RADIO... ELECTRONICS... INSTRUMENTS... AUDIO...

practical WIRELESS

50p

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New Zealand 85c
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Malaysia $2·25

MAR 1979

8-PAGE SUPPLEMENT
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HINTS & TIPS FOR CONSTRUCTORS

THE PW 'WINTON' STEREO AMPLIFIER

50 + 50W

using power FETs

also: THE PW 'SOUNDLITE' SOUND TO LIGHT UNIT

TTL ★ ★

[illegible]	11p
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7410	12p
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7421	20p
7422	15p
7423	20p
7425	20p
7426	22p
7427	22p
7428	25p
7430	12p
7432	20p
7433	28p
7437	20p
7438	20p
7440	12p
7441	45p
7442	40p
7443	60p
7444	60p
7445	65p
7446	50p
7447	50p
7448	50p
7450	12p
7451	12p
7453	12p
7454	12p
7460	12p
7470	25p
7472	20p
7473	25p
7474	25p
7475	25p
7476	25p
7480	40p
7481	85p
7482	75p
7483	75p
7484	70p
7485	60p
7486	25p
7489	130p
7490	25p
7491	40p
7492	35p
7493	30p
7494	70p
7495	45p
7496	45p
7497	120p
74100	80p
74104	40p
74105	40p
74107	25p
74108	100p
74109	25p
74118	75p
74120	80p
74121	25p
74122	35p
74123	40p
74125	35p
74126	35p
74128	60p
74130	120p
74131	90p
74132	45p
74135	90p
74136	80p
74137	90p
74138	100p
74141	50p
74142	180p
74143	270p
74144	270p
74145	55p
74147	100p
74148	90p
74150	65p
74151	45p
74153	45p
74154	70p
74155	45p
74156	45p
74157	45p
74160	55p
74161	55p
74162	55p
74163	55p
74164	60p
74165	60p
74166	75p
74167	160p
74170	100p
74173	80p
74174	60p
74175	60p
74176	50p
74177	50p
74178	75p
74179	120p
74180	90p
74181	130p
74182	50p
74184	120p
74185	100p
74188	320p
74190	70p
74191	70p
74192	60p
74193	60p
74194	55p
74195	50p
74196	50p
74197	50p
74198	100p
74199	100p
74293	90p
7LS00	18p
74S112	80p
7805	100p
7812	100p
7815	100p
7818	100p
7824	100p

POWER SUPPLY CAPACITORS

2200/16	35p	4700/63	120p
2200/63	80p	4700/70	135p
2200/100	150p	10000/10	100p
3300/30	50p	10000/25	150p
3300/63	90p	15000/15	150p
4700/25	50p	22000/25	200p
4700/40	65p		

ENQUIRIES FOR ANY OTHER TYPES

CMOS

4000	12p	4047	80p
4001	12p	4048	50p
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4006	80p	4050	25p
4007	14p	4054	100p
4009	30p	4055	130p
4011	12p	4056	120p
4012	12p	4060	100p
4013	30p	4066	35p
4015	50p	4069	12p
4016	30p	4070	12p
4017	50p	4071	12p
4018	55p	4072	12p
4019	40p	4081	12p
4020	50p	4082	12p
4022	50p	4093	70p
4023	12p	4510	60p
4024	40p	4511	70p
4025	12p	4516	65p
4026	80p	4518	65p
4027	30p	4520	65p
4028	45p	4528	80p
4029	50p	4583	70p
4030	30p		
4032	80p		
4033	100p		
4040	60p		
4043	60p		
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FX1593 FERRITE RINGS
O/D 12mm, I/D 6mm
10 for 70p

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Single Pole C.O. Biased 85p

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CA3039	70p	NE562B	400p
CA3046	60p	SAD1024	1500p
CA3060	225p	SL917B	650p
CA3065	200p	SN76003N	150p
CA3076	250p	SN76013N	110p
CA3080	75p	SN76013ND	125p
CA3084	250p	SN76023N	110p
CA3085	85p	SN76023ND	125p
CA3086	60p	SN76033N	150p
CA3088	190p	SN76227N	160p
CA3089	160p	SN766228N	180p
CA3090AQ	360p	SN7666DN	75p
CA3123E	130p	TAA300	100p
CA3130	100p	TAA350	190p
CA3140	60p	TAA550	35p
LF356	80p	TAA570	220p
LF357	80p	TAA661B	140p
LM211H	250p	TAA700	350p
LM300TR5	170p	TAA790	350p
LM301AN	30p	TAD100	150p
LM304	200p	TAD110	130p
LM307N	65p	TBA120S	60p
LM308TO5	100p	TBA120T	85p
LM308DIL	100p	TBA480Q	200p
LM309K	100p	TBA520Q	200p
LM310TO5	150p	TBA530Q	200p
LM311TO5	150p	TBA540	200p
LM317K	325p	TBA550Q	250p
LM324	70p	TBA560C	250p
LM339	60p	TBA641A12	250p
LM348N	90p		
LM380	60p	TBA700	180p
LM381N	90p	TBA720Q	225p
LM382	90p	TBA750Q	200p
LM391	180p	TBA800	80p
LM555	25p	TBA810	100p
LM709C	40p	TBA820	100p
LM710TO5	69p	TBA920Q	280p
LM710DIL	65p	TCA270Q	220p
LM723TO5	40p	TCA270S	220p
LM723DIL	40p	TCA760	300p
LM733	120p	TCA4500A	450p
LM741	20p	TDA1008	300p
LM748	40p	TDA1034	450p
LM1303N	100p	TDA2002	300p
LM1458	100p	TDA2020	300p
LM3080	75p	TL084	120p
LM3900	55p	XR320	250p
LM3909N	65p	XR2206	450p
MC1310P	140p	XR2207	450p
MC1312P	150p	XR2208	600p
MC1314P	190p	XR2216	650p
MC1315P	230p	XR2567	250p
MK50398	650p	XR4136	150p
MM5314	380p	XR4202	150p
MM5316	480p	XR4212	150p
NE529K	150p	XR4739	150p
NE555	25p	ZN414	100p
		95H90	700p

ELEC CAPACITORS

0·47/25	7p	47/10	8p
1/16	7p	47/16	8p
1/25	7p	47/25	8p
1/50	7p	47/35	8p
2·2/25	7p	47/50	9p
2·2/35	7p	100/10	8p
3·3/25	7p	100/16	8p
4·7/10	7p	100/25	8p
4·7/16	7p	100/50	8p
4·7/25	7p	100/63	16p
4·7/50	7p	220/16	12p
6·8/25	7p	220/25	14p
10/10	7p	220/50	22p
10/16	7p	330/25	17p
10/25	7p	330/35	18p
10/50	7p	330/50	20p
22/6V3	7p	470/10	14p
22/10	7p	470/25	19p
22/16	7p	470/35	20p
22/25	7p	470/50	24p
22/35	7p	1000/16	27p
22/50	8p	1000/25	30p
33/6V3	7p	1000/35	35p
33/16	8p	1000/40	40p
33/25	8p	1000/63	50p
33/40	8p	1200/63	60p
33/50	9p	2200/10	30p

POLY CAPS

1000 PF	5p	0·1 uF	6p
2200	5p	0·22 uF	7p
3300	5p	0·33 uF	9p
4700	5p	0·47 uF	12p
6800	5p	1·0 uF	20p
0·01 uF	5p	2·2 uF	25p
0·022 uF	5p	4·7 uF	35p
0·033 uF	5p	6·8 uF	40p
0·047 uF	5p	10 uF	60p

TANT. BEADS

0·1/35V	14p	3·3/16V	14p
0·15/35V	14p	4·7/16V	14p
0·22/35V	14p	4·7/25V	14p
0·33/35V	14p	4·7/35V	14p
0·47/10V	14p	6·8/6V3	14p
0·47/35V	14p	6·8/35V	14p
0·68/35V	14p	1·0/35V	14p
1·00/10V	14p	22/15V	21p
1·00/35V	14p	33/16	25p
1·5/35V	14p	47/3V	20p
2·2/25V	14p	47/16V	25p
2·2/35V	14p	100/3V	25p

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26MM Long 10 for
50MM Long £1·00p

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AC121	30p
AC126	20p
AC127	20p
AC127/01	25p
AC128	20p
AC151	25p
AC153	30p
AC153K	40p
AC154	30p
AC187	20p
AC188	20p
ACY17	35p
ACY19	35p
ACY20	35p
ACY22	40p
ACY40	50p
ACY41	50p
ACY42	50p
AD130	150p
AD143	150p
AD149	80p
AD161	30p
AD162	30p
AD161/2MP	70p
AF114	25p
AF115	25p
AF116	25p
AF118	80p
AF178	95p
AF139	35p
AF239	45p
AF279	50p
AU110	180p
BA114	12p
BA121	12p
BA154	12p
BA157	15p
BA173	15p
BAX13	5p
BAX16	5p
BAW21	20p
BB105	35p
BB110	35p
BC107	10p
BC108	10p
BC108C	15p
BC109	10p
BC109C	15p
BC113	12p
BC114	15p
BC115	15p
BC116	15p
BC117	18p
BC118	12p
BC119	25p
BC125	16p
BC125B	20p
BC126	20p
BC134	15p
BC136	16p
BC137	16p
BC138	30p
BC140	30p
BC141	30p
BC142	30p
BC143	30p
BC147	10p
BC148	10p
BC148C	14p
BC149	10p
BC153	16p
BC154	18p
BC157	10p
BC158	10p
BC159	10p
BC167A	12p
BC168	14p
BC169	15p
BC171	12p
BC172	12p
BC177	15p
BC178	15p
BC182	10p
BC182L	12p
BC183	10p
BC183L	12p
BC184	10p
BC184L	12p
BC186	20p
BC204	12p
BC205	12p
BC207	12p
BC212	11p
BC212L	12p
BC213	10p
BC213L	15p
BC214	15p
BC214L	18p
BC237	10p
BC237B	15p
BC268	16p
BC294	30p
BC300	25p
BC301	25p
BC303	30p
BC307	15p
BC308	15p
BC317	12p
BC318	12p
BC323	30p
BC328	18p
BC337	20p
BC338	18p
BC348	20p
BC461	35p
BC516	35p
BC517	35p
BC547	12p
BC547B	13p
BC548	12p
BC548C	14p
BC549B	13p
BC549C	14p
BC557	13p
BC557B	15p
BCY34	80p
BCY38	100p
BCY42	25p
BCY43	25p
BCY58	18p
BCY59	25p
BCY70	15p
BCY71	20p
BCY72	15p
BD115	45p
BD121	85p
BD131	35p
BD132	35p
BD133	45p
BD135	35p
BD136	35p
BD137	40p
BD139	40p
BD140	40p
BD144	160p
BD181	100p
BD182	100p
BD188	130p
BD207	70p
BD220	65p
BD222	65p
BD233	50p
BD238	50p
BD252	50p
BD263	65p
BD607	80p
BD608	80p
BD609	80p
BD610	80p
BDX32	200p
BDX42	50p
BDY10	100p
BF115	20p
BF120	50p
BF121	45p
BF123	45p
BF125	45p
BF127	50p
BF137	35p
BF154	18p
BF160	18p
BF161	18p
BF173	20p
BF178	25p
BF179	25p
BF180	30p
BF181	30p
BF182	30p
BF183	25p
BF184	20p
BF186	25p
BF194	10p
BF195	10p
BF196	10p
BF197	10p
BF198	25p
BF199	25p
BF200	30p
BF224	20p
BF225	20p
BF241	16p
BF244B	35p
BF255	25p
BF257	25p
BF258	25p
BF259	25p
BF271	25p
BF274	30p
BF324	30p
BF336	35p
BF337	35p
BF451	25p
BF367	20p
BF394	35p
BF458	50p
BF594	50p
BF596	50p
BF597	50p
BFR40	30p
BFR80	30p
BFW58	20p
BFW60	25p
BFW88	30p
BFW89	30p
BFW91	30p
BFX29	25p
BFX34	25p
BFX38	25p
BFX44	35p
BFX48	45p
BFX81	100p
BFX85	30p
BFX87	25p
BFX88	25p
BFY10	30p
BFY18	100p
BFY19	100p
BFY50	20p
BFY51	20p
BFY52	20p
BFY53	25p
BFY90	125p
BR101	35p
BRY39	35p
BRY56	35p
BSX20	20p
BSY40	25p
BSY95	20p
BT100A	80p
BU105	200p
BU133	180p
BU208	220p
BY100	25p
BY126	15p
BY127	15p
BY133	25p
BY164	50p
BYX94	8p
C1120	30p
C1164	20p
E100	42p
E300	47p
E310	60p
E420	180p
E430	120p
MJE340	45p
MPSA05	30p
MPSA06	32p
MPSA56	32p
TIP29	35p
TIP29A	40p
TIP29C	40p
TIP30	35p
TIP30A	40p
TIP30B	40p
TIP30C	45p
TIP31	40p
TIP31A	45p
TIP31B	50p
TIP31C	55p
TIP32	40p
TIP33	60p
TIP34	70p
TIP35	200p
TIP35C	225p
TIP41A	70p
TIP41B	75p
TIP41C	80p
TIP42A	80p
TIP42B	85p
TIP42C	90p
TIP2955	70p
TIP3055	50p
TIS90	25p
TIS91	25p
IN914	5p
IN3754	20p
IN4001	5p
IN4002	5p
IN4003	5p
IN4004	5p
IN4005	5p
IN4006	6p
IN4007	7p
IN4148	4p
2N456A	90p
2N929	20p
2N930	20p
2N1302	25p
2N1303	30p
2N1305	30p
2N1306	38p
2N1308	50p
2N1711	22p
2N2219A	25p
2N2483	30p
2N2906	16p
2N2907	20p
2N3053	20p
2N3054	50p
2N3055	60p
2N3702	11p
2N3703	12p
2N3704	12p
2N3705	12p
2N3706	12p
2N3708	12p
2N3715	300p
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★

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3p each 100 for £2·00

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100K LIN	250K LOG
250K LIN	500K LOG
500K LIN	1M LOG
1M LIN	2M LOG

2M LIN All at 30p Each

GANGED POTS
5K+5K LIN or LOG
10K+10K LIN or LOG
25K+25K LIN or LOG
50K+50K LIN or LOG
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250K+250K LIN or LOG
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BC148
BC149
BC157 100
BC158 Assor-
BC159 ted
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BF195
BF196
BF197

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B5092	125p
CD43	125p
CV4523	100p
GN4A	125p
GN9A	125p
VX9181	70p
XC25	50p
XE3P	70p
XFW47	50p
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Vertical 50R–IM
Ohm **8p** Each

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LA5 30-100KHZ
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100p
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BZY88 ZENER DIODES
400m..
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1 AMP 200V	35p
1 AMP 400V	35p
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1 AMP 1000V	55p
2 AMP 50V	40p
2 AMP 100V	50p
2 AMP 200V	55p

R.C.A. TRIACS
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practical WIRELESS

MARCH 1979
VOLUME 55
NUMBER 3
ISSUE 865

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG

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Components are usually available from advertisers. A source will be suggested for difficult items.

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☐ NEWS & VIEWS

☐ FOR OUR CONSTRUCTORS

☐ GENERAL INTEREST

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"HINTS & TIPS FOR CONSTRUCTORS" — A special 8-page supplement on all aspects of construction

We regret that, owing to circumstances beyond our control, the size of this issue of *Practical Wireless* has had to be reduced at short notice by eight pages. We apologise to readers for any disappointment caused.

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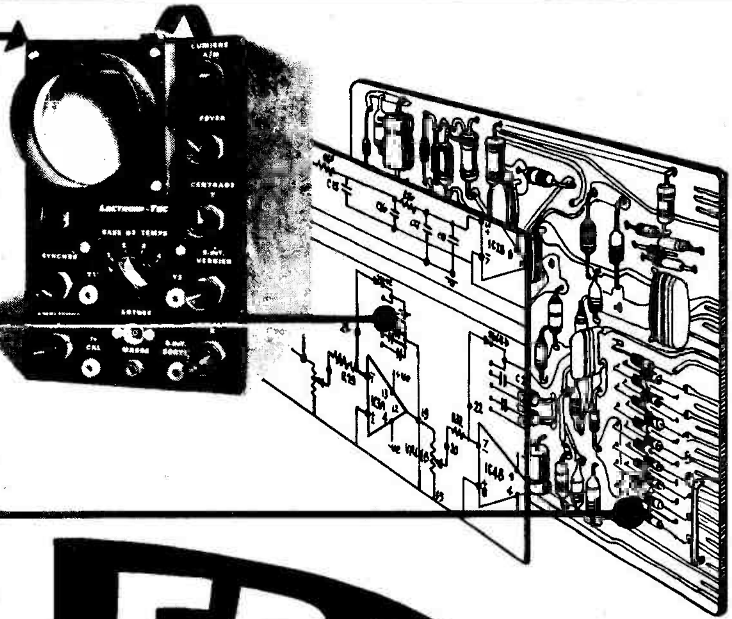

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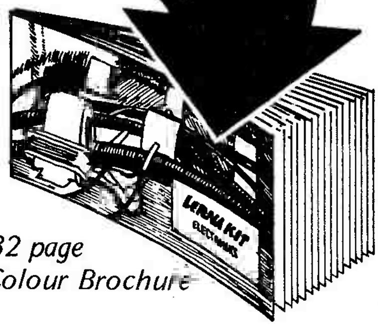

32 page Colour Brochure

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Production of the new catalogue has been held up for a few weeks - since we have just been appointed as distributors for two of the most exciting ranges of radio components products yet : The Micrometals range of iron dust torroids cores and formers, and the OKI range of VLSI for digital frequency displays for receivers.
We apologize for any inconvenience, but these two ranges are really worth the wait, and include some products you will find hard to believe, like the MSM5523 IC, an IC with less than ten external components that gives AM frequency readout to 1kHz from LW to 39.999MHz, FM frequency readout in 100kHz steps - (all usual IF offsets programmable by diodes), a 24 hour format clock with 12 hour display, independent on and off timers, time signals on the hours, stopwatch facility and a sleep timer. This costs £14 with its timebase crystal, and makes all that has gone before an expensive and time wasting excercise. Rather like the way the Intersil ICM7216 has revolutionized the instrument counter market. (See the OSTS ad.)
And those of you familiar with Amidon and IG dust torroids, favoured in many new RF designs, will be pleased to know Ambit will be stocking a broad range of the Micrometals types for applications from EMI filters to RF PA stages.

OKI frequency counter ICs: details in cat2

MSM5523	for CA LEDs with RHDP such as FND507	£14 inc xtal
MSM5525	for 3½ digit LCD AM/FM with direct segment drive. no clock or timers	£11 inc xtal

Other types for fluorescent displays etc OA

Other new semiconductor additions:

KB4437	pilot cancel mpx decoder	4.35
KB4438	muting stereo preamp	2.22
HA1370	supercedes TDA2020	2.99
TDA1090	HiFi AM/FM	3.35
TDA1220	low cost AM/FM	1.45

PRICES DOWN ON VMOS: as expected, this new technology in power transistors is getting cheaper. 120v comp pairs /100W for £10.00

Price reduction on CA3189E ....now £2.20

New varicaps: to add to the biggest range.....
KV1211 2:9v bias to tune MW, like the KV1210, but a double diode £1.75

New pilot tone filters from TOKO................
208BLR series, individual per channel with a 26/38kHz version for pilot cancel decoder applications. Flat to 15kHz £0.90

New crystal filter for amateur NBFM...........
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SEE THE OSTS ADVERT FOR CMOS/TTL REGULATORS, OPTO DISPLAYS, and other types of linear devices.

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PIN and other Varicap diodes:
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METER MADE low cost panel meters : 3 x 930 series with blanks and dry transfer sheet of scalas and ledgends for £12.5 *

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

In much the same way as we have swept away the 'old technology' in frequency/timer counters - with the OKI and Intersil single IC counters, we now offer a single IC "All Band" radio tuner. Don't confuse this one chip radio with things like the ZN414 - for this is a genuine superhet receiver with a mechanical AM IF filter, and ceramic IF filters for FM.
The AM section employs a balanced input mixer section, covering all broadcast bands - plus a BFO and MOSFET product decetor for SSB/CW - though at this price, the tuner is not intended as a "communications receiver" - although we know of many lesser designs that make that claim. The AM sensitivity is nevertheless better than 5uV, and FM sensitivity is 1.2uV for 30dB S/N. As a multiband broadcast superhet receiver, it is a unique constructor project that fulfills the requests we very frequently get for a general coverage circuit that isn't over complicated. The set has CA3089E FM performance, with mute etc., and a PLL stereo decoder with full pilot tone filtering.
The tuner board - with "on board" PCB mounted switching, all components etc : £33.00
The case/cabinet with PSU, meter and mechanics etc £25.00
An SAE for full details please. See the feature article in Practical Wireless (Dec/Jan)

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 .

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December 4th-8th Royal Horticultural Hall, Westminster, London SW1

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(Nov. 75 article by A. C. Ainslie) *Copy of original article supplied on request*

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4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
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4050	55p	4516	125p		
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5082- 7653 red CC
5082- 7660 yellow CA
5082- 7663 yellow CC
5082- 7670 green CA
5082- 7673 green CC
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5082- 7730 red CA
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} 147p

0.5" Fairchild
FND500 red CC 150p
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	'N'	'LSN'
7400	13	20
7401	13	20
7402	14	20
7403	14	20
7404	14	24
7405	18	26
7406	38	
7407	38	
7408	17	24
7409	17	24
7410	15	24
7411	20	24
7412	17	24
7413	30	52
7414	51	130
7415		24
7416	30	
7417	30	
7420	16	24
7421	29	24
7422	24	24
7423	27	
7425	27	
7426	36	27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
7433	40	32
7437	40	24
7438	33	24
7440	17	24
7441	74	
7442	70	99
7443	115	
7444	112	
7445	94	
7446	94	
7447	82	
7448	56	99
7449		99
7450	17	
7451	17	24
7453	17	
7454	17	24

	'N'	'LSN'
7455	35	24
7460	17	
7463		
7470	28	
7472	28	
7473	32	
7474	27	38
7475	38	40
7476	37	
7478		
7480	48	
7481	86	
7482	69	
7483A		
7484	97	
7485	104	99
7486		40
7489	205	
7490	33	90
7491	76	110
7492	38	78
7493	32	99
7494	78	
7495A	65	99
7496	58	120
7497	185	
74100	119	
74104	63	
74105	62	
74107	32	38
74109	63	38
74110	54	
74111	68	
74112	88	
74113		38
74114		38
74116	198	
74118	83	
74119	119	
74120	115	
74121	25	
74122	46	
74123	48	
74124		
74125	38	44

	'N'	'LSN'
74126	57	44
74128	74	
74132	73	78
74133		29
74136		40
74138		60
74139		60
74141	56	
74142	265	
74143	312	
74144	312	
74145	65	
74147	175	
74148	109	
74150	99	
74151	64	84
74153	64	54
74154	96	
74155	54	110
74156	80	110
74157	67	55
74158		60
74159	210	
74160	82	130
74161	92	78
74162	92	130
74163	92	78
74164	104	
74165	105	
74166		
74167	20	
74168		
74169		200
74170	230	200
74172	625	
74173	170	
74174	87	120
74175	87	110
74176	75	
74177	78	
74180	85	
74181	165	350
74182	160	
74183		210
74184	135	

	'N'	'LSN'
74185	134	
74188	275	
74190	115	92
74191		
74192	105	180
74193	105	180
74194	105	187
74195	95	137
74196	99	110
74197	85	110
74198	150	
74199	160	
74248		90
74249		93
74251		90
74253		105
74257		108
74258		153
74259		420
74260		153
74261		353
74266		40
74273		124
74275		312
74279		52
74283		120
74290		90
74293		95
74295		120
74298		100
74324		157
74325		242
74326		247
74327		237
74352		100
74353		100
74362		715
74365		49
74366		49
74367		43
74368		49
74373		77
74374		77
74375		60

	LSN
74377	124
74378	93
74379	130
74386	37
74390	140
74395	139
74396	133
74398	180
74399	150
74445	92
74447	90
74490	140
74668	110
74670	249

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TERMS: CWO pse., VAT to be added at 8% (inland), pp 25p per order. When ordering from the OSTS and Ambit - a single combined remittance and pp charge is sufficient. Account details OA.

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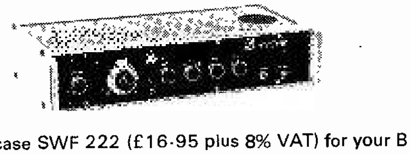

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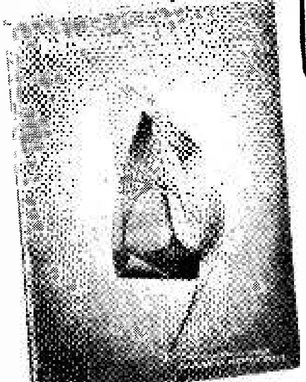

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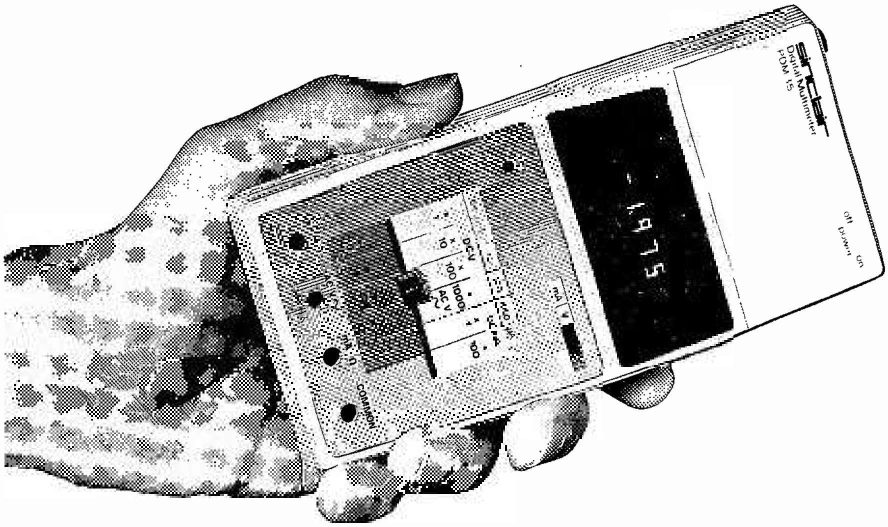

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DC Volts (4 ranges)
Range: 1 mV to 1000 V.
Accuracy of reading 1.0% ±1 count.
Note: 10 MΩ input impedance.
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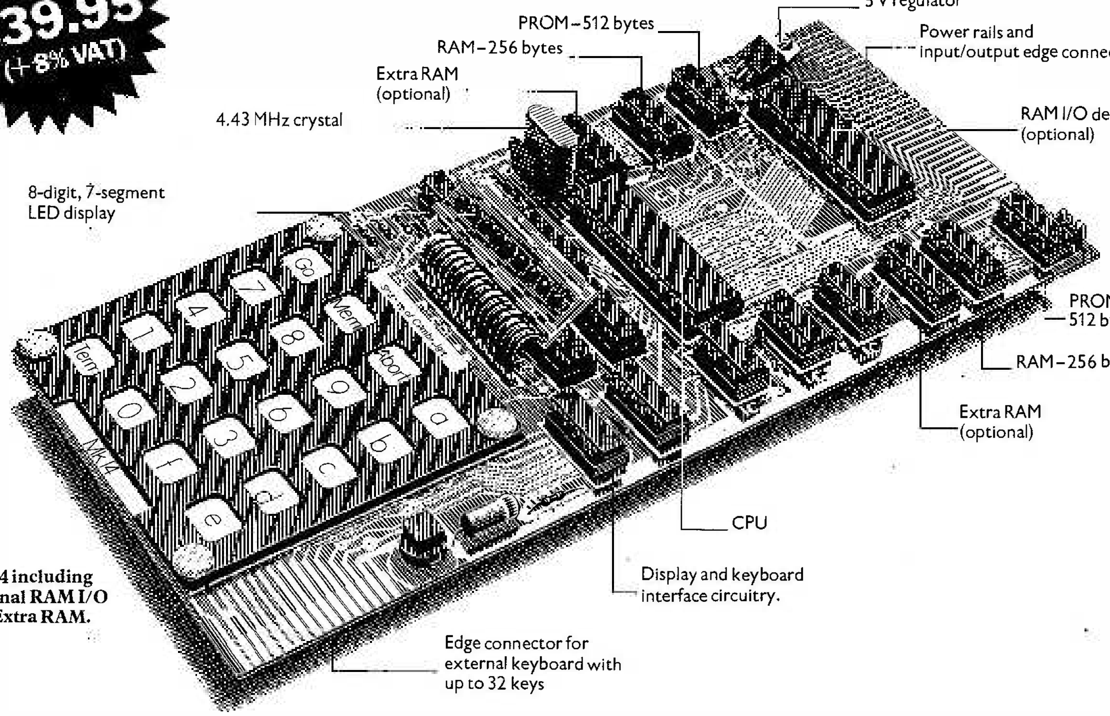

MK 14 including optional RAM I/O and Extra RAM.

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SPECIFICATIONS

• Hexadecimal keyboard • 8-digit, 7-segment LED display • 8 x 512 PROM, containing monitor program and interface instructions • 256 bytes of RAM • 4 MHz crystal • 5 V regulator • Single 8 V power supply • Space available for extra 256-byte RAM and 16 port I/O • Edge connector access to all data lines and I/O ports

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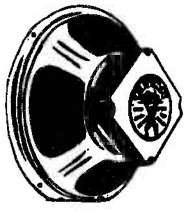

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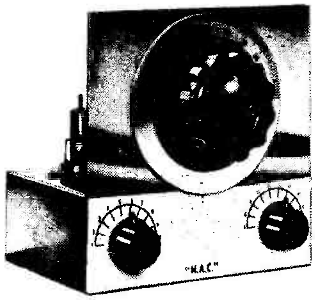

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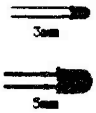

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7401	£0·09	7428	£0·25	7473	£0·22	74110	£0·35	74166	£0·75
7402	£0·09	7430	£0·08	7474	£0·22	74111	£0·55	74167	£2·00
7403	£0·09	7432	£0·20	7475	£0·27	74118	£0·75	74174	£0·60
7404	£0·09	7433	£0·28	7476	£0·22	74119	£1·10	74175	£0·60
7405	£0·09	7437	£0·20	7480	£0·40	74121	£0·22	74176	£0·55
7406	£0·22	7438	£0·20	7481	£0·80	74122	£0·35	74177	£0·55
7407	£0·22	7440	£0·10	7482	£0·65	74123	£0·38	74180	£0·80
7408	£0·12	7441	£0·45	7483	£0·55	74136	£0·50	74181	£1·25
7409	£0·12	7442	£0·38	7484	£0·82	74141	£0·50	74182	£0·55
7410	£0·09	7443	£0·68	7485	£0·65	74145	£0·54	74184	£1·00
7411	£0·15	7444	£0·68	7486	£0·22	74150	£0·65	74190	£0·68
7412	£0·14	7445	£0·64	7489	£1·60	74151	£0·45	74191	£0·68
7413	£0·22	7446	£0·60	7490	£0·30	74153	£0·45	74192	£0·65
7414	£0·45	7447	£0·45	7491	£0·60	74154	£0·80	74193	£0·60
7416	£0·22	7448	£0·52	7492	£0·32	74155	£0·48	74194	£0·55
7417	£0·22	7450	£0·09	7493	£0·28	74156	£0·48	74195	£0·55
7420	£0·09	7451	£0·09	7494	£0·70	74157	£0·48	74196	£0·60
7421	£0·19	7452	£0·09	7495	£0·45	74160	£0·55	74197	£0·58
7422	£0·15	7453	£0·09	7496	£0·48	74161	£0·60	74198	£1·00
7423	£0·20	7454	£0·09	74100	£0·80	74162	£0·60	74199	£1·00
7425	£0·18	7460	£0·09	74104	£0·35	74163	£0·60	74279	£1·00
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CD4014	£0·70	CD4028	£0·60	CD4049	£0·35	CD4518	£0·85
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No. 16135	20 3 amp Sil. stud Rect.	40p
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No. 16137	30 NPN Plastic trans. like BC107/8	40p*
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No. 16139	25 NPN trans. like 2N697/2N1711 TO39	40p
No. 16140	25 PNP trans. like 2N2905 TO39	40p
No. 16141	30 NPN trans. like 2N706 TO18	40p
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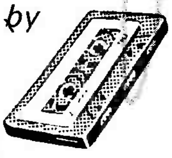

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16196	6 × 47 K LOG Single	40p*
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S27	6 × 100 K LIN Single	40p*
S28	6 × 100 K LOG Single	40p*
S29	6 × 500 K LOG Single	40p*
S32	6 × 50 K LIN Single	40p*

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S30	6 × 2·5 K LOG Single	40p*
S34	4 × 5 K LOG Dual	40p*
S36	4 × 100 K LOG Dual	40p*
S37	4 × 4·3 MEG LOG Dual	40p*
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S133	4 switch bank 5 way incl silver knob	£0·75
S134	2 × Magnets suitable for reed switches	£0·10
S135	1 Veroboard pak 2 pcs 45sq. ins. approx.	£0·80
S136	15 Veroboard pak 2 pcs 60sq. ins. approx	£1·10
16199	1 Veroboard pak 30sq. ins. approx.	£0·50
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STA125 125 watts per channel amplifier kit Consists: 2 × AL250; 1 × PA200; 2 × SPM120/65 – 2 × 2041; transformers; 1 × reservoir capacitor; 2 × coupling capacitors **£72·85** inc. VAT. £1·25 P&P.

