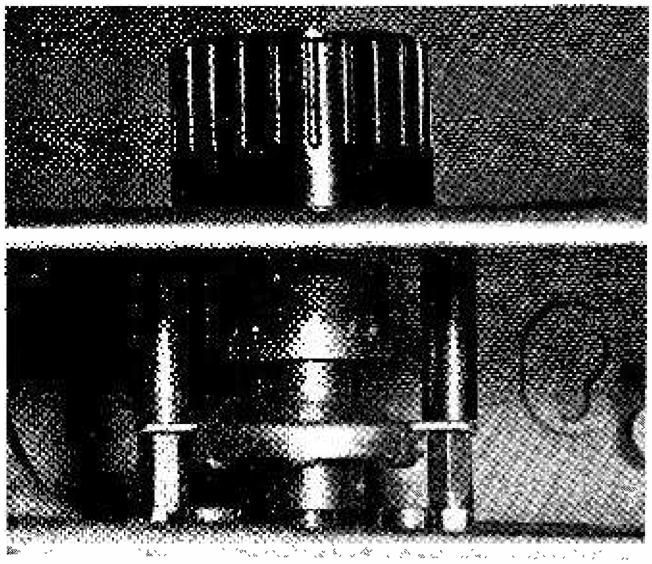




The Author set the core of the short-wave coil for minimum inductance, i.e., with all the adjusting screw showing, giving a tuning range on s.w. from about 1·8 to 6MHz. This includes two amateur bands "top band" (160 metres and 80 metres), as well as most of the m.f. and the lower end of the h.f. marine bands and almost reaches up to the 49 metre broadcast band.

Before trying to calibrate the scale, set the tuning capacitor fully in mesh and the pointer to 180 on the logging scale. At the other end of the scale, the pointer will actually move past 0, but this does not correspond to the useful tuning range—in fact the capacitance actually starts to rise again slightly, so you may hear the same station at two points.

Calibration of the scale is most easily carried out by tuning in a station on a commerical receiver at or near a dial calibration point and then tuning in the same station on the newly completed receiver. In this way, each waveband can be calibrated in turn. In fact for greater accuracy, the commercial receiver can be set exactly to scale calibration points and the reaction control advanced until oscillation occurs. The Imp can then be tuned in to the commerical set which will respond with a whistle if it is already receiving a station or by going quiet if it is not.



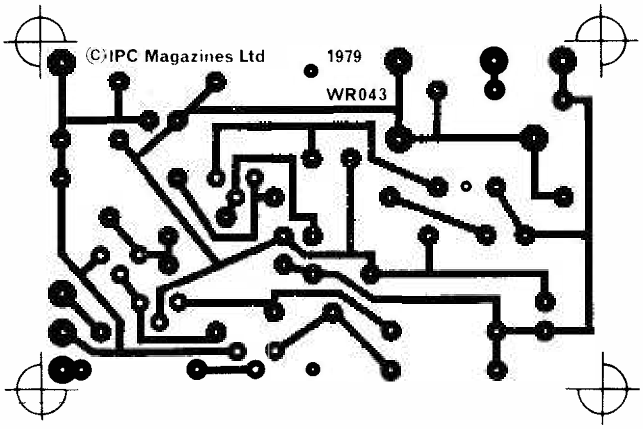
Using the Imp

Long and medium wave will bring in quite a few stations, even in daylight, the author having heard many of the local radio stations in the south of England on medium wave as well as the more powerful BBC regional services. After dark, conditions really open up and one can hear stations from all over Europe and occasionally beyond.

On short wave, don't expect many stations in daylight, especially on the telescopic aerial. Much more signal will be provided by a "sling-out" aerial consisting of 3 or 4 metres of wire, in conjunction with an earth. The latter can be picked up with a three pin plug at the nearest ring-main socket. If you really get interested in short wave then an aerial tuner unit as described in the free supplement to the March 1978 *Practical Wireless* would be worth building.

After dark is the best time for s.w. listening. Turning up the reaction until oscillation just occurs will reveal many more stations using c.w., i.e., just transmitting dots and dashes of carrier without any modulation. The carrier beats with the receiver oscillation to produce an audible tone, whereas otherwise the morse is virtually unreadable.

Likewise, turning up the reaction until oscillation just occurs enables s.s.b. (single sideband suppressed carrier) transmissions to be received. Very accurate tuning is needed here, as unless you tune to within 20Hz or so of the right frequency, the result will sound like Donald Duck. This is why a good slow motion drive is required. Even when the tuning is accurate enough for the speech to be readily understood, it still tends to sound like someone talking down a drain pipe unless you happen to hit on exactly the right frequency to within 1 or 2Hz!



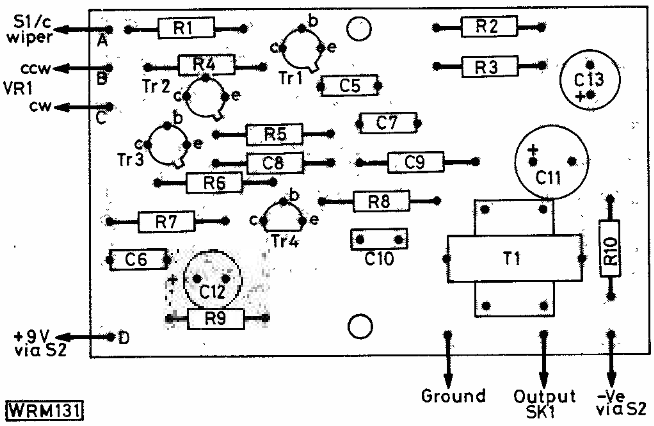
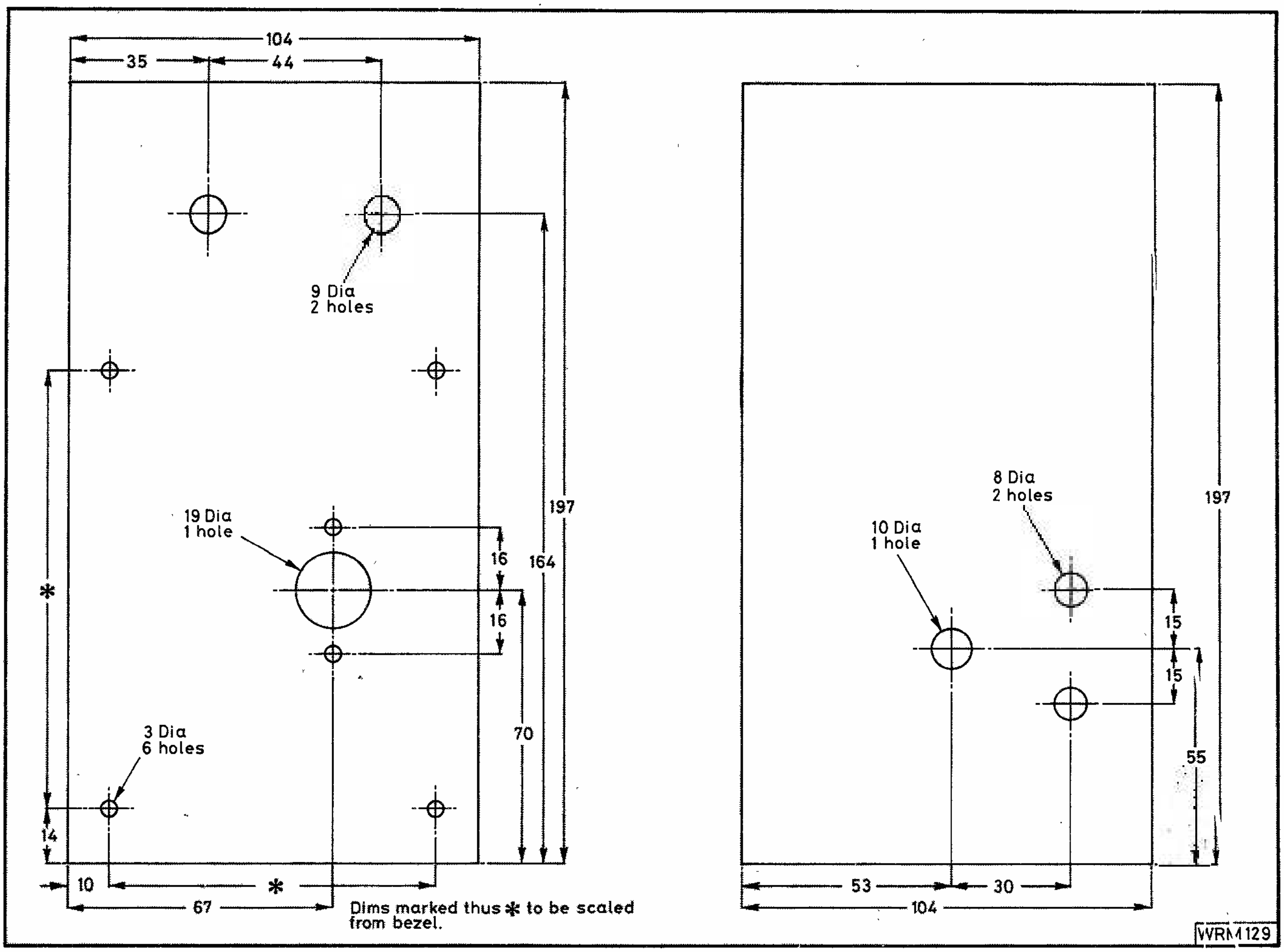
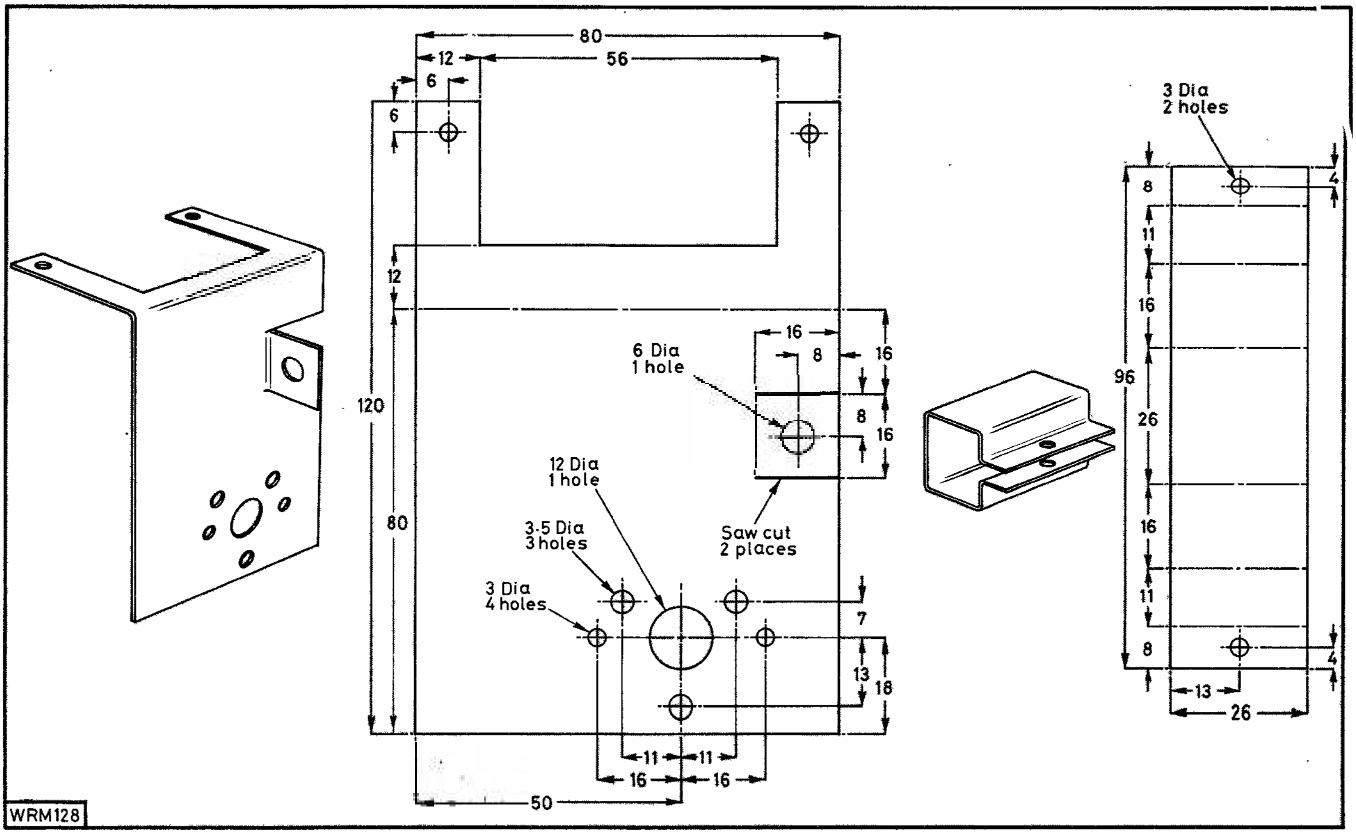


Fig. 7 (Top): The full size p.c.b. copper track pattern
Fig. 8 (Above): The component placement for the p.c.b
The picture on the left shows the mounting of the slow-motion drive unit to the mounting bracket at the bottom



Details of the front and rear panels (Above) and the mounting bracket and battery holder (Below). The bracket is made from 20 s.w.g. aluminium, the battery holder from thin tinplate