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BRAND NEW—FULLY GUARANTEED

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AC127	16p	BC179	12p	BF196	*12p	TIP32C	36p	2N1893	28p
AC128	16p	BC182	*9p	BF197	*12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC182L	*9p	BF200	25p	TIP41B	35p	2N2218A	18p
AC176	16p	BC183	*9p	BFX29	22p	TIP41C	36p	2N2219	15p
AC176K	24p	BC183L	*9p	BFX84	18p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	*9p	BFY50	12p	TIP42B	37p	2N2221	15p
AC187K	26p	BC184L	*9p	BFY51	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	*10p	BFY52	12p	TIP2955	65p	2N2222	15p
AC188K	26p	BC212L	*10p			TIP3055	42p	2N2222A	16p
AD161/		BC213	*10p	MPSA05	*22p	ZTX107	*6p	2N2369	10p
162 MP	80p	BC213L	*10p	MPSA06	*22p	ZTX108	*6p	2N2904	14p
AF139	30p	BC214	*10p	MPSA55	*22p	ZTX109	*7p	2N2904A	15p
AF239	30p	BC214L	*10p	MPSA56	*22p	ZTX300	*7p	2N2905	14p
BC107	6p	BC251	*10p	OC44	12p	ZTX301	*7p	2N2905A	15p
BC108	6p	BCY70	12p	OC45	12p	ZTX302	*9p	2N2906	12p
BC109	6p	BCY71	12p	OC71	9p	ZTX500	*8p	2N2906A	14p
BC118	*10p	BCY72	12p	OC72	12p	ZTX501	*10p	2N2907	12p
BC147	*8p	BD115	40p	OC75	10p	ZTX502	*12p	2N2907A	13p
BC148	*8p	BD131	*35p	OC81	14p	2N696	10p	2N2926G	*8p
BC149	*8p	BD132	*37p			2N697	10p	2N2926Y	*7p
BC154	*16p	BF115	17p	TIP29A	35p	2N706	*7p	2N3053	12p
BC157	*9p	BF167	19p	TIP29B	36p	2N706A	8p	2N3055	35p
BC158	*9p	BF173	20p	TIP29C	38p	2N708	8p	2N3702	*7p
BC159	*9p	BF180	25p	TIP30A	36p	2N1302	12p	2N3703	*7p
BC169C	*10p	BF181	25p	TIP30B	37p	2N1303	15p	2N3704	*6p
BC170	6p	BF182	25p	TIP30C	38p	2N1304	15p	2N3903	*11p
BC171	*6p	BF183	25p	TIP31A	32p	2N1307	18p	2N3904	*11p
BC172	*6p	BF184	25p	TIP31B	33p	2N1308	22p	2N3905	*11p
BC173	7p	BF185	25p	TIP31C	34p	2N1309	22p	2N3906	*11p

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BA100	6p			BYZ17	28p	OA90	6p	IN5400	10p
BA115	5p	BY100	15p	BYZ18	28p	OA91	7p	IN5401	11p
BA144	5p	BY127	*10p	BYZ19	28p	OA95	7p	IN5402	12p
BA148	10p	BYZ10	32p	OA47	5p	IN34	5p	IN5404	13p
BA173	10p	BYZ11	32p	OA70	5p	IN60	6p	IN5406	16p
BAX13/		BYZ12	32p	OA79	7p	IN914	4p	IN5407	17p
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LM381	*£1·25	µA741C	£0·20	NE555	£0·22
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Sorry!

TO those readers who have suffered delay and disappointment in obtaining their copies of *Practical Wireless* of recent months, we offer our sincere apologies. In some of the more remote parts of the UK, late publication and some hiccups in distribution have combined to produce a particularly trying situation. We hope that these difficulties are now being overcome and that the magazine will be on sale by the specified date each month.

Another disappointment for some of our readers, is being unable to obtain a copy of an issue because every one has been snapped up, and their newsagent just cannot get any more. Worse still is picking up a casual copy of *PW* only to find that an interesting series has been running for some months and they can't get hold of the previous issues. We always do what we can to help someone in this predicament, and have recently increased the number of magazines put aside each month for our back numbers service (see page 1). Unfortunately though, many issues are now completely out of print, and only very limited stocks exist of some others. The table below summarises the situation as we went to press.

	1979	1978	1977	1976	1975	1974
JANUARY	✓		✓			
FEBRUARY	✓	✓			✓	
MARCH		✓		✓		
APRIL			✓		✓	
MAY				✓		✓
JUNE		✓				
JULY						
AUGUST		✓				✓
SEPTEMBER		✓				
OCTOBER		✓			✓	
NOVEMBER		✓				
DECEMBER		✓	✓			

If you want to make sure of getting your copy of *PW* each month, either place a regular order with your newsagent, or take out a subscription—again, see page 1 for details.

PW PERSONALITY

Debbie Chapman, Copy Typist

A secretarial course which she completed immediately after her normal schooling at the Purbeck School, Wareham, led Debbie into her first job which, luckily for us, was with *PW*.

She was born in Kenya, where her father was serving in the Army, and most of her life so far has been spent on a "world trip" with her father and the rest of the family. Dad is an instructor with the 3rd Royal Horse Artillery at Bovington Camp, specialising in tanks. Mum also works for the Army, and Debbie is engaged to a Police Constable—she certainly maintains an interest in uniforms!

Among her other interests, which include swimming and looking after children, she quotes cooking as the most important. Future husband Martin seems to have it made in no uncertain terms—good food and a willing baby sitter while he's out working can't be bad.

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

Well done Erzsebet

The 1978 Girl Technician Engineer of the year is Mrs Erzsebet Kibble (see News, October 1978): the award was announced by The Secretary of State for Education and Science, The Rt Hon Mrs Shirley Williams, MP, at a meeting of The Institution of Electrical and Electronics Technician Engineers (IEETE) in London on Monday, 4 December.

Erzsebet, aged 25, is an Assistant Test Manager with Thorn-Ericsson Telecommunications (Sales) Ltd. Born in Hungary, Erzsebet is married to an Englishman and lives in Woking, Surrey. She joined her present employers in 1974 and gained the Higher National Certificate in Electrical and Electronic Engineering in 1976.

The Award, accompanied by a cheque for £250 and an inscribed rose bowl, is sponsored by The Caroline Haslett Memorial Trust and the IEETE. Its aim is to focus attention on electrical and electronic engineering as a worthwhile career for women. *IEETE, 2 Savoy Hill, London WC2R OBS. Tel: 01-836 3357*

New catalogues

Barrie Electronics Ltd. inform me that their latest catalogue is available. Although the 32 page catalogue lists a good deal of Barrie's stock, they have many other components, too numerous to list. They also invite readers to contact them if they need assistance with purchasing any difficult items.

The catalogue is obtainable for 15p, from: *Barrie Electronics Ltd., 3 The Minories, London EC3N 1BJ. Tel: 01-488 3316/7/8.*

Suhner Electronics, the UK subsidiary of the Swiss company Huber & Suhner, have recently issued 2 new catalogues covering just part of the range of connectors they manufacture.

1. High Voltage Connectors; this 16 page catalogue covers 3 different series of coaxial high voltage connectors with 50 ohm nominal impedance and bayonet coupling mechanisms. In all a total of 80 different connectors.

2. RF Connectors Series TNC; this comprehensive 28 page catalogue details Suhner's range of TNC medium-sized coaxial cable connectors.

Copies of these catalogues are available, free of charge, from: *Suhner Electronics Ltd., Telford Road, Bicester, Oxfordshire.*

Three new parts of the Mullard Technical Handbook are now available. They are: RF power devices—Book 1, Part 2—£2·00; Thyristors and triacs—Book 1, Part 5—£1·50; Loudspeakers, television assemblies and modules—Book 3, Part 5—£2·00.

The Mullard Technical Handbook is broken down into twenty-one different parts which can be purchased separately—the prices depend on the contents and include P&P.

The handbooks and a leaflet giving further details is available from: *Central Enquiry Handling Unit, Mullard Ltd., New Road, Mitcham, Surrey CR4 4XY.*

Operation Drake

Radio communications equipment, supplied by companies in the GEC-Marconi Electronics group, will play a big part in Operation Drake—the two year round-the-world voyage by parties of experienced explorers, scientists and 24 young explorers in the 150 ton brigantine *Eye of the Wind*, which left Plymouth on Wednesday, 8 November, to celebrate the 400th anniversary of Sir Francis Drake's circumnavigation of the globe.

Marconi Marine is providing one of its new 400 watt Transocean/Pacific s.s.b. radiotelephones to satisfy the vessel's requirements for m.f. and h.f. communications with shore-stations round the world. This equipment is powered by the vessel's a.c. mains supply.

In case of generator failure on board, Marconi Marine is also supplying a 24V d.c. operated Falcon II, a m.f./h.f. s.s.b. radiotelephone as a back-up set for the main equipment.

When working within 40 miles of the coast, the primary ship-to-shore communications will be supplied by an Argonaut S v.h.f. radiotelephone.

For emergency purposes Marconi Marine is also to provide a Survivor II survival craft radio equipment.

Communications in the v.h.f./f.m. bands will be provided by three UK/VRC353 transceivers for the overland expeditions.

PW Gillingham

It has come to our notice that readers are having difficulty obtaining the 1·280MHz crystal for the PW Gillingham Short-wave Receiver Frequency Readout, published in the October 1978 issue.

A special arrangement has been made to supply these devices, at an inclusive price of £4·15, from *P. R. Gollege Electronics, Merriott, Somerset TA16 5NS. Tel: (0460) 73718.*

Project Index

A new index of electronic projects has been compiled by M. L. Scaife, Principal Librarian (Technical) of North Tyneside Libraries and Art Department.

The index provides a descriptive guide to over 2500 projects published between 1972 and 1977, in journals such as *Practical Wireless, Practical Electronics, Wireless World* and *Television Magazine.*

The project is not intended as a profit-making venture, as the following inclusive prices indicate: 1–2 copies—£1·50, 3–6 copies—£1·40, 7–10 copies—£1·35, over 10 copies—special rates.

Copies of the index are obtainable from: *M. L. Scaife, Central Library, Northumberland Square, North Shields, Tyne and Wear NE30 1QU. Tel: (08945) 82811.*

NEWS... NEWS...

QSO? GB2RN

The amateur radio station aboard *HMS Belfast* moored in the pool of London, between Tower Bridge and London Bridge, has been granted the use of the special callsign GB2RN when the ship is open to the public. Summer hours 1100 to 1800, winter hours 1100 to 1630, all British local time.

The station is interested in establishing schedules with other museum and special interest stations worldwide, these and other stations who would like to arrange skeds, please contact *Don Walmsley G3HZL, 153 Worple Road, Isleworth, Middlesex TW7 7HT, England.*

All h.f. bands from 1·8 to 28MHz are covered on c.w. or s.s.b.; it is hoped to have RTTY in the near future.

G4HMS will be operational outside of the stated hours.

LCDs

Two liquid crystal displays (l.c.d.s) will be available from Mullard in quantity early in the year. These devices join the Company's already established ranges of solid-state and plasma display devices. This announcement is the result of a long-term development programme which not only involved investigation into different techniques but also into basic materials in order to ensure that the displays would give continuing high-standard performance coupled with assured long-term reliability.

The technology selected for the Company's l.c.d.s was field-effect twisted-nematic. This technology has been in the market place for some time, but the Mullard l.c.d.s will incorporate the latest developments in this field. In particular, nematic liquid crystal materials have been developed to provide high standards of chemical stability and special precautions have been taken to eliminate chemical reaction between the different materials used. Also, to ensure satisfactory viewing, the l.c.d.s incorporate the results of a great deal of research into viewing angles, colour balance and the brightness ratio of the character to the background areas.

Many different types of l.c.d.s are in use today in watches, clocks, calculators and a great deal of instrumentation where their low power consumption, compared to that of l.e.d.s, enable them to be driven directly by m.o.s. devices.

The Mullard l.c.d.s were designed specifically for time displays and provide a 4-digit read-out with a colon between the second and third digits. Each digit is 12mm high and is formed from 7 segments. The first of these l.c.d.s, type LTC001R, is designed for use in the reflective mode: that is, it collects ambient light and reflects it back to the viewer. The second l.c.d., type LTC001T, is used in the transmission mode with a light source behind the display.

Mullard Limited, Mullard House, Torrington Place, London WC1E 7HD.

GB3WM

The Home Office have granted the special callsign GB3WM to the Wireless Museum at Arreton Manor, near Newport, Isle of Wight. Arreton Manor is the home of The Count and Countess Slade de Pomeroy, the Manor is open daily from Easter until November, and also by appointment during the winter months.

The Wireless Museum contains a unique collection of very early radio and television receivers, including a 30-line Baird Televisor with spinning-disc mechanical scanning.

It is now planned to build an exhibition short-wave experimental transmitting station, as used by radio amateurs before the last war, and display it side-by-side with a modern piece of equipment, showing a direct comparison between the old type of rack-mounted equipment and today's "state of the art".

All amateur bands will be used, with both c.w. and s.s.b. on the high frequencies and f.m. on two-metres (via GB3SN, the Alton, Hampshire repeater).

Official station operators will be Messrs. D. Byrne G3KPO (Museum Curator), A. R. Williams G3KSU, D. E. Denny G3ZQE, A. Wakeley G3MAD, R. W. Fisher G2DZN, K. B. Pearse G3MLC, F. D. Cawley G2GM, H. Childs G3IOW, L. Critchley G3EEL, D. Hoult G4OO and W. Carter G2NJ.

A special QSL card will be printed and issued to all initial QSOs. Short-wave listeners are also invited to send in report cards, for which QSLs will be exchanged—all via the RSGB Bureau, or on receipt of an s.a.e.

D. Byrne G3KPO, The Wireless Museum, Arreton Manor, near Newport, Isle of Wight.

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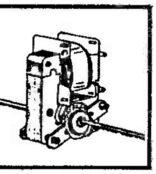

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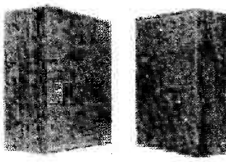

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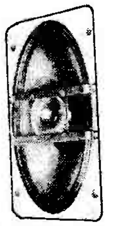

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7415	—*	.19*	7483	—	.75*	74160	1.21*	.99*	74248	—	.95*
7416	.25*	—	7485	1.18*	.88*	74161	1.21*	.65*	74249	—	.95*
7417	.34*	—	7486	.25*	.29*	74162	1.21*	1.25*	74251	—	.83*
7420	.16*	.19*	7489	2.60*	—	74163	1.21*	.65*	74253	—	.99*
7421	—*	.19*	7490	.34*	.62*	74164	1.02*	1.15*	74257	—	.99
7422	—*	.19*	7491	.73*	1.05*	74165	—	.78*	74258	—	.99
7423	.25*	—	7492	.46*	.75*	74166	1.02*	—	74259	—	1.50*
7425	.25*	—	7493	.34*	.65*	74168	—	1.85*	74266	—	.35*
7426	.25*	.19*	7495	.54*	.88*	74169	—	1.85*	74273	—	2.25*
7427	.39*	.19*	7496	.67*	1.25*	74170	1.85*	1.65*	74279	—	.48*
7428	.38*	.19*	74107	.27*	.35*	74173	1.41*	.88*	74283	—	.99*
7430	.16*	.19*	74109	.44*	.35*	74174	1.01*	1.05*	74290	—	.83*
7432	.25*	.25*	74112	—	.35*	74175	.81*	1.05*	74293	—	.83*
7433	—*	.19*	74113	—	.35*	74176	1.01*	—	74295	—	1.05*
7437	.25*	.25*	74114	—	.35*	74177	1.01*	—	74298	—	1.25*
7438	.25*	.25*	74121	.27*	—	74180	1.01*	—	74365	—	.51*
7440	.17*	.19*	74122	.50*	.75*	74181	2.21*	2.99*	74366	—	.51*
7441	.70*	—	74123	.60*	.78*	74182	.81*	—	74367	—	.51*
7442	.50*	.55*	74124	—	1.25*	74184	1.81*	—	74368	—	.51*
7445	.60*	—	74125	.51*	.39*	74185	1.62*	—	74386	—	.39*
7446	.60*	—	74126	.51*	.39*	74188	2.97*	—	74670	—	1.85*
7447	.60*	.87*	74132	.72*	.65*	74189	3.17*	2.25*			
7448	.60*	.87*	74133	—	.19*	74190	1.21*	.75*			

CMOS

4000	.15*	4053	.81*
4001	.16*	4054	1.29*
4002	.16*	4056	1.46*
4006	.92*	4059	5.18*
4007	.18*	4060	1.24*
4008	.92*	4066	.48*
4009	.54*	4068	.21*
4010	.54*	4069	.21*
4011	.18*	4070	.21*
4012	.18*	4071	.21*
4013	.48*	4072	.21*
4014	.92*	4077	.21*
4015	.92*	4081	.21*
4016	.43*	4082	.21*
4017	.81*	4085	.92*
4018	.92*	4086	.92*
4019	.56*	4093	.81*
4020	.92*	4099	1.81*
4021	.92*	4502	.92*
4022	.92*	4508	2.46*
4023	.18*	4510	1.07*
4024	.65*	4511	.95*
4025	.18*	4514	2.70*
4026	1.84*	4515	2.70*
4027	.51*	4516	1.07*
4028	.70*	4517	4.10*
4029	1.18*	4518	.95*
4030	.56*	4521	2.54*
4032	1.08*	4522	1.89*
4034	1.89*	4526	1.89*
4035	1.06*	4528	.92*
4040	.92*	4534	7.12*
4042	.70*	4536	3.74*
4043	.81*	4543	1.62*
4046	1.06*	4553	4.53*
4049	.43*	4566	1.51*
4050	.43*	4583	1.02*
4051	.81*	4585	1.07*
4052	.81*		

I.C. sockets

DIL (Texas)

8 pin	.10*
14 pin	.12*
16 pin	.13*
18 pin	.18*
20 pin	.20*
22 pin	.24*
24 pin	.26*
28 pin	.30*
40 pin	.44*

Wire Wrap

8 pin	.23
14 pin	.34*
16 pin	.37*
18 pin	.43*
20 pin	.55*
24 pin	.60*
28 pin	.65*
36 pin	.95*
40 pin	1.05*

VAT INC PRICES

BITS and PIECES

Static RAM's

		1+	17–63	64+
2102A	(350ns)	1.05*	.95*	.88*
2102A-2	(650ns)	1.29*	1.15*	1.08*
2111A-1	(500ns)	2.46*	2.19*	2.05*
2112A-2	(250ns)	2.14*	1.90*	1.78*
21L02	(350ns)	1.07*	.96*	.86*
MM5257	(TMS4044)	8.10*	7.19*	6.75*
2114	(450ns)	8.10*	7.19*	6.75*
6810		3.50*	2.97*	2.52*

CPU's

8080	5.95*
6800	8.99*
9900	42.50*

E-Prom's UV

1702AQ	5.57*
2708Q	7.87*

TriState Buffers

81LS95	.75*
81LS96	.75*
81LS97	.75*
81LS98	.75*
74365	.75*
74366	.75*
74367	.75*
74368	.75*

Dynamic RAM

4116	12.75*

Buffers

8T26P	1.65*
8T28P	1.65*
8T95P	1.49*
8T96P	1.49*
8T97P	1.49*
8T98P	1.49*

Regulators

78L Series
+(POS) 100mA
5v, 6v, 8v, 12v & 15v.
All **30p*** each

78M Series
+(POS) 500mA
5v, 6v, 8v, 12v, 15v, 20v & 24v.
All **60p*** each

79M Series
—(NEG) 500mA
5v, 6v, 8v, 12v, 15v, 20v & 24v
All **85p*** each

78 Series
+(POS) 1A
5v, 8v, 12v, 15v, 18v & 24v
All **85p*** each

79 Series
—(NEG) 1A
5v, 8v, 12v, 15v, 18v & 24v
All **£1.00*** each

µA723 (DIL)	.40*
L200	1.99*
LM304H	2.40*
LM323K	6.25*
LM325N	2.60*
LM326N	2.60*
LM345K	8.10*
L129/30/31	.85*

Linear I.C's

CA3080	.75
CA3130E	.90
CA3140E	.37
LM301AN	.30
LM324N	.73*
LM348N	.99
LM380N	.97
LM381N	1.73
LM382N	1.33
LM3900N	.65
LM3909N	.70*
SN76001N	1.02
SN76003N	2.32
SN76013N	1.55
SN76023N	1.55
TBA810AS	.90
TCA940	1.75
ZN414	.90
ZN424E	1.35
ZN425E	3.78*
ZN459CT	3.54
ZN1034E	2.03*
ZN1040E	8.43*
ZNA116E	6.75*

CD4011 7 for £1.00*

OPTO

.125"			1+	10+	50+	100+
TIL209	Red	x	.15*	.10*	.10*	.09*
TIL212	Yel	x	.20*	.18*	.16*	.14*
TIL216	Red	x	.20*	.18*	.16*	.14*
TIL232	Gre	x	.20*	.18*	.16*	.14*

x = High Brightness

.2"			1+	10+	50+	100+
TIL220			.16*	.125*	.125*	.11*
TIL224	Yel	x	.23*	.21*	.195*	.17*
TIL228	Red	x	.23*	.21*	.195*	.17*
TIL234	Gre	x	.23*	.21*	.195*	.17*

LM380 3 for £2.50

DL747 4 for £6.00* | **µA741 5 for £1.00** | **NE555 4 for £1.00*** | **TIL209 10 for £1.00*** | **TIL220 8 for £1.00***

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letters

The Editor,
PRACTICAL WIRELESS,
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG

Radio 3

Sir: While admiring the ingenuity of the BBC Engineering Department in replacing Radios 1, 2, and 4 transmitters, I must complain about the allocation of 1215kHz for Radio 3. This frequency is only fit for its original purpose—a back-up for l.w. transmissions in big cities. The map on page 41 of 18-24 Nov 1978 issue of *Radio Times* confirms this. The 1215kHz frequency is subject to hideous phase distortion here, and swamped by Radio Albania after 3 pm.

I am primarily concerned with conditions during daylight hours. Most people have v.h.f. at home, although that is difficult in some parts of this town, and v.h.f. car radio is ineffective here.

I am waiting for the howls of protest, when we have the first "Test Match Special" on m.w. only. I have had a long correspondence with the BBC and I am now hopeful that they will, after 23 November, try to improve Radio 3 outlets. Small relays could go on an international common frequency—or even a borrowed one, as at Cambridge (that is not on the Geneva list). What we urgently need is one more frequency to be used by alternative main stations as for Radios 1 and 2. We still have, as yet unused, an allocated frequency of 227kHz, although it may be liable to interference.

It is a scandal that the Home Office did not even ask for extra channels at Geneva (see Richard Last, page 12, *Daily Telegraph,* 13 November 1978). How did small countries like Belgium, Holland and Eire, manage to get new valuable long and medium wave allocations, all more efficient than the 648kHz, which is now lost to us, for the BBC European Service.

I hope that all your readers who enjoy Radio 3, especially in cars, as I have done for years, will make their views known to the BBC as soon as possible. Then, perhaps, some improvements will occur.

Dr H. S. Brodribb
St Leonards-on-Sea

Any offers

Sir: I have for sale approximately 150 copies of various electronic magazines, such as PW, PE, EE and WW. Some of the issues date back to 1946/7, if anyone is interested, I would accept any reasonable offer plus postage.

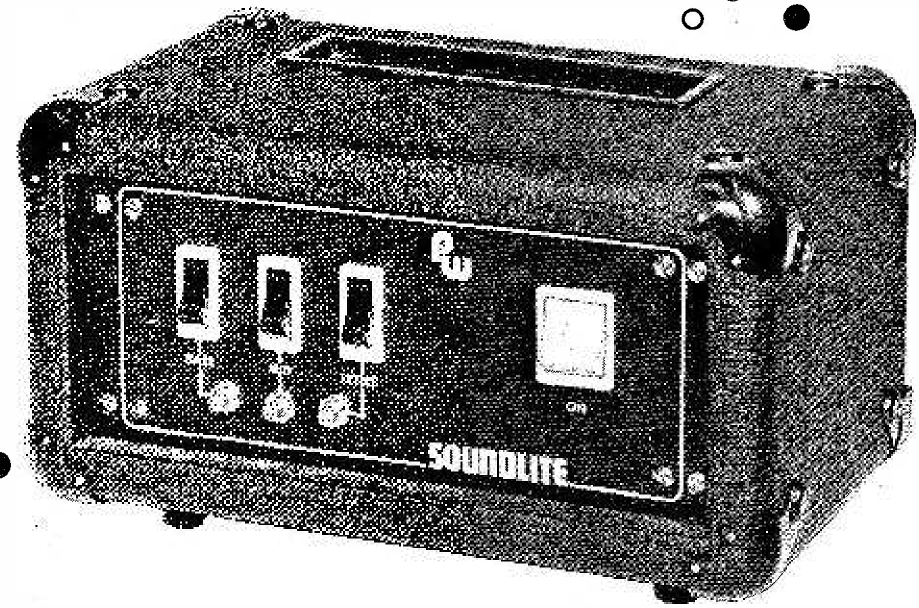
I also have a quantity of electronic bits and pieces (valves, transistors, transformers, motors etc.), for which all I require is the postage.

Mr. H. C. Leivers
4 Cavendish Place
Gwaun Miskin
Beddau CF38 2RP

THE PW 'SOUNDLITE'

SOUND TO LIGHT UNIT

T. P. Hopkins



In recent years, Sound-to-Light (STL) units, in various forms, have become extremely popular for discos, pop concerts, parties, shop displays and so on. In its simplest form, a STL unit consists of three of more CR filters fed from the loudspeaker terminals of an audio amplifier, feeding transistors which trigger triacs (or thyristors) via pulse transformers. Each channel has its own level control, and there may be a "master" control as well. This form of STL has several drawbacks; the sensitivity is low (an audio signal of 2–3V may be required) and continual adjustment is required to compensate for changes in volume and tone. The apparent separation between channels is poor, due to the simple filters used: the unit generates interference spikes on the mains, since the triacs may be triggered at any point on the mains cycle, and it uses several heavy and/or expensive transformers.

The STL unit to be described overcomes all of these disadvantages; it uses interference-free "zero-voltage switching", so that the triacs are triggered only when the voltage across them is very low; it has active filters for excellent separation between channels and automatic gain control (a.g.c.) amplifiers to eliminate manual adjustments; the sensitivity is approximately 700mV to control 1kW of lights per channel, and it uses only one inexpensive transformer. Due to the virtual elimination of transformers, this design is little more expensive to construct than the conventional version described above.

The Circuit

As can be seen from the simplified block diagram (Fig. 1), the circuit comprises several blocks each with a well-defined action. Each block is identified in the circuit diagram (Fig. 2). The signal from the loudspeaker circuit of an audio amplifier is fed via transformer T1. This provides isolation between the amplifier and the remainder of the circuit, which is at **mains line voltage.** Consequently, **extreme caution** is required when constructing the circuit.

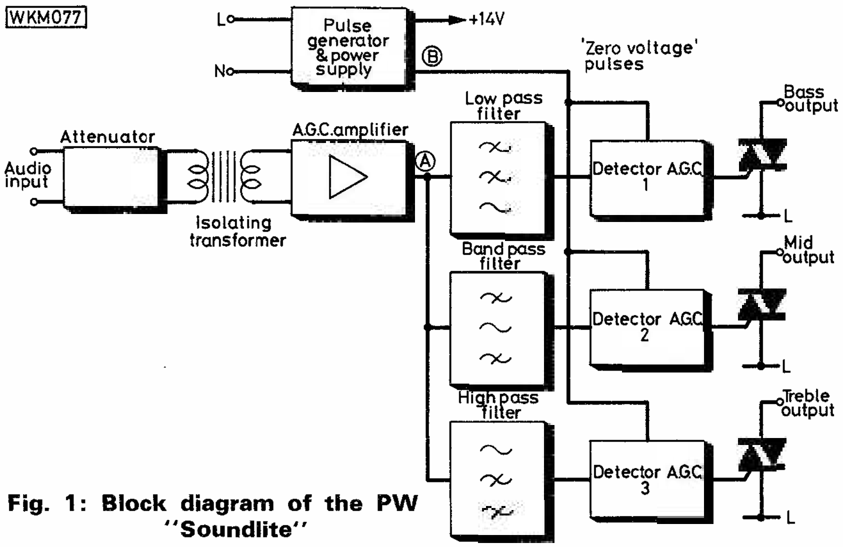


Fig. 1: Block diagram of the PW "Soundlite"

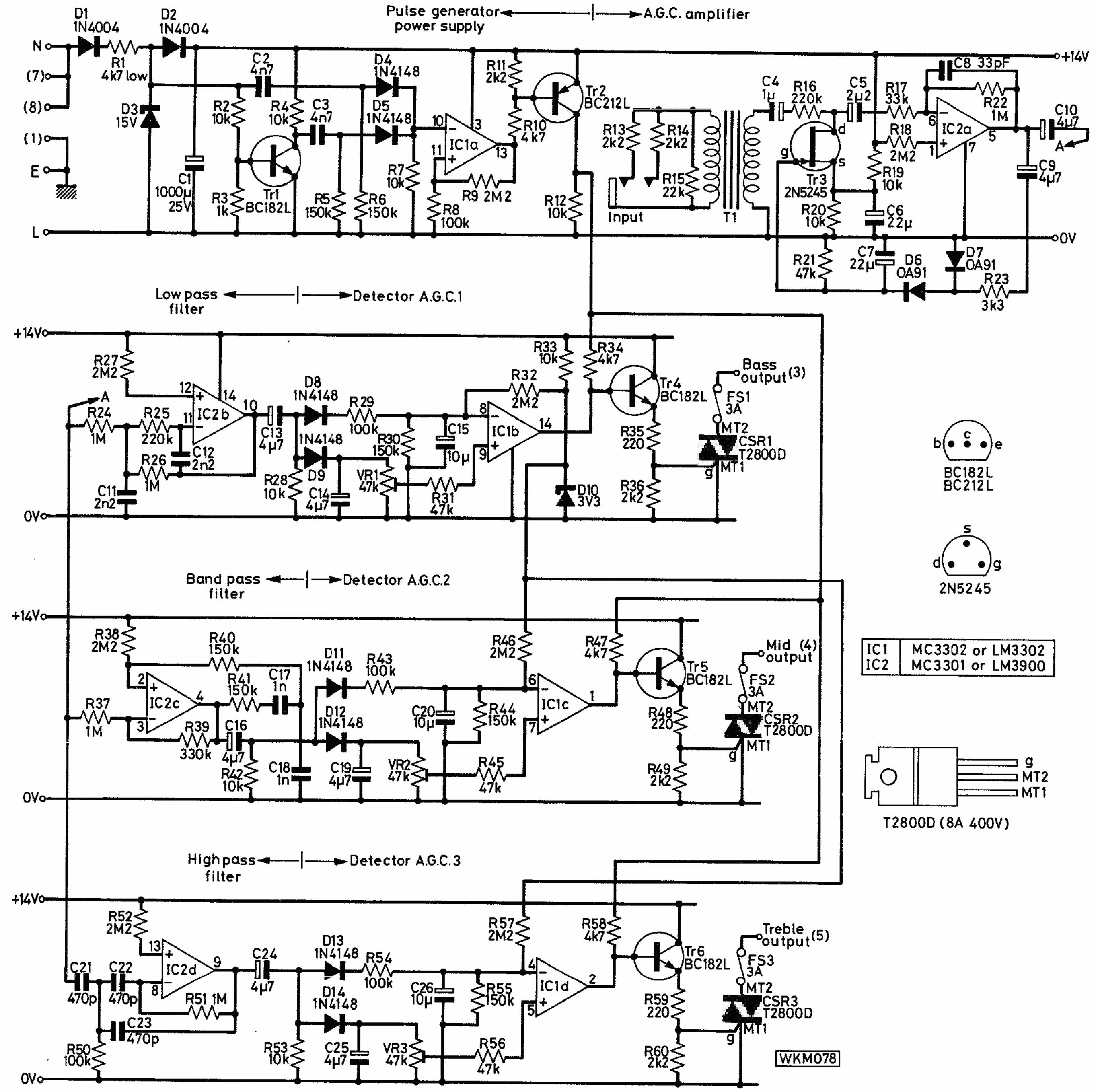


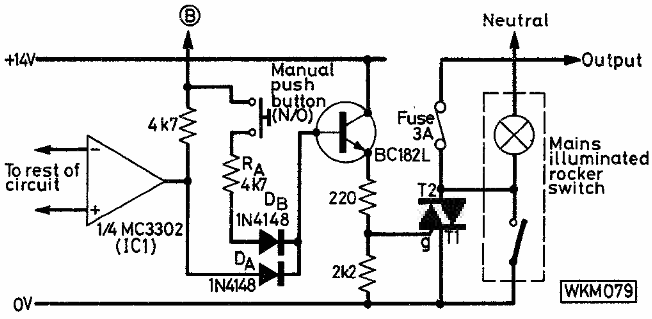
Fig. 2: Complete circuit diagram (excluding options)

Note that T1 is actually a miniature mains transformer, which has good isolation and adequate frequency response for this application. The audio signal then enters an a.g.c. amplifier which allows the STL to operate with inputs from 700mV r.m.s. (0·12W/4Ω to 25V (150W/4Ω). This consists of a voltage controlled attenuator R16/Tr3, followed by a X30 amplifier IC2a, with a control voltage derived from the rectifier circuit D6/D7.

If more sensitivity is required, R13/R14 may be reduced to, say, 1kΩ 1W, but this loads the audio amplifier somewhat more, and increases the possibility of noise affecting the lights. If a high voltage source is used (e.g., 100V lines) R13/14 should be increased to 15kΩ 1W. Note that a stereo input is provided; if mono only is required, both inputs should be tied together, alternatively a mono jack plug in the (stereo) jack will work with slightly reduced sensitivity.

After processing in the a.g.c. amplifier, the audio signal is fed to three active filters: low-pass (bass, IC2b), bandpass (midrange, IC2c) and high-pass (treble, IC2d). These have their cut-off frequencies chosen to give subjectively good separation between channels with most types of music from a variety of sources from a portable transistor radio to powerful discotheque systems. The output of each filter is connected to one of three identical detector/a.g.c. circuits constructed around a quad comparator integrated circuit.

For simplicity, consider the circuit connected to the low-pass filter (IC1b). If there is no audio signal, the comparator output will be low due to the bias voltage from D10 and R32, and no trigger pulses will be applied to the triac. Now, if a steady audio tone is applied, capacitor C14 will rapidly charge via D9 and the comparator output will go high. This allows trigger pulses, timed to coincide with the points in the mains cycle where the voltage is zero, to be applied to the triac. Thus, the triac will turn on when the voltage across it is small and the appropriate lights will come on without any interference being generated. However, C15 slowly charges via D8 and eventually the voltage across it exceeds that on C14. The comparator switches again, turning the lights off. With more complicated dynamics in the audio signal the situation is more complex, but it can be seen that this circuit provides



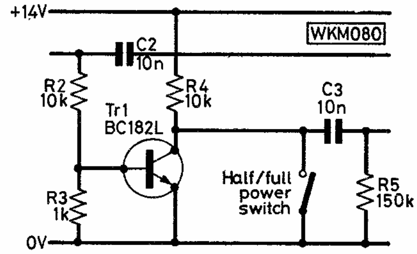
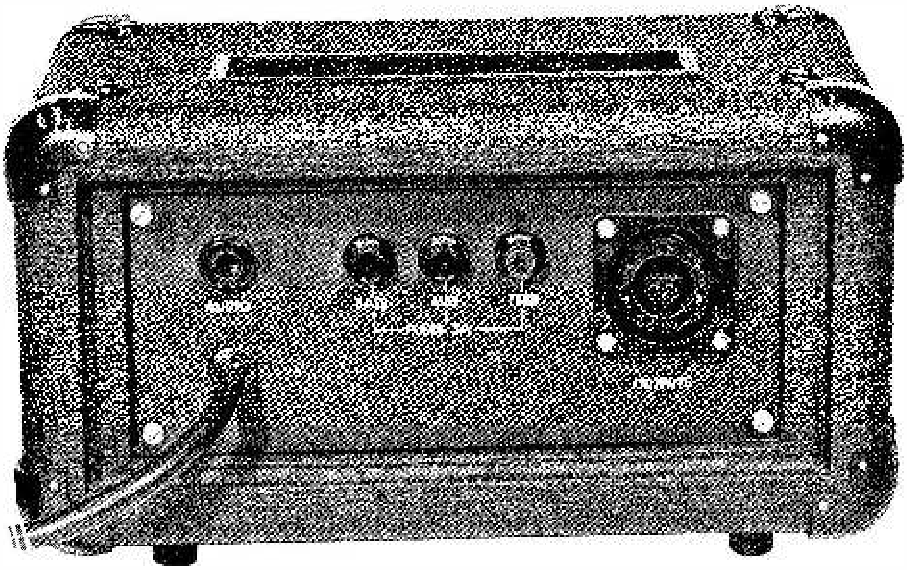


Fig. 3: (a) (top) Addition of push-button and switched override facilities. (b) Half/full power switching



A rear view of the prototype, showing input jack, fuses and eight-way output socket

an a.g.c. type action. The preset VR1 allows adjustment of the operating point of the circuit for optimum operation.

The detector circuits described above are fed with "zero voltage" pulses from the pulse generator circuit Tr1/IC1a. The mains input is clipped by D3, and an inverted squarewave is produced at Tr1 collector. The positive-going edges of both are differentiated by CR networks, and trigger a comparator IC1a providing short positive-going pulses at Tr2 collector. The positive supply for the whole unit is provided by D2 and C1.

Circuit Modifications

The circuit described so far is capable of forming a simple but effective "no frills" STL unit, with no external controls whatsoever! If, like the writer, you prefer more facilities, several additions can be made, some of which are provided for on the printed circuit board described later.

First, a mains on-off switch can be provided—useful for quick changes between lighting effects. Switches can be provided (Fig. 3(a)) to override the triacs on each channel, switching the lights permanently on. If the switches have built-in neon indicators, these can be connected to provide monitoring of the light display. These switches must be capable of carrying the full load current. However, low power switches or push-buttons may be used with a simple diode gate (also shown in Fig. 3(a)), providing fast, noise-free switching. This method is particularly suitable for push-buttons, allowing the lights to be rapidly flashed under manual control. These additions are included in the version described in the constructional details and positions for the extra components required are included on the p.c.b.

Other improvements include the addition of a half/full power switch (Fig. 3(b)). This short-circuits Tr1, so that only half of the differentiated pulses reach the comparator. Thus, the triacs are only triggered on positive half-cycles, so the lights will be less bright. In a similar manner, an audio on/off switch can be added, allowing the override push-buttons to be used alone. This switch short-circuits R15, preventing audio signals from reaching the a.g.c. amplifier.

More ambitious modifications include making presets VR1–VR3 front panel controls (for the "knobs with everything" man!) or even providing controls with a switched "automatic" position. If this is tried, the controls **must** be well insulated. Also, a sequencer facility can be added, using transistors in place of the push-buttons in Fig. 3(a), or a dimmer control can be added using a 555 oscillator. These modifications are left to the more experienced constructor.

Construction

WARNING: Most of the circuit board and wiring is at MAINS LIVE VOLTAGE and EXTREME CAUTION is necessary when testing or adjusting the circuit. The use of an Epoxy Glass Fibre p.c.b. is strongly recommended; Veroboard, etc., is NOT suitable, as it has insufficient intertrack voltage rating.

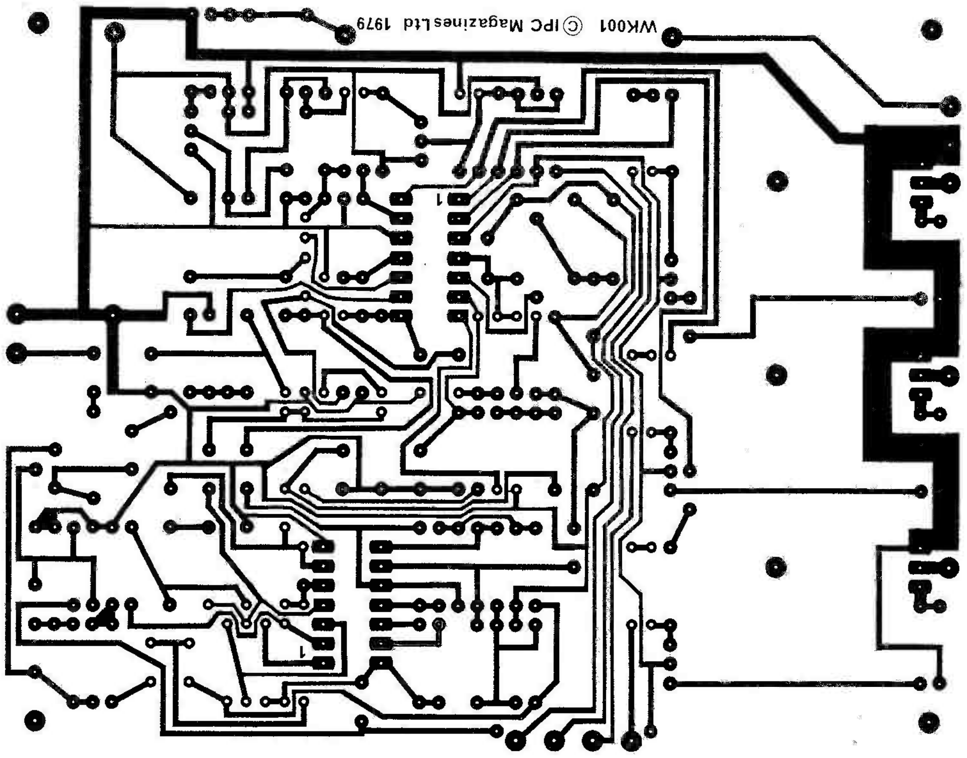
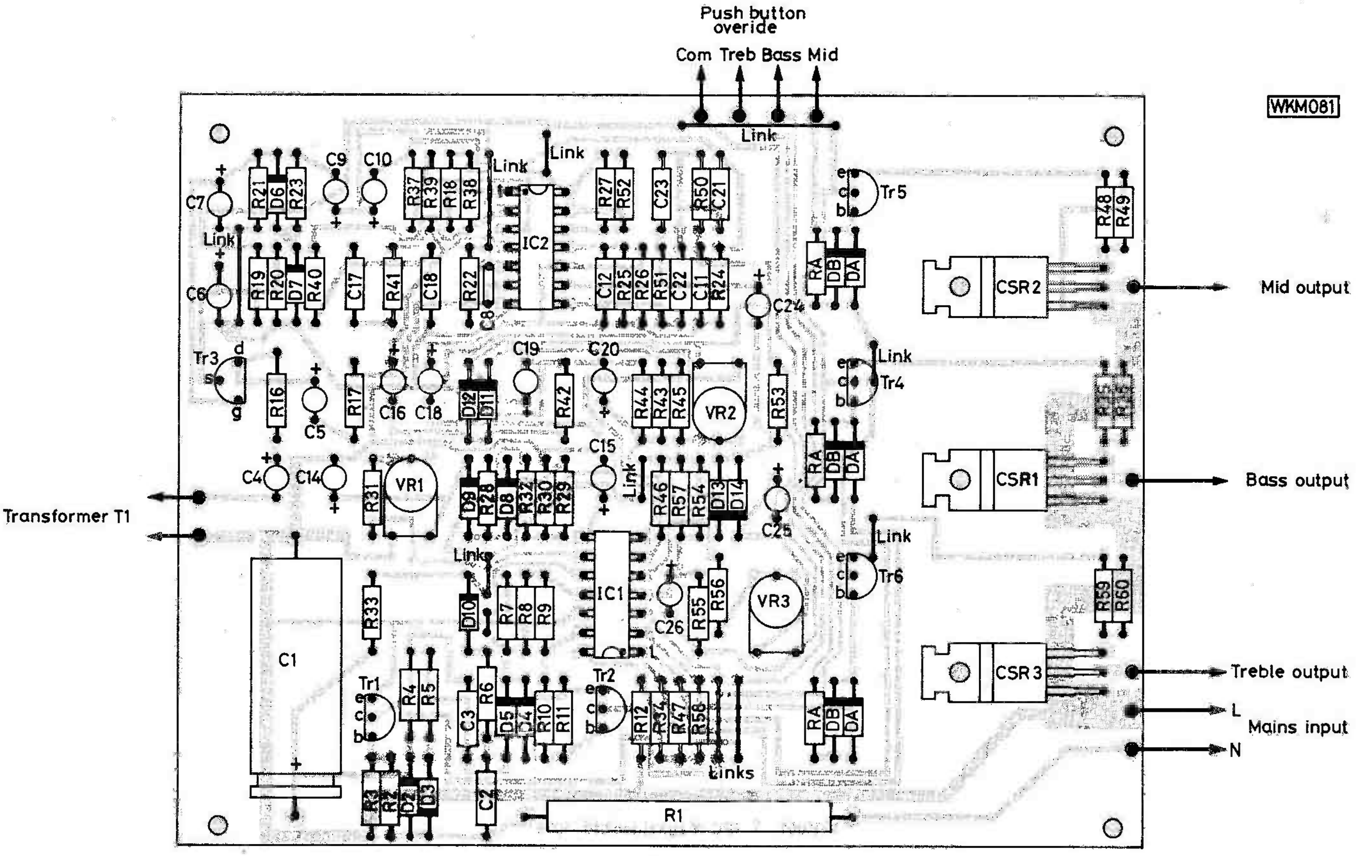
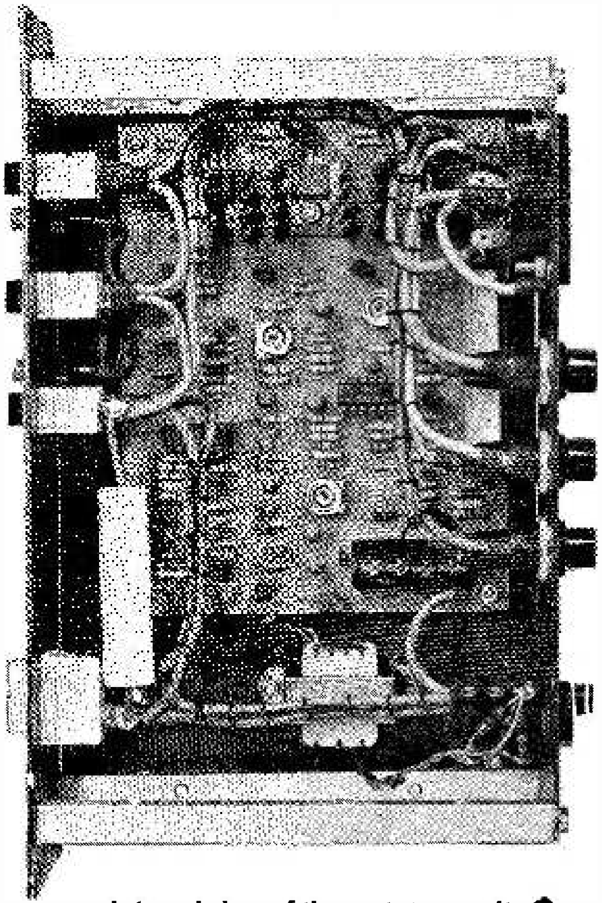


Fig. 4 (above): Printed circuit board track pattern, shown full size.

Fig. 5 (below): Component layout



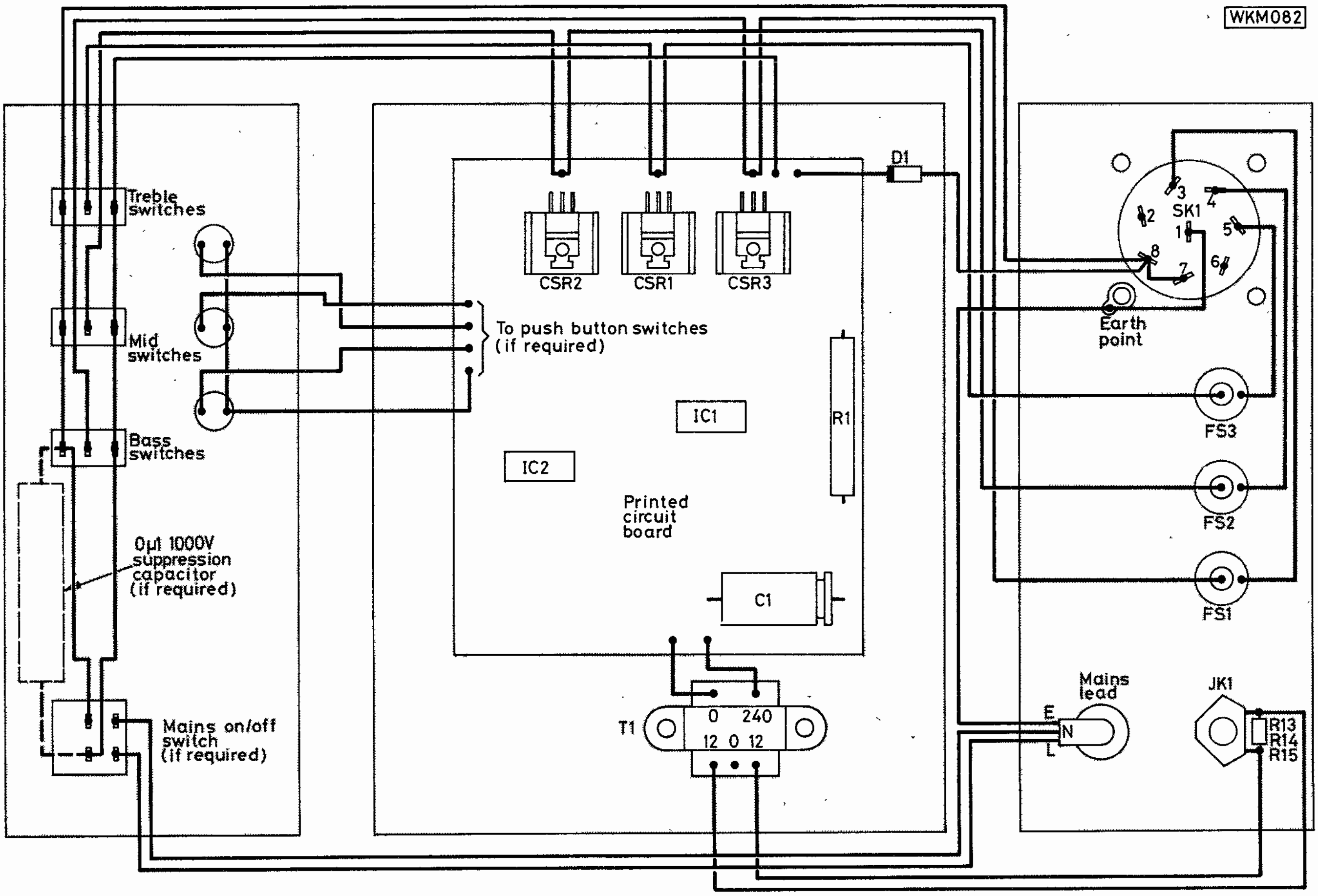


Internal view of the prototype unit

The p.c.b. track pattern is shown in Fig. 4 and the component layout in Fig. 5. Constructors should have little trouble in assembling the board provided the specified components are used. The usual precautions against the effects of static electricity should be taken when handling the two c.m.o.s. integrated circuits. It is safest to use sockets as specified in the components list, and insert the i.c.s only when the remainder of the components have been fitted to the p.c.b. Note that the wirewound resistor R1 gets hot in operation and should be mounted away from the board. Also, the triacs may require larger heatsinks if the unit is constructed in a small, enclosed box. If a common heatsink is used, mica washers and insulating bushes will be required. If the push-button override facility is not required (this is shown on the layout diagram), D_A, D_B and R_A (three of each) may be omitted and D_A replaced by a wire link. Finally, the p.c.b. has extra holes to allow the presets to be replaced by fixed resistors when the optimum values have been found.

The wiring of the unit is not critical and any convenient layout may be used. For guidance, the wiring used in the writer's unit is shown in Fig. 6, drawn flat for clarity. All mains wiring should, of course, use thick wire, say 40/0·2mm, remembering that some leads can carry up to 12A! Note that diode D1 is mounted off the board and resistors R13–R15 are mounted on the input jack JK1. Any convenient case may be used, but the circuit must be securely protected from prying fingers. All metal parts except the heatsinks must be efficiently earthed. The writer's unit was constructed on a metal chassis in a wooden sleeve as shown in the photographs, but alternative construction methods could easily be used.

Fig. 6: Wiring diagram of a unit incorporating options of Fig. 3(a)



★ components

Resistors

¼W 5%

220Ω	3	R35, 48, 59
1kΩ	1	R3
2·2kΩ	4	R11, 36, 49, 60
3·3kΩ	1	R23
4·7kΩ	4	R10, 34, 47, 58
10kΩ	10	R2, 4, 7, 12, 19, 20, 28 33, 42, 53
22kΩ	1	R15
33kΩ	1	R17
47kΩ	4	R21, 31, 45, 56
100kΩ	5	R8, 29, 43, 50, 54
150kΩ	7	R5, 6, 30, 40, 41, 44, 55
220kΩ	2	R16, 25
330kΩ	1	R39
1MΩ	5	R22, 24, 26, 37, 51
2·2MΩ	8	R9, 18, 27, 32, 38, 46, 52, 57
1W 5%		
2·2kΩ	2	R13, 14 (see text)
10W 5%		
4·7kΩ	1	R1

Potentiometers

Min. horizontal presets

47kΩ	3	VR1, 2, 3

Capacitors

50V plate ceramics		
33pF	1	C8
470pF	3	C21, 22, 23
1nF	2	C17, 18
2·2nF	2	C11, 12
4·7nF	2	C2, 3
16V tantalum bead		
2·2μF	1	C5
4·7μF	8	C9, 10, 13, 14, 16, 19, 24, 25
10μF	3	C15, 20, 26
22μF	2	C6, 7
35V tantalum bead		
1μF	1	C4
25V electrolytic		
1000μF	1	C1

Semiconductors

Integrated circuits		
MC3301P	1	IC2 (or LM3900N)
MC3302P	1	IC1 (or LM3302N)
Transistors		
BC182L	4	Tr1, 4, 5, 6
BC212L	1	Tr2
2N5245	1	Tr3
Diodes		
BZX61C15V	1	D3 (or similar 15V 1W Zener)
BZY88C3V3	1	D10 (or similar 3·3V 400mW Zener)
OA91	2	D6, 7
1N4004	2	D1, 2
1N4148	8	D4, 5, 8, 9, 11, 12, 13, 14
Triacs		
T2800D	3	CSR1, 2, 3 (or similar 8A 400V triacs)

Miscellaneous

T1 Min. mains Transformer, 12-0-12V secondary; FS1–3 3A ceramic quick-blow fuses, with panel-mounting holders; JK1 6mm (¼in) stereo jack (see text); SK1 8-pin socket, Bulgin P552 (plus mating plug P551); Mains on/off switch, d.p.s.t. (if required); Soldercon socket strips to mount IC1 and IC2; Heat-sinks for CSR1–3. Printed circuit board. Box to suit

OPTIONAL EXTRA FACILITIES

1—Push-button control

Resistors

¼W 5%

4·7kΩ	3	R_A (x 3)

Diodes

1N4148	6	D_A, D_B (x 3)

Switches

Normally open push-buttons s.p.s.t. 3

2—Switched override

Switches

Illuminated mains rocker s.p.s.t. 3

3—Half/full power switch

Switch

Toggle s.p.s.t. 1

Testing and Setting Up

After construction is completed, all wiring should be double-checked and all presets set to their central position. Connect a set of lights and switch on. The lights may flicker briefly then they should remain off. The push-button switches (if fitted) should be tested at this point; this checks the operation of the triacs. If all seems well, switch off and connect an audio source. Setting up is best done with a moderately large input signal (2–3V r.m.s.). Switch on again and the lights should show some response. The presets should be adjusted, with an **insulated** tool, to give the best results with various types of music; this need only take 15 minutes or so. Finally, vary the volume over a wide range and check that the display is similar at different volume levels. The a.g.c. amplifier takes a second or so to "catch up" after rapid changes in volume, so allow a little time between adjustments, etc.

Any faults found are likely to be due to incorrect assembly (e.g., short-circuits on the board, reversed tantalum capacitors), faulty semiconductors or "dry" joints. Note that it is no use trying to test the unit using only the neon indicators in the override switches (where fitted), instead of external lamp loads. The neons do not draw sufficient current to hold the triacs on after they have been triggered.

In cases where there is an exceptional amount of electrical noise on the mains supply from other sources, the lights may flicker even when no audio signal is present. If this is a problem, a 0·1μF 1000V capacitor across the mains supply should cure it (see Fig. 6); alternatively, or in extreme cases additionally, the sensitivity may be reduced slightly by increasing the value of R17.

The unit described has been very reliable in use, and several prototypes have been constructed. With care, constructors will have a Sound-to-Light unit of professional standard, capable of long service. ●

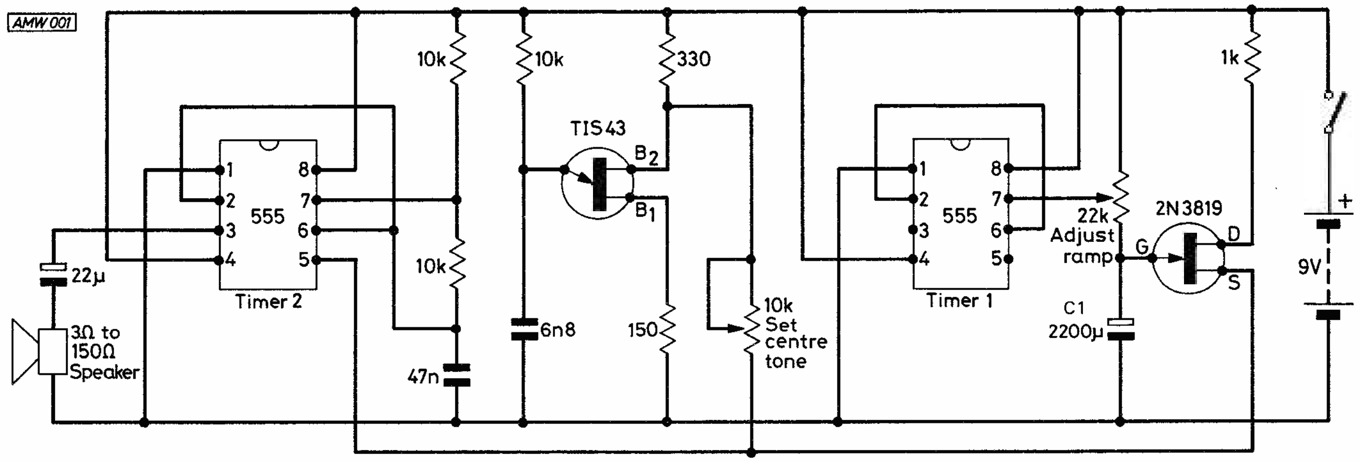
Ideas DEPARTMENT

Some original circuit ideas provided by our readers. These designs have not been proved by us, and we cannot therefore guarantee their effectiveness. They should at least provide a basis for experimentation.

Why not send us your idea? If it is published, you will receive payment according to its merits. Articles submitted should follow the usual style of PW in circuit diagrams and the use of abbreviations. Diagrams should be clearly drawn on separate sheets, not included in the text.

Each idea should be accompanied by a declaration that it is the original work of the person submitting it, and that it has not been accepted for publication elsewhere.

STEP TONE GENERATOR



This circuit produces a sound which relates to defined increments stepping up and down a musical scale. No shift register or counter is required to produce each step, and with the exception of the peripheral components the circuit consists of only two 555 timers, an f.e.t., and a unijunction transistor.

One 555 is used as an astable driving a loudspeaker, with the other functioning as a triangular waveform generator providing a control ramp for feeding back into the astable.

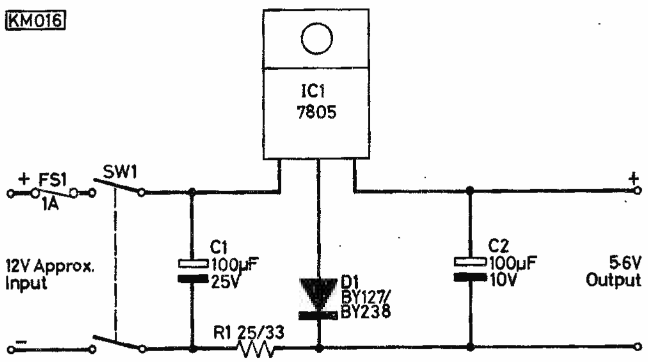
Increments are provided by spikes from the unijunction at intervals of 100µs, which are impressed onto the triangular waveform. The output of the astable is frequency modulated at the same rate, and as the triangular waveform changes, a series of loud beats are produced, running up and down the musical scale. The f.e.t. acts as a buffer to prevent loading of C1. This circuit could be modified to become a "blind man's d.v.m." or a relatively sophisticated voltage to frequency noise scrambler.

D. Brown GM8FFH,
South Hawthornhill,
Dumbarton.

CAR CASSETTE POWER SUPPLY

This simple circuit uses a 7805, which is a compact device used mainly with TTL i.c.s and fed with an ample input of at least 8V will produce a stabilised output of 5V at up to 1 amp, provided it is mounted on a heat sink. The minimum of smoothing is required, and the overall circuit will provide 5·6V to power a cassette player from a car battery.

Only a handful of components are needed and R1 was selected such that no voltage drop occurred at maximum volume and of course, the voltage never rises beyond 5·6V without a load. There is, therefore, little chance of the device becoming faulty and damaging the cassette recorder. If a higher output voltage is needed, another diode can be connected in series with D1 giving 6·2V but for safety, the existing output is sufficient for most applications.



The output can either be connected directly to the battery connectors in the recorder or alternatively a low voltage power plug can be used to connect externally to the recorder if a socket is fitted.

The unit will work with cars using either positive or negative earth but if a metal box is used as a case, care must be taken to prevent it coming into contact with any part of the car body, especially if a positive earth is used.

M. Burrell,
Halstead,
Essex.

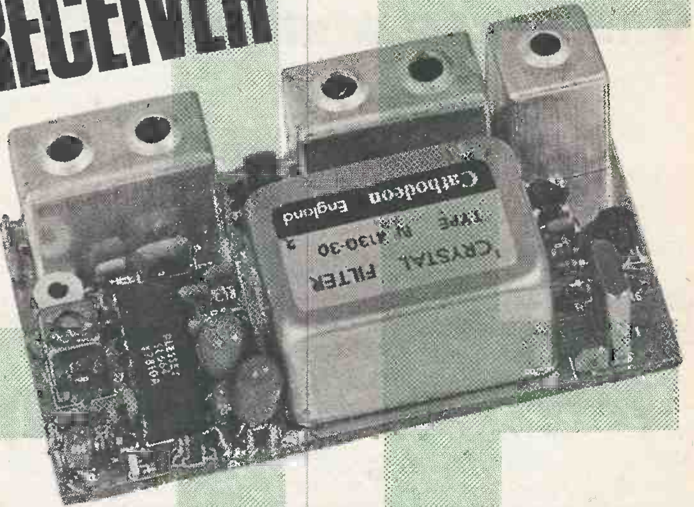
NEXT MONTH IN...

practical WIRELESS

ON SALE 2ND. MAR.