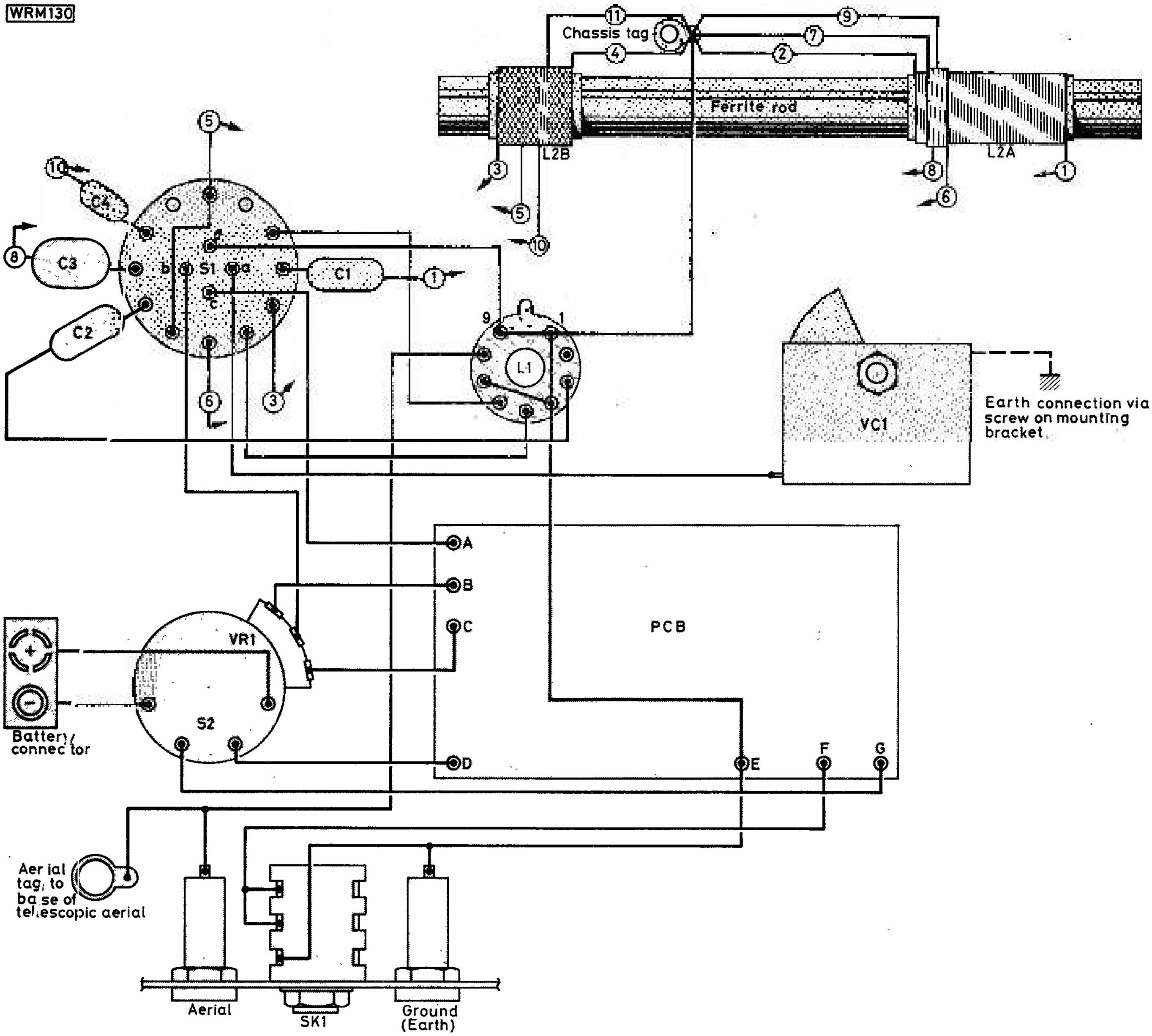


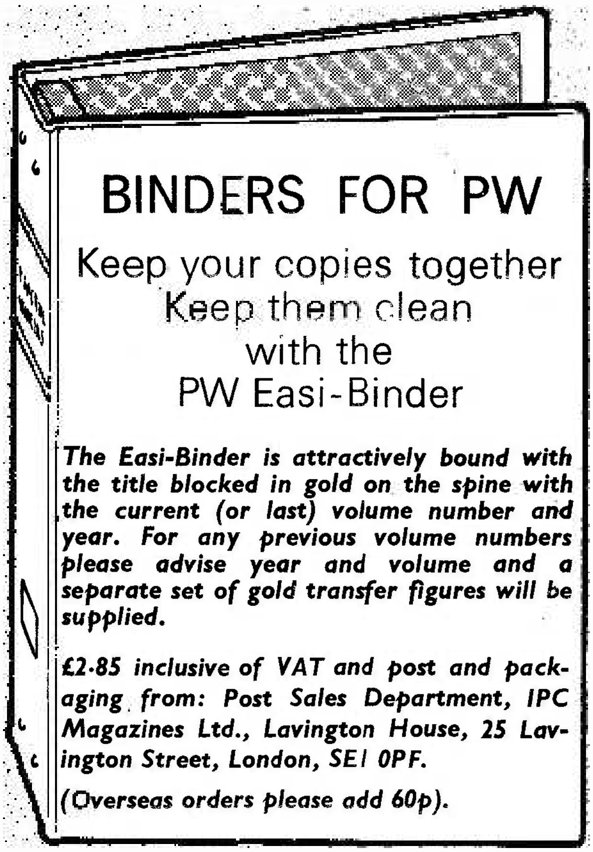
Fig. 9: The complete point-to-point wiring diagram for the PW Imp. It is suggested that this layout be followed closely to ensure good results. Note that the four polystyrene capacitors mounted on the rotary switch are not mechanically anchored at the opposite end to the switch tags so that care is needed to ensure that the free ends do not short to any metal parts

Jammers and things

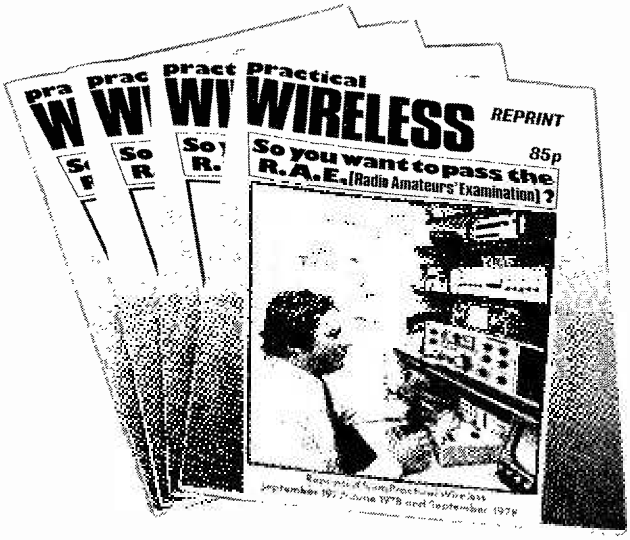
Here are a few points to watch out for when listening on s.w. which might otherwise puzzle the beginner.

Firstly, you may find stations which seem to extend across much of the band. This is usually a very strong station just outside your s.w. range. An a.t.u. (aerial tuning unit) will help here, but if you don't have one, try using the telescopic aerial instead of the external aerial. Next, you may find a "station" just emitting a buzzing noise. This may be a real station transmitting "facsimile" or an Iron Curtain jammer. But if you find it in several places, check that there isn't a TV set working in the next room—it could be stray radiation from that! Fluorescent lighting fixtures can also emit radio interference.

Although the final circuit of Fig. 4 uses four transistors and drives headphones only, it has several advantages. Firstly, following the layout of Fig. 9 and using new, reliable components, excellent results are assured and at 10 or 15p each, four transistors are no undue expense. Secondly, more than ample volume is provided for headphone use, yet the circuit draws a mere 5mA—very economical on batteries. Thirdly, the design achieves what was originally aimed at, a smooth control of reaction with minimal backlash, resulting in sensitivity not much less than that of a super-het with the necessary selectivity to go with it. But unlike a super-het there are no i.f.s to line up, nor padders and trimmers to adjust.



So You Want to Pass the RAE?



For details and coupon see page 36

KINDLY NOTE!

Ideas Department—
Step Tone Generator, March 1979

In the circuit diagram, pins 2 and 6 of Timer 1 should be linked to the Gate of the 2N3819. The last line of the text should read ". . . sophisticated voltage to frequency voice scrambler."

PW "Soundlite", March 1979

The comment at the top of page 29 regarding the handling of c.m.o.s. integrated circuits should be ignored. The MC3301 and MC3302 are not c.m.o.s. but bipolar devices, and therefore unlikely to be damaged by static charges. Our apologies to the author for this error, the result of a mental aberration whilst the article was being prepared for publication in this office. The use of sockets for the i.c.s is therefore unnecessary, and probably inadvisable in a portable device of this type.

Where intermittent triggering of triacs on noise occurs, resistors R35, 48, 59 can be increased to 1kΩ or 2·2kΩ; R36, 49, 60 can be reduced to 1kΩ or 470Ω. This also reduces the dissipation in R1, allowing cooler running.

VHF Monitor Receiver, April 1979

Details of the companies supplying the special plated-through-hole p.c.b. for this project regretfully contained an error. This should read: The special p.c.b. for this project is available from Kelan Engineering Ltd., 27-29 Leadhall Lane, Harrogate, Yorkshire HG2 9NJ. Tel: (0423) 879126.

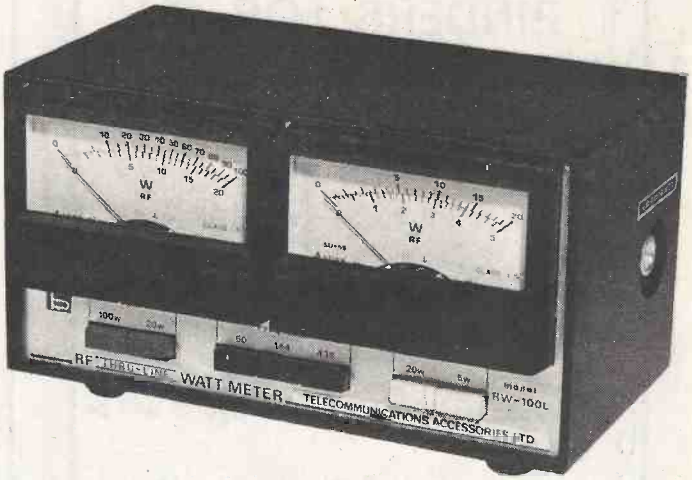
Ambit International are also able to offer a multi-channel option using 3rd overtone crystals.

PLEASE MENTION
PRACTICAL WIRELESS
WHEN REPLYING
TO ADVERTISEMENTS

SPECIAL
PRODUCT
REPORT

Telecommunications
Accessories Limited

VSWR BRIDGE (TYPE RW100L)



The problems of coupling transmitters to aerials are well known and are discussed in detail by F. C. Judd elsewhere in this issue. Briefly, the object is to achieve an optimum transfer of the r.f. energy from the transmitter power output stage(s), along the feeder to the radiating device, which calls for quite precise matching.

One of the most convenient methods of measuring the parameters involved is to use a *bridge,* which is placed in-line with the aerial and gives a visual indication of the forward and reflected power levels present.

A variety of types are available costing from a few pounds to several hundreds. If meaningful *measurements* are to be made, however, the very cheap instruments are unlikely to afford the accuracy required. Indeed they can, in certain circumstances, introduce problems if their own input and output characteristics do not match those of the circuit under test.

Assuming the average amateur's budget does not extend to a Bird Thruline with several plug-in elements, one is faced with the decision of what to buy for a reasonable outlay which measures, rather than indicates.

Telecommunications Accessories Ltd. (until recently known as Antenna Specialists UK Ltd.) import a v.s.w.r. bridge and power meter combination, type **RW100L** which is intended for the commercial mobile market but is equally suited to amateur applications.

Two meters, each with a 76mm (3in) display area, are employed, so that forward and reflected power can be directly compared without the arduous business of having to switch between the two functions and memorise the values from one to the other. Full-scale deflection is selected by two push-buttons in each mode, the readouts being 0–20, 0–100 watts forward and 0–5, 0–20 watts reflected.

Input and output is by "N" type connectors into 50Ω ports. A very close match to the 50Ω circuit under test is maintained by the bridge.

Three switched frequency ranges are provided covering 50–430MHz in the one unit, without the use of separate directional couplers. The meter under test proved very easy to operate and read, its accuracy being quite remarkable when compared to a much costlier professional model.

Although the instrument is intended for laboratory or "shack" use, its rugged construction also makes it suitable for applications in the field where a less expensive, high integrity meter is called for.

There are other less-sophisticated devices within the range available, and the distributors have indicated their willingness to supply detailed information on the product line when requested to do so.

Peter Preston

★ specification

Frequency range:	50–430MHz in 3 ranges
Power ranges:	0–20 and 0–100W forward 0–5 and 0–20W reflected
Input and output impedance:	50Ω
Connectors:	50Ω "N" type
Size:	190 x 108 x 114mm ($7\frac{1}{2}$ x $4\frac{1}{2}$ x $4\frac{1}{2}$ins)
Weight:	1·75kg (3·8lbs)
Price:	around £130

Telecommunications Accessories Ltd, Thame Industrial Estate, Bandet Way, Thame, Oxon OX9 3SS. Tel. (084421) 3621.

In~line Crystal Calibrator

M. TOOLEY

Radio amateurs often need a reliable means of scale calibration for home-constructed projects. The unit to be described is an in-line crystal controlled calibrator which produces markers at 1·0MHz, 100kHz and 25kHz with harmonics well into the v.h.f. band. Its fundamental signals will be found useful for calibrating the timebase of an oscilloscope, for example, whilst the harmonics offer a simple solution to the problem of scaling a receiver tuning dial.

This calibrator has been designed to be left permanently in circuit with an aerial feeder. When not in use, it presents a through path for the signals, the markers being readily available if called for. A useful life of around twelve months can be expected from the internal battery with normal operation.

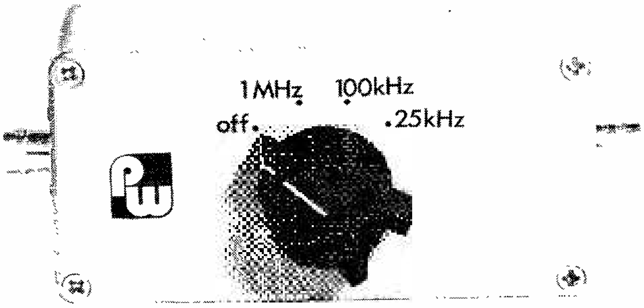
The calibrator consists of a 1·0MHz crystal oscillator with logic dividers to give additional outputs at 100kHz and 25kHz. Square waves, rich in harmonics, are produced, generating markers which extend to v.h.f.

Three CMOS inverters IC1f, IC1e and IC1d are arranged in a feedback configuration which ensures good loop gain and reduces the possibility of overtone oscillation (Fig. 1). The crystal determines the oscillator frequency and resistor R1 provides a d.c. path around the loop. Fine tuning is by the trimmer TC1 and IC1a shapes the output pulses to produce a good square-wave pattern.

A Johnson counter, IC2, divides the oscillator output to give a signal at 100kHz. The two halves of IC3 are each arranged to divide by two and are cascaded after IC2 to obtain an output at 25kHz. Switch S1c selects the marker required, which is again shaped by Tr1 to sharpen up the waveform and thus ensure good v.h.f. harmonic content. Finally, the signal is capacitively-coupled to the aerial via the output loop L1. When 1·0MHz is selected, IC2 is inhibited to avoid the problem of unwanted and ambiguous l.f. signals. Similarly, IC3 is inhibited in the 100kHz position. The control is via S1b and uses IC1b and IC1c repectively.

Construction

This instrument is built into a small die-cast box, which also acts as an effective screen. Be sure that it is deep enough to provide adequate clearance for the crystal, if you choose to use a type different from that in the components list. The general layout is given in Fig. 2.



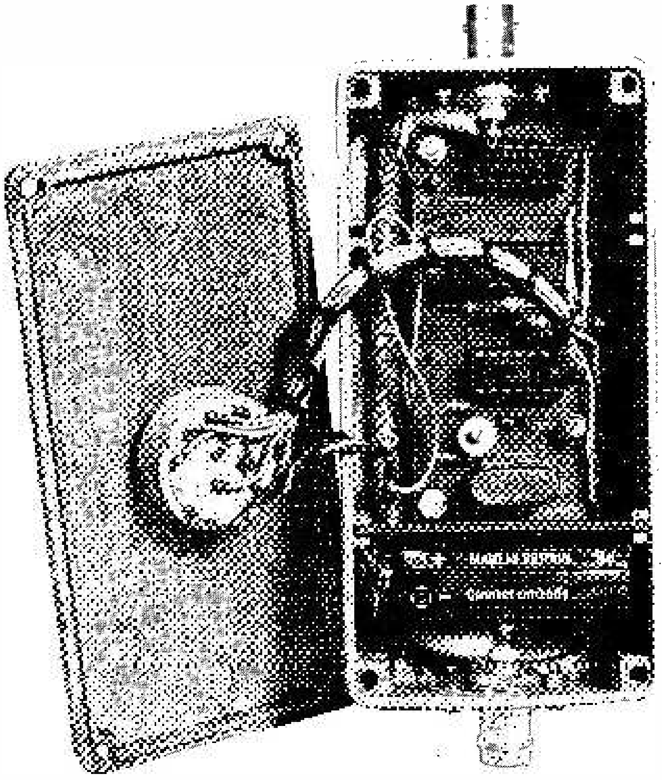
All components are mounted on a p.c.b. which is spaced from the box with two 6BA nuts, or short pillars. The copper track pattern is shown in Fig. 3 and Fig. 4 is the component overlay.

The crystal is an HC33U type, soldered (with care!) directly to the board, whilst the integrated circuits can be plugged into sockets, if this method is favoured. With regard to the CMOS, the usual precautions should be taken to avoid destruction. Leave the devices in their static protection until you are ready to use them. With a properly earthed iron and sensible approach they can be handled quite safely.

The selector switch is mounted centrally on the lid of the box. Depending on the type used, it may be necessary to slightly shorten the tags to prevent contact with other components on the p.c.b. A suitable piece of Paxolin or plain Veroboard forms the battery compartment.

The coaxial line is made from 160mm of low-loss coaxial cable, with the outer sheath removed to allow the loop L1 to be fed under the braiding, entering and leaving 20mm from each end.

As with all projects, a thorough visual check should be made before applying power, with special attention to supply polarity, the positioning of the i.c.s and the possibility of solder bridges on the tracks of the p.c.b. On all ranges, the supply current should be approximately 5mA, so if a



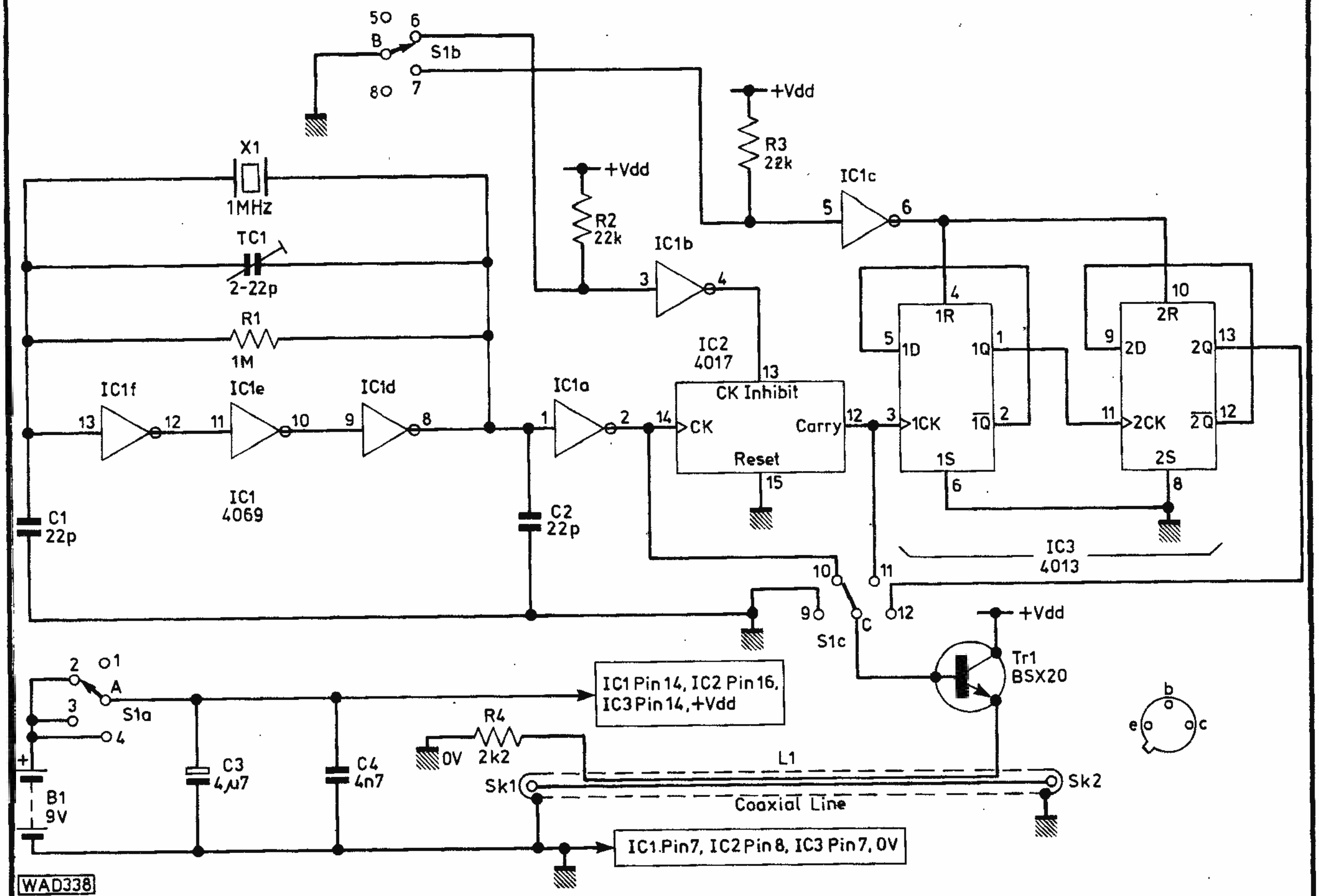


Fig. 1: Complete circuit diagram of the In-Line Crystal Calibrator. Note lead orientation of Tr1 on p.c.b. (Fig. 4)

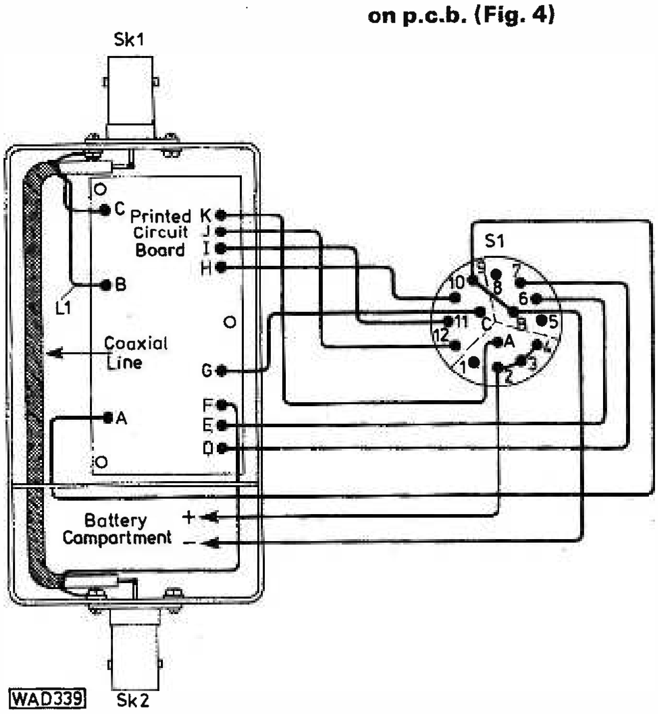


Fig. 2: Wiring diagram of the unit

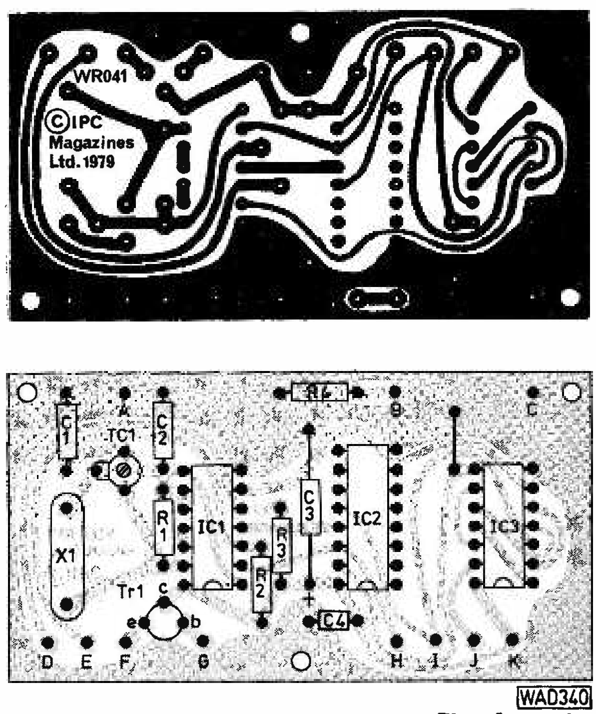


Fig. 3: Full-size track pattern and Fig. 4, p.c.b. component layout

continued on page 55

THE PW 'WINTON' Stereo Amplifier

Part 3

E.A.RULE

Front Panel

Although the front panel is intended to be held in place with an adhesive it is also secured by the nuts holding the mains and speaker switches as well as the jack socket. Take great care not to scratch the panel when tightening these components. It is a good idea not to fit the front panel until all testing, etc., is completed, and you are satisfied that further work on the chassis will not be needed.

Wiring

Final wiring is straight forward and providing care is taken no difficulties should be encountered.

It is very important to follow exactly the wiring sequence shown in Fig. 17. In particular, the earth wiring must be followed exactly if distortion or hum loops are to be avoided. Note that some of the screened leads have their braiding connected to one end only, also that the earth wiring of the disc input is different from the other inputs. Wire exactly as shown in the diagram, do not take short cuts. Fig. 18 shows good and bad examples of earth wiring of the disc input. The same general idea holds true for the whole amplifier.

Note that a signal-to-noise of −68dB relative to 3 millivolts on an input is an equivalent noise voltage of approximately 1 microvolt flowing in the input wiring and it won't take much induced hum or noise to degrade this figure. In fact when you consider that the disc input with RIAA equalising includes nearly 20dB of boost at 20Hz the actual noise present to achieve −68dB is nearer 0·1 microvolts!, need I say more.

The input leads from the disc DIN socket to the p.c.b. should also be twisted together with the earth lead as shown in the photograph. The physical position of other wiring is not critical (within reason) provided that the actual sequence of connections are followed.

Testing and Setting Up

The minimum equipment required for setting up consists of a 20kΩ/V multimeter (AVO 8 or equivalent), and two 30Ω wire wound 5W resistors.

Those of you who possess a range of audio test equipment, such as generators, scopes, distortion meters and the like, will already know how to test equipment to specification and it is not intended to give details of this here. However, the basic test procedure should be carried out first as the simple method described will avoid expensive mistakes.

Before proceeding set the controls as follows:

Mains switch off.
Speaker switch to loudspeaker position.
Volume at minimum.
Balance and tone controls to centre of movement.
Push buttons all out except tape.

Do not connect any form of load to the loudspeaker terminals at this stage.

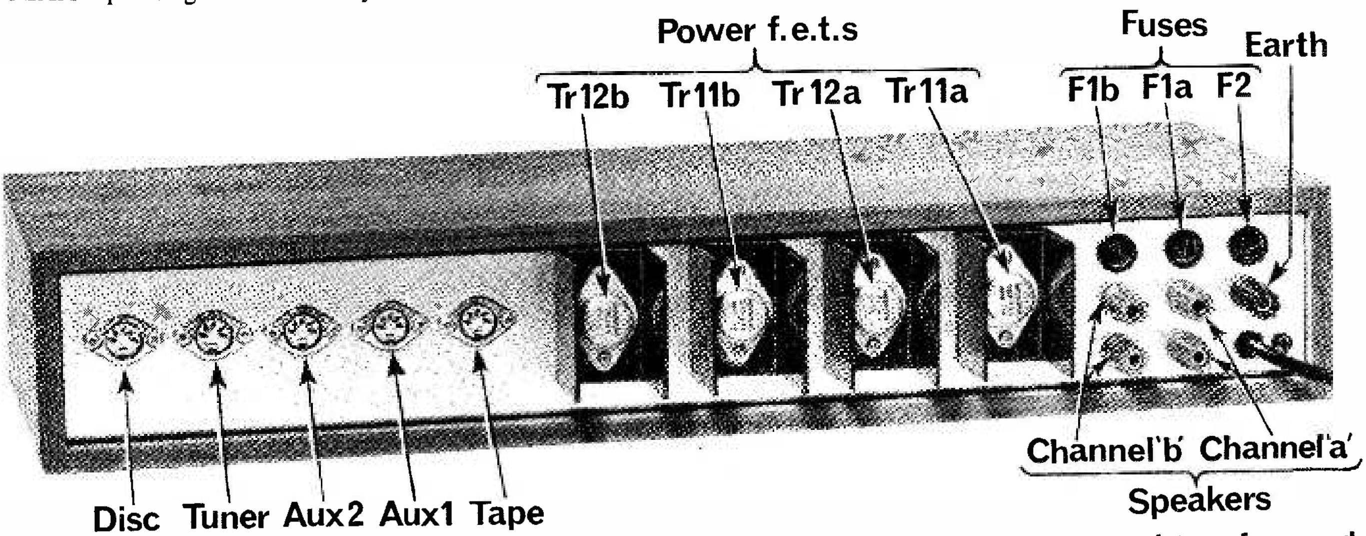


Fig. 16: Back panel of the complete amplifier showing the input sockets, power output transistors, fuses and output terminals. The terminal post under F2, and marked "Earth", is the means of connecting the earths from other equipment to the Winton

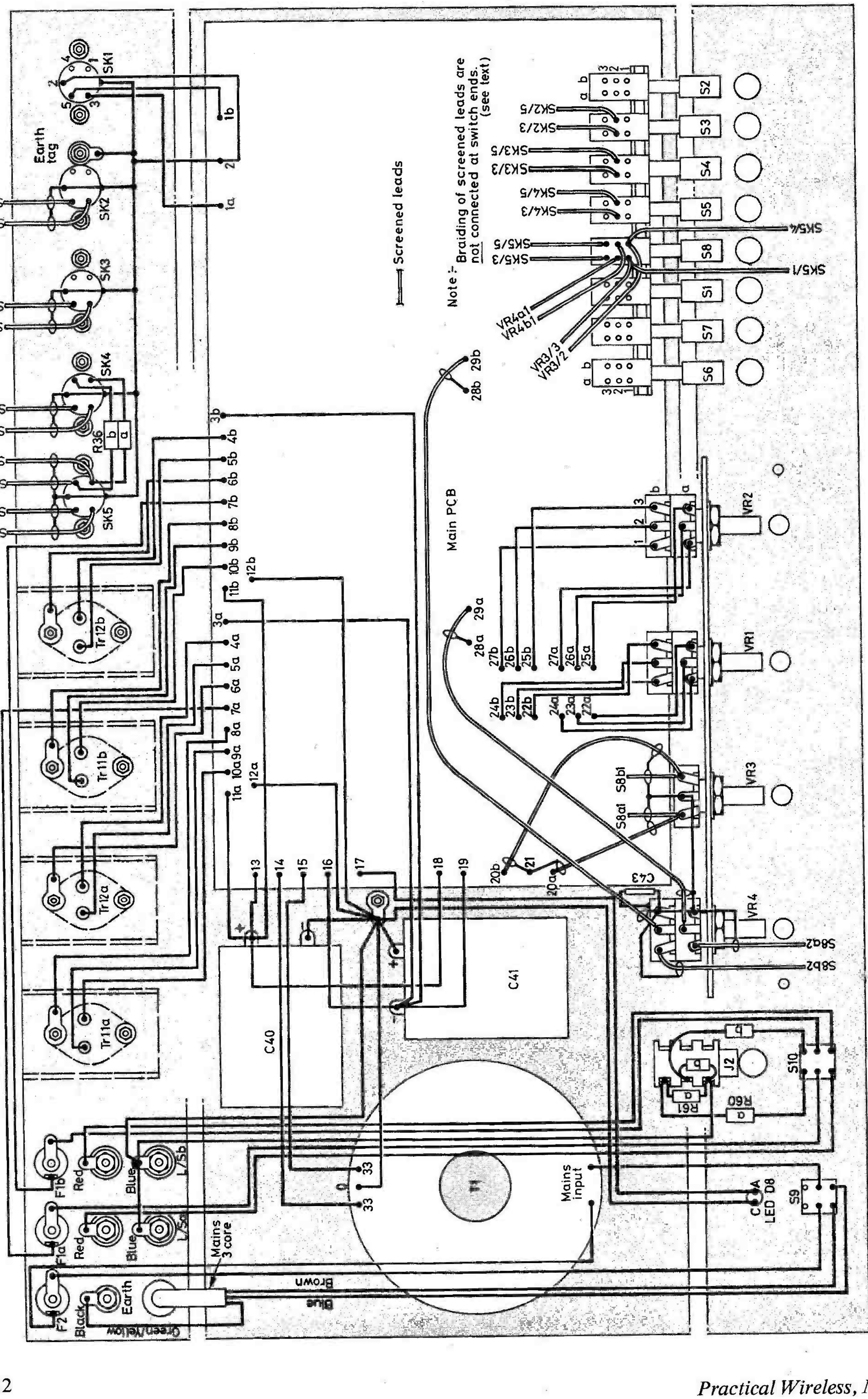


Fig. 17: The wiring diagram for the PW Winton amplifier. This layout should be followed as closely as possible to avoid problems later on

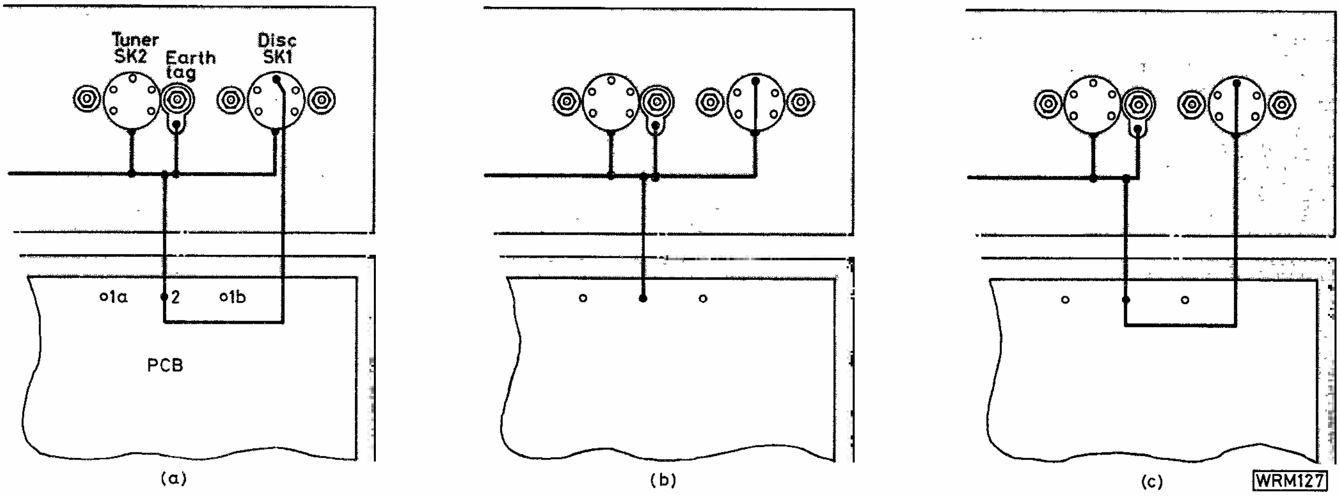


Fig. 18: The correct earthing arrangements for the input sockets is shown in drawing (a). The other two methods (b) and (c) are both wrong and will give rise to hum and noise problems

Fuses

Check that the correct fuses have been fitted. One 1A slow-blow in the mains fuse holder and two 2·5A quick-blow, one in each loudspeaker fuse holder.