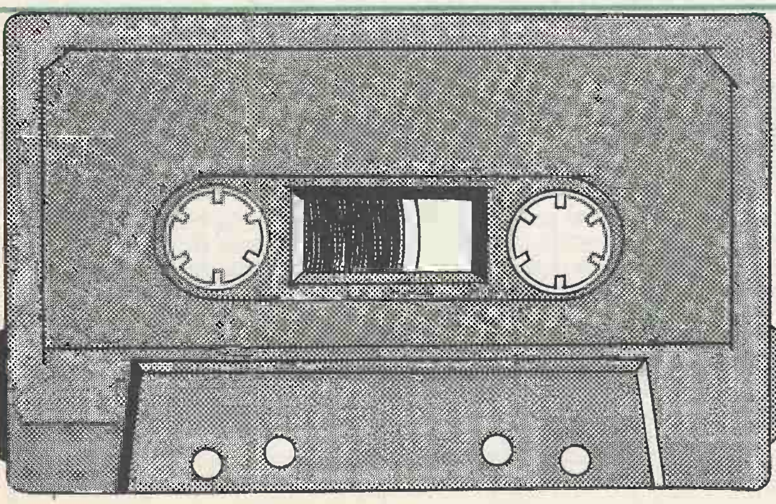
2 METRE MONITOR RECEIVER

A miniature high-performance, single-channel v.h.f. receiver for narrow-band f.m. operation, based on the Plessey Semiconductors SL6640 integrated circuit



VHF/UHF FOLDED COLINEAR AERIAL ARRAY

An omni-directional, vertically polarised design, giving 3dB gain over a dipole. Details are given for both 2 metre and 70cm versions



THE CASSETTE TAPE MEDIUM

The development of the Compact Cassette system from its inception to the present day is reviewed by Gordon J. King

HYTHE marine band receiver Part 2

M. TOOLEY & D. WHITFIELD

After completing the assembly of the receiver as shown in Fig. 5, a careful visual check should be carried out on all wiring, the unit connected to a 12V d.c. supply and the supply current measured. This should be approximately 75mA in the absence of a signal. If a signal generator is available, this should be connected to the aerial socket via a suitable attenuator, and set to 455kHz ($\pm$1kHz) with internal modulation. A tone should be heard when the receiver is switched to give a.m. reception, and it should be possible to peak IFT1 and the filter IFT2 for maximum output. If necessary, increase the attenuation between the signal generator and the receiver progressively as the i.f. circuits are peaked. This alignment is best done with a relatively weak signal since the a.g.c. action will, to some extent, mask changes in the output level for strong input signals.

An input to the receiver of about 1mV at 455kHz will be all that is required in order to produce a strong audio output signal if the i.f. stages are working correctly. If a signal generator is not available, the i.f. stages may be aligned by tuning the receiver for a weak signal and then adjusting IFT1 and the filter for maximum output. In either case, the alignment process is greatly simplified by reference to the signal strength meter. To adjust the meter, VR4 is first set to mid-position and, with the aerial disconnected, VR5 is then adjusted to zero the meter. VR4 may later be set to calibrate the meter. Constructors should note, however, that there may be a slight interaction between these two controls and the setting-up procedure may have to be repeated whenever the calibration is being altered.

After completing the i.f. alignment, the r.f. tuned circuits of L1 and L2 should be aligned. The signal generator should be set to 1·45MHz with internal modulation and VC1 set for maximum capacitance (i.e., vanes fully meshed). VC2 should be set to mid-position and the core of L2 adjusted until a strong signal is heard. The core of L1 is then peaked for maximum signal. The signal generator is then set to 3·5MHz and VC1 adjusted to near minimum capacitance (i.e., vanes almost fully open) until a strong signal is again heard. The core of L1 should again be peaked for maximum signal but the core of L2 should be left alone. If, however, the 3·5MHz signal is not located, the core of L2 may be adjusted until a signal is heard at minimum capacitance. This establishes the high frequency end of the receiver's tuning range. There will be a noticeable difference in the settings of the core of L1 at 1·45MHz and 3·5MHz, due to the "tracking" error. With VC2 still set to mid-position, the signal generator is tuned to 2·5MHz and a strong signal located at approximately mid-position of VC1 (i.e., middle of the tuning range). The core of L1 is peaked for maximum, when its position should be roughly mid-way between the 1·45MHz and 3·5MHz positions.

If a signal generator is not available, signals on known frequencies can be used as an aid to alignment. These could include broadcast signals at around 1·5MHz, coastal radio stations on frequencies around 2MHz, and the 2·5MHz standard frequency and time signal. The vernier dial can be calibrated by first removing the scale, painting it with a matt-finish white or silver paint, and then using dry transfers to provide markings every 100kHz from 1·5MHz to 3·5MHz. Alternatively, a somewhat simpler solution is to draw a calibration curve for the receiver and to refer to this whenever exact frequency readout is required. A typical calibration curve is shown in Fig. 6.

BFO

In order to align the b.f.o. transformer, IFT4, a strong carrier, preferably with no modulation, should be selected. With the receiver switched for a.m. reception, VC1 should be carefully tuned to provide maximum indication on the signal strength meter. The mode switch, S1, is then set to the s.s.b./c.w. position and, with VR3 set to mid-position, the core of IFT4 is adjusted for zero-beat.

A beat note may not, in some cases, immediately be heard since the heterodyne produced may lie outside the audible range. If this is the case, adjustment of the core of IFT4 should readily produce an audible note. The quadrature detector tuned circuit, IFT3, is best adjusted using a known f.m. signal of preferably 3kHz peak devia-

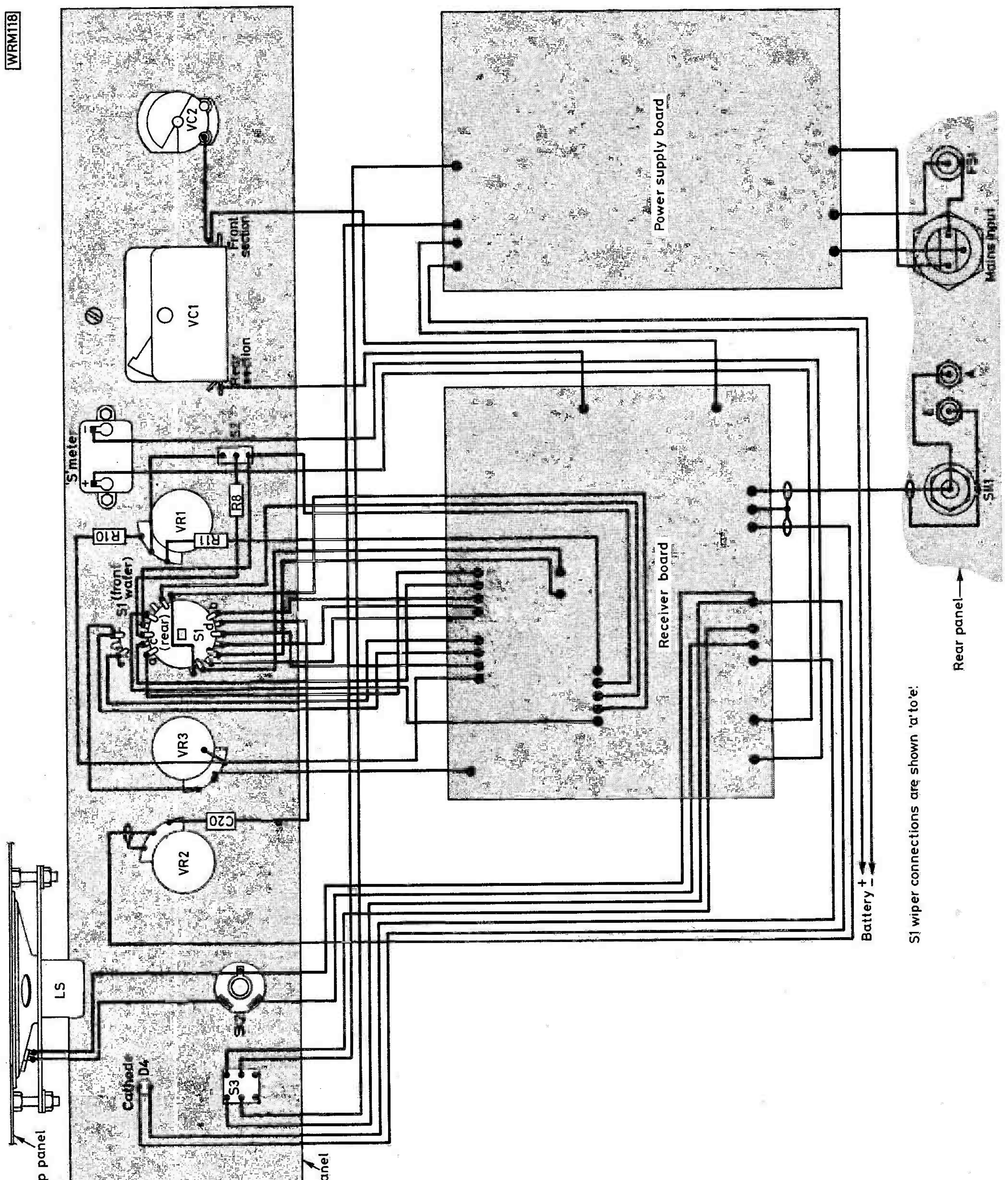


Fig. 5: Complete wiring diagram of the receiver

tion. The receiver is switched to f.m. and the core of IFT3 is then adjusted for maximum undistorted audio output.

Note that the recovered audio level may be significantly less on f.m. than for a.m. The volume control can be adjusted accordingly to compensate for this reduction in level. This completes the alignment and calibration of the receiver, which is now ready for "air testing".

Using the Receiver

The receiver is simple to use and automatic gain control is provided for a.m. reception, but this may be switched out if required when c.w. or s.s.b. signals are being received. This facility will be found to be most useful when strong signals are concerned; the r.f. gain is then simply backed off for best results. The facility to receive f.m. (which is very rarely used at h.f.) was thought to be a useful addition to a receiver which can potentially be used as a tuneable i.f. in conjunction with a v.h.f. converter. The f.m. facility provides for the reception of narrow-band f.m. signals of typically not more than 3kHz peak deviation. Limiting action is automatically provided for strong signals. The f.m. detector will, however, not perform well with wide-band f.m. signals and, should this be an important consideration, constructors are advised to replace the i.f. filter IFT2 with a comparable type having a wider bandwidth (e.g., the CFT455B which has a nominal 8kHz bandwidth and is pin-compatible).

The receiver is eminently suitable for either fixed or portable use. In each case the receiver will benefit greatly from the use of a properly designed aerial system and tuning unit or preselector. This ensures optimum performance and also helps to reject signals on the image channel. These sometimes appear as breakthrough of strong h.f. signals spaced by twice the intermediate frequency (i.e., 910kHz) above the wanted signal. A particular problem associated with sensitive low- and medium-frequency receivers is that of line-timebase interference from nearby television receivers. There is often little that can be done to prevent this nuisance, but in exceptional circumstances it may be necessary to site the aerial some distance away from dwellings and to employ a buried coaxial feeder with its screen earthed at each end.

For mobile use, a simple base-loaded whip aerial should be adequate although, here again, some form of preselector or tuning unit will give vastly improved results.

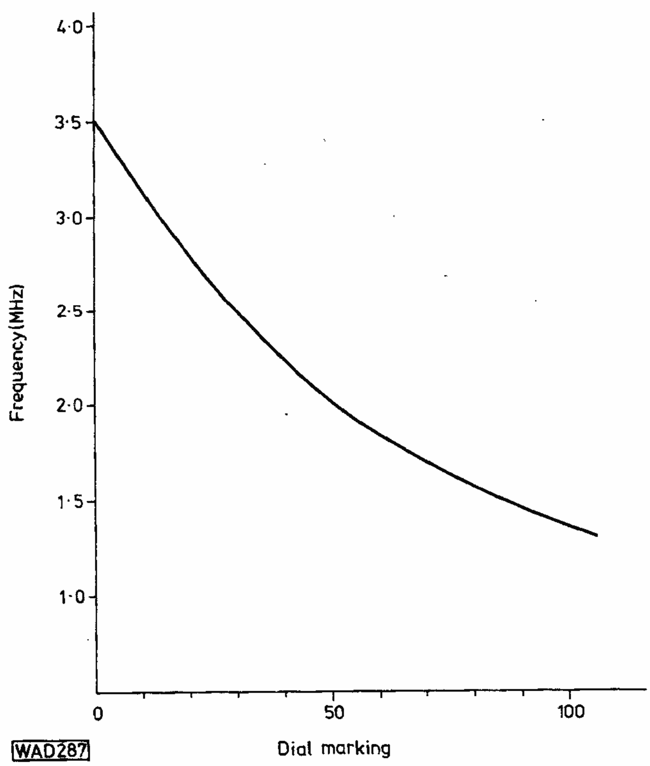


Fig. 6: Tuning calibration curve, used as an aid to alignment

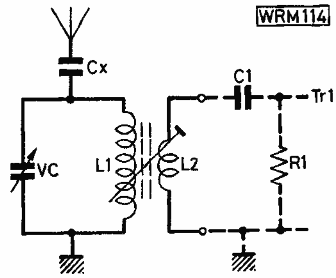


Fig. 7: The basic circuit of the image channel rejector

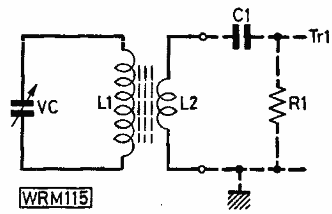


Fig. 8: An input tuned circuit using a ferrite rod

Aerial Matching

The additional tuned circuit shown in Fig. 7 will provide an extra 20dB of image channel rejection. The variable capacitor VC should have a maximum value of about 500pF. L1 consists of 100 turns of 36 s.w.g. enamelled copper wire wound in two layers on a 4·8mm diameter former fitted with a dust core, base and screening can. L2 consists of 10 turns of 30 s.w.g. over-wound on L1. C_x can be 47pF for short aerials or 15pF for a long-wire aerial.

If desired, this form of circuit can be modified to use a ferrite-rod aerial, as shown in Fig. 8, though it should be remembered that such an aerial is directional. Here, VC should have a maximum value of 208pF. L1 is 22 turns of 30 s.w.g. enamelled copper wire wound at one end of a 180mm ferrite rod (see Fig. 9), and L2 is 5 turns of 30 s.w.g. enamelled copper wire over-wound on L1. The ferrite rod should be mounted on pillars about 50mm long, either above or to the rear of the receiver.

An aerial matching unit provides an excellent method of improving the r.f. selectivity of the receiver, thus adding considerably to the image channel rejection, and also acts as an impedance match. In the circuit of Fig. 10, Tr1 is operated as an emitter follower which exhibits a voltage gain of slightly less than unity with a high input impedance and a low output impedance. The circuit can be constructed on a small piece of Veroboard or matrix board. Component details for the input tuned circuit are shown in the table.

Tuned Circuit Details for the Aerial Matching Unit

L1	L2	VC	Notes
5 turns 30 SWG wound on ferrite rod	22 turns 30 SWG	208pF	Not recommended for use with external aerials, directional
10 turns 30 SWG wound on 4·8mm dia. former with dust core	100 turns 36 SWG	365pF or 500pF	Recommended for use with external aerials

★ components

POWER SUPPLY UNIT		
Resistors		
¼W 10% carbon		
470Ω	2	R1, 2
1kΩ	1	R5
4·7kΩ	2	R3, 4
Variable Resistors		
Min. horizontal preset		
10kΩ	1	VR1
Capacitors		
25V electrolytic		
10μF	1	C2
470μF	1	C1
Semiconductors		
Diodes		
1N4001	4	D1, 2, 4, 5
BZY88C6V2	1	D3
Transistors		
BC548	1	Tr2
BD131	1	Tr1
Miscellaneous		
T1 240V primary, 2 × 15V secondaries, 6VA		
FS1 1A 20mm fuse, with panel holder		
Printed circuit board. Heat-sink for Tr1		

WRM116

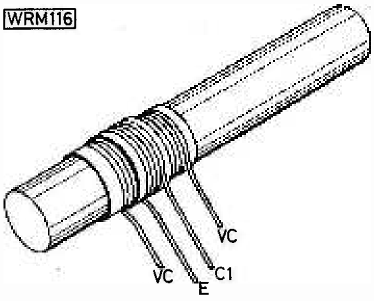
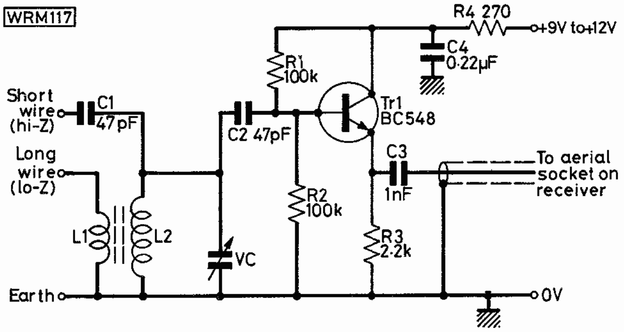


Fig. 9: Details of the ferrite rod aerial

Fig. 10 (below) the circuit diagram of the aerial matching unit

WRM117



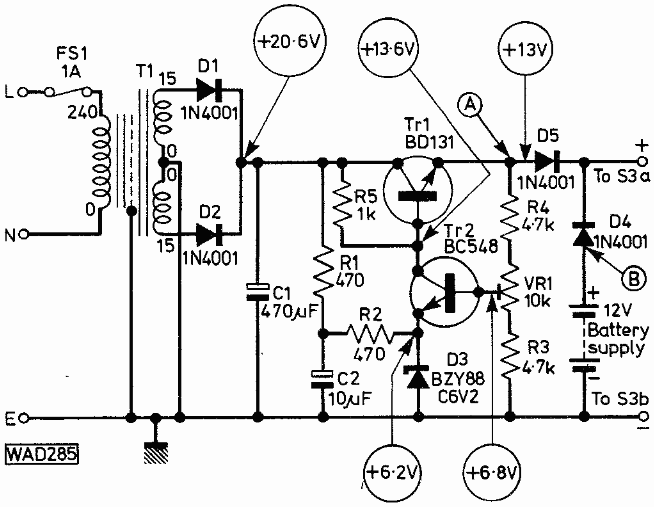
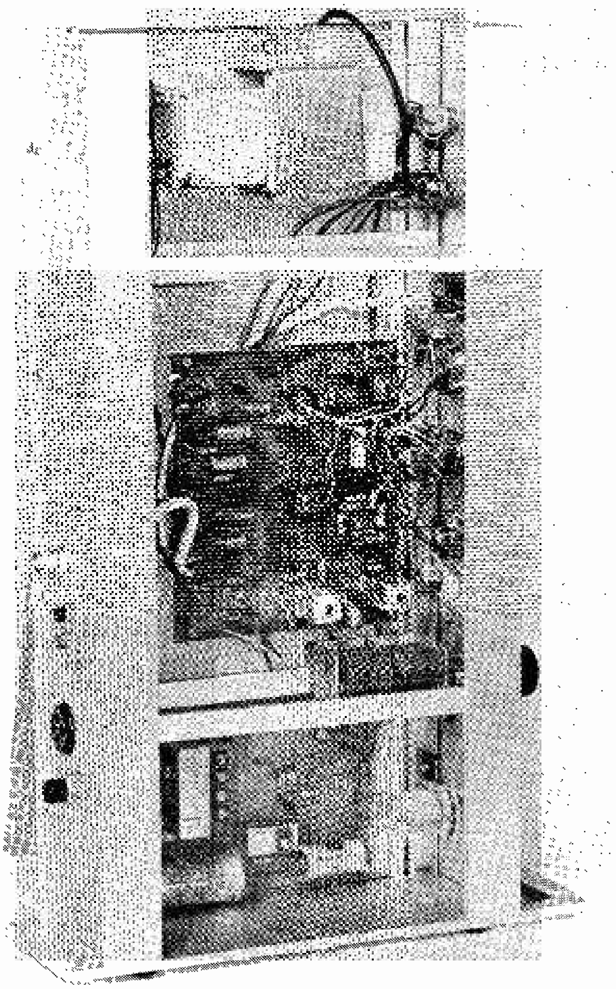


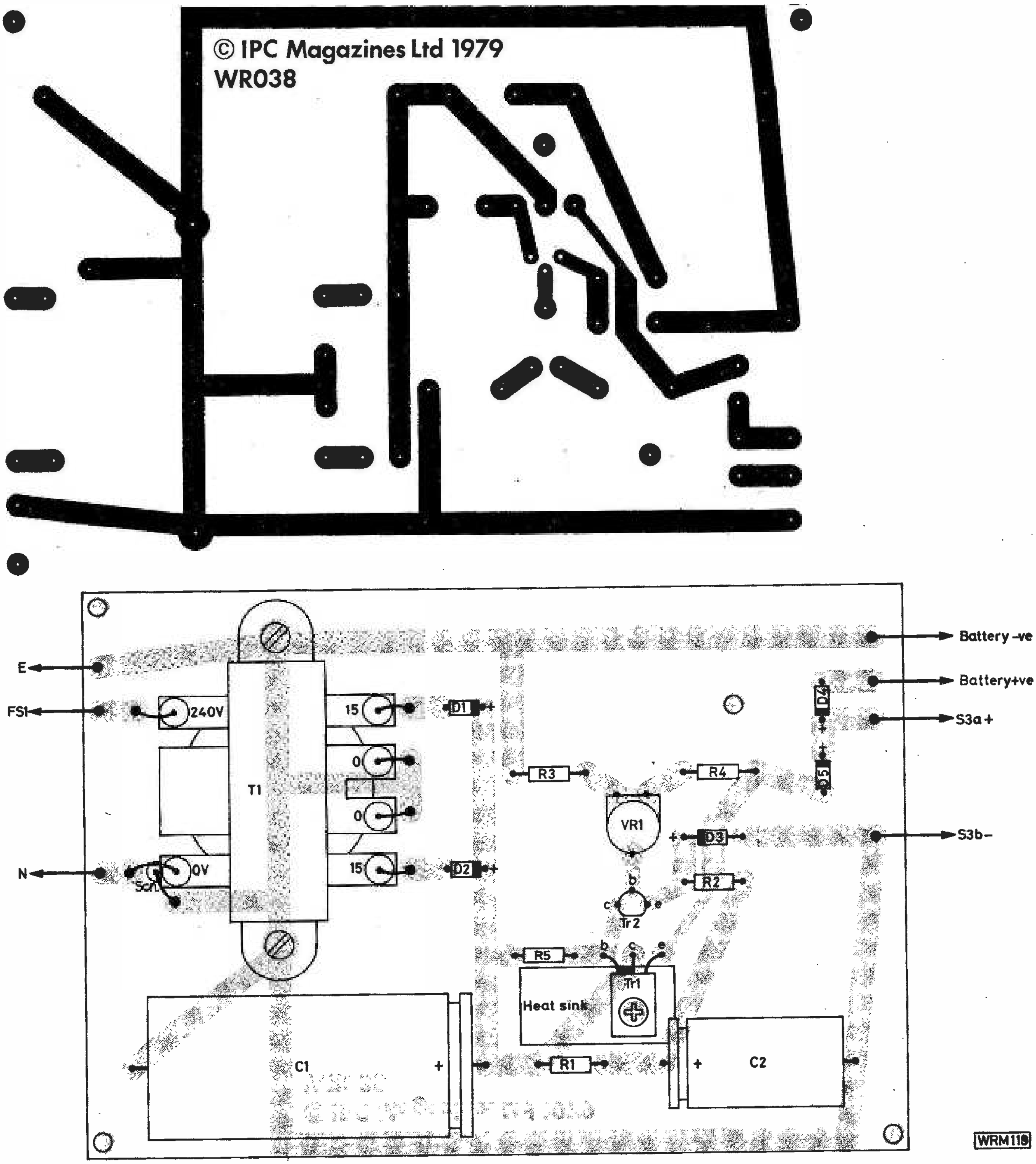
Fig. 11: The circuit diagram of the mains power supply unit



Power Supply

The receiver will give many hours of operation from its internal battery supply which consists of eight U11 cells or equivalent. However, a mains power supply is a very useful addition to any receiver which is likely to be used for any length of time at a fixed location. The circuit diagram of a suitable supply is given in Fig. 11, with p.c.b. track pattern and component layout shown in Figs. 12 and 13 respectively.

A centre-tapped mains transformer T1, and a full-wave rectifier (diodes D1 and D2) are used to build up a d.c. voltage across the reservoir capacitor C1. The smoothed output is stabilised by the series regulator transistor Tr1, driven by a d.c. amplifier based on Tr2. Control of the output voltage from the unit is achieved by supplying the base of Tr2 from an adjustable tap on the potential divider



Copper track pattern and layout of the power supply unit shown full size

formed by R4, VR1 and R3. Zener diode D3 provides an emitter-reference potential for Tr2. Changeover from a.c. mains to battery power is automatic in the event of a supply failure. This is achieved by the steering diodes D4 and D5. When the mains supply is present, the potential at point "A" will exceed that at point "B" (see Fig. 11). This will reverse-bias D4 and forward-bias D5, effectively open-circuiting the battery supply. When the mains supply is removed, either by accident or design, D4 will be forward-biased and D5 reverse-biased, supplying battery power to the receiver.

The power supply is straightforward to build and only one adjustment is necessary. Before connecting the output of the supply to the receiver board, the voltage at point "A" should be set to +13V by adjustment of VR1. In case of any problems, typical test voltages as measured using a 20kΩ/V multimeter on the 25V range are indicated on the circuit diagram.

The a.c. mains plug should be removed from the supply when the receiver is not required for operation over an extended period, since the mains unit remains working independently of the front panel on/off switch. ●

THE PW 'WINTON' Stereo Amplifier

Part 1

* E.A.RULE

The Winton amplifier has been designed primarily for the home constructor who would like a high fidelity amplifier equal to the best commercial design available, but at a price that enables it to be built within a sensible domestic budget, the total outlay being in the region of £110 for the complete project.

All the components are available and no special test equipment is needed for testing or setting up. The amplifier uses the very latest techniques and is capable of a standard of performance at least equal to the best commercial designs available with similar power ratings. In some aspects of its design it will outperform other amplifiers costing very much more.

Power f.e.t.s are used in the output stage and allow a wider power-bandwidth response with lower distortion than could be obtained if conventional bipolar output transistors were used. In the control unit section, bi-f.e.t. op.amps are used. These have an improved slew rate over the more common types, as well as much lower distortion. In the disc (magnetic) pre-amplifier, a three stage circuit using ultra low noise transistors enables noise figures of −68dB *unweighted* relative to 50W output to be obtained, with distortion so low that the input (normally 3mV) has to be increased to 140mV (+33dB) before the distortion even reaches 0·1%. A full circuit description will be given later.

On the front panel the Winton amplifier has controls for Volume, Balance, Bass, Treble and push buttons for selecting, Disc, Tuner, AUX 1, AUX 2, Tape monitor, Mono, h.f. and l.f. filters. Plus switches for mains on/off and loudspeaker or phones.

The headphone socket is also mounted on the front panel. DIN sockets are fitted on the rear panel for all inputs, terminals for the loudspeaker connections, an earth terminal, and fuse for the mains and each loudspeaker output. The heat sinks for the power f.e.t.s are also mounted on the rear panel.

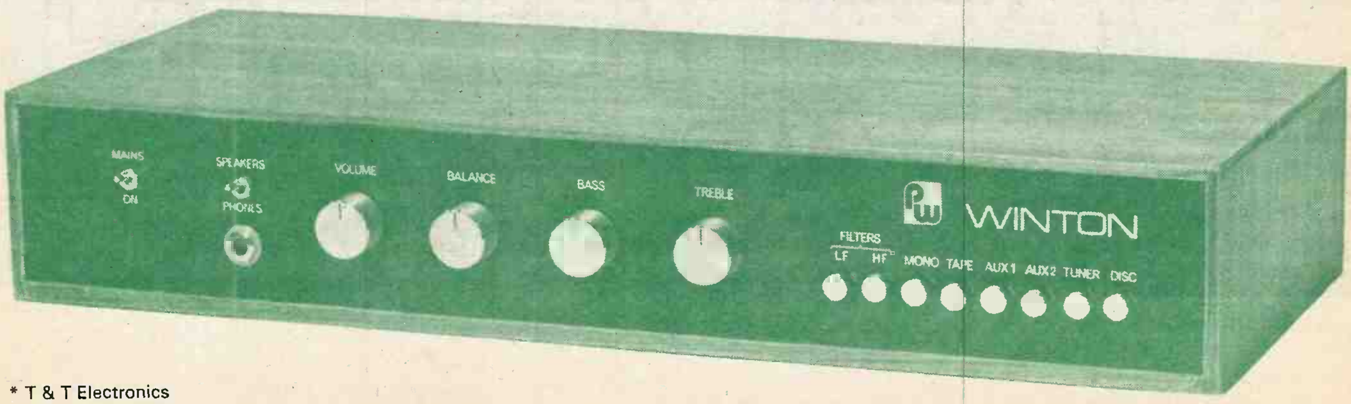
Power f.e.t.s

Until recently bipolar transistors have been used in almost every Hi-Fi available (the exceptions using valves). Bipolar transistors require a wide area of Safe Operation to achieve reliability and a large gain-bandwidth product so that large amounts of negative feedback can be used at the higher audio frequencies to reduce the distortion. They also have a positive temperature coefficient which means that any increase in transistor temperature causes an increase in transistor collector current which causes the temperature to increase further, and so on requiring careful design to avoid thermal runaway. Also, as bipolar transistors are minority carrier devices, they suffer from storage effects at high frequencies which can cause a most objectionable distortion, which may well account for the so called "transistor sound".