Disconnect the wires to pins 3 and 11 on each channel, these are the power supply leads to each power amplifier. Taking each channel in turn and leaving the other disconnected, connect a 30Ω WW resistor in series with each pin (3 and 11) on channel A and its respective supply lead. The object of the series resistors is to limit the current and avoid damage to the transistors in the event of a fault condition occurring when switching on for the first time.

Next turn VR6 on each channel fully anti-clockwise (minimum) and VR5 on each channel to its middle position.

Quiescent Currents

Connect the mains supply and switch on. The l.e.d. on the front panel should glow indicating that the d.c. supply is on. Watch for any sign of a fault condition, such as overheating. Should everything seem to be in order, proceed; if not switch off and investigate the problem. Connect the multimeter set to read at least 50V between chassis (negative) and C40 positive tag, the reading should be about 48V. Transfer the meter to pin 11 channel A. The voltage here should be 1 or 2 volts lower.

The actual voltage drop will depend on the quiescent current through the output devices but at this stage should not be more than a few volts drop. Should it be more than, say, 5V then switch off and check the wiring again.

If in order, transfer the meter leads to C41 negative tag and chassis and then to pin 3 channel A, the voltages should be the same as before but of reverse polarity. Now, while watching the voltage reading, adjust VR6. As its resistance value is increased the voltage on pin 3 (and 11) should fall as the quiescent current is increased. Reset VR6 fully anti-clockwise. Switch off.

Disconnect the meter and remove the two 30Ω wire wound resistors. Connect pin 3 back to the wire from C41 negative tag. Connect the multimeter (on its highest current range) in series with the wire from C40 (positive) and pin 11 channel A. (Check that leads are not shorting to anything.) Switch on. With the meter set to a lower current range, adjust VR6 for a reading of 50 to 60 milliamps. Switch off. Remove meter and reconnect lead from C40 to pin 11 on channel A. Repeat all of the above instructions for channel B.

Table 1

All voltages are with respect to chassis

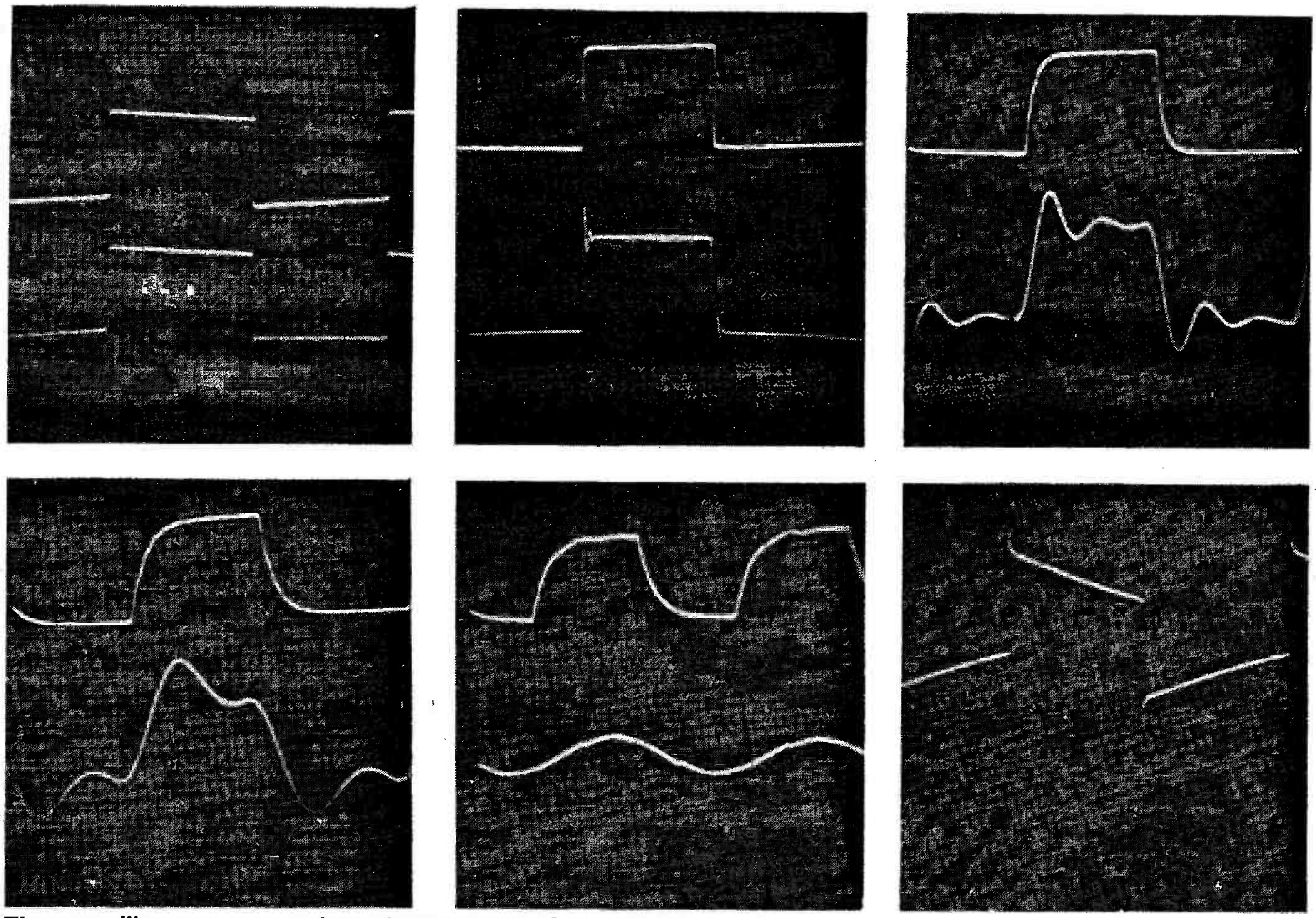
	Collector	Base	Emitter
Tr1	10·3V	0V	−0·5V
Tr2	10·5	0	−0·5
Tr3	0	10·3	11·1
Tr4	−42·7	0·2	0·5
Tr5	−42·9	0	0·8
Tr6	9	−42·9	−43·6
Tr7	0·8	−42·7	−43·6
Tr8	0·5	43·5	44·2
Tr9	47	45	44·5
Tr10	−47	−45	−44·5
	Drain	Gate	Source
Tr11	47V	0·5V	0V
Tr12	−47	−0·8	0

PIN	1	2	3	4	5	6	7	8
IC1	=	=	=	−12·7V	=	=	=	+13·3V
IC2	=	=	=	−14·2	=	=	=	+14·7
IC3	=	=	=	−14·2	=	=	=	+14·7

	Cathode	Anode
D1	14·7V	0V
D2	0	14·2
D3	44·1	43·7
D4	0·5	0·4
D5	0·4	0
D6	0	−0·7
D7	−0·7	−0·8
D8	1·6	0
D9	+47	34 a.c.
D10	+47	34 a.c.
D11	34 a.c.	−47
D12	34 a.c.	−47

Offsets

Having now set up the quiescent currents for each channel, the d.c. offset can be adjusted. Connect the multimeter, switched to a high d.c. voltage range, across the loudspeaker output for channel A (red and blue terminals). Switch on and the meter should not read. Switch to the lowest meter range and adjust VR5 for zero voltage on the



These oscilloscope traces show the response of the PW Winton to various square wave inputs. In each case the upper trace is for the output of the amplifier with 8Ω resistive loading, while the lower traces are for a load of 8Ω and 2μF. The top row shows the response (left) at 100Hz, (centre) at 1kHz and (right) at 10kHz. The lower row shows the response (left) at 20kHz, (centre) at 100kHz. The last picture shows the power amplifier output at 100Hz into an 8Ω dummy load with a square wave fed to the disc input through an inverse RIAA network. The sub-sonic filter is switched in accounting for the slope to the top and bottom of the trace. Note, however, that the trace is smooth and straight

speaker output terminals. It should be possible to swing the voltage either positive or negative by adjusting VR5. The correct setting is Zero Volts. Switch off. Repeat the procedure for the other channel.

A full voltage check list is given in Table 1. These are actual voltages measured on the prototype amplifier and may vary by about 10 per cent in normal practice, depending on the meter and the mains voltage at the time.

Table 2

Mains switch	Switches amplifier on/off.
Speaker switch	Selects either headphone jack socket or speaker outputs.
Volume control	Adjusts volume of signal and maintains 2dB matching between channels.
Balance control	Adjusts output of either channel from maximum to zero, for correcting unbalanced left/right signals; also operates on tape output.
Bass control	Boosts or cuts lower audio frequencies.
Treble control	Boosts or cuts higher audio frequencies.
Push buttons:	
LF	Low frequency filter. Reduces output below 50Hz.
HF	High frequency filter. Reduces output above 5kHz (for removing scratch or hiss).
Tape	Selects tape input; also used for monitoring tape during recording.
Mono	Parallels both channels.
AUX 1	Selects AUX 1 input, which also has a tape output on it. This input is suitable for most cassette recorders.
AUX 2	Selects AUX 2 input.
Tuner	Selects Tuner input.
Disc	Selects Disc input.
Jack socket	Suitable for most types of stereo headphones.
Mains indicator	Indicates that mains supply is on. Note: the supply for the l.e.d. is from the filtered d.c. and will continue to glow for some time after switching off.

It is advisable to carry out a full voltage check before connecting loudspeakers to the amplifier. When you are sure that everything checks out correctly, connect up the loudspeakers, tape and pick-up.

Set the controls as follows, volume at minimum, balance and tone controls to mid-position, all control buttons except "disc" out, speaker/phones switch to "speaker" position and switch on the amplifier.

At this stage nothing should be heard, not even a "switch-on" click. Place a test record on the turn-table and, having placed the pick-up on the record, slowly advance the volume control.

You should now hear the record and can proceed to check the various controls for their proper function. A full list of the controls and their functions is given in Table 2.

Response

Although not vital it may be possible to improve the frequency response/phase relationship through the control unit. The amplifier should be set up, using suitable test equipment, to reproduce a flat frequency response across 8Ω dummy loads. Adjust the two tone controls for optimum "flat" response between 20Hz and 20kHz using the AUX 2 input. The volume control should be set at maximum and the level of input signal (a sine wave) should be adjusted to give approximately 4V output across the 8Ω resistor dummy loads.

Switch the input signal to reproduce a square wave form at 1kHz. Do not touch the tone controls. The square wave should have a "flat" top and bottom; if so, no adjustment is required. However, it may have a slight "slope" depending on the matching of capacitors C21, C22. Any "slope" can be corrected by connecting extra capacitors across either C21 or C22 (which one will depend on the direction of the slope of the square wave form).

COMPONENT SUBSTITUTION

In order to realise the true potential of the Winton specification it is emphasised that the constructor should only use those components specified in the articles. This applies in particular to the mains transformer which has been especially designed for this project. Substituting other apparently suitable types, such as RS Components 120VA 207–497, can only lead to dissatisfaction with the performance of the completed amplifier

Depending on the degree of mismatch between C21, C22, extra capacity up to 0·01μF may be required. If for example, the 0·047μF used for C21, C22 had a tolerance of ±10%, one could be 0·0517μF and the other 0·0423μF, a 0·0094μF difference between the two. This is why the capacitors used should be matched to better than 2·5%. (0·0481μF to 0·0458μF, or a difference of only 0·0023μF.)

It is doubtful if such a correction of phase response would be audible under normal domestic conditions and is really just a case of "gilding the lily."

The PW Winton must be connected to other equipment so that earth loops are avoided. Only the amplifier is earthed at the mains. No direct connections must be made between pick-up and chassis or tape deck. Earths, if provided, on tape deck and record deck are connected to EARTH on the rear of the Winton. Care in the installation as a whole will ensure that the full performance potential of the PW Winton is achieved. Poor results will almost certainly be entirely due to either the ancillary equipment used and/or a poor installation. ●

IN-LINE CRYSTAL CALIBRATOR

continued from page 50

★ components

Resistors
¼W 5%

2·2kΩ	1	R4
22kΩ	2	R2, 3
1MΩ	1	R1

Capacitors
Miniature polystyrene

22pF	2	C1, 2

Disc ceramic

4·7nF	1	C4

Electrolytic—axial leads, 16 volt

4·7μF	1	C3

Trimmer—film dielectric

2–22pF	1	TC1

Semiconductors
Transistors

BSX20	1	Tr1

Integrated circuits

4069	1	IC1
4017	1	IC2
4013	1	IC3

Crystal
1·000MHz HC33U 30pF (P. Golledge Electronics)

Switch

3p4w rotary	1	S1

Sockets

50Ω BNC	2	SK1, 2
14-pin d.i.l.	2 }	optional
16-pin d.i.l.	1 }	

Miscellaneous
Control knob with position indicator. Type PP3 battery. Battery clips. Die-cast box 120 × 60 × 44mm. Printed circuit board (C. Bowes & Co.). Small length 26 s.w.g. enamelled copper wire. 160mm low-loss coaxial cable (Type UR203 from Maplin)

significant departure from these readings is noticed the unit should be disconnected and re-checked.

When the calibrator is included in the aerial feeder the markers should be easily detectable and a small adjustment (TC1) to set the oscillator precisely to 1·0MHz will be all that is required. This may be carried out with reference to a frequency counter or by zero-beating the oscillator to an off-air standard frequency transmission. If the latter technique is employed, the accuracy will be greater for higher-frequency transmissions, due to the audio passbands involved in reducing the heterodyne frequency. Suitable transmissions are on 2500kHz, 5·0MHz and 10·0MHz. An alternative would be to use the BBC Radio 4 signal on 200kHz. In all cases, the accuracy of the standard is better than one part in 10^9. ●

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

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

Light Powered Buzby

Fibre optics and their uses in communications is a subject that is to have far-reaching effects. The latest application I've come across is the use of light fibres as a means of connecting your telephone up to the exchange. That in itself has some interesting consequences — like if we use fibres and not metal cables it could mean a vast loss of market for the cable makers.

But now there's a difference in this particular application. Telephones need power to make them operate and this was previously provided by power supplies and via cables. The difference now is that engineers have come up with the idea of having your telephone receiver powered by light which is fed to it up the same fibre that's carrying the speech! One of the biggest problems was the bell — the bit that makes all the noise when someone phones. It requires considerable power compared to that needed for the rest of the system. In America, where these experiments are taking place, an 80V ramp was required to power the electromechanical ringing device. The end of the fibre was found to supply 5mW at best.

The answer was to design a new ringing device that needed only 2V. The tiny 5mW available from the laser diode is used on a very thin piezo-electric element and the result is a staggering overall efficiency (optical input to acoustic output) of 33%.

Billions of Bits

Every time I look at a news item on disc storage, someone has come out with something even more staggering. The newest piece of disc magic is one that measures 12 inches in diameter and is used in an optical recorder (those optics again). The problem with the development at this stage is that of access time — the time it takes to find a piece of information on the disc. These new discs can store 10 billion (American style) bits of information but it takes some 250ms to access information from the 5 billion bits stored on each side. This contrasts with current magnetic discs with their lower 2·5 billion bits per side but offering a 30ms access time to make up. The new optical discs are interesting because they are presently in their infancy and doubtless as time goes by their access times will shrink.

Better Batteries

Batteries have a nasty habit of going "flat" at the wrong moment. Rechargeable might be the magic word if this keeps happening to you. An even better phrase might be lithium battery — and a better phrase still — rechargeable lithium battery. These power cells have long been known for their very high energy densities but they couldn't be recharged. Now they can. An American company has come up with a button cell giving 2·4V and with a theoretical energy density of something like 100 watt hours per pound weight. The cell can be discharged fully, and then recharged. Not yet available over here, but when they are they certainly should cell!

Helping People

Electronics has found many pleasing applications in helping people. Two of the latest really appeal to me. The first is able to compose messages for people who cannot speak. The other enables blind people to use a cassette recorder to take notes in braille.

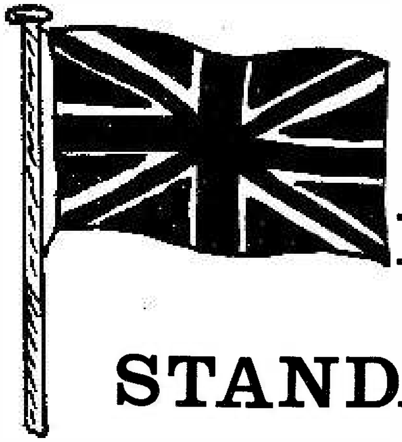
The first device is aimed at helping people who cannot speak nor who have any co-ordination such that they might use a keyboard device. The new beastie is called an Autocom and it looks rather like an electronic Ouija board. The user has a flat tray-like affair on his/her lap. The tray is divided up into squares and each has words, phrases or symbols. All that has to be done by the user is to push a magnetic pointer over the desired square. Beneath the board are magnetic sensors that can sense exactly where the pointer is. A microcomputer is employed and is complete with its own memory. A readout shows the user what is being done/selected. While all this is going on an accessory, rather like an electric typewriter, is busy printing it all out as hard copy.

The other piece of equipment is called Versabraille. It uses a cassette recorder to store information that is keyed into it using a six-cell braille code. The nice thing about all this is that the designers haven't just left it at that; they have laid on facilities for record and playback. plus the ability to erase, and to edit and indexing as well. Something like 200 pages can be stored on a single C60 tape — and that's only using one side of it.

Transistorised Vampires

Now I've heard it all — an electronic vampire. It doesn't actually nip you and nick your red cells, but it can tell all about your blood. The obvious application is bloodless, painless blood tests: no pricking, no nicking. To operate the apparatus, the user simply presses his lips against a flat plate, and the job is done. The magic technique that makes all this possible is infra-red spectroscopy. The i.r. beam is "shone" through the lips, and various "ingredients" in the blood cause a different effect on the beam. By looking up a little dictionary of what things in the blood cause what effects in the i.r. beam, an accurate readout can be made. The apparatus can measure things like cholesterin, glucose, ethanol, etc. One very worthwhile application is to allow diabetics to keep a check on the glucose content of their blood. Yet another would be to test accurately for alcohol levels in the blood. According to first figures published, the apparatus is able to measure alcohol content level in the blood right down to 0·001%.

Ginsberg



THE NEW STANDARD

PW WINTON

The P.W. WINTON has simply got to be the new standard against which all D.I.Y. amplifiers will be judged, (quite a few commercial jobs too we suspect).

The superb specification is totally fulfilled in the quality of reproduced audio, and to judge from the number of flattering comments we have received we are not in isolation when we reaffirm our original statement that "WE SINCERELY BELIEVE IT TO BETTER SIGNIFICANTLY ANYTHING AVAILABLE TO THE HOME CONSTRUCTOR IN THIS POWER RANGE".

So! all you sceptics out there, stop hiding behind your BI-POLARS, you can't lick us so why not join us in the MOSFET REVOLUTION? and hear Hi-Fi as it should be heard with the accent heavily on the Fidelity bit, (FIDELITY; Latin Root FIDELITAS; **EXACT** correspondence to the original), marvellous thing this state education innit?

Compare our spec's, if you don't fully understand the subtleties of some of them, ask someone who does, tot up how much you will save over the commercial equivalent, and write out a cheque as fast as your trembling hand will allow.

Whilst very gratified at the enormous amount of interest this design has generated, we fear that some may not have read Part 1 of the WINTON article (March '79 P.W.) as thoroughly as we had hoped, the reason for this assumption is that we have received a lot of letters and 'phone calls asking if we can supply the MOSFET Power Amplifier in isolation, i.e. without the control unit.

We cannot do this without a drastic re-design, but to those who have posed this question to us we would respectfully point out that the WINTON was designed from first principles as an INTEGRATED UNIT, and the performance figures we obtain are a direct result of the very careful thought and development that went into the unit as a **WHOLE**, for example the quoted figure of 140 mV overload on the disc input (that's +33 dB!) before distortion reaches even 0·1% would almost certainly not be obtainable if the MOSFET Power Amp were fed from a Control Unit of indifferent performance, the whole point of course being that the PRE-AMP, and the POWER AMP were designed to complement each other, and if you try to hack a bit off and attempt to graft it on to your own or someone elses pet design we don't think you will be too happy with the results, of course you pays yer money and you please yourself, but if a soprano ends up sounding like a baritone don't blame us, we told you so!

The WINTON is available in the following form:

	Price Inc. V.A.T. & carriage.
Pack (A) Capacitors & Fixed Value Resistors	**£21.45**
Pack (B) Switches, Potentiometers, Pre-Sets & Knobs	**£13.26**
Pack (C) Printed Circuit Board, and Terminal Pins	**£8.10**
Pack (D) Hardware Pack, consisting of Chassis, Heat Sinks, Cabinet, Screws, Wire, Fuseholders etc., and a Brushed Aluminium Fascia Front Panel.	**£32.99**
Pack (E) Semiconductors (including HITACHI MOS Power Fets)	**£30.53**
Pack (F) Toroidal Mains Transformer	**£17.22**
Complete Kit of all parts necessary to build the WINTON	**£120.00**

ORDER WITH COMPLETE CONFIDENCE (Cash with order please) FROM:-

T. & T. ELECTRONICS. GREEN HAYES, SURLINGHAM LANE, ROCKLAND ST. MARY, NORWICH, NORFOLK. NR14 7HH.

PLEASE ALLOW **28 DAYS FOR DELIVERY.**

INDICATOR UNIT special purpose aircraft ind 115v 400c I/P as int EHT supply & heaters reqs ext 250v & -150 contains CRT type 3WP1 3" flat face with P.1 trace plus 13 minature valves was part of direction finding equip gives trace similar to CRDF display reqs ext sine cosine resolver to generate scan in clean cond in case size 10×8×21" with circ. £25.

TRANS/RX MK.123 very compact mains or 12v operated unit 2·5 to 20Mc/s manual tuned Rx crystal controlled Tx see March P.W. for full spec or write £54.

MOTOR DRIVE CONTROLLER removed from Radar simulators as 24v DC motor driving into gearbox the o/p shaft turns a 360' Ind & sine cosine pot approc speed at 24v 1 RPM controller enables speed to be controlled from 0 to max in both directions supplied with P.U. transis control circ etc. £10·50.

TAPE RECORDERS made for use in language lab equipment 240v 50c/s I/P uses BSR type TD.10 deck 3 speed will take 7" spools two chan transis amps with separate O/Ps can be used for stereo provision for record & playback power unit & amp circs mounted below deck overall size 12×11×7". O/P intended to work phones, supplied in clean cond may have control knobs & Ind lamps missing, some circ details supplied, no ext case £13 also valve unit with TD.2 deck £8·50.

U.H.F. CAVITIES new spares to take 2C39 type valves will tune over range 990/1040 Mc/s with int fittings circ sup-plied £6·50, also Rx section tunable preselector 1080/1130 Mc/s 4 section with 1N21 mixer diode for 60Mc/s IF with circ new £4·50.

MISC CIRC BOARDS (A) H.V. rect board contains 4 10Kv PIV 100 Ma Silican rect, 4 150v 1 watt Zen 30×220K 2 watt res etc size 9×7" £2·20. (B) Display board with 12 ·2" Red L.E.Ds 9 I.Cs size 10×4" £2·20. (C) With 741 op amp 2N3583 HV sil NPN pwr, misc comp 60p. (D) With 12v reed relay with 2×N.O. contacts 1000 ohm coil 14v Zen 60p.

PHOTO TRANSISTOR type FPT120 end viewing high sensitivity new with data 60p. ea. 2 for £1.

DIGITAL DISPLAY 7 segment 9 digit $\frac{1}{4}$" high digits with connector & red bezel new £2·30.

U.H.F. T.V. TUNERS manual tuned type transis with $\frac{1}{4}$" shaft new with circ possible use as aerial pre amps £2·50.

COUNTERS 4 digit with reset panel mounting coil 115v AC 6 watt £3·50.

AUDIBLE WARNING DEVIZE $1\frac{1}{2}$" dia will work on 6 to 12v DC solid state gives tone about 800c/s takes 100 Ma at 12v new £1 ea. or 2 for £1·70.

HELIPOT DIALS standar 10Tr type approx $1\frac{3}{4}$" dia to fit $\frac{3}{8}$th bush & $\frac{1}{4}$" shaft £1·50 or with 100K helipot £2.

CRYSTAL UNIT dual 100Kc & 1 Mc/s in 10X case with suggested circ £2·80.

TIME DELAY UNIT panel mounting range 3 to 60 Secs contacts 1p c/o supply 115v 60c/s (times are for 60c/s) size front $3\frac{3}{4}$" sq. 3" deep new £6·50.

OSC UNITS telematry osc freq. nom 450Mc/ with some ajustment with DET22 disc seal triode in die cast case $3\times2\frac{1}{4}\times2\frac{1}{4}$" these are normally freq mod £5·40.

ATTEN in line piston atten var40 to 100 Db 50 ohm good to 500Mc/s fitted SO239 UHF sks with short connector £3.

SIGNAL GEN type 6 special purpose 17 crystal controlled chan in range 60 to 70 Mc/s as single & double freq AM & FM on some channels reqs ext P.U. with circs fuller spec on request £25. We have the following for callers subject to being unsold CD711 Dual trace bench scopes £40. Marconi TF801A Sig Gens 10/300Mc/s £30-£45. Murphy B41 L.F. Rx £25. Marconi Spec Anylizers 3/30Mc/s £55.

Above prices include Carriage & VAT.
Goods ex equipment unless stated new.
S.A.E. for enquiry or List 21.

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Phone: 444278 (0742)

STEREO DECODERS
DEVICES & CIRCUITS
PART 2

M. J. DARBY

The TDA1005 (continued)

Note that Figs. 7 and 8 appeared in Part 1

The frequency multiplex circuit of Fig. 7 using an inductor provides slightly better channel separation and rejection of unwanted frequencies from the output. The hum suppression is about 40dB in both circuits.

An automatic monaural/stereo switch controlled by the pilot tone and by the field strength of the received signal is included. A lamp is shown in the circuits of Figs. 7 and 8 for indicating the mode of operation (stereo or monaural), but this could be replaced by a light-emitting diode in series with a suitable resistor. The capture range of the voltage controlled oscillator is guaranteed to exceed ±3·5% (or 2·7kHz).

The supply voltage must be within the range 8 to 18V, the total current to pin 8 being typically 21mA. The maximum stereo indicator lamp driving voltage, V_L, is 22V. The circuits can be switched to the monaural mode by connecting pin 12 directly to ground or by raising the voltage at pin 14 to more than +1·2V. The typical distortion at the output at various frequencies is shown in Fig. 9 for the Fig. 7 circuit, but there is appreciable variation with the exact circuit conditions.

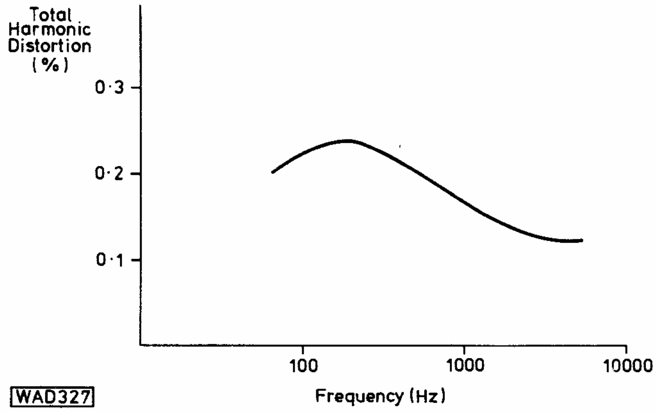


Fig. 9: Typical total harmonic distortion in the output of a TDA1005 integrated circuit

The MC1309

Motorola announced their MC1309 phase-locked loop stereo decoder device about the middle of 1978 and it is not yet generally available. This device (Fig. 10) is pin-for-pin compatible with the established MC1310 device, but incorporates the latest I²L, ion implant and bandgap technologies to produce an improved performance. The particular advantages claimed for this device are low distortion, low power consumption, high supply-line noise and ripple rejection and automatic transient-free switching between the monaural and the stereo modes of operation.

In place of a conventional Zener internal bias regulator, the MC1309 employs a bandgap reference circuit. This type of voltage reference not only provides outputs with lower noise, but also permits operation from power supply lines as low as 4·5V; the maximum supply voltage is 16V.

The use of I²L technology permits efficient operation of the logic circuits at very low power. In addition, ion implantation allows high value internal resistors to be fabricated on the chip with well controlled values. As in the case of the MC1310, the MC1309 requires a variable resistor for the setting of its free-running frequency. The use of external load resistors with this device enables the gain to be adjusted somewhat.

The MC1309 will accept a composite input signal in the range 0·25V to 1·7V peak to peak, the distortion being as low as 0·1% at an input of 0·85V in a typical device.

The MC1309 will sink up to 50mA through a small lamp or light emitting diode stereo indicator. It

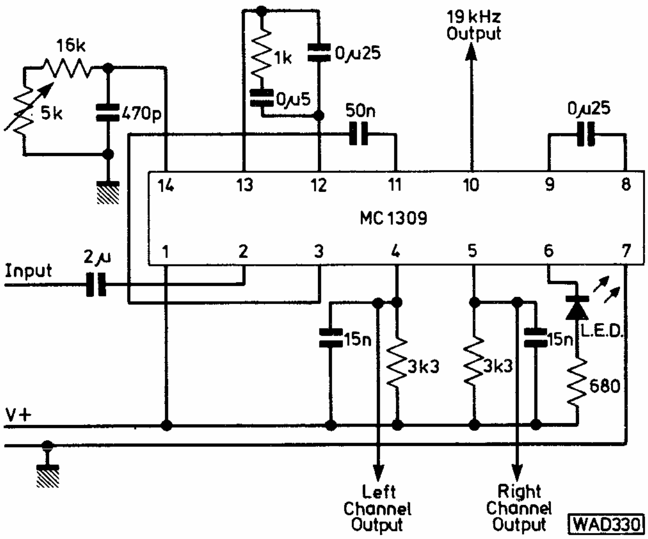


Fig. 10: External circuitry for the Motorola MC1309

incorporates internal current limiting in the indicator light circuit. Channel separation is typically 46dB at 1kHz and 44 dB at 10kHz. The capture range of the phase-locked loop is about ±8·9%.

Stereo Output Filters

We have already seen that stereo decoder circuits generate frequencies of 19kHz, 38kHz and 76kHz and that the output contains some low amplitude signals of these frequencies. Although most modern monolithic circuits contain circuitry which provides some 25dB to 50dB of rejection of the unwanted frequencies, these ultrasonic frequencies can nevertheless cause whistles and other troubles, especially if the output signals are fed into the input of a tape recorder. Harmonics of these low level signals can beat with the bias signal of the tape recorder and produce frequencies in the audio band.

This problem can be eliminated by placing a suitable filter between the output of the stereo decoder and the next amplifier stage. The Toko Company offer a number of suitable filters which are available from Ambit International; they are designed to provide a considerable amount of attenuation of the 19kHz and 38kHz signals. These filters must have a suitable resistance connected across their output or their frequency characteristics may be affected.

It can be seen from the table that most of these filters hardly changed the response at 15kHz, but provided considerable attenuation of the spurious output frequencies at 19kHz and 38kHz. The cross-talk between channels does not exceed about −45dB relative to the signal between 50Hz and 10kHz. Minor undulations of the response characteristic in the passband do not exceed about 0·5dB.

The BLR-2011N is an excellent filter for the ouput of a stereo multiplex decoder, providing not less than 30dB attenuation of unwanted frequencies, yet introducing no more than 1dB attenuation of the highest wanted frequency at 15kHz (which older people cannot hear anyway). The price is £1·95 plus VAT at the time of writing and the price of the other filters is similar.

Future Developments

At the present time, stereo transmissions are available only in the v.h.f. bands with f.m. signals. However, there is a very strong interest in the USA in the development of a system for transmitting stereo programmes using amplitude modulation in the long, medium and short wavebands. It is not clear how much demand there would be for stereo signals in the lower frequency bands, but such transmissions can cover much larger areas than v.h.f. transmissions with small receivers using ferrite rod aerials. In addition, they may provide better reception in car radio receivers than stereo v.h.f. signals in locations where reception is difficult, for example, when the vehicle is passing under a large bridge, etc.

It is not possible to transmit high quality f.m signals on the lower frequency bands, since the bandwidths available are too narrow. Stereo v.h.f. radio involves the use of a 38kHz suppressed sub-carrier, but the narrow bandwidth on the lower frequencies does not permit this. However, a number of techniques have been proposed which in essence involve the transmission of a left-plus-right signal, amplitude modulated on to the carrier in the normal way, but with the left-minus-right signal also modulated on to the same carrier. Such systems must be compatible in the sense that any conventional receiver must be able to be used to listen to the left-plus-right signal, as there are not enough channels available to allow special channels to be used for the stereo transmissions alone.