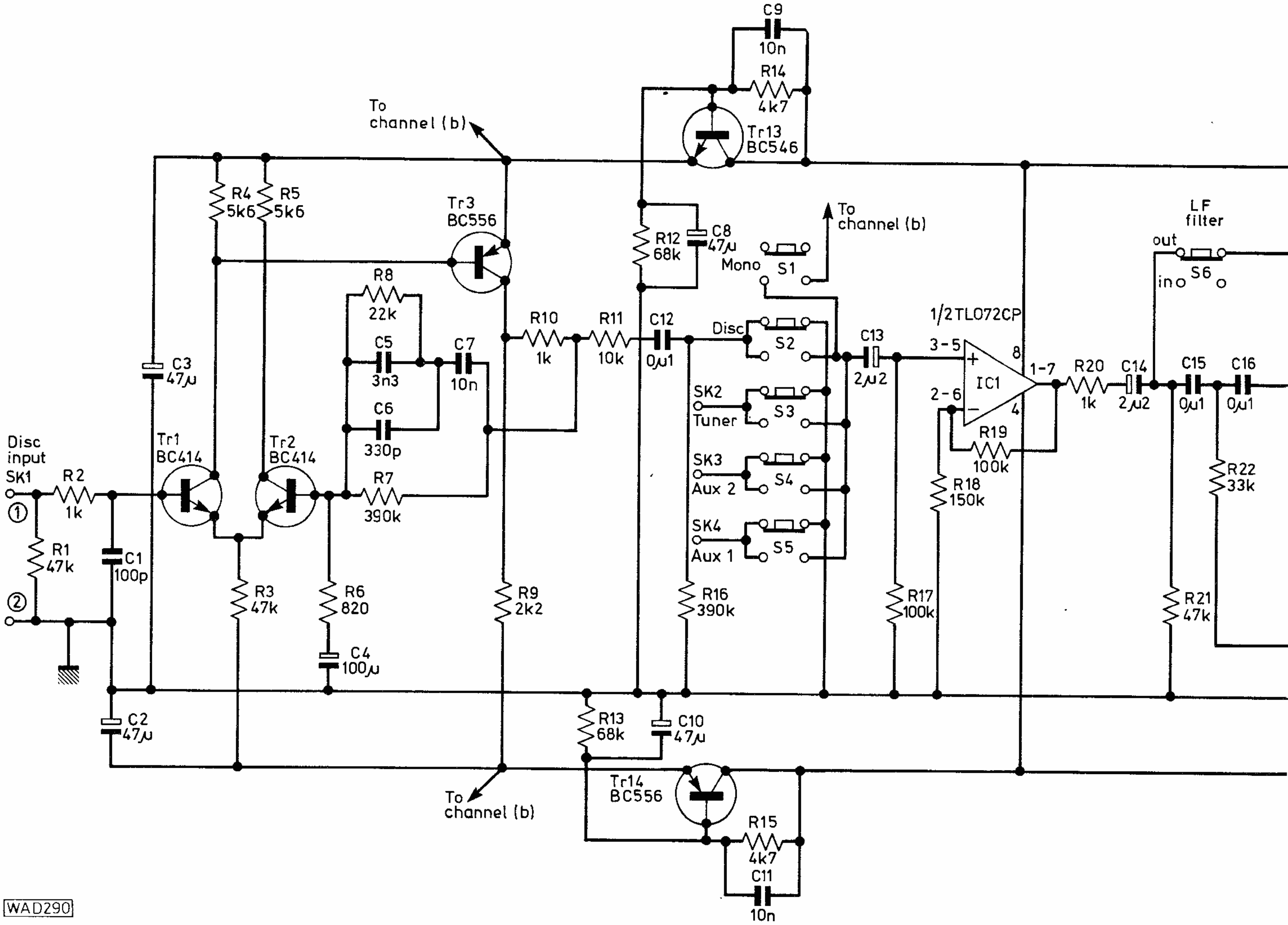
In the light of all these problems a considerable amount of money and research has gone into looking for a better device. One result of this has been the power f.e.t.s developed by Hitachi Ltd., of Tokyo, Japan. Some advantages over conventional transistors are:

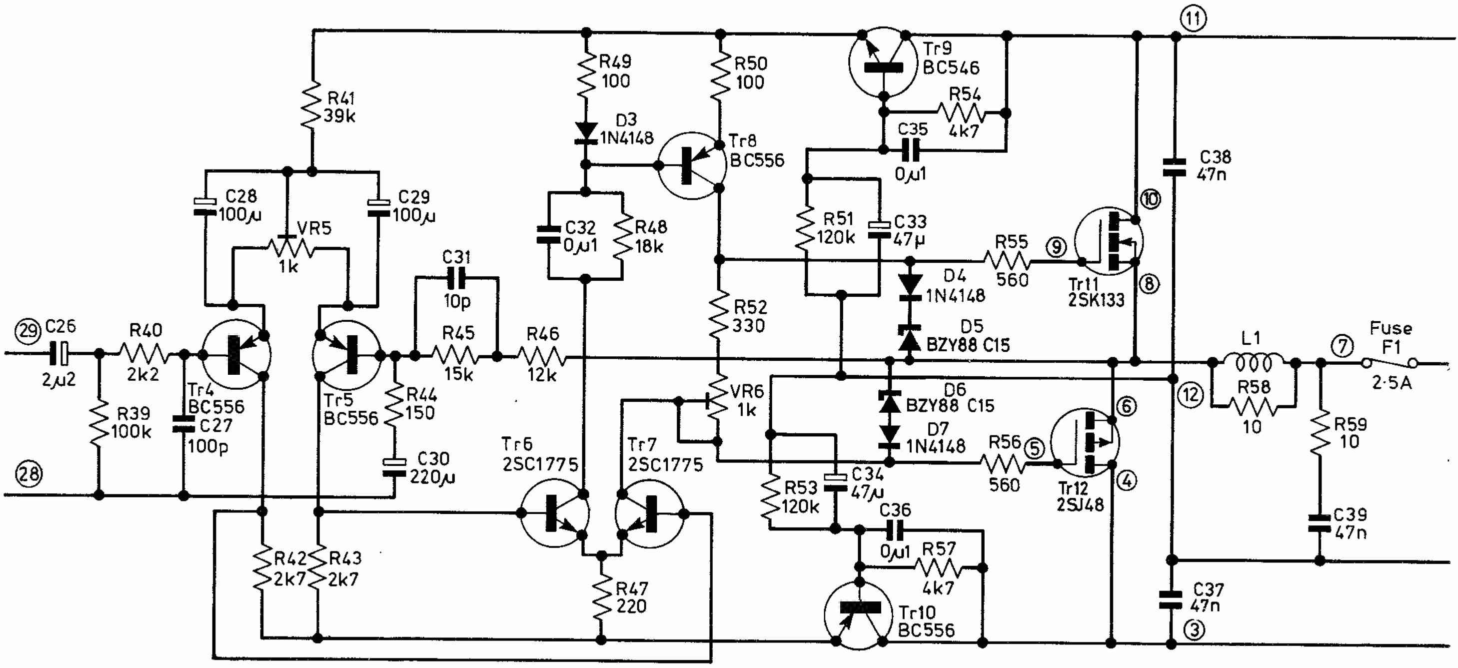
1) Good frequency response because of fast carrier speed.
2) No storage effect.
3) Negative temperature coefficients, so no risk of thermal runaway.
4) No secondary breakdown.
5) High input impedance and high gain.

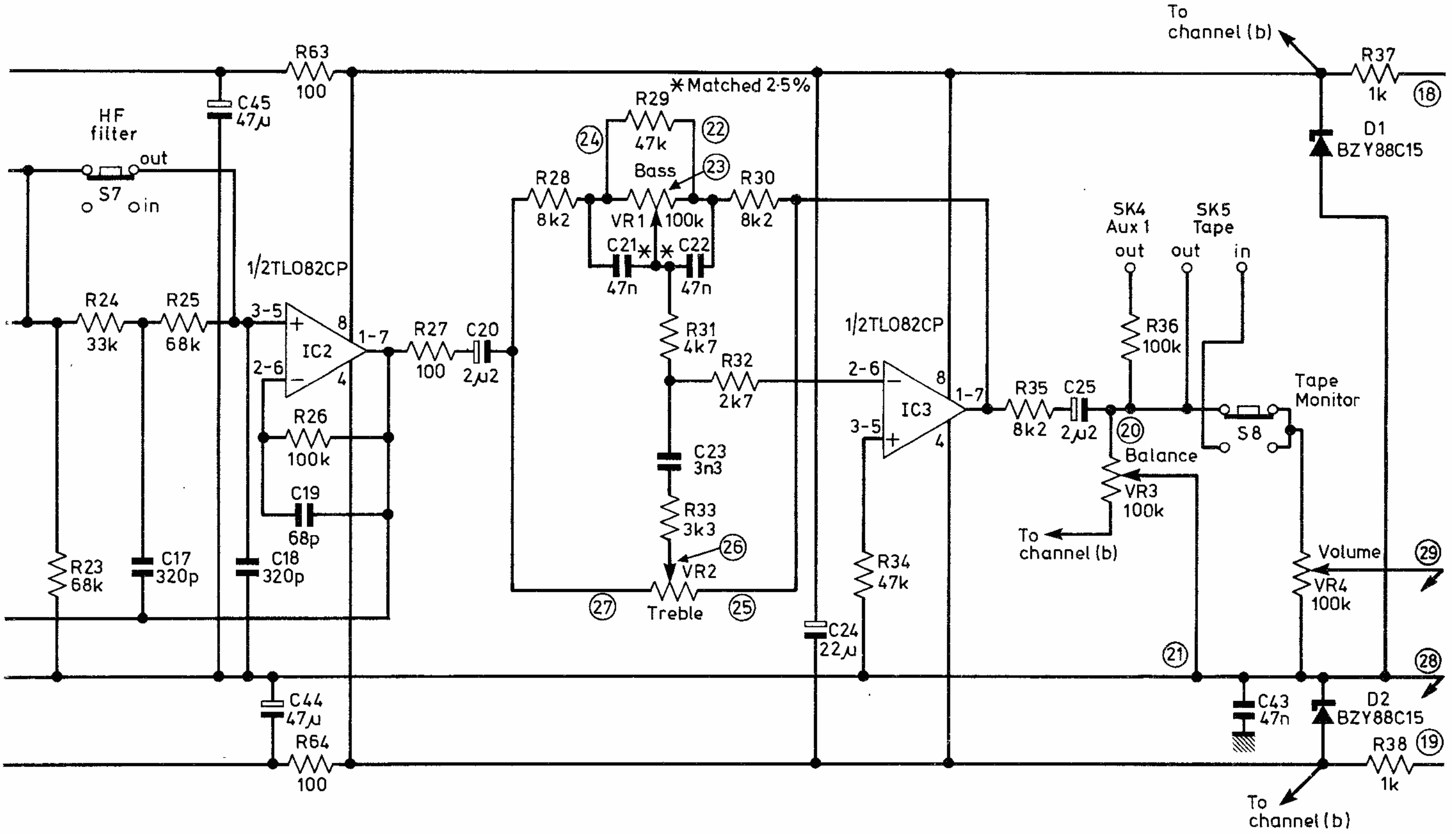
The Winton amplifier uses a complementary pair of Hitachi power f.e.t.s Type 2SJ48 (*p*-channel) and 2SK133 (*n*-channel). These devices have a maximum dissipation rating of 100W each, so when used in an amplifier of 50W output, each device is only dissipating about 25W, or just ticking over! In fact combined with a 120V drain to source breakdown voltage and a drain current of 7A they are almost indestructible when used in the Winton, which



* T & T Electronics


C9 10n
R14 4k7
Tr13 BC546
To channel (b)
R4 5k6
R5 5k6
Tr3 BC556
R12 68k
C8 47µ
To channel (b)
LF filter
out
in
S6
Mono
S1
R8 22k
R10 1k
R11 10k
C12 0µ1
Disc
S2
C13 2µ2
1/2TL072CP
3-5
8
IC1
1-7
R20 1k
C14 2µ2
C15 0µ1
C16 0µ1
C5 3n3
C7 10n
C3 47µ
C6 330p
SK2 Tuner
S3
2-6
4
R19 100k
Disc input SK1
Tr1 BC414
Tr2 BC414
R2 1k
R7 390k
SK3 Aux 2
S4
R18 150k
R22 33k
SK4 Aux 1
S5
R1 47k
C1 100p
R3 47k
R6 820
R9 2k2
R16 390k
R17 100k
R21 47k
C4 100µ
C2 47µ
R13 68k
C10 47µ
Tr14 BC556
To channel (b)
R15 4k7
C11 10n
WAD290


11
Tr9 BC546
R49 100
R50 100
R54 4k7
R41 39k
D3 1N4148
Tr8 BC556
C35 0µ1
C38 47n
C28 100µ
C29 100µ
VR5 1k
C32 0µ1
R48 18k
R51 120k
C33 47µ
R55 560
10
9
Tr11 2SK133
8
C31 10p
D4 1N4148
D5 BZY88 C15
R52 330
29
C26 2µ2
R40 2k2
R45 15k
R46 12k
L1
Fuse F1
7
2·5A
Tr4 BC556
Tr5 BC556
R44 150
VR6 1k
D6 BZY88 C15
12
R58 10
R39 100k
C27 100p
D7 1N4148
6
R56 560
5
R59 10
Tr6 2SC1775
Tr7 2SC1775
C30 220µ
C34 47µ
Tr12 2SJ48
4
28
R53 120k
C36 0µ1
R57 4k7
C39 47n
R42 2k7
R43 2k7
R47 220
Tr10 BC556
C37 47n
3



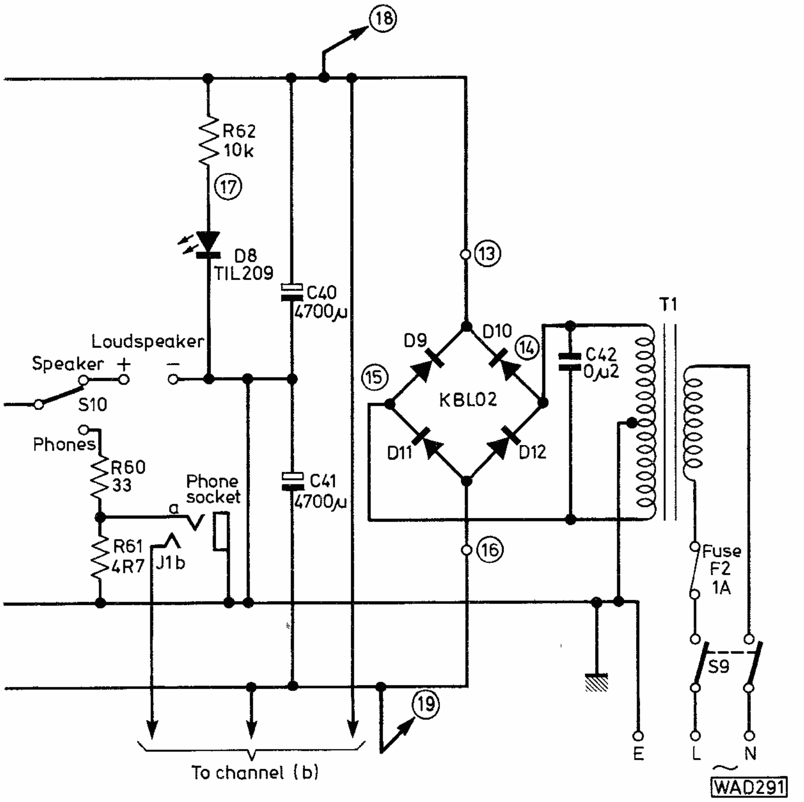


Fig. 1: Circuit diagram of the PW "Winton" stereo amplifier, showing Channel "a" (left) only. The following components are shared between the two channels: R12–15, 37, 38, 62–64; C2, 3, 8–11, 24, 40–45; Tr13, 14; IC1–3; D1, 2, 8–12; VR3; T1; F2; S9. The remainder are duplicated for the other channel

★ specification

Power Output
Continuous sine wave power, both channels driven
50 + 50W into 8Ω

Power Bandwidth *(power amp. only)*
−1dB 15Hz−100kHz

Frequency Response *(power amp. only)*
−0·5dB 10Hz − 40kHz
−3dB 5Hz − 150kHz

Harmonic Distortion *(50 + 50W)*
1kHz 0·013%
10kHz 0·015%
20kHz 0·018%
100Hz 0·011%
20Hz 0·019%
No significant increase at lower powers

Intermodulation Distortion *(28V pk into 8Ω)*
$f_1 = 15$kHz $2f_1 - f_2$ 0·005%
$f_2 = 16$kHz $2f_2 - f_1$ 0·004%
$f_2 - f_1$ 0·003%

Damping Factor
20Hz − 1kHz 80
20kHz 20

Rise Time *(power amp. only)* 2μs

Slew Rate *(power amp. only)* 26V/μs

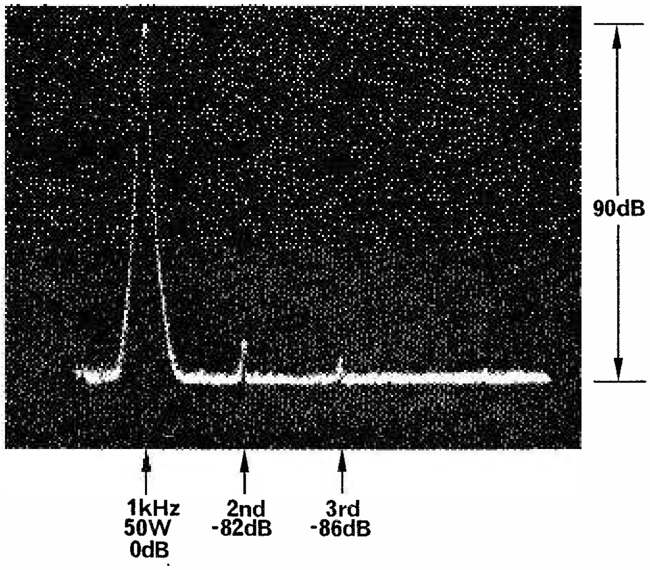
Stability – Unconditional

Sensitivity *for 50W*
Disc 3mV
Tuner 100mV
AUX 100mV
Tape 100mV

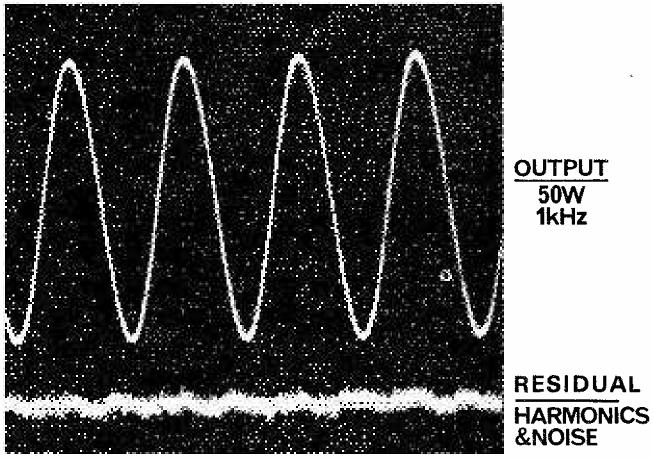
Input Impedance
Disc 47kΩ
Tuner 100kΩ
AUX 100kΩ
Tape 100kΩ

Maximum Input *for 0·1% t.h.d.*
Disc 140mV
Tuner 4V
AUX 4V

Frequency Response ±0·5dB
Disc RIAA
Tuner 20Hz–20kHz
AUX 20Hz–20kHz
Tape 10Hz–40kHz

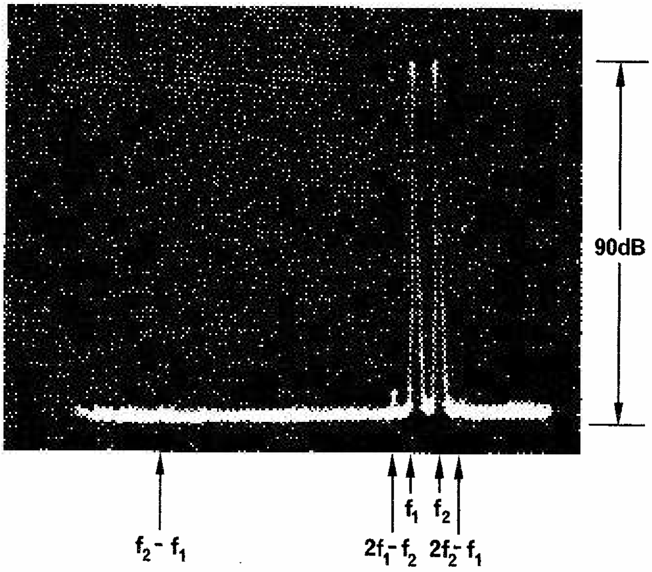


Plot of Harmonic Distortion components generated when handling a 1kHz signal dissipating 50W in an 8Ω load. The 2nd harmonic is at −82dB and the 3rd harmonic −86dB relative to the fundamental



The upper trace shows the *PW* "Winton" output when handling a 1kHz signal dissipating 50W in an 8Ω load. Note the complete absence of crossover distortion

The lower trace shows the residual harmonic content of the above signal, after the fundamental had been removed by the distortion meter filter. The total harmonic distortion is about −78dB, but is masked by noise



Plot of Intermodulation Distortion components generated when driven to full power into an 8Ω load by two equal-amplitude signals, f_1 = 15kHz, f_2 = 16kHz. Component $2f_1 - f_2$ is at −86dB, $2f_2 - f_1$ at −88dB, and $f_2 - f_1$ estimated at about −90dB

This test, using these frequencies, is very critical of the power-bandwidth capability of an amplifier, and is seldom given in specifications due to the generally poor figures obtained

Hum & Noise
Unweighted with reference to rated sensitivity*
Disc −70dB
Tuner −75dB
AUX −75dB
Tape −75dB

Hum & Noise
Disc input with reference to 10mV input
Unweighted 80·5dB

Cross Talk** −48dB

Tape Output 100mV
AUX 1 100mV via 100kΩ

* *See comments regarding specifications.*
** *Important to note that cross talk residual is clean, i.e., does not introduce distortion into the other channel—a common failing in many amplifiers and seldom mentioned.*

Tone Controls
Bass ±10dB at 100Hz
Treble ±10dB at 10kHz

Balance Control
+0·5dB to zero, each channel

Channel Matching 0·5dB

Filters

l.f. −3dB 50Hz	12dB/Octave
h.f. −3dB 5kHz	12dB/Octave

Subsonic, disc only, non-switchable

(IEC 65) −3dB	20Hz
−8dB	10Hz
−17dB	5Hz

Ultrasonic, all inputs except tape, non-switchable
−3dB 60kHz
−7dB 100kHz

Before making any measurements, the amplifier was pre-conditioned for 1 hour at 30% full power with both channels driven. Measurements were made after a further 5 minutes at full power.
Unless otherwise stated, the volume control was at maximum, tone controls at centre and filters switched out.
The stability tests were made using various combinations of loads with capacitors up to 2µF and also with capacitors up to 2µF without additional load. Square wave signals were used over a frequency range of 20Hz to 20kHz.
The figures given are those obtained on the prototype amplifier.

Test Equipment
Hewlett Packard HP3580 spectrum analyser; *Kron-Hite* 4100 low distortion oscillator; *Sound Technology* 1700B distortion analyser, power output meter and low distortion oscillator; *Telequipment* D83 oscilloscope; *Polaroid* oscilloscope camera.
This equipment was kindly made available by *Armstrong Audio Ltd.*, at their research laboratory.

General Comment
Be very careful when comparing specifications of other amplifiers with the Winton. Many other published specifications use a weighted signal to noise figure. This would allow an extra 10dB or so to be added to their figures and tends to favour the poorer quality amplifiers at the expense of the really good amplifiers.

means that the circuit can be kept simple as no protection circuits are required, eliminating another source of distortion.

The Bi-f.e.t. Op.amps

The use of the Texas bi-f.e.t.s in the control unit section offers a number of advantages over the more usual 741 type of op.amp. The main ones being:

1) Wider bandwidth. 3MHz typical.
2) High slew rate 13V/µs.
3) Low distortion 0·01%.
4) High input impedance j.f.e.t. input stage.
5) Low noise 18nV/Hz (TL072CP).
6) 80dB supply ripple rejection.

When used in low or unity gain circuits using large amounts of negative feedback the noise and distortion from the device is almost unmeasurable. The Winton amplifier has a basic sensitivity at the AUX inputs of 100mV and this has to be increased to 4V before the distortion reaches 0·1%. At any normally used input level the distortion is below the noise and completely inaudible.

Circuit Description

Both channels are identical and are pre-fixed "a" for left and "b" for right. Only the "a" channel will be described. See Fig. 1.

The Disc Pre-Amplifier

The input from a magnetic cartridge is fed into the base of Tr1, a low noise BC414 via the input load R1, 47kΩ, and an r.f. filter R2 C1. The transistor Tr1 forms one half of a differential input pair. Operating at a low current, approximately 100µA each half, ensures the minimum amount of noise.

The output from Tr1 is coupled directly to Tr3 a BC556. This in turn is coupled to a subsonic filter (as recommended by IEC65) consisting of C12, R16 and R17. This subsonic filter has its −3dB point at 20Hz, Fig. 2. This response, coupled with the normal RIAA response provides a 12dB/octave filter at subsonic frequencies and prevents intermodulation at low frequencies caused by warped records, etc., from being produced and affecting the overall sound quality. The RIAA negative feedback equalising circuit consists of R7, R8, C5, C7 and is connected between the output of Tr3 and the base of Tr2.

In order to ensure further the low noise factor in the disc amplifier, electronic decoupling is used, Tr13 (BC546) Tr14 (BC556) in each supply rail to remove any ripple or noise from the power supply. This supply has already been decoupled and stabilised by the Zener diodes, D1, D2.

The output from the disc pre-amplifier then goes to the selector switches S 1-5.

Control and Filter Section

From the selector switches S 1-5, each channel goes to one half of IC1 a bi-f.e.t. op.amp, Type TL072CP. This is used as a low noise buffer amplifier (with 4dB of gain) to provide a high impedance input, and a low impedance output suitable for driving the next stage, which also uses a bi-f.e.t. op.amp, Type TL082CP. This is used as an active high- (C15, C16, R22, R23) and low- (C17, C18, R24, R25) pass filter. Operating at unity gain, the filter is designed to provide a 12dB/octave cut-off with the −3dB points at 50Hz and 5kHz respectively, Fig 3. A slope of 12dB/octave is considered to be optimum for Hi-Fi use as a steeper slope could introduce ringing on transients, which would sound most objectionable.

The tone controls follow the filters, again using a bi-f.e.t. op.amp, Type TL082CP, and the circuit is a Baxandall negative feedback type.

This type of tone control circuit keeps distortion and noise to a much lower level than the passive type and also provides frequency response contours more acceptable to the ear, Fig. 4.

The amount of bass and treble boost and cut has been restricted to around + or − 10dB at 100Hz and 10kHz. Although it is possible to obtain up to 20dB boost and cut at these frequencies by removing R29 and reducing R33, extreme amounts of boost or cut are considered by the author to be bad design, as in practice large amounts can rarely be used. For example, suppose we have a signal requiring +10dB at 100Hz, with our circuit we can obtain this with only an extra dB or so at lower frequencies. If the unrestricted circuit was used, 10dB of boost at 100Hz would also produce 20dB of boost at 20Hz, as the response would continue to rise as shown in Fig. 4. The effect of this would be to increase all the rumble and other low frequencies a further 10dB over the required level at 100Hz. This would be in effect asking the amplifier for a considerable increase of power at low frequencies and as it cannot provide this, severe distortion would result. Note:

10dB of boost equals a voltage ratio of 3·16:1.

If our amplifier is already producing 50W into 8Ω, i.e., 20V, then 20V × 3·16 = 63·2V, power = $V^2 \div R$ = 3994 ÷ 8 = 499·28 watts!!

Even with the amount of boost restricted to + 10dB, if the bass control is at maximum and the amplifier is just reaching maximum power (50W) at say 20Hz then the maximum power at 1kHz must be limited to 5W (assuming a flat frequency response of the input signal). In practice, the tone controls are normally used to make up for the deficiency in the incoming signals, i.e., to restore the signal to an overall "flat" response, so the power restriction normally won't apply.

The output from the tone control circuit then passes to the balance control and the tape monitor switch S8. This switch selects either the output from the control unit section or the output from a tape recorder (connected to the tape socket) and feeds the signal via the volume control to the power amplifier. A tape output signal is permanently connected from the control unit output to both the tape socket and via 100kΩ resistors to the AUX 1 socket. This arrangement allows the use of either or both reel to reel and cassette recorders with the Winton. When using a reel to reel or cassette recorder fitted with a monitor head (plugged into the "tape" socket) tape monitoring can be achieved by simply pressing the "tape" button.

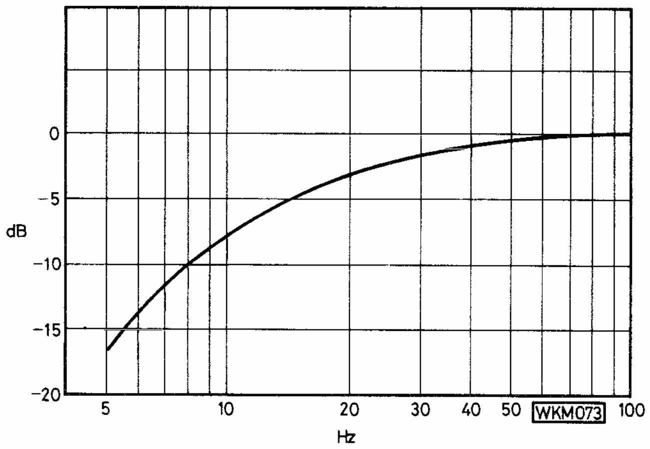


Fig. 2: Disc input — Subsonic filter response

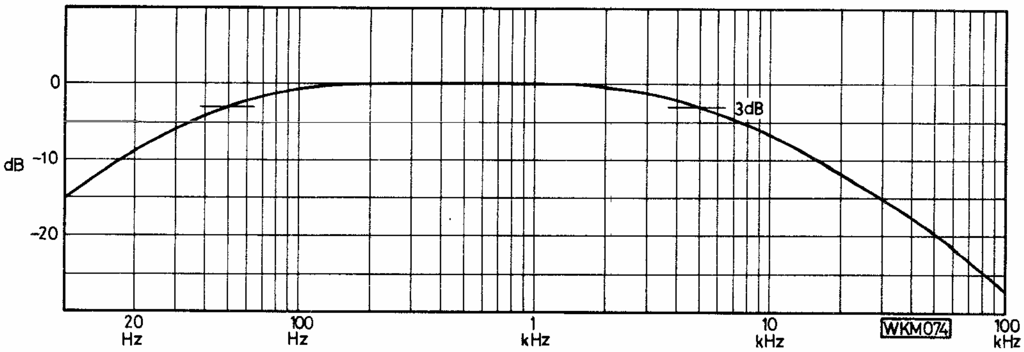


Fig. 3: Frequency response of l.f. and h.f. filters

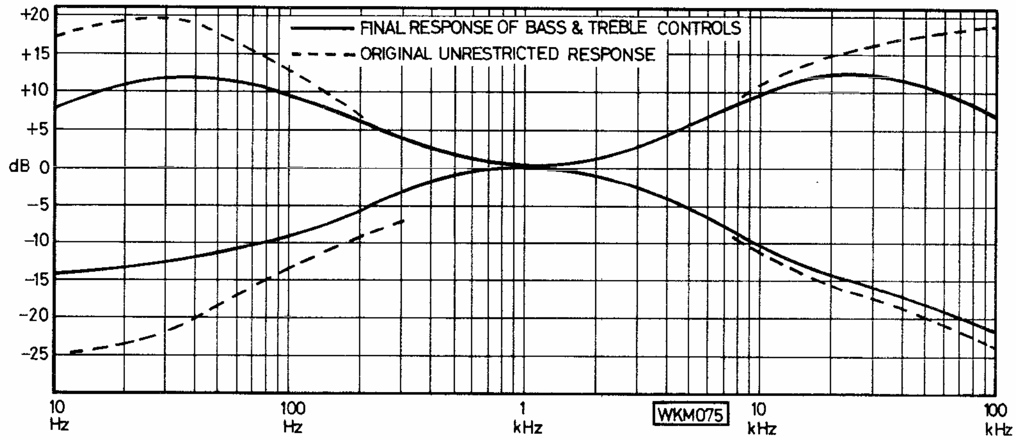


Fig. 4: Frequency response range of Bass and Treble controls

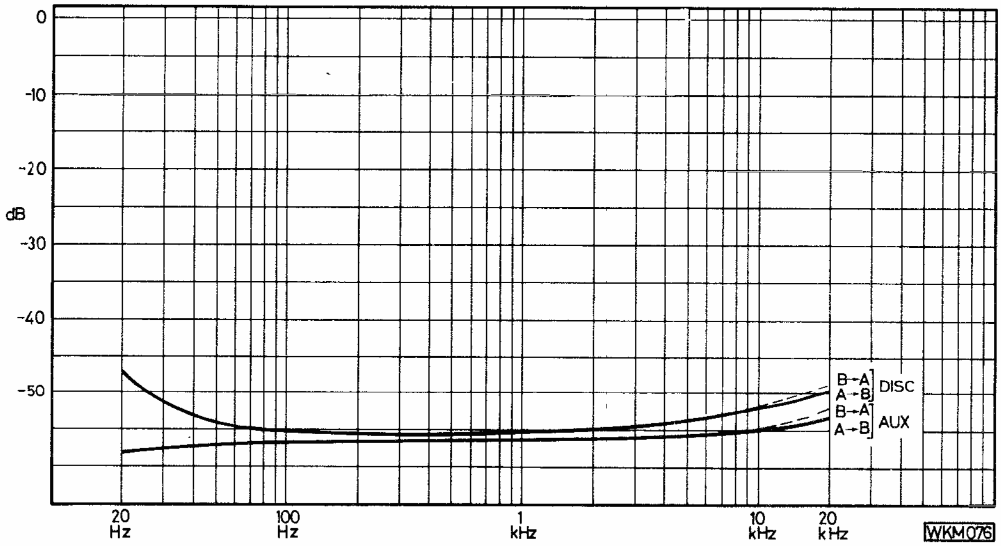


Fig. 5: Cross-talk between the two channels, for Disc and Auxiliary inputs

Power Amplifier

The circuit used for the power amplifier is based on a design produced by Hitachi for their power m.o.s.f.e.t.s. The original circuit has been modified by the author to suit the requirements of the Winton and electronic decoupling added to further improve the overall specification.