Unfortunately, the use of a double modulation technique to convey both the left-plus-right and left-minus-right signals on the same carrier without the use of a sub-carrier necessarily involves some increase in distortion of the received signal. The amount of distortion and the signal-to-noise ratio obtainable vary from one proposed system to another.

Frequency response of Toko stereo decoder output filters

Type Number	Attenuation relative to 400Hz (dB) 15kHz (Max)	19kHz (Min)	38kHz (Min)	Input Impedance Ω	Output Impedance Ω
BLR-2011N	1	30	30	1000	4700
BLR-2007N	3	20	55	3000	3000
190-BLR-3107N	1·2	26	50	4700	4700
Two cascaded 190-BLR-3107N	1·2	45	75	4700	4700

In the Belar system, the left-minus-right signal is frequency modulated on to the amplitude modulated carrier, whereas in the Magnavox system the left-minus-right signal is phase modulated on to the carrier. The Kahn-Hazeltine and Motorola systems involve a left-minus-right signal transmitted in phase quadrature with the left-plus-right signal, whereas a system proposed by Harris Broadcast Products involves a phase difference of only 30°.

Magnavox System

The basis of a typical proposed system may be considered using the block diagrams of Figs. 11 and 12, which show a transmitter and receiver respectively, employing the Magnavox system.

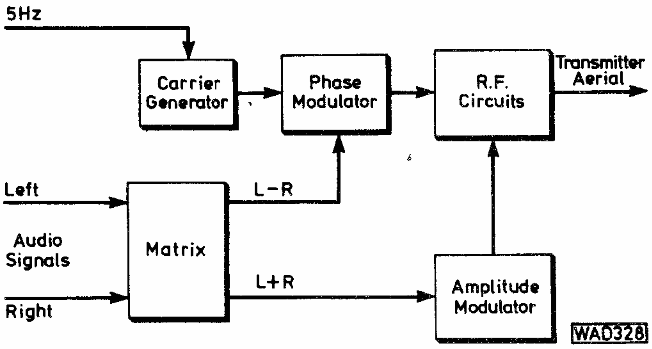
In the transmitter, the left and right signals are fed into a matrix which provides outputs of the left-plus-right and left-minus-right signals. The left-plus-right signal is fed directly to the amplitude modulator to produce an amplitude modulated carrier. The left-minus-right is fed to a phase modulator circuit which modulates the phase of the carrier. A 5Hz stereo identification tone has been proposed for this system. This would act merely as a control for the stereo/monaural mode switch, and would not take any part in the actual demodulation process.

In the Magnavox receiver system of Fig. 12, the first part of the a.m. receiver is quite conventional. The i.f. signal at 455kHz is fed to an a.m. detector to provide the left-plus-right signal. A separate part of the i.f. signal is fed into a limiter which removes the amplitude modulation and then into a phase detector which produces a left-minus-right output. A matrix circuit is used to develop separate left and right signals which pass through the stereo/monaural mode switch to the appropriate loudspeakers.

The output from the phase detector in Fig. 12 is also fed to a 5Hz detector. The latter produces an output which causes a stereo indicator lamp to be lit when the 5Hz signal is present, and which also switches the mode to stereo. When no 5Hz signal is present, as in monaural transmissions, the stereo indicator lamp is extinguished and the mode switch causes the left-plus-right signal to be fed to both loudspeakers.

The other systems proposed have various differences from the Magnavox system, but none of them can produce signals of a quality comparable to that of our present f.m. stereo broadcasts. Nevertheless, the advantages mentioned previously make it desirable to consider the possibility of stereo transmissions in the lower frequency bands. Also, the use of a.m stereo transmissions would avoid the problems of multi-path distortion which can occur in f.m. stereo reception. If any of the proposed systems are developed, it seems likely that new integrated circuits will be produced by many of the major manufacturers for use in a.m. stereo receivers — indeed, a number of them have

Fig. 11: A Magnavox a.m. stereo transmitter in block form



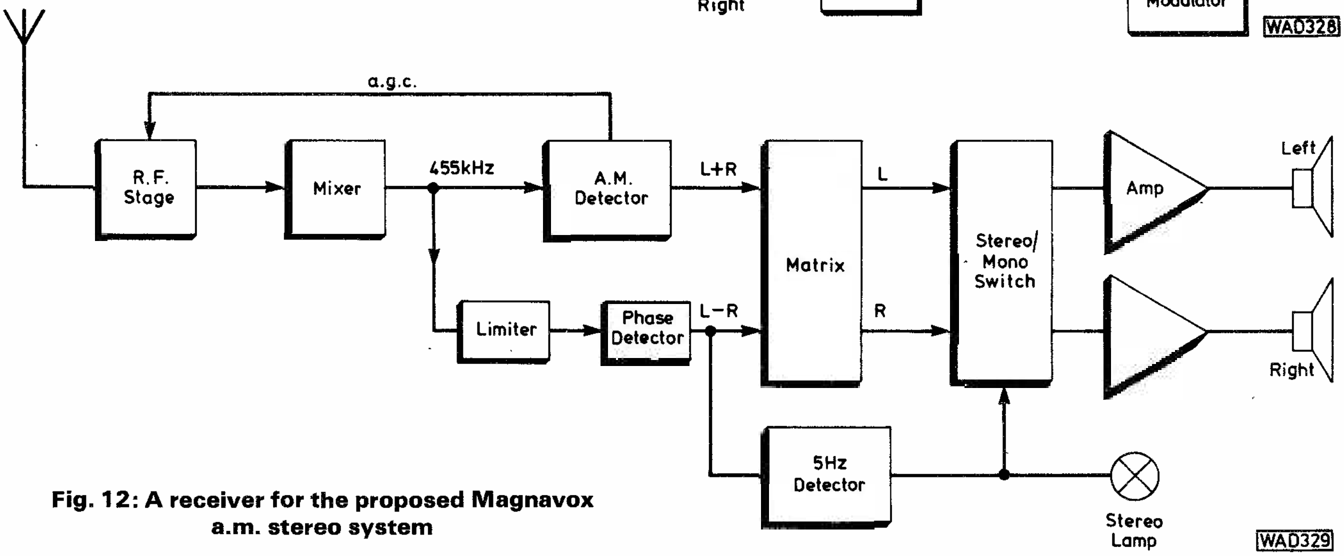


Fig. 12: A receiver for the proposed Magnavox a.m. stereo system

already developed some devices suitable for one or more of the proposed systems.

Quadraphony

A quadraphonic system involves the use of four loudspeakers placed in the four corners of a room. A few experimental quadraphonic transmissions have been made in the UK, but it seems doubtful whether there will be widespread use of this type of transmission outside the USA in the near future.

However, a series of Motorola devices is available for use in quadraphonic systems. The MC1312P can be used for converting the two multiplexed quadraphonic input signals, either from a radio receiver or from a record, into the four quadraphonic channels. The MC1313P is somewhat similar, but can operate from a supply voltage as low as 8V, and is intended for use in car equipment. The MC1314P is used with a single potentiometer balance control and enables other adjustments to be made conveniently to a quadraphonic system.

The MC1315P device can be used to enhance the front-to-back signal ratio by first detecting whether the front or back signal is dominant, and then providing an increased gain of between 6dB and 20dB in the dominant channels, whilst keeping the overall volume unaltered.

Conclusion

It can be seen that the devices we have discussed make it relatively easy to construct a stereo f.m. receiver, whilst manufacturers are certainly looking into possible future markets for a.m. stereo equipment and quadraphony. ●

PW GILLINGHAM FOLLOW-UP

continued from page 38

★ components

Resistors ($\frac{1}{4}$W 10%)		
10kΩ	1	R1
Integrated circuits		
14161	2	ICA, B
14011	1	ICC
Diodes		
1N914	4	D1–4

held low via the diodes. When the reset goes off ICs A and B count up until ICA pin 12 and ICB pins 12, 13 and 14 go high. When this happens ICC pin 2 goes high, allowing pulses through to IC4 pin 27. At the same time ICC pin 4 goes low, preventing the counters from incrementing. ●

by Eric Dowdeswell G4AR

Letters have been arriving from readers who took the RAE in December last. I would have dearly loved to have reproduced the whole of the letter from **Norman Wilson** of Darlington, Co Durham. He studied at home for the RAE with the help of the *PW* RAE series, and although he didn't fancy his chances he took the exam and has just learned that he passed with credit in both sections. He is now going for the code test, intending to get his G4+3 by his birthday, March 3. **On that day Norman will be 75!**

How's that for perseverance? Let me not hear any more whimperings from younger folk on the imagined difficulties of the RAE, especially when they have clubs and colleges providing courses that Norman was unable to attend. Good luck Norman, and hope to hear of your new call very soon.

Candidates for the next RAE, in May, will be guinea pigs in a fashion, as the format becomes multiple choice. After this exam it will be necessary to rewrite a lot of the material published on the RAE in the light of the questions to be set. Hopefully, *PW* may be able to take the lead with an article or two of practical hints and tips when dealing with multiple choice questions. I know of a number of people who would have been scared to sit the previous type of exam, but who will be at ease in the new format, because they are essentially practical people who can do better with their hands than with their brains. They, in my view, are of more benefit to amateur radio than the theorists.

On to **David Parker** BRS40420 (or was), of Elstead, Surrey, who passed the RAE and also intends going straight to G4. Congrats David and hope to QSO you some day. Now on to yet another hard worker, **Alan MacWood** in Arnold, Notts, who knew nothing of amateur radio a year ago, or of electronics, but who studied two hours every night from books that resulted in a distinction in Part 1 and a credit in Part 2 of the RAE. Alan hopes this anecdote will help others to success. Fantastic OM, and good luck on 2m and 70cm with your new ticket.

A very kind note from reader **W. H. Simcock,** who has donated a Hallicrafters SX28 receiver to one of the younger readers on my long list of those anxious to get a start in amateur radio. Any reader having a set that is suitable for the amateur bands, but which is no longer wanted, should contact me and I will arrange for it to be picked up without any further problems.

Vic Tuff BRS41507 of 38 Fourth Avenue, Blyth, Northumberland, has kindly volunteered to help any reader wanting info on ex-WD sets, but do send a sensible size stamped envelope for a reply. Incidentally, Vic wants info on the HF156 transmitter/receiver!

Ted Cawkwell writes from RAF Akrotiri, Cyprus, thinking he is a little old at 52 to be considered as a newcomer to amateur radio, but some of my previous comments ought to dispel that idea! Ted has a Tokyo Skylark receiver that covers 145kHz to 30MHz in 12 bands, and as it has a b.f.o. he has been able to start copying some s.s.b. on the bands. He intends to fix up a 60ft long wire and a.t.u. but I have a horrible feeling that severe cross-modulation will be the result with such a receiver, so don't expect too much, OM.

Backtracking to the receiver appeal I have a letter from an ex-amateur, now aged 76, in the Crediton area of Devon, who was licensed pre-war and who would like to get hold of a s.w. receiver "from somebody's cupboard". Drop me a line first if you can help. **Ian Calvert** of Shipley, Yorks, who appeared to be a bit of a newcomer, now tells me he has passed out as a marine Radio Officer but is still busy with courses on radar maintenance. So no problems with the code after he passes the RAE next May!

From Aberystwyth, Dyfed, comes news from **Pete Lewis** and his ex-WD R209 set which, unfortunately covers only 1 to 20MHz, but on 20m he has copied 8P6, FR8, ZL and VK using a 33ft aerial. Pete started five years ago with a one-valve regen job on 80m but, being a student on a grant, finds ex-WD equipment the best way to a decent receiver.

Band Activity

Sympathetic to my request for c.w. logs **C. P. Palfreyman** of Loscoe, in Derbys, sent in a short one for 80 and 160m where he uses an Eddystone EC10 and indoor aerial. On 160m W-land was no problem but he missed the calls of a PY and an EP. A UA9 on 80m was a good catch. **Bob Bell** in Blyth, Northumberland. found an interesting AG5H but I suspect this is yet another strange US call. On 40m 9Y4NP was a new one for Bob. **Bernard Hughes** BRS25901 agrees it is about time he had a go for the RAE but finds spare time hard to come by. However he seems to have done well on the bands with VP9JC, UM8MAW, 7X5AB and 8P6AH on 80m, FH8CL, FO8DF, LU3ZY (S. Sandwich Is) on 20m, and H44DX (QTH???), D4CBS, FP8GG and KA1NC on 10m.

Ean Retief ZS1PR of Paarl, S. Africa, kindly wrote to say that the ZD9GI reported by Dave Greenhalgh (Dec

78) is intended to be a beacon station but is not operational yet, and is located on Gough Island. Ean says only other ZD9 is ZD9GH on Tristan da Cunha, op Arthur, around 14 230kHz from 1900 onwards.

In Stevenston, Ayrshire, **Peter Ramsay** has added a TS500 receiver to his AR88 and FRDX400 so he's all set up on the receiving side after he gets his RAE next May. However, a manual on the TS500 would not come amiss as he feels it needs aligning, so contact Peter at 79 Campbell Avenue, if you can help. Peter's catches included VP8PM, 9N1MM, XT2AV and HS1WR on 20m, with KL7HJD and ZL4BO on the 15m band. **John and Steven Goodier** sharing an FRG-7 and 30ft wire in Marple, near Stockport, Cheshire, were delighted to get A35RB on Tonga after much chasing around the band for the last couple of months, locating him on the P29 net on 14 222kHz. J & S reckon the AG5H mentioned previously is on Guam so let's hope I'm wrong in thinking he is in the States. They also reveal that H44DX, queried above, is in the Solomon Islands, another good catch indeed. J & S seem to have been doing a round of the islands, a la Bill Rendell of Truro, with JW1BA (Svalbard), KC6GF (E. Caroline), VK2AGT (Lord Howe). VK2BVJ/VK9 (Norfolk), VK9XW (Christmas), VR1AB (Gilbert) not to mention 3D2UP (Fiji) and D68AD (?) (Comoros) all on 20m s.s.b.

Bill Rendell, just mentioned, found a goodly collection on his ancient valved AR3 plus preselector which he seems to coax to perform like a full-blown communications receiver! EP2TY, KG4W and VP2LFZ on 80m s.s.b. were coupled with D4CBS, DU9RG, EA9VO, KC6GF and XT2AV on 20m while 15m provided FG7BA, VP2FCW and VP2SZ, with VE8MA on Ellesmere Island reporting a temperature of minus 40°C, so we should complain!

A late note from **Bruce White** of Perth, W. Australia, says the FRG-7 is very popular there and affectionately known as the "Frog". He'd like to see reviews of amateur equipment included in *PW* from time-to-time so, Editor, please note. *This is already in hand—watch future issues! Ed.*

Old timers will be sorry to hear of the death of Bert Mathews G6QM of Cheltenham at the early age of 62 after a lifetime of amateur radio, having been active since the 30s. He had been an RSGB QSL Manager for many years, handling millions of cards on behalf of members. During WWII he was employed in a civilian capacity in a signals unit, and later worked for GCHQ in Cheltenham. He was a member of RAOTA and helped form the Cheltenham ARA.

Club Activity

Roger Wilson G8OOW of 112 Upgate, Louth, Lincs and friends are endeavouring to start a club in the area. Anyone caring to join in should contact Roger or ring Louth 2200. Let us pray for better weather than that which we have been having for the North Midlands Mobile Rally on Sunday, April 29 at Drayton Manor Park, Tamworth, Staffs organised by the **Midland ARS** and **Stoke-on-Trent ARS.** Location is on A4091 and easy reach of M1, M5 and M6. Talk-in stations on 2m and 70cm. Details, free car stickers, etc., from Norman Gutteridge G8BHE, 68 Max Road, Quinton, Birmingham B32 1LB or ring 021-422 9787.

Don't forget the **Stevenage ARS** meeting first and third Thursdays, 8pm at British Aerospace, Gunnels Wood Road, Stevenage, Herts. Sunday, April 22, sees the group visiting the NRSA radio and electronics show at Belle Vue, Manchester, while May 3 finds G4BWU talking on SSTV. Tuesday, April 10 means G8NOF talking to the **Bury RS** on Orbitting Test Satellites, with G8EUM discoursing on how to modify Pye equipment on Tuesday, May 8. Alternate Tuesdays are informal meetings with club station G3BRS activity, etc. Contact: M. Bainbridge G4GSY, 7 Rothbury Close, Ainsworth Road, Bury, Lancs or ring 061-761 5083.