The signal from the volume control, VR4 is fed via an r.f. filter R40, C27 to the base of Tr4. This is one half of a differential pair Tr4, Tr5 using low noise transistors Type BC556. These in turn drive a second differential pair, Tr6, Tr7, Type 2SC1775, which has an active collector load (current mirror formed by Tr8 and D3), to maintain the pushpull action. The power m.o.s.f.e.t.s Tr11, Tr12 are driven directly from the second differential pair. As the inherent distortion of the amplifier is very low, only 45dB of negative feedback is used, this is fed from the output, back to the base of Tr5 via R46, R45, C31. The use of less feedback means that, at the overload point, the onset of distortion is less severe then would be the case with amplifiers using considerably more negative feedback. Diodes D4, D7 and Zeners D5, D6 form an overdrive protection circuit to prevent the gates of the m.o.s.f.e.t.s from receiving excessive drive voltages in the event of a fault condition.

Due to the excellent high frequency response of the amplifier only minimal feedback phase correction is required via C31, R45, and L1, R58, R59, C39. The amplifier is unconditionally stable.

As mentioned earlier, electronic decoupling has been included in each power amplifier to reduce the power

★ components

Resistors

5% 0·25W

100Ω	8	R27, 49, 50, 63, 64
150Ω	2	R44
220Ω	2	R47
330Ω	2	R52
560Ω	4	R55, 56
820Ω	2	R6
1kΩ	6	R2, 10, 20
2·2kΩ	4	R9, 40
2·7kΩ	6	R32, 42, 43
3·3kΩ	2	R33
4·7kΩ	8	R14, 15, 31, 54, 57
5·6kΩ	4	R4, 5
8·2kΩ	6	R28, 30, 35
10kΩ	2	R11
12kΩ	2	R46
15kΩ	2	R45
18kΩ	2	R48
22kΩ	2	R8
33kΩ	4	R22, 24
39kΩ	2	R41
47kΩ	10	R1, 3, 21, 29, 34
68kΩ	6	R12, 13, 23, 25
100kΩ	10	R17, 19, 26, 36, 39
120kΩ	4	R51, 53
150kΩ	2	R18
390kΩ	4	R7, 16

5% 0·5W

10Ω	2	R59
10kΩ	1	R62

5% 1W

10Ω	2	R58
4·7Ω	2	R61
1kΩ	2	R37, 38

7W wirewound

33Ω	2	R60

Potentiometers

100kΩ + 100kΩ lin.	2	VR1, 2
100kΩ + 100kΩ log	1	VR4
100kΩ lin.	1	VR3

Min. Preset horizontal mounting

1kΩ	4	VR5, 6

Switches

Min. toggle d.p.d.t.	2	S9, 10
Push button unit 8 keys	1	S1 to 8 (T & T Electronics)

Capacitors

Electrolytic

2·2µF 63V	10	C13, 14, 20, 25, 26
22µF 63V	1	C24
47µF 63V	10	C2, 3, 8, 10, 33, 34, 44, 45
100µF 16V	6	C4, 28, 29
220µF 16V	2	C30
4700µF 63V	2	C40, 41 (Note: 7A ripple rating)

Polystyrene

10pF	2	C31	
68pF	2	C19	
100pF	4	C1, 27	
320pF	4	C17, 18	
330pF	2	C6	2·5%
3·3nF	4	C5, 23	2·5%
10nF	2	C7	2·5%

Polyester

0·2µF	1	C42
0·1µF	12	C12, 15, 16, 32, 35, 36
47nF	7	C37, 38, 39, 43
47nF	4	C21, 22 (Note: matched 2·5%)
10nF	2	C9, 11

Semiconductors

Diodes

TIL209	1	D8
BZY88C15	6	D1, 2, 5, 6
1N4148	6	D3, 4, 7
KBL-02	1	D9–12

Transistors

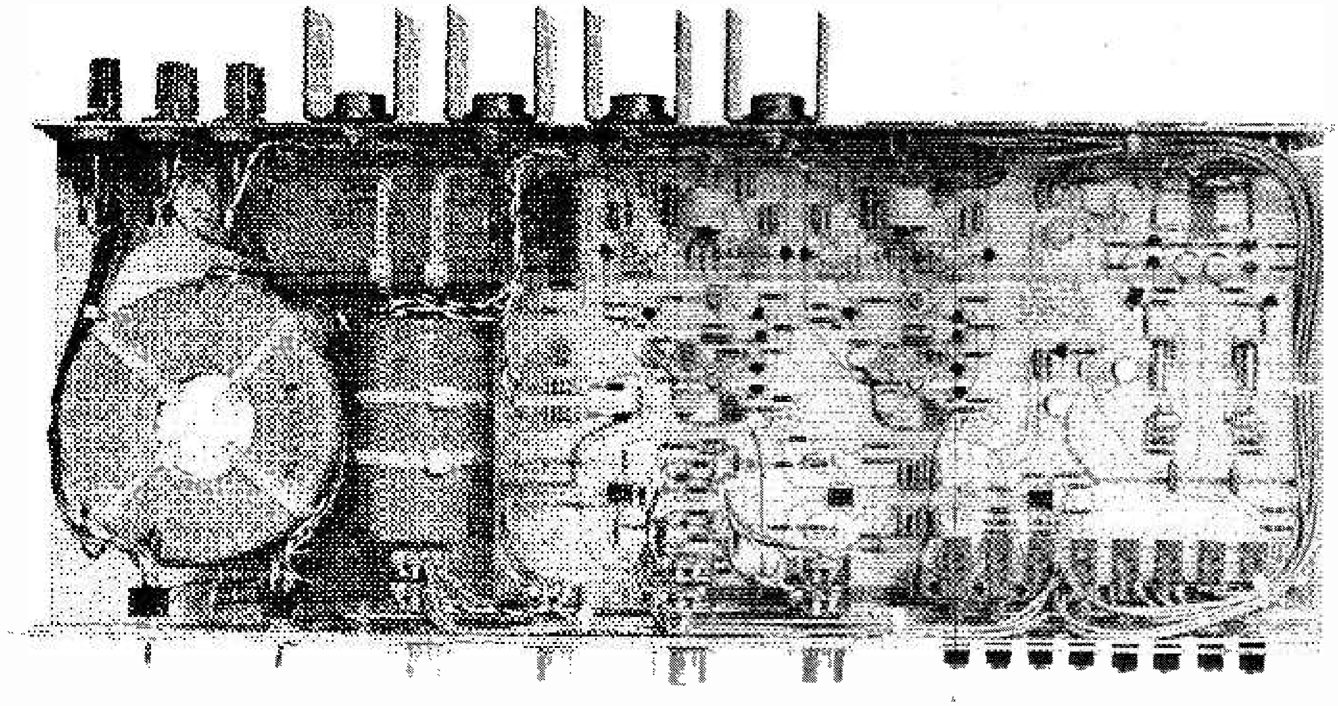
BC414	4	Tr1, 2
BC556B	11	Tr3, 4, 5, 8, 10, 14
BC546B	3	Tr9, 13
2SC1775E	4	Tr6, 7
2SK133	2	Tr11
2SJ48	2	Tr12

Integrated Circuits

TL072CP	1	IC1
TL082CP	2	IC2, 3

Miscellaneous

PCB Winton (T & T Electronics). Mains Transformer, Belclere 6854/3 (T & T Electronics). Chassis and front panel, Winton (T & T Electronics). Case Winton (T & T Electronics) Pins, RS 433-630 (47); Fuse holder, RS 412-879 (3); Fuse 2·5A Quick Blow (2); Fuse, 1A Slow-Blow (1); Pillars, RS 543-737 (5); Cable Ties, RS 543-349 (8); Cable Ties, RS 543-428 (6); 4mm Terminals, Black (1), Blue (2), Red (2); DIN Socket 5-way 180° (5); Jack Socket, RS 478-015 (1).



Internal view of the *PW* "Winton" amplifier. Here, we show the final version using a printed circuit board. The model illustrated on our front cover is the prototype, which was constructed on perforated board with hard wiring

supply noise and ripple voltage, as well as improving the cross-talk (Fig. 5) between channels. Transistors Tr9, BC546 and Tr10, BC556 are used for the decoupling circuit.

Provision is made to adjust the d.c. offset at the output to zero. By adjusting VR5, the current through the differential input stage can be adjusted to compensate for the slight gain variation in each half of the differential pairs. It is very important that the output from the amplifier does not contain any d.c. voltage, as this would cause the loudspeaker cone to take up a position away from its centre which in turn would cause distortion because of the resulting non-linear cone movement.

Power Supply

By no means least important, the power supply of the Winton has been subjected to the same standard of design as the rest of the circuits, although on the surface it may look simple.

In a high fidelity amplifier the power supply can either turn a good amplifier into a top quality model or into a not so good one. There are two main reasons for this:

1) The regulation of the supply volts must enable the amplifier to reach its full power potential under the worst possible signal conditions. At the same time, it must not let the voltage rise to dangerous levels under quiescent conditions.
2) The external magnetic field from the transformer must not inject any hum into the amplifier circuits, particularly the disc amplifier.

To enable the full performance that the Winton is capable of to be achieved, it was decided to use a toroidal type of transformer. The design and development of this special low-field transformer was carried out by Belclere Ltd., and this transformer is now available from T & T Electronics.

The output from the transformer goes to a bridge rectifier and then to the two 4700µF capacitors C40, C41. These, and the electronic decoupling circuits used in the power amplifiers, coupled with the Zener stabilised supply to the control unit and further electronic decoupling to the disc pre-amplifier, ensure that only about 0·001% of the total output from the Winton is noise from the power supply. Even on the disc input the total noise in the output from all sources combined is only about 0·04%.

Heat Sink Ratings

When designing an amplifier for domestic use, the design is almost always a compromise between all the various requirements. In the case of the Winton amplifier this applies to the size of the heat sink and mains transformer.

It is possible to make both of these components in such a way that the amplifier could deliver 50 + 50W continuous power for hours on end without much temperature rise. The cost of doing this would be so high as to put the amplifier out of reach of most peoples' budget. On the other hand these components could be made down to a low price and the amplifier allowed to run very hot, which would lower the reliability.

In the design of the Winton the author has arranged that these two components will allow the power f.e.t.s and the transformer to run well inside their respective maximum rating under continuous drive conditions, although under these conditions both the heat sink and transformer will reach quite high temperatures and certainly be too hot to touch.

When used for its normal purpose, i.e., reproducing music, the temperature rise is very much less and after some hours of loud music will still be only moderately "Hot". The actual heat sink may reach 60°C under these conditions.

This compromise doesn't reduce the quality of the reproduced sound in any way, but it does avoid a severe pain in the wallet.

NEXT MONTH
Constructional details

Follow-up to THE PW 'AVON'

Peter Preston

Those who built the Avon transmitter described in *PW*, July 1978, may be interested in one or two simple yet significant modifications which were ultimately incorporated into the prototype. The purpose was to increase the power output to approximately 20 watts for the original 24 volt supply and to give some consideration to a repeater access facility. The question of powering the transmitter from 12 volts—a car battery, for instance—was also examined, and the update caters for this at a reduced r.f. output of around 9 watts.

In the first place, the "Calibrate" facility provided by S1 in the switching arrangements of Fig. 10, p. 52 (*PW*, Aug. '78) was dispensed with and the switch re-assigned to a toneburst facility for repeater working. Details of the toneburst module appear elsewhere in this issue: the board on which it is constructed can easily be accommodated in the available space.

Step two is to replace the 15V regulator (7815) with a 12V type 7812. Our attentions are then directed towards the power amplifier board, where the majority of changes take place. Here a little care is needed, although the modifications are far from complex. The revised board could, of course, be constructed as an "afterburner" which would provide a substantial increase in output from, say, a hand-held tranceiver.

Initially, remove the resistor R1 (82Ω 2W) and take the h.t. feed (now 12V) directly to the board. The collector supply to the p.a. transistors remains routed to the *input* of the 7812 voltage regulator, via the switching of Fig. 10 (Aug. '78).

Now take out the BLY83 transistors and carefully expand the holes in the p.c.b. to accommodate the new 2N5642 devices. The leads will require a little trimming and this should be done fairly accurately to permit the transistors to fit on the appropriate islands on the board.

The increased output of the new p.a. inevitably means that appreciably more heat will be dissipated by the final stages. Additional heatsinking will have to be provided and in the prototype this took the form of a piece of aluminium 100 × 50 × 4mm, drilled to accept the studs of the power transistors. The sink is fixed to the main chassis by means of a suitable nut and bolt in each corner and the surface in contact with the chassis coated with Thermopath grease or similar compound. Insert the 2N5642 devices and tighten down, carefully soldering the connections to the p.c.b. afterwards (Fig. 1).

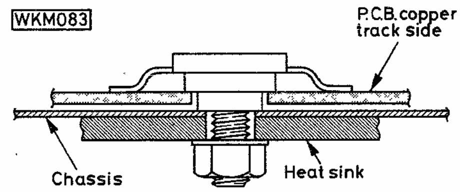


Fig. 1: Mounting the power transistors

The installation of the toneburst module designed by Philip Hodson is extremely simple. A power supply is taken, via the defeat switch S1, from across the energising coil of the keying relay RLA, which is shunted with a diode to absorb switching transients. Miniature screened lead feeds the signal input to the base of Tr2 (Board 1), with a 1μF tantalum capacitor placed in series.

The prototype exhibited some problems which ultimately were attributed to stray r.f. entering the microphone input. It is therefore recommended that a

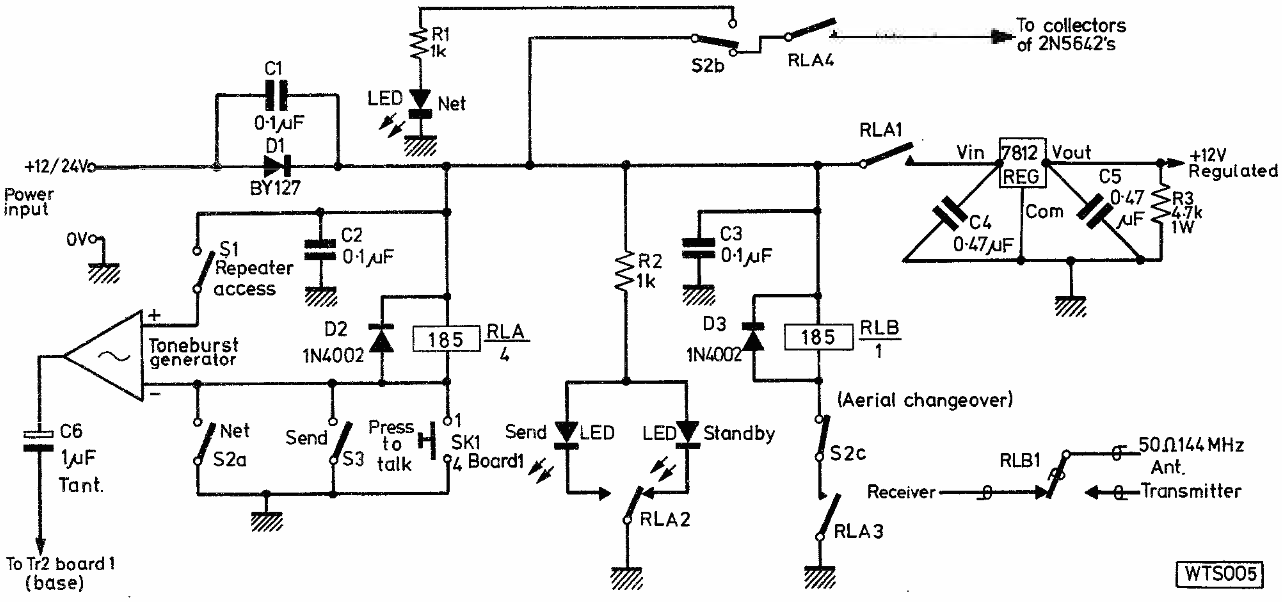
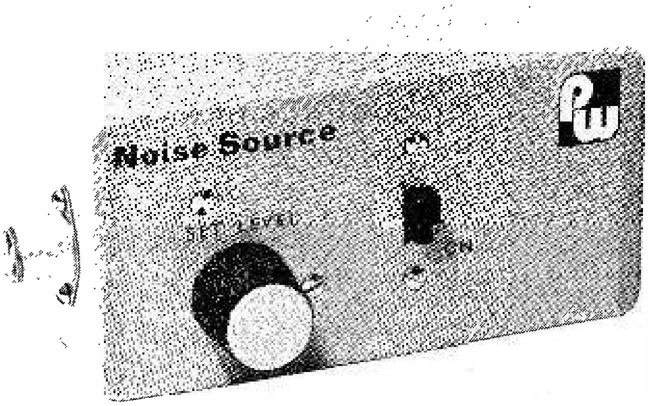


Fig. 2: The new switching arrangements — note the earth on changeover contacts RLA2, the option of different coil resistances for RLA and RLB from the original article, and the addition of diodes D2 and D3

continued on page 53

Wideband RF Noise Source

D.Whitfield



A wideband r.f. noise generator is a most useful device for carrying out rapid performance checks on all types of h.f. and v.h.f. receiver. The wide variety of applications of such an instrument includes gain checks, receiver sensitivity measurements and, where a calibrated attenuator is available, the noise generator may also be used to carry out accurate measurements of gain, noise figure, a.g.c. characteristics, and the calibration of signal strength meters.

The noise generator described here uses a minimum of components, is simple to construct and, although its output level is uncalibrated, is eminently suitable as a source for receiver alignment with an output which is substantially of constant level over a very wide frequency range. A previous article dealt with the construction of a matching calibrated 50Ω attenuator.

True "white" noise can be thought of as a signal which is evenly distributed over an infinitely wide range of frequencies and, although the instantaneous voltage varies randomly, the r.m.s. noise voltage developed into a resistive load will be constant when measured over a short time period. The noise power developed into a purely resistive load is thus directly proportional to the bandwidth in which it is measured.

Generating Noise

The simplest form of noise source is that due to thermal agitation current in a conventional carbon resistor. The fluctuation in current caused by the random movement of electrons is evenly distributed in frequency but the noise voltage produced is usually extremely small. Practical noise generators do not provide an infinite noise spectrum. This is due both to the limitations of the noise source itself and to the bandwidth of any following amplifier. The choice of noise source depends on a number of factors. Thermionic diodes are popular in commercial noise generators but, for economy of supply and portability, the noise source employed in this design is a conventional Zener diode. A considerable noise voltage is developed across the series load resistor of a Zener diode when it is undergoing breakdown. It is, however, usually necessary to include a stage of amplification following a noise source so that its output voltage is of a sufficient level for general purpose use. This has the added advantage that the amplifier stage also provides a degree of isolation between the noise source and the input of the circuit or receiver under test.

Circuit Description

A block diagram of the noise generator, together with its Thevenin equivalent circuit, is shown in Fig. 1. The noise output of the Zener diode is amplified using a two-stage wideband amplifier, Tr1 and Tr2. Both transistors operate in the common emitter mode and the gain of the second stage, Tr2, is made variable by the application of negative feedback by means of VR1. The device used in the Tr2 position has an effect on the bandwidth of the noise output. For use at v.h.f. the transistor recommended is a BFY90 as this has a very high cut-off frequency. For general purpose use at h.f. (i.e. to at least 30MHz) a much less expensive transistor may be used, and the 2N706 is quite adequate.

In order to facilitate matching to a standard 50Ω system, the output of the wideband amplifier is terminated in a 56Ω carbon resistor. This, together with the parallel effect of the collector load resistor of Tr2, ensures an output resistance of almost exactly 50Ω. The output noise voltage can be thought of as being generated in this resistor and thus the Thevenin equivalent circuit of Fig. 1b is realised.

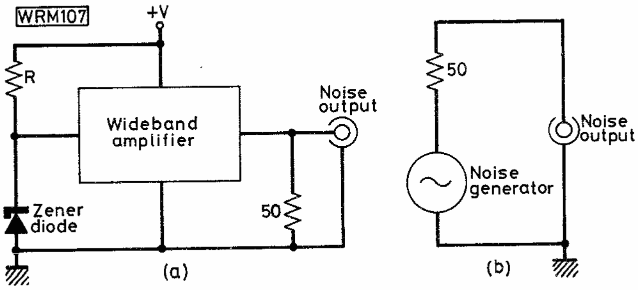


Fig. 1: Block diagram (a) and Thevenin equivalent circuit (b) of the noise source

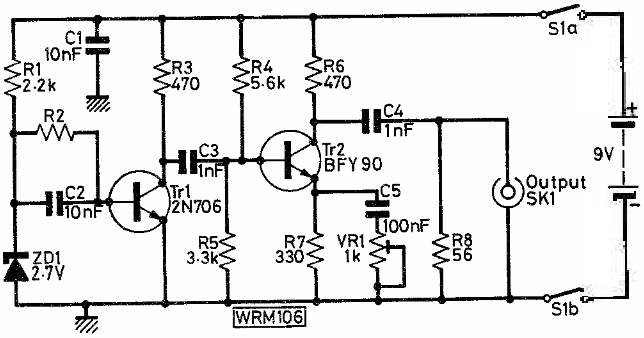


Fig. 2: Circuit diagram of r.f. noise source

Construction

Construction is straightforward and the use of the printed circuit board layout described is highly recommended. Where a printed circuit board is not used, care must be taken to ensure that all wiring is neat and as direct as possible. The noise generator is housed in a standard diecast box. Any alternative screened metal box can be used provided that the leads from the printed circuit board to the output socket are kept as short as possible. A small

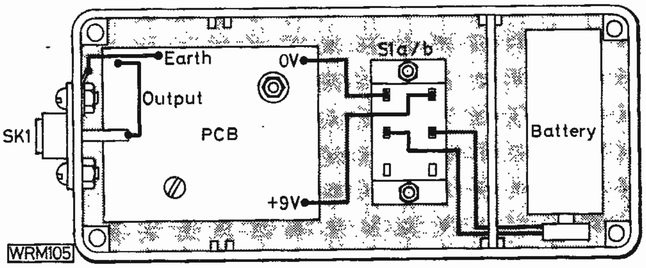


Fig. 3: Internal arrangement of components

★ components

Resistors
All ¼W carbon 5%

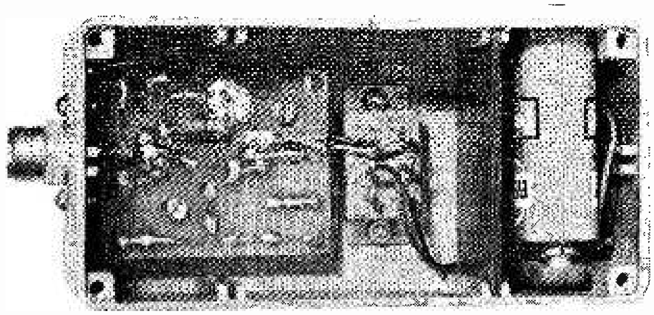
56Ω	1	R8
330Ω	1	R7
470Ω	2	R3, 6
2·2kΩ	1	R1
3·3kΩ	1	R5
5·6kΩ	1	R4
22kΩ	1	R2

Potentiometer
Miniature, horizontally-mounted pre-set
1kΩ 1 VR1 (Linear law)

Capacitors
Miniature polyester
10nF 2 C1, 2
100nF 1 C5
Miniature ceramic
1nF 2 C3, 4

Semiconductors
Diodes
2V7 1 ZD1 BZY88 series 2·7V Zener
Transistors
2N706 2 Tr1, 2 (Replace Tr2 with BFY90 for h.f. and v.h.f. version)

Miscellaneous
S1, d.p.d.t. slide switch; Diecast box 120 × 60 × 44mm; SK1, coaxial socket; Stand-off pillars, 6BA (2); PP3 Battery connector. Printed circuit board



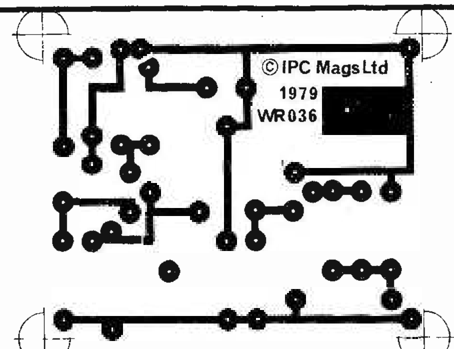
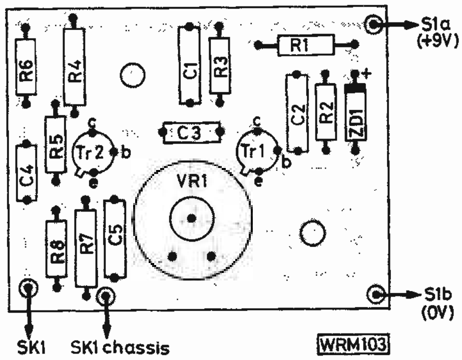


Fig. 4: Printed circuit board copper track pattern shown full size

Fig. 5: Component placement on p.c.b.



hole is made in the front panel of the box to provide access for the adjustment of VR1. Either a skeleton type or a knob type pre-set may be used. The latter will prove to be more satisfactory where frequent adjustments of output level are likely to be made. Care should be taken to ensure that the hole made in the case aligns correctly with the adjusting slot or shaft of the pre-set. Standard variable resistors are not recommended for use since they are not only too large but have considerable stray reactance which may impair the frequency response of the amplifier. The BFY90 is available in both TO18 and TO72 packages—the latter type should have pin 4 (case connection) clipped off before soldering the remaining connections to the board.

Testing

When the wiring of the noise generator has been completed, a thorough visual check should be made before connecting the battery. Connect the noise generator to the input of a receiver and check that an output is obtained. If the receiver has a signal strength meter this should show a steady indication; if no signal strength meter is fitted a 'rushing' sound should be heard from the loudspeaker. Adjustment of VR1 should cause a change in the noise level. If possible, a check should be made over a range of frequencies. If the receiver sensitivity is constant over a range of frequencies its signal strength reading (or audible output level with a.g.c. off) should remain constant as the receiver is tuned across its entire frequency coverage. Receiver alignment may be carried out using the receiver's signal strength meter in a conventional manner. The use of an a.f. voltmeter connected across the loudspeaker terminals as an output level indicator is strongly recommended when alignment is carried out on receivers not fitted with a signal strength meter. ●

tone-burst generator

R HODSON

Amongst the majority of would-be and newly-licensed amateurs there still seems to exist an air of uncertainty with regard to repeaters. This is quite apparent by the number of new 2m stations openly admitting "I'm recently licensed and don't fully understand repeater operation". This article looks at the principle of repeater working and suggests a suitable design for a toneburst generator with which to access them.

Operation via Repeaters

A repeater may be simply described as a remotely-operated transceiver which simultaneously transmits on one frequency and receives on another. Such a function is usually referred to as *duplex,* as opposed to *simplex,* when transmission and reception occur on the same channel but not at the same time. In the duplex mode, the repeater transmit and receive frequencies are well separated, the transmit channel being the higher of the two. This difference is referred to as the "shift" and is 600kHz in the case of 2m and 1600kHz at 70cms.

The amateur therefore would normally transmit on the repeater receive channel, which is known as the input. Some confusion arises here, especially when the term "reverse repeater" is used. This, as the name implies, refers to the amateur transmitting on the repeater **transmit** channel, effectively by-passing the facility. The function can be useful when calling a station known to be within point-to-point distance, and under normal circumstances you would transfer to one of the simplex channels when contact has been established. For obvious reasons you should not call a station in this mode unless you can hear him on the repeater input.

Table 1: 2m Repeater Channels

Channel	Frequency (Receive)	Frequency (Transmit)
R0	145·000	145·600
R1	145·025	145·625
R2	145·050	145·650
R3	145·075	145·675
R4	145·100	145·700
R5	145·125	145·725
R6	145·150	145·750
R7	145·175	145·775
R8	145·200	145·800
R9	145·225	145·825

Table 1 shows the frequency and channel allocations for duplex repeater operation. Not all of these are at present in use within the UK however, our own stations being between R3 and R7 inclusive.

Access to a repeater is gained by a short burst of tone (1750Hz) generated at the beginning of the transmission and lasting for 500ms typically. Some repeaters require this to be followed by several seconds of speech without loss of carrier, and this is quite difficult to arrange if all the switching is done manually. The device described in this article fulfils all these functions by one operation of the push-to-talk switch.

Most repeaters, with the notable exception of GB3LO (London), restrict the duration of transmission. After a pre-determined period a *time-out* occurs and the repeater releases, having first sent a series of "pips" to advise the receiving station of its intention.

When the input of the repeater senses the absence of a carrier, an advisory signal is sent, indicating that the station is ready to be re-accessed. Here it should be clearly understood that the terms "access" and "re-access" do not relate to the same function. Re-access involves the re-setting of the timing mechanism immediately after the repeater has been used, whereas access is given to mean "starting from cold", as it were.

British repeaters vary considerably in the method by which re-access takes place. Some require a toneburst with or without speech to follow, others operate on receipt of speech alone whilst some require only to receive a carrier, whether modulated or not. Some very interesting information is given in the *International VHF-FM Guide*†, for those who would like to consider individual cases.

The Toneburst Module

Referring to the circuit of Fig. 1, we can see that the crystal oscillator operates at a frequency of 910kHz. The Schmitt trigger IC2a converts the waveform into a sharp-edged square wave which is fed to the twelve-stage ripple counter IC3 as the clock reference. This counter, in conjunction with other gates, divides the clock frequency by 520, thereby obtaining the required 1750Hz necessary. The output is routed via another Schmitt trigger IC2c into a 3-pole Butterworth filter, which produces a relatively pure sine wave.

† *Available from J. Baldwin (G3UHK), 41 Castle Drive, Maidenhead, Berkshire (90p post free).*

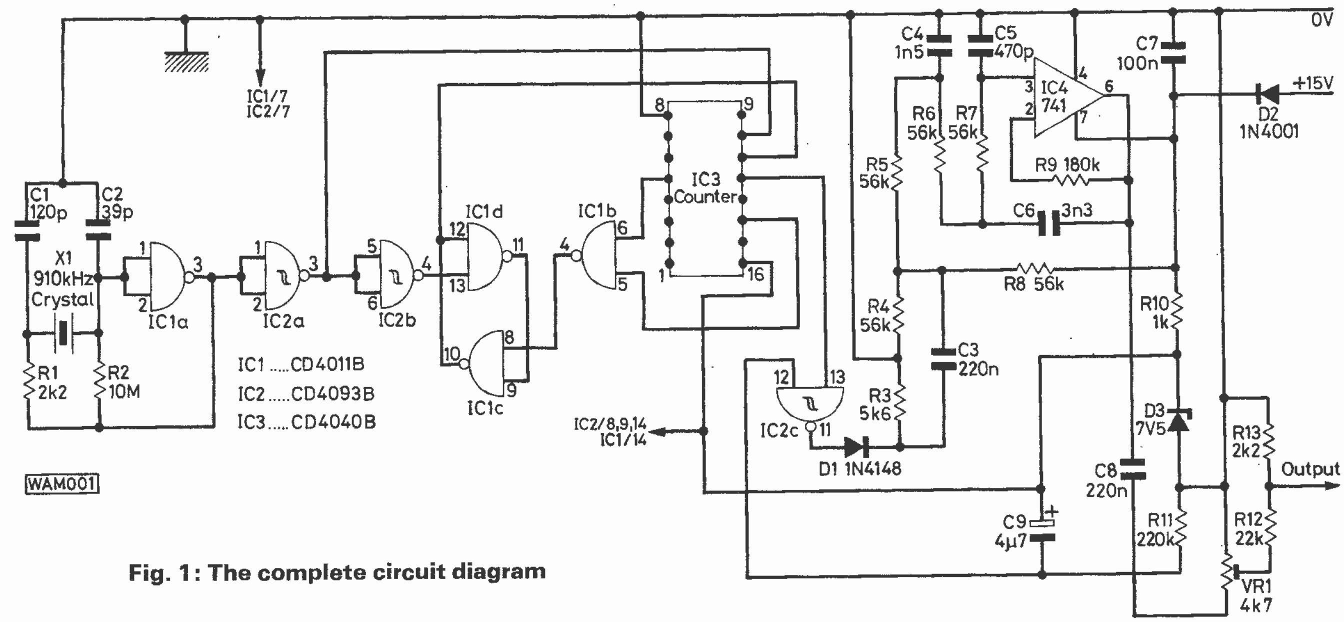


Fig. 1: The complete circuit diagram

Immediately power is applied, the capacitor C9 starts to charge through R10. As the potential rises towards that of the supply, a point is reached where IC2c changes state, effectively blocking the path of the 1750Hz signal. When this occurs, the system has to be re-set by disconnecting the power supply and consequently allowing the capacitor to discharge.

By installing the toneburst module in such a way that on pressing the microphone p.t.t. switch power is simultaneously applied to the transmitter, the access signal will be generated on the initiation of each "over" and the possibility of dropping carrier is eliminated. The provision of a switch in the power supply to the module permits its isolation when working simplex.

Construction

The discrete components should be mounted initially, leaving the crystal and integrated circuits until last. Omit resistor R12 at this stage, otherwise it will have to be removed in order to test the board.

If you do not wish to use holders, leave IC1–3 until last. These devices are c.m.o.s. and so should be handled as infrequently as possible prior to installation. The techniques for soldering these components have been considered on many occasions within these columns and in other publications. These should be closely adhered to if damage is to be avoided from static charges. The crystal is also susceptible to damage from excessive heat. The best method of soldering this is to use a very hot iron and to complete the process as quickly as possible.

★ components

Resistors
¼W 5%

1kΩ	1	R10
2·2kΩ	2	R1, 13
5·6kΩ	1	R3
22kΩ	1	R12
56kΩ	5	R4, 5, 6, 7, 8
180kΩ	1	R9
220kΩ	1	R11
10MΩ	1	R2

Pre-set, horizontally mounted

4·7kΩ	1	VR1

Capacitors
Miniature ceramic plate

39pF	1	C2
120pF	1	C1

Miniature polystyrene

470pF	1	C5
1·5nF	1	C4
3·3nF	1	C6

Miniature polycarbonate

220nF	2	C3, 8

Ceramic disc

100nF	1	C7

Tantalum. 16 volt 10% tubular. Axial leads

4·7µF	1	C9

Semiconductors
Integrated circuits

CD4011B	1	IC1
CD4093B	1	IC2
CD4040B	1	IC3
741	1	IC4

Diodes

1N4148	1	D1
1N4001	1	D2
BZY88C7V5	1	D3

Miscellaneous
Crystal 910kHz 30pF HC6U. Available from C. P. Developments, 16 Hughendon Road, High Wycombe, Bucks; Printed circuit board.

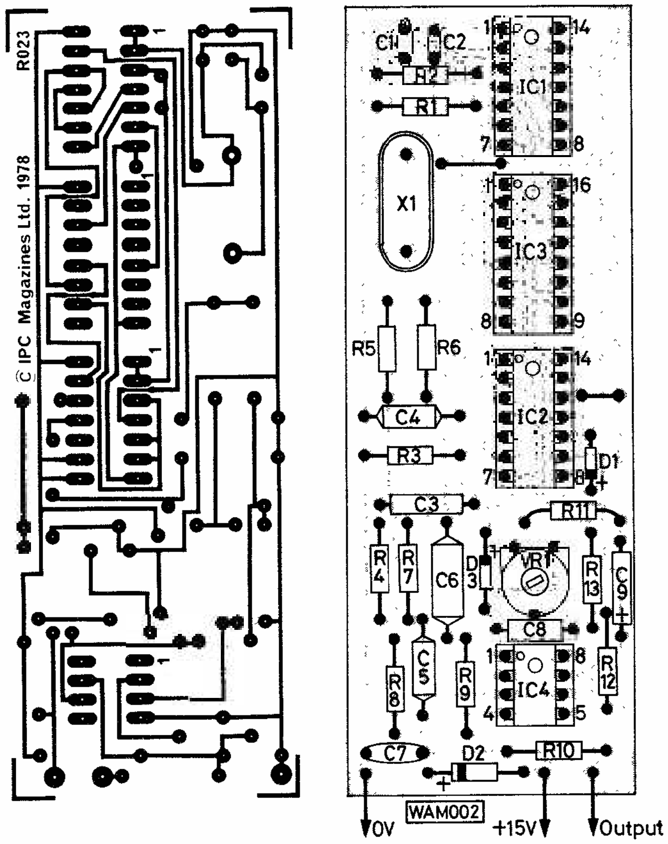


Fig. 2 (left): Copper track layout of the p.c.b. shown full size and (right) the component layout

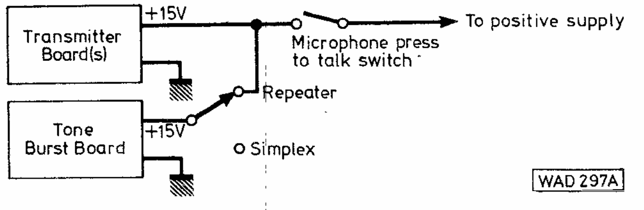


Fig. 3(a): The toneburst module fitted to a simple push-to-talk arrangement

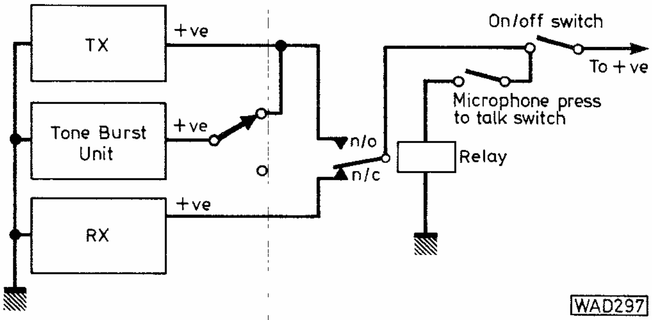


Fig. 3(b): Fitting the module into a high-power transmitter, where a keying relay is used

The capacitor C9 is specially selected, and it has been found that only the type in the components list is suitable. Most tantalum beads have a tolerance of 20%, and these gave rise to problems in the prototypes. For this reason a tubular version with axial leads and a tolerance of 10% is required. Increasing the value of this device will lengthen the duration of the toneburst.

Testing the Board

Make certain that you have not fitted R12 before commencing. Now connect a small loudspeaker or pair of headphones between the slider of VR1 and earth, then temporarily short across C9 with a small piece of wire. Apply around 15 volts and you should hear a continuous 1750Hz tone. Disconnect, and remove the short across C9. Re-apply power, and the tone should occur for a period of approximately half a second. Should it happen that the burst is appreciably longer, then reduce the value of the capacitor slightly. Selection of the correct value proved to be the only variable in the prototypes. The final decision to use 4·7µF was taken only after exhaustive experimentation, which indicated that this value produced the most consistent results. Provided the burst duration falls between 540 and 650ms, no difficulties should be encountered.

After carrying out these procedures, don't forget to insert R12!

If you are installing the module into the Avon transmitter, the following information may be helpful. Connect a microphone to the transmitter, key the device and adjust VR1 on Avon Board One to obtain a clear and undistorted speech output. Do not attempt to set for maximum volume; this is not the function of the deviation control. Too little deviation is preferable to an excess. Once adjusted, do not touch this control again, but alter VR1 on the *toneburst* module to give a level of tone slightly lower than that obtained with speech. If you are lucky enough to have access to an oscilloscope, the speech should be set for a maximum deviation of 5kHz and the toneburst limited to 3·5kHz. ●

Follow-up to the PW Avon

continued from page 48

100pF silver mica capacitor be connected from the input to earth, as close to the p.c.b. as possible, to provide the necessary decoupling.

Replace the p.a. board and the modifications are now complete. Retuned, the transmitter will produce about 9 watts of r.f. with a power supply of 12 volts, rising to around 20 watts for the original 24 volt supply.

Operating the microphone pressel switch with the "Access Repeater" facility enabled will automatically generate toneburst, thus providing the required conditions to open repeater stations.

The power supply featured in the September '78 issue of *PW* can easily be modified to handle the increased current drain, provided the transformer is capable of delivering it. Merely place another 0·47Ω 25 watt precision wirewound resistor in parallel with R2 (Fig. 1, p. 30, September '78 issue). ●

OF THE MONTH 74

Brian DANCE M.Sc

THOMSON-CSF TDE 1607

When using a small current (such as that from a t.t.l. or c.m.o.s. logic device) to control a much larger current in a load, it is possible to employ a simple transistor amplifier in some cases, whereas if a higher current gain is required a power Darlington device may be used as an amplifier. However, simple circuits employing such devices do not incorporate any means of limiting the current in the load so as to protect both the load and the amplifier device from possible damage. Also they do not incorporate any means of protecting the amplifier device if it should undergo an excessive temperature rise.

The TDE 1607 is a new integrated circuit from Thomson-CSF which can be used to overcome these problems. Basically it is a protected operational amplifier, being designed for fairly high currents and voltages, and is specifically intended for the control of the current in such loads as relays, lamps and stepping motors.

The TDE 1607 is essentially fail-proof in operation provided that the absolute maximum permissible supply voltage and input voltage (both 36V) are not exceeded. An external resistor can be incorporated in the circuit so as to limit the current in the load to any chosen value up to 0·5A (although the TDE 1607 has a maximum permissible output current of 1A). If the silicon chip in the device becomes too hot for safety, the internal circuit will automatically reduce the output current and thus prevent possible damage.

Connections

The TDE 1607 is supplied in a small circular metal transistor-type package with 6 leads. The connections are shown in Fig. 1, but it must be remembered that this is a **top** view. This device can operate over the wide temperature range of −25°C to +85°C.

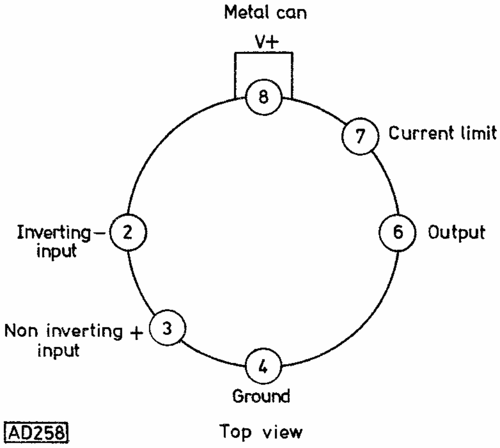


Fig. 1: Package outline and connections

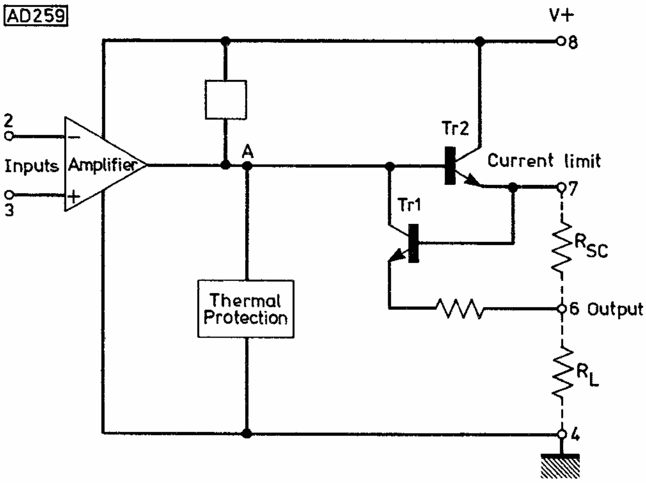


Fig. 2: Block diagram and "pass" transistors

The way in which the device operates can be understood using the block diagram of Fig. 2. When the non-inverting input to the amplifier (marked +) is at a voltage greater than that of the inverting input at pin 2 (marked −), the output voltage from the amplifier at point A in Fig. 2 will be relatively high (only a little below that of the V^+ supply line).

The output from the amplifier will then normally feed a current into the base of the transistor Tr2 (inside the TDE 1607) so that this transistor conducts and passes a current through the external resistor R_{SC} and through the load, R_L. The value of the current sensing resistor R_{SC} determines the maximum current which can flow in the output circuit. For example, if the value of R_{SC} is about 1·5Ω, a current of 0·5A will produce about 0·75V across R_{SC} and this voltage is applied between the base and emitter of the transistor Tr1. It is adequate to cause this transistor to commence to conduct, so instead of the current from A passing to the base of Tr2, it will pass to the collector of Tr1. Thus Tr2 will pass only just enough current to maintain a large enough voltage across R_{SC} to keep Tr1 conducting. The current passing through R_{SC} is equal to the load current, so the internal transistors Tr1 and Tr2 can be used to limit the load current.

If R_{SC} has the value of 1·5 ohms mentioned above, the load current will be limited to about 0·5A, whereas as R_{SC} is increased to 3 ohms, the maximum load current will be about 0·25A. The writer found experimentally that still larger values of R_{SC} could be used, a value of 100Ω producing a maximum current of some 10mA. The exact value of the maximum current varies somewhat with the case temperature of the device, typical values being plotted in Fig. 3. Obviously the output current will never exceed the value of V^+ divided by (R_L+R_{SC}), since an adequate voltage is required to cause the current to flow.

The output current will flow only when the non-inverting input of the internal amplifier (pin 3) has a potential exceeding that of the inverting input (pin 2); if this condition is not satisfied, the device will be 'off' and little output current will flow. If the silicon chip of the device ever becomes too hot for safety, the thermal protection circuit of Fig. 2 passes current from point A to ground so that there is little bias current to feed the internal transistor Tr2; the output current therefore falls until the device cools. However, it is unwise to operate the device for an appreciable time at such a high temperature that the thermal protection circuit is in operation, since such high temperature operation can tend to impair device reliability and certainly tends to produce surface defects on the chip. It should rather be regarded as a safety circuit which is not normally used.

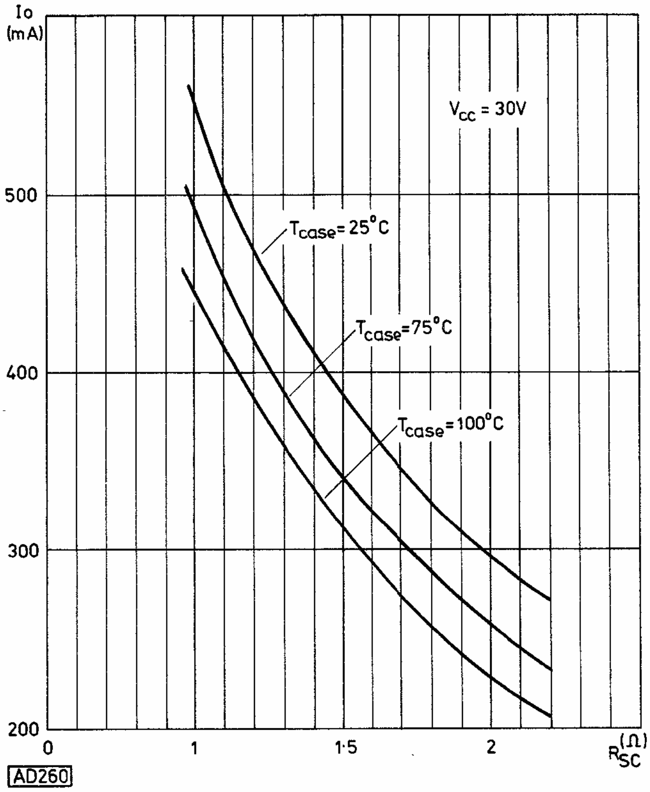


Fig. 3: Typical output current plotted against case temperature

Power Supply

It is recommended that TDE 1607 device is fed from a power supply of between 10V and 30V; it is, of course, possible to use ±15V balanced supplies if desired. The supply current is typically only 3mA (maximum 5mA for any TDE 1607 device) from a 24V supply, when the output current is zero.

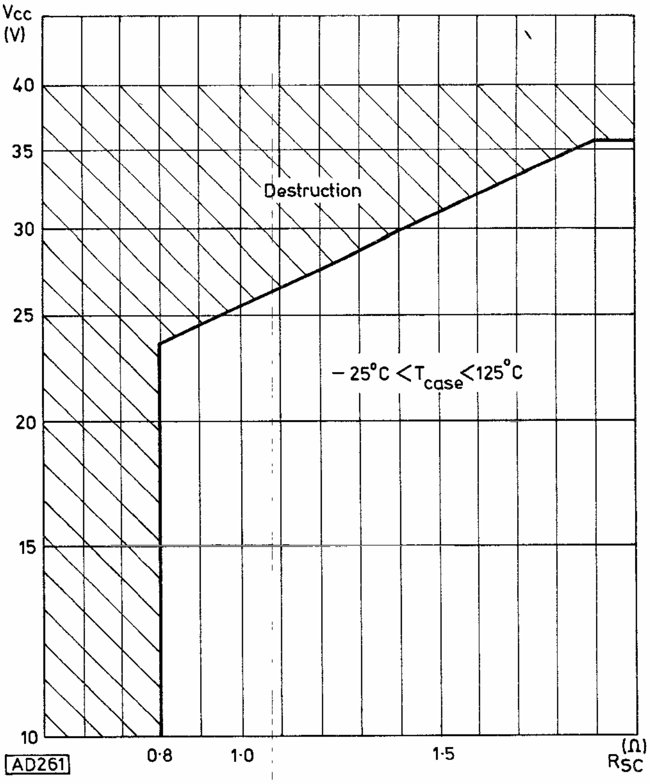


Fig. 4: Graph showing safe operating area

When the output voltage from the device is low, ideally no output current should flow and the output voltage should be zero. In practice, an output leakage current of up to 100μA can flow through the load at a junction temperature of 20°C or up to 500μA at a temperature of 85°C, whilst the output voltage may be a volt or so above the potential of the ground line. Similarly, when the output voltage is in the high state, there may be a potential of up to 1·8V between the output and the positive supply line.

The input currents required by the TDE 1067 are quite small, typically 100nA (maximum 1·5μA). The input offset voltage at which switching from one state to the other occurs is typically 2mV (maximum 50mV) between the two inputs.

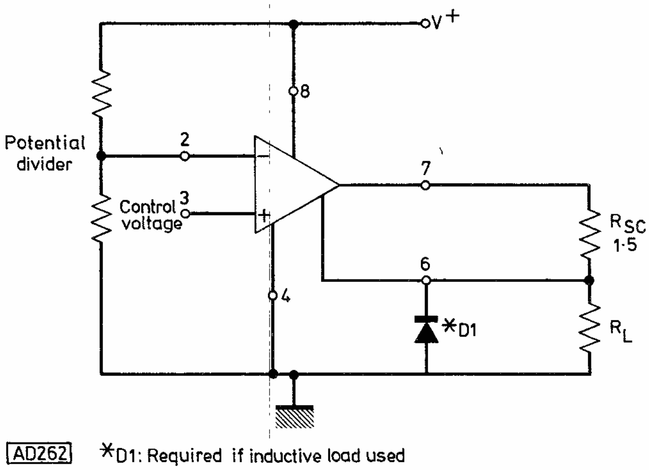


Fig. 5: An application circuit of the device

In order to provide adequate protection for the device, the value of the resistor R_{SC} should be chosen so that one operates within the unshaded area of the graph of Fig. 4. For example, with supply volts of up to 24V the value of R_{SC} should not be less than 0·8Ω so that the output current is never allowed to exceed about 1A. Obviously there is no objection to the use of larger values of R_{SC} where a smaller output current is adequate for the application concerned.

Typical Circuits

A typical application circuit for the TDE 1067 is shown in Fig. 5. The inverting input is biased by the potential divider to the desired value; a load current flows when the potential of pin 3 exceeds that of pin 2.

The diode D1 is required only if the load is inductive, such as a relay. When the current ceases to flow through the relay or other inductive load, a short transient reverse voltage can be developed across the relay coil. The diode is used to short this transient voltage to ground, since transients can damage the TDE 1067 device.

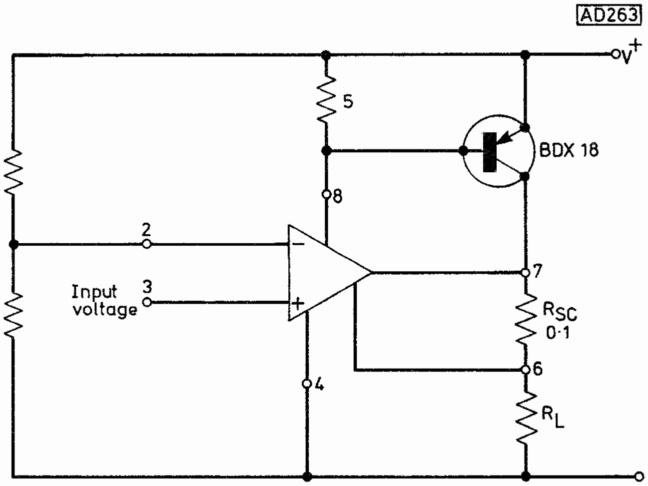


Fig. 6: Extension of the Fig. 5 circuit providing higher output current

5A Output

To provide a higher current than the TDE 1067 can itself supply, the circuit of Fig. 6 may be used in which an extra *pnp* power transistor fitted to a heat sink is used with the TDE 1067. Current limiting is again provided by the resistor R_{SC}, but the value of this component is much smaller owing to the higher current passing through it. Such small resistors are conveniently made from a length of resistance wire wound around a high wattage resistor of much higher value.

Conclusion

The TDE 1067 is a versatile device which can be operated by very low currents to its inputs. When used correctly in circuits, it is almost impossible to damage the device even if the output is short-circuited to ground. At the time of writing the price is £2·99 (including VAT) plus £0·20 for packing and postage from Phoenix Electronics Ltd, 46 Osborne Road, Southsea, Hants PO5 3LT. ●

KINDLY NOTE!

Car Radio LW Converter, December 1978.
The MVAM115 varicap diodes are shown on the circuit diagram but omitted from the components list. They are available from Ambit International, Gresham Rd., Brentwood, Essex.

Breadboards Supplement, December 1978.
On the 5V regulated supply (p. 2 of supplement), D1 is shown incorrectly. The configuration should be identical to that of D2.

Digital Door Chimes, December 1978.
In the audio amplifier section in Fig. 1, Tr3 (BC160) is shown inverted. The emitters of Tr2 and Tr3 should be linked. The collector of Tr3 goes to chassis.

Sandbanks Metal Detector, January 1979.
C17, 18, 19, and 20 are incorrectly shown in the components list (p. 50) as 10nF. These should all be 1nF, as correctly shown on the circuit diagram on p. 49. In the circuit diagram, Fig. 2, diode 3 should be reversed in polarity.

PW "Purbeck" Oscilloscope

Some readers seem to have misunderstood the information given in the "Follow-up" article (p. 55 January 1979) regarding the mains transformer.

Due to an unfortunate combination of circumstances, the differing characteristics of the transformers supplied by Watford Electronics with their PW "Purbeck" kits were not picked up by the author when incorporating the sample transformer in the original PW "Purbeck" oscilloscope. This oscilloscope and transformer have been in daily use now for many months, but two changes have proved necessary as follows.

If you are using one of the original Watford Electronics transformers then, as stated in the follow-up article, all that need be done is to replace R103 by a wire shorting link, and to reduce the value of R101 to around 120Ω (5W wire-wound), or better still, replace R101 by a wire shorting link. This provides a greater margin for low mains voltage. **It is NOT necessary to change the transformer.**

Don't forget to check, as stated previously, that the X and Y Boards draw 20mA and 30mA respectively from the ±150V stabilised supply.

Please note that, when adjusting the input attenuator trimmers (C3-C10), a metal-bladed screwdriver is not suitable. An insulated coil-core adjuster should be used, and the hand held well clear to reduce stray capacitance effects.

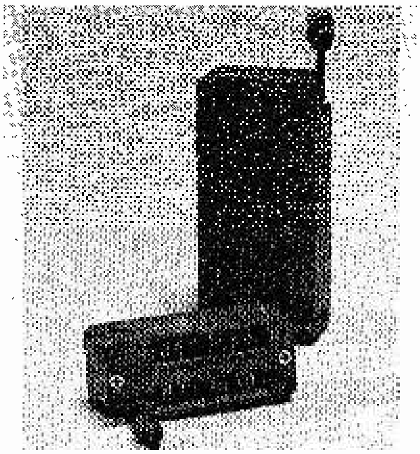
PRODUCTION LINES

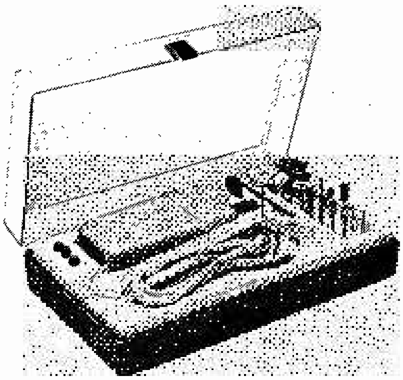
alan martin

Easy

Verospeed have announced the introduction of two "Zero Insertion Force" (AB 052) d.i.p. sockets, available in 16- and 24-way configurations. They are designed to eliminate mechanical damage to expensive integrated circuits during test, burn-in or programming operations. The i.c.s may be inserted or removed with zero force on the leads.

When the lever is operated the socket exerts uniform force on the leads and compensates for varying lead thicknesses. They are priced at £5·36 and £7·10 respectively and are available from: *Verospeed, Barton Park Industrial Estate, Eastleigh, Hants SO5 5RR. Tel: (0703) 618525.*





Mini-drill

Recently introduced by Boss Industrial Mountings Ltd. is a mains drill plus accessory kit housed in a specially designed carrying/presentation case with transparent lid.

This small but powerful 220/240V a.c. BIMDRILL is supplied with 4 collets capable of accepting tools with shanks of 1mm, 2mm, 2·4mm and 0·125in diameter, and will readily drill brass, steel, aluminium and p.c.b.s.

Complete with spring-loaded on/off switch and a 2 metre long cable fitted with a 2-pin DIN plug, this BIMDRILL has a fully insulated, high impact, ABS body, weighs less than 250g and has an off load speed of approximately 7500 r.p.m.

The accessories include 20 assorted twist drills, mops, burrs, grinding wheels and mounted points, all individually and securely located within the 230 × 130 × 50mm case. Priced at £22·14 which includes VAT and P&P, the kit is available from: *Boss Industrial Mouldings Ltd., Higgs Industrial Estate, 2 Herne Hill Road, London SE24 0AU. Tel: 01-737 2383.*

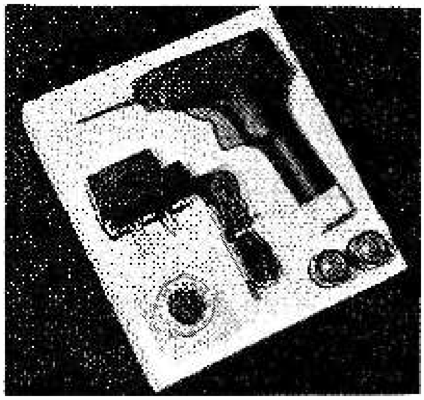
Wire-wrapping

OK are probably the only company who produce wire-wrapping equipment specifically for the hobby market and their latest kit HW-KI brings power wire-wrapping within economic reach of the home electronics enthusiast.

The main item in the kit is a newly designed battery-operated wire-wrapping gun, based on the design of the company's industrial units. It is for use with 0·6 × 0·6mm mini-wrap terminals and has a bit and sleeve to give modified wrap. The tool is also self indexing and has a back force device to prevent overwrapping.

It is powered by two NiCad batteries, the two batteries provided having a year's guarantee, and a mains-operated charger is included. Also in the kit is a handy 'pocket-sized' wire dispenser, containing 50ft of 0·25mm wire. The other item is a hand tool which can strip wire, wrap and unwrap.

Suggested retail price of the HW-KI is £46·28 (inc. VAT and carriage). *OK Machine & Tool (UK) Ltd., 48a The Avenue, Southampton, Hants SO1 2SY. Tel: (0703) 38966/7.*

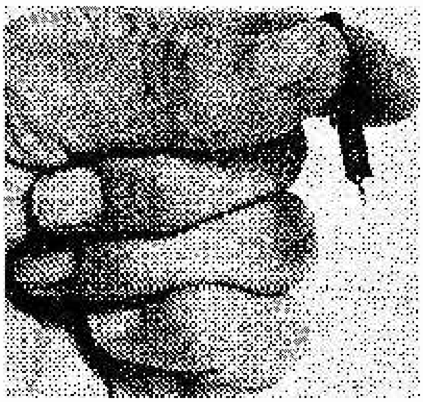


Drill-Mills

A circuit board without a track? A single Stahler drill-mill bit simultaneously drills holes and mills isolated pads in plain copper clad board to produce circuit boards without etching.

Drill-mills are designed to perform two separate functions—Isolated-pads drill-mill drills a hole and mills a circular moat leaving an electrically isolated copper pad. Insulated-spot drill-mill also drills a hole, but instead of milling a moat, it mills out a disc from the copper cladding around the hole. The application is to provide clearance spots for ground-plane mounting of d.i.p. sockets, feed-through sockets, etc.

In each case the tools comprise a replaceable high speed or carbide twist drill, either 0·0400in diameter or 0·0292in diameter. Each tool is also available in three pad milling sizes, 0·01in, 0·15in and 0·20in. Prices and a free catalogue are available from: *Carel Components, 40–44 The Broadway, London SW19 1SQ. Tel: 01-540 7186.*



ON THE AIR

by Eric Dowdeswell G4AR

An interesting letter from **Les Light** G3KDL of Wembley, Middx, prompts me to write a few words for the reader who may be reading this column for the first time, perhaps after having had interest aroused elsewhere by contact with amateur radio.

Les received a letter from a young but obviously enthusiastic listener simply saying he had heard Les on the 80m band. Time and frequency were given, but little else, except some details of the receiver and aerial. Now, with the best will in the world, the report was not of much use at all, but Les, no doubt thinking back to his own early days in amateur radio, did send a QSL.

It is naturally very exciting for the newcomer to listen to amateurs for the first time especially when they realise the comparatively low power of the amateur, possibly being accustomed to the high power stuff on the BC bands. So off goes a report such as quoted above, with a request for a QSL, and probably no s.a.e!

With the advent of so much commercial gear and high-gain beam aerials, worldwide working by amateurs is commonplace and the excitement of working and then getting a QSL from some DX spot has waned somewhat. QSLing had decreased over the years to the extent that some amateurs don't even bother to have cards printed!

So the report from a listener, even if from the other side of the world, is of little use, generally speaking. It has got to be something unusual in the reception, or perhaps the other fellow is using very low power, before it is worth sending a report. I would counsel any beginner to first get the *Guide to Amateur Radio* from the RSGB to see what it is all about and to study, in particular, the section dealing with QSL matters.

The cost of QSL cards and postage today is enough to deter anyone from the hobby, so if you must send a report and request for a QSL, then make it easy for the other station by sending a s.a.e., or International Reply Coupons for overseas stations, and a report worthy of attention. Don't use these silly 5 × 3in envelopes! Send something a bit bigger. Having sent tens of thousands of QSLs out when I was ST2AR I rate the small envelope as the biggest annoyance of all!

Collecting QSLs can be fun, or used to be, but if there is any intention of going on to get a transmitting licence I would say the best policy is to spend the money on the receiver and associated gear rather than on QSLs and QSLing. You'll need every penny for the entrance fee for the RAE and the ticket itself. Then you can have your own QSL card, and receive them from stations you work, when they really mean something.

General Notes

An interesting note from **Owen Frame** G4EIF of Reading, Berks, on the mysterious H44LW mentioned in the December issue. Owen confirms that it is the Solomon Islands, as he has a QSL for an s.s.b. QSO. QTH is Box 19, Honiara. Owen added, that he used to be ST2WF in Khartoum in 1934 with the RAF, with 80W of c.w. from 12V accumulators! As he says: "happy days".

N. Eddy writes from Truro, Cornwall, for the first time although he has been reading *PW* for many years. He is a member of the Cornish ARC and sports an AR88 and BC348 with main interest on 14MHz. He also has a 62H receiver which he'd like to convert for 2m operation, if any reader can help him on mods. Write to: Little Tregadles, Laity Moor, Ponsanooth, Truro, Cornwall, all expenses paid of course. **John Bell** BRS40279 in Melksham, Wilts, had "quite an amazing response" to his request for info on the AR88, particularly from Michael Swain G8MMP. John recently got hold of an Eddystone EC10 and, as an instructor to mentally handicapped people, he is going to try to teach elementary geography using the EC10 to demonstrate the reception of BC stations from various parts of the world. Apparently a fellow instructor has had some success this way.

Newcomer to the column **Derek Brabrook** of Laurghame, Dyfed, Wales, has been using a domestic type Pye set for a couple of years or so, as it goes up to 26MHz. However, he finds his 223ft aerial "difficult and poor". I'm not surprised! It must be overloading the front end I imagine on the stronger signals, as I doubt whether there is any r.f. gain control, and selectivity can't be much good on such an old set. Instead of blaming the set, I suggest keeping the aerial and getting a more modern set!