West Kent ARS meets Fridays with alternating formal and informal meetings but all are welcome at any time. April 27 is fixed for the AGM with May 11 deciding on who has won the club's construction contest this year. Member G8CDD keeps putting up challenges to members, backed by a small prize, the latest being the loudest noise produced by a circuit powered by a U2 cell! Contact: Sec Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks, Kent on 0732 56708.

New Sec of the **Cheltenham ARA** is Grant Cratchley who will be pleased to give you details of club meetings. Write to 47 Golden Miller Road, Prestbury, Cheltenham, Glos. or ring 43891. The **Wirral and District AR Club** has just celebrated its first birthday and elected Alan G3NPJ as publicity officer. Meetings second and fourth Wednesdays at 8pm at the Sports Concourse, West Kirby. Contact: Sec Malcolm Mackintosh G8NMG on 051-334 1027 for details of meetings, visits, etc.

Tars Talk is the small but pleasant magazine of the **Torbay ARS** edited by F. Bolton G3VTQ. One recent article described means of adjusting the very popular 88μH toroids for use in audio filters. Potential members might like to meet the whole committee of TARS at one fell swoop at its AGM on April 28, at Bath Lane, rear of 94 Belgrave Road, Torquay. Sounds a bit cloak and daggerish!

I'm glad to report that the Wessex AR Group did decide to call itself the **Bournemouth Radio Society** at an EGM recently, Chairman, Roy Scott G2CZH, was so confident of success in changing the name that he was immediately able to present a suitably engraved gavel to President, Frank Hicks-Arnold G6MB! If this issue of *PW* gets out on time you will not miss the auction sale of gear and equipment on April 6, if you don't know about it already. April 20 sees Jerry Todd G2KV holding forth with slides on the basic principles of radar. Meetings on Fridays in the Club Room of the Dolphin Hotel, Holdenhurst Road, Bournemouth or contact The Chairman, Roy Scott G2CZH, 17 Dreswick Close, Christchurch, Dorset or ring (02015) 77103.

Bournemouth Radio Society will sadly miss their Sec/Ed Geoff Cole G4EMN, who died suddenly on Sunday 11 March.

Very important, don't forget, all logs, letters, copy, club news to reach me **by 15th of the month.**

Log Extracts

P. Lucas:—80m JA3EMU **20m** HM5MK SU1DT TU2HS VP2SAB 8P6JA

W. Rendell:—80m EP2TY KG4W TF5TP VP2LFZ **20m** D4CBS DU9RG EA9VO KA1MI KC6GF KP6AZ M1D P29JS XT2AV 8R1X 9X5PM **15m** EP2LI FG7BA VE8MA VP2FCW VP2SZ

J. & S. Goodier:—20m A35RB AG5H C21AA H44DX JW1BA KA1MI KC6GF VK2AGT VK2BVJ/VK9 VK9XW VR1AB 3D2UP **15m** D68AD HM6ZX **10m** ZP9AC 5Z4PD

P. Ramsay:—20m VP8PM 9N1MM XT2AV VE8RCS HS1WR **15m** ZL4BO KL7HJD

B. Hughes:—80m VP9JC UM8MAW 7X5AB 8P6AH **20m** A35BD FH8CL FO8DF LU3ZY **15m** FB8XV JR6LQP 5W1XV **10m** D68AD FP8GG H44DX

C. Palfreyman:—160m c.w. VO1HP W1BB K1PBW W4NVN **80m c.w.** KP4A UA9CNF VE2EZU

All s.s.b. except where stated otherwise.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

"Why should the medium waves be inferior to all other bands?" asks **K. Lewis** of Pensilva in Cornwall, who is referring to the sensitivity values quoted in the manual of his Realistic DX160. An examination of the specification of many receivers will reveal a similar situation and the answer in some, though not every case, is that the receiver performance has been deliberately degraded on the medium waves. It seems that the m.w. band is added to some excellent short-wave receivers so that the user can tune to his local station when he is not actually DXing. After all, who wants full communications facilities on the medium waves?

Performance on the Medium Waves

Why is it necessary to downgrade performance and how is it done? One object is to decrease selectivity and hence improve audio quality. Since only one band is involved, the easiest place to do it is in the r.f. stages where different tuning inductors are switched in for each band. My BRT400 uses staggered tuning on the m.w. "The two r.f. stages are aligned 10kHz on either side of the aerial tuning circuit" to quote the operating handbook. Unfortunately this has the effect of reducing receiver gain and sensitivity as well. Another method is to fit a damping resistor across one of the tuned circuits which reduces the *Q* and broadens the response. Receiver sensitivity is also reduced which may be an advantage if the receiver is liable to overloading on strong local signals.

Sensitivity

The ability to pick up weak signals is called sensitivity. A sensitive receiver will pick up more stations than a less sensitive one. How is it measured? By the smallest input, in microvolts, that will give a standard output, often 50 millivolts of audio. Signal-to-noise ratio has also to be taken into account as there is not much use hearing a weak station if it is drowned in noise. The signal-to-noise ratio (S to N) is actually measured as the ratio of S+N to N but none-the-less it is known as the signal-to-noise ratio, a figure of 10dB being normal. A sensitivity of 2µV for a S to N ratio of 10dB is good; 0·5µV is exceptional; 100µV is poor.

Look through the specification for "Sensitivity". It should be in the handbook or advertising literature. If the figure for the short waves is substantially better (lower) than for the medium waves then the receiver has probably had its performance degraded on the m.w. It is possible in some cases to counteract this and I have re-aligned my BRT400 without adverse results. It is not a good idea though to use a receiver in a way different to that intended by the designer, and there is also the guarantee to consider if the set is a new one. Some old receivers such as the CR100 outperform their modern counterparts on the medium waves because they have not been desensitised on this band.

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, Ashtead, 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.

Spain and the Geneva Plan

A list of the new frequency assignments in Spain and the Canary Islands is now available to DXers in return for unused Spanish postage stamps to the value of 25 pesetas or for two International Reply Coupons (available in main post offices). Write to Keith F. Hatcher, Duquesa de la Victoria 50bis, Logroño, Spain. His list is extracted from the "Bolitin Oficial del Estado" of 13 November last year, and it contains authorised frequencies and stations under the Geneva Plan though not all of them are actually operating at the moment. Medium wave DXers interested in Spanish DX should find this list of value.

Frequencies where chains of local outlets are to be found are 1134, 1224, 1314, 1395, 1413, 1476, 1485, 1503, 1584 and the new international common frequency 1602kHz. There has been considerable change in the Canary Islands but the 200kW Santa Cruz de Tenerife has only moved 1kHz to 621 where it should not be too difficult to hear. An interesting move is EAJ50 Las Palmas which is now on 1008kHz instead of 953 and it may be easier to hear on the new channel. EAJ46 in Ceuta is now on 1602kHz and this could be quite a catch as Ceuta is a Spanish enclave on the North African coast and is regarded as a separate DX country! Ceuta incidentally is pronounced Thayootah.

The proposals for the long waves are worth comment. Madrid is allotted 191kHz with a power of 1000kW, while 227kHz is shared between Barcelona 800kW, Bilbao 400kW, Linares 400kW and Lugo 200kW though none of these has appeared up to the time of writing. A long-wave loop will be of value on 227, to null out Poland.

UK Station List

The Twickenham DX Club have updated their "Broadcasting Stations of Great Britain" to take account of the reorganisation that took place on 23 November last year. The list includes m.w. and l.w. transmitters, including all those in synchronised networks, times of operation and postal addresses. Outlets for local BBC and Independent stations on v.h.f. are also covered. The list costs three 7p stamps in the UK or two IRCs from abroad and can be obtained from the TDXC, 13 Tennyson Avenue, Twickenham TW1 4QX, England.

There has been a scarcity of information about the changes that occurred last November. The 1979 issue of the World Radio and TV Handbook should fill the gap but it is expected to cost £8 a copy which may put it beyond the reach of many DXers. DX clubs and some individuals have been compiling lists of their own. Any information about such lists, for inclusion in this column would be welcomed.

Readers' Letters

From Thurso in the north of Scotland comes a letter from **David Stevenson** who has been chasing local radio stations in the UK with his National Panasonic RF2200 and internal aerial. Stations heard included Radio Trent in Nottingham on 999kHz at 0150, Downtown Radio in Belfast on 1026 at 0130, Radio Manchester on 1458 at 2340 and Capital Radio in London on 1548kHz. **Mark Hattam** prefers to do his local radio DXing during the hours of twilight in the morning or evening when European DX is lighter than at night, which is a point well worth noting. A portable receiver is ideal for hunting out local radio stations as many of them share the same frequency and the directional properties of the receiver's internal aerial can be utilised to null out QRM simply by rotating the whole receiver.

Radio Paradise in St Kitts on 1265kHz is in the news again with a report from **T. H. Lawrence** of Leicester who used an ex-WD R107T receiver along with the G2DYM anti-TVI trap dipole to pull in this station at 0014, with news and soul music. The Morse signal on 930kHz has been identified by **Geoff Halligay** who reports that "SW" is an aeronautical beacon located at Vykhma in Estonia. It is not a harmonic but does actually operate on 930kHz which is very surprising as the medium wave band is supposed to be allocated exclusively for broadcasting. More QRM!

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

Last month congestion on the short-wave bands was referred to and suggestions were made that might ease the problem from the DXers' point of view. The total amount of "space" available on the seven main bands (49 to 13m) is 1·85MHz. Although this may seem a lot, only a fraction of it is available at any one time, perhaps only a quarter, because of the peculiarities of propagation. This amount of space is wholly inadequate for the amount of international broadcasting that takes place at the present time. As a result, a number of stations operate just outside the band edges.

For example, the 25m band officially extends from 11 700 to 11 975kHz giving a band 275kHz wide but in practice broadcasting takes place between 11 620 and 12 100kHz giving a range of 480kHz. This is not illegal, as a number of readers have suggested, as the ITU regulations allow out-of-band broadcasting provided no interference is caused. A better solution would be to allocate a larger part of the spectrum to broadcasting and an international conference will have a look at this later in 1979.

World Administrative Radio Conference 1979

The WARC is to be held in Geneva next September. One of its tasks will be to have a look at the allocation of frequencies in the light of changes that have occurred since the last conference some 20 years ago. There have been significant changes. A lot of commercial traffic has moved from radio to submarine cables or to satellite links, so additional space in the spectrum is available and some of it may be allocated to broadcasting. Developing countries who would like to enter international broadcasting have a hard task to find frequencies. A number of administrations, including the BBC, have prepared proposals for the WARC and it might be useful to have a look at some of the possibilities.

An obvious solution is to enlarge the existing bands well beyond even the unofficial limits. For example, double the size of each band. This would cause few problems with existing receivers. Another is to have additional bands between 25m and 19m or between 19m and 16m though these might be outside the range of some sets. Although these suggestions would reduce overcrowding they would do nothing to ease the problems of short distance reception. At my QTH Radio Sweden and Radio Netherland come in well on 49 metres during the day, but after dark reception deteriorates and a move to a lower frequency is then required. At the moment only the 75m band is available which provides a mere 50kHz between 3950 and 4000kHz. This band is outside the range of most receivers.

Save 60 Metres

The main tropical band is 60 metres which extends from 4750kHz to 5060kHz, with a gap between 4995 and 5005 to leave space for frequency standard and time signal stations. One proposal to the WARC is that 60 metres should be allocated to broadcasting on a worldwide basis, a proposal which has generated some heat in the DXing world. A Belgian DXer has started "Operation SOS" to save 60m while an enthusiast in the Faroe Islands hopes to contact tropical broadcasters and offer them "support".

Tropical band DXing has a large following and some of the most skilful people in the hobby operate in this area. One can understand the dismay that such a proposal arouses, but one has to be realistic about it. We live in a changing world and the changes confronting the DXer are ones he is unlikely to influence. There is already considerable QRM on 60m from commercial stations and presumably this would reduce or be eliminated if the band becomes a worldwide one. We might even end up with a band something like the medium waves! I don't know whether this is something to look forward to or not. It is idle to speculate. Some of the proposals may not be adopted and current fears may therefore be groundless. The problems with overcrowding are so bad that some change is inevitable, change which might inject new life into the hobby of short-wave listening.

Reporting Codes

"Could you explain the meaning of the numbers designated in the SINPO code?" asks **Robert Darwent** of Sheffield, who is a newcomer to the hobby. This subject was fully covered in the April 1978 issue of *PW* but for the benefit of those who have just taken up DXing, a short recap might be useful.

The simplest code is SIO where S stands for signal strength, I for interference (from other stations) and O for overall merit. The figures 1 to 5 denote the degree. For both S and O, 5 means excellent, 4 good, 3 fair, 2 poor, 1 barely audible or unusable. The corresponding values for I are 5 nil, 4 slight, 3 moderate, 2 severe, 1 extreme. This is the code used in my logbook and it is adequate for most purposes.

SINPO and SINFO are just SIO plus additional letters which denote noise (N), propagation disturbance (P), and

fading (F), all being on a similar scale to I. Fading can also be measured as the number of fades per minute, though what use this information would be to anyone is not clear. The trouble with SINPO and SINFO is that they are too complicated and give rise to doubts in the mind of the DXer, judging by the number of readers who write to me about them. My advice is to forget all about SINPO/SINFO. Stick to SIO. It is simple, unambiguous and quite adequate for normal DXing.

31 Metre Band

When I first started DXing, 31 metres was my favourite band, mainly because good DX was to be found there during the evening which is a convenient time to tune around the short waves. There is some middle distance DX to be heard during the day though, so look for Greece on 9530kHz, Switzerland on 9535, Finland on 9559, Italy on 9575, Vatican City 9645, Portugal on 9740 and Austria on 9770. DX to be found after dark includes Cairo on 9475kHz, Turkey 9515, Qatar 9570, Japan 9585, Taiwan 9600, Chile 9630 and 9750, Baghdad 9758. Australia can be logged on 31m at breakfast time. Listen on 9570kHz between 0600 and 0900, reception being best at the start of this transmission.

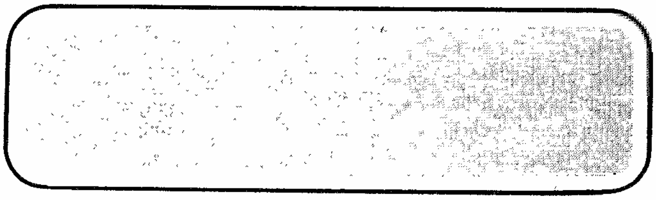
Readers' Letters

The scale markings on the Lafayette HE30 receiver have been puzzling **J Markham** of Darlington. They are actually in MHz, even on the medium waves but only figures are indicated on the scale. **Gerald Yates** (Paignton) points out that it is easy to convert from MHz to metres. Divide 300 by the frequency in MHz to get the wavelength in metres and vice versa. To convert MHz to kHz multiply by 1000.

Peter Smith (Fareham) and **Bernard Hughes** (Worcester) would like to hear Radio New Zealand. Try 6105kHz at 0600 and 9620 a little later. RNZ has also been heard on 11 800 at 2000 and on 15 130 at 0630 but these frequencies may have changed recently. Has anyone up-to-date information on RNZ? **Chris Howles** asks if a loop aerial would work on 60m. Only on ground wave signals, see *PW* December 1978 issue. **Brian Hall** writes from Aberdeen to say that he has a liking for the older type of valve set (so have I) and he operates a Pye PE60 with an a.t.u. which he built recently from a kit of parts supplied by Codar. **Bill Stevenson** (Swinton) likes to listen to DX Juke Box from Radio Netherland but he finds reception from Holland rather difficult after dark. He has found the R Netherland relay in Madagascar on 11 730 at 1830 with SIO 544 which provides the answer.

Radio Finland

Radio Finland is starting a series of programmes for the short-wave enthusiast entitled "World of Radio" and these will be aired fortnightly as part of the Sunday Best programme. Frequencies in use to Europe are 11 755 and 15 265 from 1300 to 1430. The 11 755 transmission is also on the air from 0800 to 0930. Of particular interest is Short-wave Broadcasting on 22 April. Other subjects to be covered are Amateurs, Propagation, Reception. Full details of the programmes and any frequency changes can by had by writing to Radio Finland, Box 95, Helsinki 25, Finland.



by Ron Ham BRS15744

Despite the appalling weather, the winter of 1978/79 produced some goodies for us v.h.f. addicts: BBC television received in South Dakota, a trophy for a chairman, a 23cm radio telescope from Henry Hatfield, pictures from the Chinese border, a super contact on 2m and good prospects for the rest of the year.

Congratulations to **Eric Letts** G3RXJ, Chairman of the Mid-Sussex Amateur Radio Society, who was awarded the G5RV Trophy by the Society for his work in the field of microwaves. Eric's home-built gear for 23cm has achieved contacts of more than 100 miles and, while experimenting with equipment for 3cm and encouraging other members to do the same, he is formulating ideas for using s.s.b. for microwave communication. The Trophy was presented at the Society's AGM in January by their President, **Louis Varney** G5RV, who donated the award. Louis also gave a cup and a trophy to the RSGB who, periodically, present them to members for outstanding work in the field of v.h.f., u.h.f. and satellite communications.

Solar Activity

For some months, **Cmdr Henry Hatfield,** Sevenoaks, has been building a 1296MHz solar radio telescope, to complement the existing 136MHz instrument in his observatory. Henry's efforts were rewarded during the afternoon of February 12 when he recorded solar noise on his new machine, and proved it by alternating his 25-element, home-brew aerial between the "cold" sky and the "hot" sun. As this is new ground for amateur radio astronomers, none of us know how the sun behaves at 23cm so we are keenly awaiting Henry's reports each time the sun is "active".

At 0915 on the 12th, I heard a massive burst of solar noise cover several megahertz around the 6m band on my R216, fed by a dipole. I was not surprised when later in the day the 2m telescopes of **John Smith,** Rudgwick, Sussex, Henry Hatfield and myself were recording a mild noise storm, while at 60MHz, the telescope run by the radio section of the South East Essex Astronomical Society recorded some of the bursts. Between 1245 and 1400 on the 6th we all recorded three large individual bursts of solar noise, Fig. 1, and two more were recorded by Henry and John, at 136MHz, at 1004 and 1020 on the 10th.

We all recorded the 3·5 minute duration burst at 1256 on the 16th which heralded the 4-day period of solar activity which reached a peak on the 18th. John Smith said it was the strongest he had recorded for three years and **John Cooper** G8NGO, Cowfold, Sussex reported S9+ background noise on 2m when he pointed his beam toward the setting sun that afternoon.

The prolonged overcast skies of January and February prevented Henry from using his spectrohelioscope to any extent and no doubt the same applied to **Neil Clarke,** BRS 34306, Knottingley, West Yorks, who uses a table-top telescope to project the sun's image on to a card in a dark box, so that he can draw the visible sunspots. Small bursts

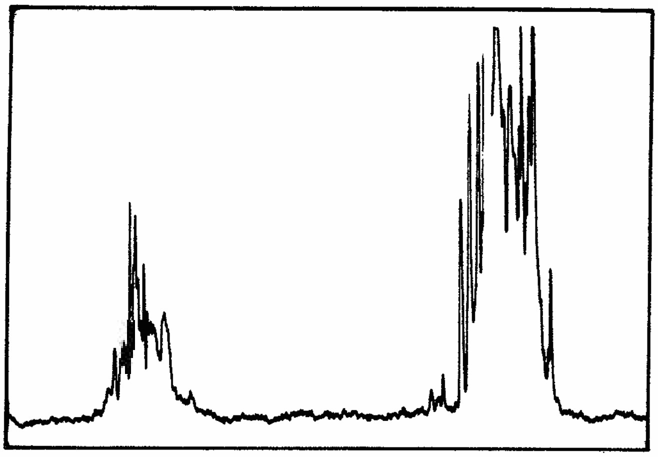


Fig. 1: Two of the solar bursts recorded by the author at 146MHz on February 6

of solar radio noise were also recorded on most days from January 16 to 30.

The 10 Metre Band

"Conditions have improved a lot since mid-January," writes Neil Clarke on February 13, "I am still hearing 3B8MS on 28·187MHz and good signals from A9XC, ZE2JV and 5B4CY on most days." Like Neil, I regularly listen on the International Beacon Project frequencies and between January 20 and February 20, I heard, almost daily, signals averaging 549 from the beacons in Bahrain, A9XC, Cyprus, 5B4CY, Germany, DL0IGI and occasionally Bermuda, VP9BA. Neil heard a new beacon, W6IRT, on 28·888MHz, so your reports about this, or any of the IBP signals are always welcome: "Now the days are getting longer," says Neil, "it's nice to see 10m opening earlier, around 0700, and staying open to "W" land till 1900 and closing about 2000 with PY and LU stations".

Alan Baker G4GNX, Newhaven, says: "It is often rewarding to look around 10m at midnight," and **John Branegan** GM8OXQ, Saline, Fife, reports: "very consistent and surprising short skip" on several days in January and early February. **Frank Luman,** Glasgow, comments about the high level of 10m s.s.b. activity on February 3, and adds: "I am now back from the US and found three letters awaiting me thanks to your mention of the club". Glad to be of service Frank, let's hope the Scottish VHF and SW DXers club continues to gain in strength.

While in New York on business, **John Keegan** is taking the opportunity to get some first hand information about 27MHz Citizens' Band operation. **Graham Lay,** West Chiltington, Sussex, is surprised by the strength of the signals received on his AR88, from these tiny CB transmitters from both Europe and the American continent.

The Sweepers

Both Alan Baker and Neil Clarke have asked: "Have you heard the sweepers?"; these are signals which sound like a rough, a.c. modulated carrier, sweeping down in frequency, and are usually heard between 21 and 28MHz. Neil has suggested that if my readers keep an ear out for these, note the date, time and prevailing band conditions and send the reports to him at 64, Mill View, Ferrybridge, Knottingley, W. Yorks, he will pass the information on to ZS6BT who requires it.

DX TV

At 1458 on February 15, **Alf Lee** G4DQS, Brighton, learnt in a 10m s.s.b. QSO with WA0QLP, South Dakota, that between 1500 and 1700 GMT on the 14th he had received BBC TV sound on 41·5MHz and vision on 45MHz. Alan Baker was not a bit surprised when told about this event because, apart from 10m being wide open on the 13th and 14th, 20m was open to the USA until about 0300.

Ian Rennison, Horsham, and myself received a mixture of pictures from eastern Europe and Russia on Channel R1, 49·75MHz, during the early mornings of February 4, 7, 11 to 17 inc., and 20, which all shows that the ionosphere was varying considerably. On most of these days many continental radio-telephone signals were heard between 40 and 50MHz, and periodically Channel R1 sound signals were received on 56·25MHz. At 0853 on the 7th, Frank Luman saw a weak test card on R1; on the 9th he positively identified a Russian test card and on the 10th, **John Cowan,** Glasgow, saw an announcer on R1 around 0820. Although John Branegan could not lock the R1 signals on the 4th, he counted eight separate pictures, overlapping via multipath reflections, between 0850 and 1015 on the 6th. At 0900 GMT on the 7th, both John and **Roger Bunney,** Southampton, caught a brief glimpse of a Russian test card with a clock which was indicating 1600 local time, suggesting that these pictures were coming from the Chinese border.

Two Metre Record Broken Twice

On hearing about some super DX, a delighted **Constance Hall** G8LY, Lee-on-Solent, prompted me to contact **Norman Joly** G3FNJ, ex SV1RX, Harrow, who said that during the disturbed conditions on the 13th a c.w. contact was made around 1800 on 144·219MHz, between SV1DH in Athens and ZS6DN in Pretoria, a distance of 7117km and believed to be a world record. At 1823 on the 16th, SV1AB, just north of Athens, also established two-way contact with ZS6DN and increased the record to 7127km. My congratulations to all three stations.

Satellites

John Branegan had seven QSOs through OSCAR 7B when it returned to life in early February, and has worked several new Italian stations via OSCAR 8J. Some visitors to John's shack have asked: "Why can we no longer hear OSCAR 8A and RS 1?" So he has been explaining how the ionosphere, which reflects long distance signals on 10m down from its lower side, sends satellite down-link signals back into space from its upper side. In his first year as a GM8, John has received 115 QSL cards confirming satellite contacts in 20 countries, and has a further 15 countries still unconfirmed. His best confirmed DX so far is with W0SL in Missouri, a distance of 4000 miles.

Tropospheric

For most of the time between January 22 and February 16 the atmospheric pressure was below 30·0in and offered little chance of any v.h.f. DX. However, this did not deter my readers from having a go and during the afternoon of January 31, **Chris Gaston** G8FBR, Hassocks, Sussex, heard an EI on 2m. On February 4, **Barry Ainsworth** G4GPW, in nearby Sompting, heard a DB9 on 2m and Alan Baker heard two French stations working through the Brighton repeater GB3SR, R3. Around 1900 on the 5th, Alan worked F6AID, Normandy, through GB3SR and could also hear the French signal on the repeater input, 145·075MHz. John Cooper has now installed a 14-element parabeam and is consistently monitoring the signals from the Cornish 2m beacon, GB3CTC, and during the evening of February 15 he received signals from both 'CTC and the French beacon at Chartres, FX0THF, 144·89MHz. Also on the 15th, **Roy Bannister** G4GPX, Lancing, had a 2m c.w. QSO with G4GXE in Stoke-on-Trent and did the same with a DF2 during the morning of the 18th.

New Callsigns

"I am no longer BRS39756", writes **David Wakefield,** Worthing: "I now have the callsign G8RVK, and after being on the air for only 13 days I have already had 115 QSOs with a total of 45 different stations including **Dermot Cronin** G4GRO, on the Royal Sovereign Light". Well done David, it is with your sort of enthusiasm that radio amateurs have pioneered their way through the radio frequency spectrum. I also know that David has been promoted to Sergeant in the Worthing, 45F Squadron, ATC, and although his new duties prevent him from operating the Squadron's transmitter as often as he used to, he makes up for it at home, on 2m, with a Pye Bantam into a Slim Jim or an 8-element beam. **Ern Hoare** G8BDJ is now G3RZD, his old /T call, and **Alec Painter,** formerly G8EAQ is now G4HUJ.

From Lowdham, Notts, 11-year-old **Stuart Hardy** says that his present receiver finishes at 18MHz and hopes one day to build the *PW* 2m converter. **Iain Muir** and his brother in Blantyre, near Glasgow, use an FRG-7 and are interested in v.h.f. TV DX.

New Repeater Group

The Mendip Repeater Group was formed on 4 October 1978, and their initial meeting was attended by 28 local amateurs who felt there is a need to fill in the 2m repeater coverage area between GB3BC, SN and NC. At present they have 70 paid-up members, the equipment is under construction and they hope to be operational by late 1979 with the callsign GB3WR on R0. Readers interested should contact the group's secretary, Barrie Stevens G8KKA, QTHR.

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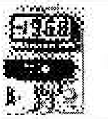

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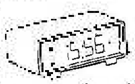

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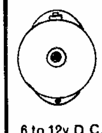

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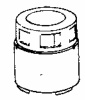

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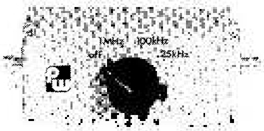

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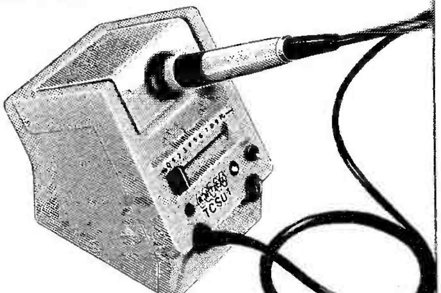
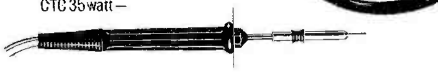
Model TCSU1 Soldering Station



CTC 35watt—



The TCSU1 soldering station with either the XTC 50watt—24/26 volt soldering iron or the CTC 35watt—soldering iron for pin point precision and exceptionally fast recovery time. We have put at least twice as much power into irons which are already well known for good recovery time. The temperature control stops them from over-heating; the "fail-safe" electronic circuit provides protection even if the thermocouple fails. TCSU1 soldering station with XTC or CTC iron **£38.88** including VAT postage extra.

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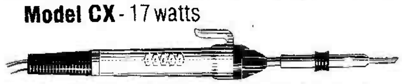

. . . a miniature iron with the element enclosed first in a ceramic shaft, then in a stainless steel. Virtually leak-free. Only 7½" long. Fitted with a 3/32" bit. **£4·37** inclusive of VAT and P.&P. Range of 5 other bits available from ¼" down to 3/64".

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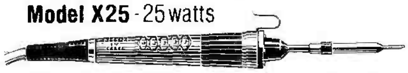

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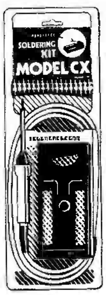

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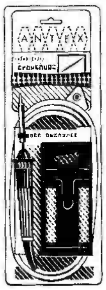

With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£6·21** inclusive of VAT and P.&P.

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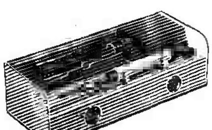

This kit contains a 15watt miniature soldering iron, complete with 2 spare bits, a coil of solder, a heat sink and a booklet,'How to solder'. Priced at **£6.48** inclusive of VAT and P.&P.

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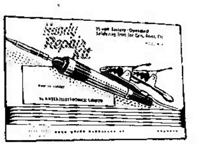
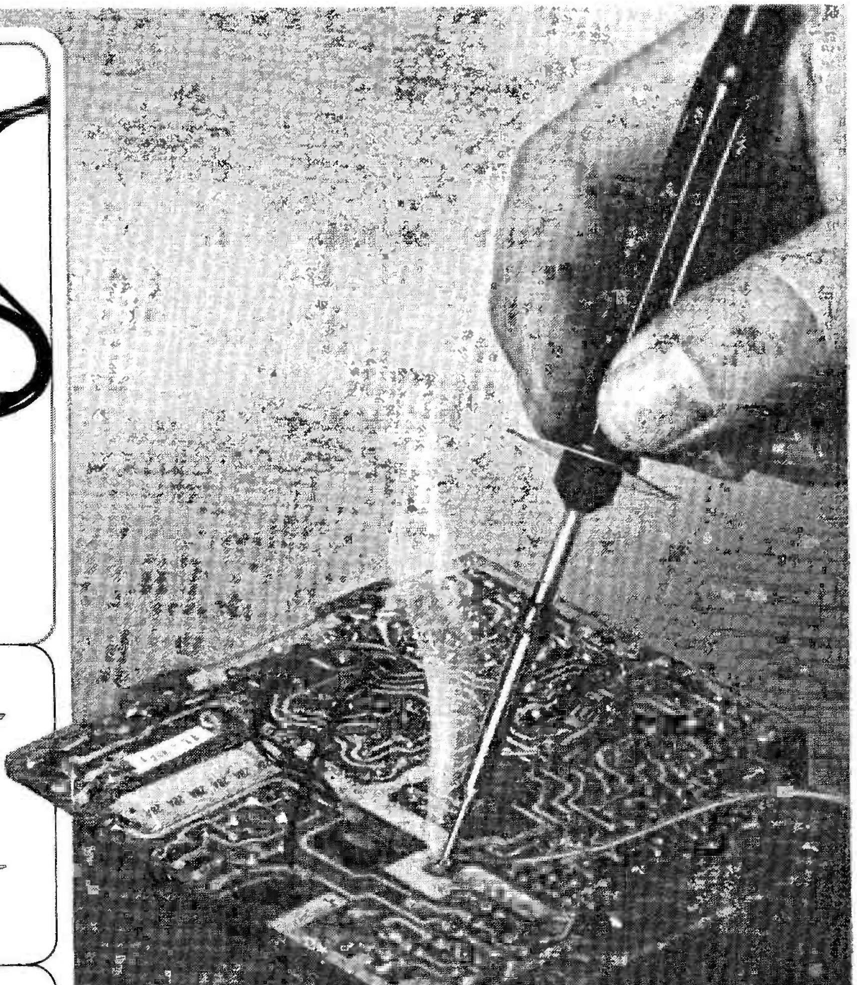


The soldering iron in this kit can be operated from any ordinary car battery. It is fitted with 15 feet flexible cable and battery clips. Packed in a strong plastic envelope it can be left in a car, a boat or a caravan ready for soldering in the field. Price **£4.83** inclusive of VAT and P.&P.



With the

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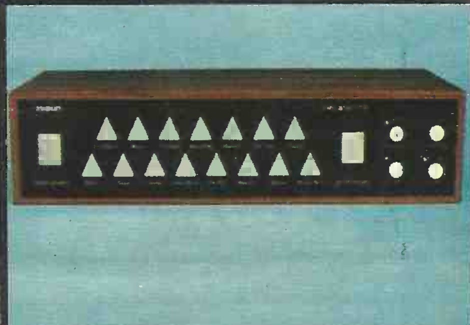

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