In Oswestry, Salop, **David Wyatt** aged 14, has acquired a BC348 and promptly found KC4USX in Antarctica on 20m s.s.b. His main regret is that it does not go above 18MHz so he can't listen to the 10 and 15m bands. Again, a case for a converter. David offers to reply to any readers who'd like to write to him on the BC348 at 11 Prince Charles Road, Oswestry. You might be overwhelmed, as the receiver was a very popular one OM! David is also learning the code from records and threatens to send in c.w. reports before long. We are certainly short of them of late; hint, hint, to other readers!

Round the Bands

Very little in the way of logs this month, unless the season's rush on the PO has held them up in the pipeline. Could be everyone's waiting to see if Father Christmas has remembered them with a nice, shiny, new receiver! **Bernard Hughes** BRS25901, who hasn't written in for a while from Worcester, liked my article on receiver accessories and wants more! Drop a line to the Editor OM! In spite of a new 20m dipole Bernard found the most interesting DX on other bands with his Drake receiver. Latest QSL received of any note was from PY0RO on St Peter & Paul Rocks. Worthy of note in his log were HS1ABD, ST0RK (!) VR3AH and XT2AT on the 10m band, KJ6BZ VP2DAY on 15m and HR1HMV, YS1RRD and 4W1BC on 40m, all s.s.b.

From Leigh-on-Sea, Essex, **Ian Marquis** A9140 keeps up the good work keeping his ears open on all the h.f. bands from Top to Ten with stuff like JA2EMU TR8BA on 80m, KL7IRT and ZL4AV on 40m, and FP8, FR7, PZ5, TU2, ZD8 and 7P8 on the 15m band, again all s.s.b.

A letter from **Bernie Crockford** ZS1BW mentions a contest for amateurs and SWLs to celebrate the 150th anniversary of the University of Cape Town, from Saturday Feb 17 to Sunday March 4, 1979, with operation from 0600 to 2000 on Sundays, and 0700 to 1000 and 1500 to 2000 weekdays. Likely frequencies are 7050, 14210, 21200, 28580, subject to QRM. Contact/log ZS1UCT plus two other ZS1s for award. Details from: Awards Manager ZS1MO, PO Box 5100, Cape Town 8000, Rep. of South Africa.

A new QTH for the **Swansea ARS** at the Sketty Park Sports and Social Club, Aneurin Way, Sketty Park, Swansea, on alternate Tuesdays, Feb 6 and 20 et seq. New members welcomed with open arms and a pint! Ring Peter Jones GW4GRI on Swansea 873986 for info or write to: 27 Gorwydd Road, Gowerton.

J. Bazley G3HCP, President of the RSGB, will be guest of honour at the 31st annual dinner of the **Sutton & Cheam RS,** taking place at the Woodstock Hotel on Saturday March 24. Details and tickets from: G. W. Brind G4CMU, 26 Grange Meadow, Banstead, Surrey.

Events to be held by the **Cheltenham AR Assoc** include: a constructors contest on Friday Feb 16 and a talk on i.c.s by Eric Hibbett G8LAY on Thursday March 1, with G4BSO and G3SSO discoursing on aerial planning permission on the 16th. Meetings at the Old Bakery, Chester Walk, Cheltenham at 2000. Info from: G. Martin G3IER, 88 Tennyson Road, Cheltenham, Glos.

Log Extracts (All s.s.b.)

B. Hughes:—10m HS1ABD KZ0DX P28NKV S79MC ST0RK VS6FI VR3AH XT2AT **15m** D68AD KJ6BZ TJ2AP VP2DAY **40m** HR1HMV HK5BCI YS1RRD ZP5LX 4W1BC

I. Marquis:—10m HP1PJ VP2MBD ZL3AAX **15m** CT2BB FP8DX FR7ZN PZ5AA TU2FH ZD8RG ZF2AG 7P8BC **20m** VP2DAO ZE3JO **40m** HK5DUS KL7IRT ZL4AV **80m** FP8DX JA2EMU LX1ST TR8BA 9H1EU

Remember, all logs and letters by 15th of the month.

Club Activity

Much more from the clubs this month than individual readers! **RAIBC** secretary, Frances Wooley G3LWY, reports that the Strumech tower raffled at the Leicester Show was won by disabled member Shirley Hesketh G4HES! Shirley has already coached to success several blind girls at Chorleywood College, for the RAE. Club net 3750kHz s.s.b. 1000 Tuesdays and 1400 Wednesdays. The Cheshire Homes net is on 3650 to 3700kHz on Thursdays 1330.

The **Silverthorn RC** meets Fridays 1930 at Friday Hill House, Simmons Lane, Chingford, London E4, with details from: C. J. Hoare, at that address. Newsletter "Spurious" would be considerably improved with less large cartoons and virtually useless photographs, and more details of events to come! Surely you must have a winter programme chaps? Tars Talk, journal of the **Torbay ARS** reveals that G3LHJ will give a slide show on Feb 24, with the society's annual dinner being held on March 10. Meetings are held at Bath Lane, Torquay (rear of 94 Belgrave Road). Details from: F. Bolton G3VTQ, 2 Lower Coombe Road, Blindwell Park, Kingsteignton, Newton Abbot, Devon.

Stevenage and District ARS continues to meet at British Aerospace, Gunnels Wood Road, Stevenage, Herts on first and third Thursdays at 2015. March 1 sees talk by GB3HR repeater group on proposed 23cm and 10GHz beacon, while the 10th sees a visit to the VHF Convention at the Winning Post, Twickenham, Middx. AGM is on the 15th. The **West Kent ARS** report in for the first time with details of meetings held at 2000 at the Adult Education Centre, Tunbridge Wells, on Fridays, with a junk sale on March 2. On March 30 an interesting talk by Tony Tory on microprocessors in amateur radio. Informal chit-chat and code practice on Tuesdays at the Drill Hall, Victoria Road, says Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks, Kent, who will supply details.

MEDIUM WAVE DX

by Charles Molloy G8BUS

It may be arguable, whether humility is the greatest virtue that a m.w. DXer should possess, but there is no doubt at all that selectivity is the attribute to look for in a receiver to be used for serious medium wave DXing. It is not that other factors such as sensitivity, stability, scale accuracy, freedom from overloading and cross-modulation, are unimportant. The present overcrowded state of the band, means that you should have the facility to winkle out DX that is close to a strong local station, and this means using a receiver that has good selectivity.

What is selectivity? It is the ability a receiver has to separate stations that are close to one another in the band. You can regard a receiver as a window into the frequency spectrum, the width of this window depending on the degree of selectivity. A narrow window means narrow (good) selectivity. It would be an easy matter, if all you had to do was to separate adjacent carriers, since a receiver with high selectivity would do the trick. Unfortunately the programme (modulation) requires space, the amount of space depending on the highest audio frequency. If it is 3kHz then a 6kHz bandwidth is required, i.e., 3kHz above and 3kHz below the carrier with the double sideband system currently in use. If bandwidth is reduced in order to reduce QRM then the audio range is reduced too, and in an extreme case speech becomes unintelligible.

How Selectivity is Measured

The handbook of a well-known receiver quotes the selectivity as 4kHz at −6dB and 18kHz at −40dB. What do these parameters mean? The first is the important one. 6dB is shorthand for 6 decibels and −6dB means "one half of the original value", so the signal at the sides of the 4kHz window is half that at the centre. Selectivity is invariably measured at the 6dB points. The statement 18kHz at −40dB is less important. It means simply that at 9kHz on either side of the carrier the signal will be 40dB down which is 1/100th of its original value. Ideally the signal would be zero at the sides of the window, but in practice it falls off gradually.

What to Look For

If you want to judge a receiver's ability to separate stations then look for the bandwidth at the 6dB points. It will be found under "Selectivity" in the handbook or specification. Sometimes it isn't mentioned at all so one can draw the appropriate conclusion. Occasionally on imported receivers the bandwidth is given as a plus or minus figure such as ± 2kHz. Multiply by 2, as the real bandwidth is 4kHz! I recently studied a one-page "spec" for a receiver currently available and after some searching found Selectivity near the end. It was 4kHz at the 6dB points which is not very good for DXing. A few years ago I tried an experiment with CJON (now CJYQ) on 930kHz using a bandwidth of 2·4kHz. It could be heard easily between the Europeans on 926 and 935. When the bandwidth was increased to 5kHz, CJON just disappeared, as the stations on either side spread out to meet each other.

My BRT400 communications receiver has a six-position selectivity switch which gives bandwidths of 0·5, 1·0, 2·0, 5·5, 9·0 and 13·0kHz at the 6dB points. Normally I use 2kHz when tuning around and this is increased to 5·5kHz or even 9kHz, QRM permitting, if I want to listen to the programme. A receiver with fixed selectivity must compromise between the needs of the DXer and the listener, and I would question whether such a receiver should be entitled to use the term "communications". A personal view that many will disagree with. It is a pity that the Q Multiplier, referred to recently by Eric Dowdeswell, has gone out of fashion as this simple device provides an easy means of obtaining variable selectivity, and it was incorporated in a number of moderately-priced receivers a few years ago.

If you do have a receiver with narrow selectivity then it is possible to use this facility and still hear the modulation. If the programme quality deteriorates as selectivity is increased, then detune slightly, away from the offending QRM. Speech quality will immediately improve, as your window will now look out on only one of the two sidebands. It may come as a surprise to some DXers to find out that the programme is actually carried twice on an a.m. double-sideband system. There is a sideband complete with programme on each side of the carrier and it is only necessary to tune to one of these to extract the modulation. You could double the number of channels on the medium waves by suppressing one sideband but there are problems in doing this.

The New Band Plan

I remained up late on the night of the big change over last November, just in case I might be missing something, and was well rewarded with the feeling that I was listening to history being made. After hearing the short announcement on 200kHz, at midnight, I tuned round the medium waves to be greeted by tuning notes on nearly every channel. The change at the h.f. end of the band was striking. Where the German power-house on 1602 had been, only a few minutes earlier, was now the third international common frequency with nothing to be heard but a burble. That evening I hunted around for any DX between channels, but all I could find was an unidentified Arab on 1570. It looks as if Asiatic DX has disappeared, in the evenings at any rate.

Readers' Letters

Steve Whitt (Cambridge) is interested in QSLs and he reports that he has had 100% returns from the 24 US stations he has reported to so far, but from further south, Radio Margarita on 1020 and Radio Coro on 1210 have not replied. This is a common experience as Latin Americans are notoriously difficult to QSL. One approach is to write a personalised letter to the station giving details of one's self, and perhaps a photo of the shack, or the locality. WEVD 1330 broadcasts in Hebrew, and Steve wonders how he can compile a report, as the programme material is meaningless to him. Make a tape of the DX and if you cannot get it translated then send the tape to the station. Many DXers send tapes instead of reports though it is rather an expensive way of doing it.

Two other questions come from Steve: 1. What is the station on 593 (pre-Geneva) underneath the West German that relays the BBC World Service? It is probably cross-modulation which can occur in the ionosphere as well as inside the receiver. If you listen on the open carrier of any high power European, just before sign-off, you may hear this effect. There are so many megawatts floating around the ionosphere these days, that all sorts of weird effects can be observed. 2. What is the easiest English speaking DX from the Caribbean? None is easy. Try ZDK Antigue on 1100 or Radio Paradise, St Kitts on 1265, but you will have to stay up late to hear them.

DX Heard

John Faulkner (Mansfield) reports hearing 19 Canadian and 13 US stations with his Trio 9R59D receiver and 40 inch *PW* loop. Toronto was logged on three points on the dial with CBL on 740, CJBC 860 and CFRB on 1010. Others include WHAM Rochester, NY on 1180 and Fort Wayne, Indiana on 1190kHz.

An HMV domestic receiver and loop are in use in Birmingham by **John Dennis Court** and his log contains two not-so-often heard stations in Newfoundland; VOWR on 800 at 0030 and VOAR on 1230 at 0200. There are still a few outlets in Newfoundland that use the old prefix "V" in the call sign, VOCM on 590 being the one that is usually heard. **Noel Cosgrave** (Dublin) has a Mullard MAS1659 receiver and 36 inch loop, which brought him Radio Belgrano, Buenos Aires on 950kHz at 0255, Radio Tupi in Rio de Janeiro on 1280 at 0315 and CB57 Santiago, Chile on 570kHz.

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

Skip is a term frequently used by DXers and it is one that may confuse the newcomer to the hobby. Very briefly it refers to a zone around a transmitter where little or no signal can be heard. The ground wave travels only a few miles from a short-wave station before petering out, while the nearest place where the sky wave returns to earth may be hundreds of miles away. The distance between the two is the skip distance. Anyone situated nearer to the transmitter than the point where the sky wave returns, will be in the skip zone and consequently will not hear the station at all, unless of course he is within range of the ground wave. This is the reason why BBC short-wave transmitters in this country are not heard within the UK. The sites of these transmitters incidentally are at Daventry in Northamptonshire, Skelton in Cumberland, Wooferton near Ludlow and Rampisham in Dorset.

The Sky Wave

Great stuff, you may say, but why is it that the sky wave fails to come back to the earth inside the skip zone. To understand this you have to look at what happens to a wave sent up vertically. If the frequency is low enough then the signal will travel some distance into the ionosphere before being returned to the transmitter. A higher frequency will go up a bit further before coming back, and if frequency is increased gradually, a time will come when the wave will travel right through the ionosphere and off into space. The highest frequency to be returned is called the critical frequency and is usually designated f_c.

Vertical radiation is not much use for broadcasting so in practice a lower angle is employed. A wave travelling at an oblique angle will have to travel a greater distance through the ionosphere than a vertical one, before coming out at the top, so frequencies higher than the critical frequency can be used at low angles. The highest frequency that will be returned will be when the wave is at a low angle, just above the horizon, which is the case for long distance transmission and this frequency may be three or four times f_c. The Maximum Usable Frequency (m.u.f.) for any particular angle can be calculated from f_c which in turn is fairly easy to measure. One final point. To get the maximum signal into the target area it is desirable to transmit as near as possible to the m.u.f., and any radiation at a higher angle than required for this distance will therefore penetrate the ionosphere and be lost. This is what happens to the signal that is missing in the skip zone.

Propagation and DXing

About 4000km is the maximum distance that can be covered by a single hop from low angle radiation and in this case the skip will be great. If the target is nearer than 4000km then a higher radiation angle will have to be used at the transmitter and a lower frequency will be needed as well. Obviously the skip will also be lower. Reception areas further away than 4000km will be reached by multiple hops, the wavefront being reflected from the earth's surface back into the ionosphere after the first hop. So, at any particular time of day, season of the year or period of the sunspot cycle, all of which affect the critical frequency, the highest frequencies available will be used for long distance working and lower ones for short distances. There is no use looking for your favourite European local on 13 metres, for even if the band is open the skip will be too great.

19 Metre Band (15MHz)

Following on from last month we will now have a look at 19 metres whose limits are 15 100 to 15 450kHz, though there is some spread on either side. 19 metres is mainly a daytime band with world-wide reception being possible. Look for Vietnam on 15 012kHz, Teheran 15 084, Japan 15 105, RSA 15 220, New Zealand 15 130, Tanzania 15 435. Some medium range DX can be heard during the day, such as Norway on 15 175, Morocco 15 195, Sweden 15 240 and Finland on 15 265, but these disappear as dark approaches and the m.u.f. falls.

During the evening Latin American DX can be heard and although at first sight this may appear surprising, it should be noted that the signal path is from the south-west from the southern hemisphere, where the greater part of the route will still be in daylight. DX heard regularly in the UK includes: Chile on 15 115, Brazil on 15 145, Chile on 15 150, Radio el Mundo Argentina on 15 290, Radio Nacional Colombia on 15 335, R. Mexico on 15 385, Venezuela on 15 400, and from the same area, Radio Grenada on 15 105kHz.

Readers' Letters

The MCR1 wartime receiver is mentioned again by **Trevor Goodenough,** who has two of them which he uses regularly with a 300ft long wire and an a.t.u. DX heard with this set-up includes Radio Japan and Radio

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.

Australia. Trevor is anxious to get hold of a copy of the circuit diagram or the manual for the MCR1 and if anyone can help, would they please contact Trevor direct at 8 Glencraig Terrace, Fenwick, Ayrshire. Postage will be refunded.

The logging of Radio New Zealand on 15 130kHz at 0630 by S.I. Fass in the December issue, is referred to by **T. W. G. Elsenham,** who points out that the RNZ schedule says that this channel closes down at 0450. Schedules are always changing and cannot be relied on. Mr Elsenham goes on to refer to the pre-war BBC weekly *World Radio*. This had a feature covering stations heard by readers which included details of the programmes, and he wonders if we could do the same here. Sounds a very good idea. There are some interesting programmes to be heard on the short waves, usually from the less conspicuous broadcasts. Details of programmes from DX stations should be brief and give the date, time, and frequency (if known).

DX Reported

An unusual log of 60 metre DX, all of Venezuelan stations, has been received from **Leon R. Sin Sun** of Aberdeen, who used a Sony CF9JOS between 2300 and 0400 to pull in Radio Lara on 4800kHz, Bolivar on 4770, Universo 4870, Juventud 4900, Yaracuy 4940, Rumbos 4970, Ecos del Torbes 4980, Barquisimeto 4990, Continente 5030. Programmes heard included local popular music, folklore and interviews which would be of interest to DXers who understand Spanish. Leon does not use any special aerial as he is rather short of space. Try the outside TV aerial if you have one or alternatively a Joystick plus a.t.u. might be useful, but consult the manufacturer, Partridge Electronics, who advertise in *PW*, to make sure that a Joystick can be used with your Sony receiver.

An FRG-7 plus 60ft loft aerial and a.t.u. are in use in Wigan by **Jim Edwards,** who reports hearing KGEI, La voz de Amistad, on 9575 at 1030, Baghdad on 9745 at 2130, Lagos Nigeria on 11 770 at 0630, WINB Red Lion on 15 185 at 2000. Jim reports that he is now a monitor for Family Radio WYFR, which he finds an interesting diversion when he is not DXing.

Australian Domestic Short-wave Stations

Lex Arnold, Hemel Hempstead (R107 ex-WD communications receiver and 9ft indoor aerial), sends some notes about the domestic service of the Australian Broadcasting Commission. He reports that ABC Melbourne has been heard regularly between 1000 and 1300 on 9680kHz. From past experience Lex suggests that DXers should try for stations in this network between late November and mid-April, especially during February and March. Listen for VLH9 on 9690 between 0730 and 1300, VLH11 on 11 880 from 1900 to 2115, VLH15 on 15 230 from 2230 to 0715, all from Melbourne; VLM4 on 4920 and VLQ 9660 between 2200 and 1400, which are in Brisbane; VLW6 on 6140 and VLW9 on 9610 from 2200 to 0100 and 1000 to 1600, both in Perth. Readers who think that Radio Australia is not really DX should try for some of these domestic stations. There is also Port Moresby in New Guinea with P2T9 on 4890 between 0715 and 1400 and again from 2000 to 2200 plus P2T9 on 9520 between 2215 and 0700.

by Ron Ham BRS15744

First, our sincere congratulations to our reader **Robin Bellerby** G3ZYE, Hove, Sussex, on his election to the council of the Radio Society of Great Britain. Robin, a member of the Brighton and District Radio Society, the Mid-Sussex Amateur Radio Society and the Sussex Repeater Group, is actively interested in all bands from 160m to 70cm. News of his election victory came just after the Brighton and District RS had made Robin the first recipient of their trophy, the Bill Pitfield Memorial Award, given for meritorious service to amateur radio by a club member. Like all RSGB council members, Robin has some hard work ahead, what with society affairs, conferences, conventions and WARC 79, the outcome of which may well affect all of us. Congratulations also to **D. J. Stewart,** ex-G8MZP, on passing his Morse test and now sporting the call sign G4HSY.

Solar Activity

Nigel Fisher, Goff Gill, Robin Knight, Peter Mynheer and **Chris Peeder** have recently completed a 60MHz radio telescope for the radio section of the South-East Essex Astronomical Society, and were delighted when their new instrument, built with the r.f. and i.f. sections of an old TV receiver, recorded solar activity on December 10, 11 and 12, as did the 136MHz telescope of **Cmdr Henry Hatfield,** Sevenoaks, and the 146MHz receiver which I use. Henry recorded a slight increase in solar radio noise during the afternoon of November 24, and again on the 25th and, using his spectrohelioscope, he observed a large prominence on the north-west limb of the sun which lived for about 24 hours and he saw another on the east limb on the 26th.

It must have been this solar activity which caused the blackout on 80m, reported by **Alan Baker** G4GNX, Newhaven, at midday on the 25th, the aurora during the same afternoon and the ionospheric disturbance reported by the BBC World Service at 0215 on the 26th. At 1015 on the 25th, I did not hear any International Beacon Project signals on 10m and Alan said that on 80m, even the strong shipping stations which share the band were weak and, from Applecross, Western Australia, Anthony Mann writes: "November 26, absolutely dead, nil above 28MHz all day".

Aurora

The land lines were soon buzzing with an alert once **Roy Bannister** G4GPX, Lancing, **John Cooper** G8NGO, Cowfold, and **Dermot Cronin** G4GRO, Royal Sovereign, heard auroral signals on 2m. Dermot worked GI and GM and G4GNX, who was soon in on the action, heard PA3. **Dave Cox** G8OPR, Andover, Hants, worked stations in 5 different QRA locator squares during the event which included 3 GMs and a GI. For **John Branegan** GM8OXQ, Saline, Fife, this aurora was a novel event because, at 1135, he had a QSO with SM4IVE and soon after with G8OGD via OSCAR 8J. The SM thought an aurora was starting over central Sweden and the G8 told John that his signal had an auroral tone.

At 1320, John again contacted SM4IVE via OSCAR 8J, who reported that the auroral activity in Sweden and Finland was fading and thought to be heading towards Scotland. Between 1340 and 1400 John was receiving auroral signals from the Russian satellite, RS-1, and when he left the satellite he found a full scale aurora affecting the 2m band, which he monitored until 1840. During the period he heard tone "A" signals from the 2m beacons in Cornwall GB3CTC, France FX0THF, Germany DL0PR, Lerwick GB3LER, Northern Ireland GB3GI, and Wrotham GB3VHF, in addition to amateur stations from EI, G, GD, GI, GM and SM. GM8OXQ said there was another, but much weaker, aurora on the 26th but only the northern GMs beyond Aberdeen could use it. **Anthony Mann** says: "It would be lovely to witness an aurora here", and thinks that the only two visible there were during the 1946/7 sunspot maxima. It really is a wonderful sight Anthony, I will never forget the beauty of the one I saw from southern England, following a big solar event in August 1972.

The 10 Metre Band

M. Mrzyglod is delighted with the performance of his new FRG-7 and with his 10m ground-plane aerial, he has been logging the IBP signals from Bermuda VP9BA, Canada VE3TEN, Germany DL0IGI and s.s.b. signals from amateurs on both sides of the Atlantic. M. Mrzyglod is looking for a circuit which he thinks was published in *Practical Wireless* some years ago for a Band I converter. If anyone can help, please let me know. Neil Clarke BRS 34306, Nottingley, York has been enjoying the DX on 10m and logging A4XFA, OX3CO, and VS6FI.

Like myself, John Branegan has found that the signal from the Bahrain beacon A9XC, was very consistent between November 19 and December 15, in fact, I heard it every day except during the blackout on November 25. John, Alan Baker and I, also heard signals from 5B4CY, DL0IGI, N4RD, VP9BA and 3B8MS. On his newly acquired Eddystone 770R communications receiver, John can tune through Bands I and II, and has already observed the effect of F2 conditions on the American and European stations which operate between 30 and 40MHz. He is looking forward to using it during the coming sporadic-E season.

From Down Under

Anthony Mann reports strong sporadic-E disturbances on November 16 and 28, producing Band I colour on an indoor aerial and m.u.f. lapping Band II. On November 18: "The best F2 opening so far", says Anthony who received strong signals from the BBC, Channel B1 sound, 41·5MHz, French Channel F2 sound, 41·25MHz, a watchable picture from a South Korean station, strong Chinese video, 57·770MHz, strong Russian TV sound, east and west Malaysian video, and strong signals from Japanese amateurs in the 6m band. We are all very envious Anthony.

Tropospheric

During the morning of November 22, Alan Baker worked F1EZP and Mick Senior G4EFO, Horsham worked F6DOP, both through the Brighton repeater GB3SR, R3, and for most of the 22nd and 23rd I heard GW stations working through GB3BC, R6. At 2201 on the 19th, Alan had an unusual contact which lasted 28 minutes, through GB3SR; he worked N2AFE/MM, Ralph, from 5th Avenue, Brooklyn, New York, who was in the engine room of the *Export Patriot* in the English Channel, and as soon as other people realised what was on, suddenly Ralph had 19 stations after him.

A more extensive v.h.f. opening took place on December 5, 6 and 7, during which time I received strong signals from both the Bristol Channel and Dover 2m repeaters. Throughout the 6th I received good pictures from the IBA transmitter at Lichfield, Channel 8, 189MHz, and signals from several continental broadcast stations in Band II. At 0030 on the 6th, John Cooper phoned G4GNX to say that he had worked a station through a Belgian repeater, and G4GNX reported hearing ON0OV on R4. During the morning, GU2FZC, St Peter Port and F1EBE, Rouen, worked through the Brighton repeater and in the afternoon GB3BC was putting a strong signal into east Sussex. Periodically, throughout the day, Band V TV suffered from co-channel interference and in the evening, G6GL, Radlett, Hertfordshire, had an effortless QSO with G3TIR in Crawley, Sussex, via the Hampshire repeater, GB3SN, R5. Signals from the French repeater on R9 were heard on December 8 by G4GNX and G4GPX, and G3TRY, High Wycombe worked a station in Yorkshire through extreme QSB.

Satellites

On December 1, our satellite expert, John Branegan, wrote: "Being a thorough optimist I still go on OSCAR 8A despite the high m.u.f., and though the ionosphere must be as thick as treacle, I have twice got across to W2BXA in New Jersey". The W2 told John that he was the only European he had heard for some time. "On Mode J at weekends it is a very different story", says John, who in 10 QSOs in November, worked 4 stations, W9KDR Conn, WB2OXJ New Jersey, WA3ZHW Penn, and VE2LI Montreal. By the end of November, John, by working his first east-German, DM2DIN, s.s.b., made his score 27 countries on 8J and pushed his total up to 35 countries via satellite.

Contests

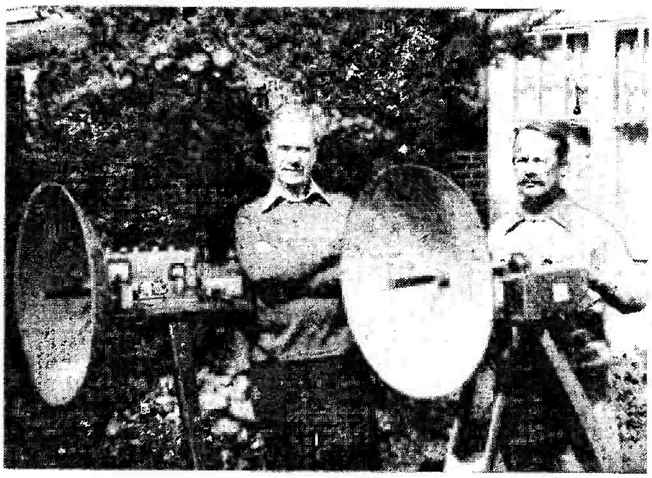
As usual the RSGB have catered for the v.h.f./u.h.f. enthusiasts in their contests calendar for 1979, and reports will be welcome from any of our readers who take part in either the transmitting or receiving sections of any of the following events:

March 3 and 4	144/432MHz and SWL
April 8	432MHz open and SWL
April 29	70MHz Open
May 26 and 27	144MHz Portable
July 7 and 8	VHF NFD
August 18 and 19	70MHz Open
September 1 and 2	144MHz Open and SWL
October 21	70MHz Fixed
December 2	144MHz Fixed

VHF PERSONALITY

by RON HAM

"THE TWO ERNS"



One of the fascinations for me when writing my column is to realise that my readers are using wavelengths from 10 metres through to 3 centimetres, which in frequency terms, is 30 million to 10 thousand-million hertz. It is men like Ern Downer G8GKV of Worthing (right), and Ern Hoare, G8BDJ of nearby Southwick (left), known locally as "The Two Erns", who are pioneering the microwave end of the radio frequency spectrum.

Ern Downer's schoolboy interest in amateur radio was fostered by a neighbour, the late G2XO of London. During the early 1930s Ern built himself a number of short-wave receivers, from designs published in the amateur radio press. His introduction to v.h.f. came in the second world war with the Royal Tank Regiment. After the war he spent some years in East Africa where he used "point-to-point" links, and on his return to the UK, a colleague, G3YHM, invited him to join the Worthing Amateur Radio Club. In May 1972 he took the RAE, and by August, his call, G8GKV, was heard on the air.

In 1927, the 10-year-old Ern Hoare began building crystal sets, progressing to valve sets, and later to a 30-line scanning disc television receiver, through which he did get a picture of sorts. Ern was a radar operator with the Royal Artillery during the second world war, using both v.h.f. and microwave systems. Later, he volunteered for the 6th Airborne Division, where he used the famous 38 sets for 3in mortar fire control. He took the RAE in 1962 and was first licensed as G3RZD/T, constructing his own gear for amateur TV. When his call was changed to G8BDJ he used home-brew gear on 2m, 70cm and 23cm.

Due to common interests, both G8GKV and G8BDJ began to inhabit the local hill tops, operating portable stations on 2m. When 'BDJ began building equipment for 10GHz, 'GKV was hooked, since when "The Two Erns" have never looked back. Now, with some very impressive home-brew portable stations, they each hold many well deserved awards, and apart from entering the RSGB's 10GHz contests, they spend a great deal of time trying out "difficult" paths of microwavelength communications.

TTLs BY TEXAS

Type	Price	Type	Price	Type	Price
7400	13p	7497	180p	74221	160p
7401	14p	74100	130p	74251	140p
7402	14p	74104	65p	74259	250p
7403	14p	74105	65p	74265	90p
7404	17p	74107	34p	74278	290p
7405	18p	74109	55p	74279	140p
7406	32p	74110	55p	74283	190p
7407	32p	74111	70p	74284	400p
7408	19p	74116	200p	74285	400p
7409	19p	74118	130p	74290	150p
7410	15p	74119	210p	74293	150p
7411	24p	74120	110p	74294	200p
7412	20p	74121	28p	74298	200p
7413	30p	74122	48p	74365	150p
7414	60p	74123	55p	74366	150p
7416	27p	74125	55p	74367	150p
7417	27p	74126	60p	74368	150p
7420	17p	74128	75p	74390	200p
7421	40p	74132	75p	74393	200p
7422	22p	74136	75p	74490	225p
7423	34p	74141	70p		
7425	30p	74142	200p		
7426	40p	74145	90p		
7427	34p	74147	190p		
7428	36p	74148	150p		
7430	17p	74150	100p		
7432	30p	74151A	70p		
7433	40p	74153	70p		
7437	35p	74154	100p		
7438	35p	74155	90p		
7440	17p	74156	90p		
7441	70p	74157	70p		
7442A	60p	74159	190p		
7443	112p	74160	100p		
7444	112p	74161	100p		
7445	100p	74162	100p		
7446A	93p	74163	100p		
7447A	70p	74164	120p		
7448	80p	74165	130p		
7450	17p	74166	140p		
7451	17p	74167	200p		
7453	17p	74170	240p		
7454	17p	74172	720p		
7460	17p	74173	120p		
7470	36p	74174	93p		
7472	30p	74175	85p		
7473	34p	74176	90p		
7474	30p	74177	90p		
7475	36p	74178	160p		
7476	35p	74180	93p		
7480	50p	74181	200p		
7481	100p	74182	90p		
7482	84p	74184A	150p		
7483A	90p	74185	150p		
7484	100p	74186	700p		
7485	110p	74190	100p		
7486	34p	74191	100p		
7489	210p	84192	100p		
7490A	33p	74193	100p		
7491	80p	74194	100p		
7492A	46p	74195	95p		
7493A	33p	74196	95p		
7494	84p	74197	80p		
7495A	70p	74198	150p		
7496	65p	74199	150p		

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74LS10	20p	74LS221	100p
74LS13	38p	74LS240	175p
74LS14	100p	74LS241	175p
74LS20	22p	74LS242	175p
74LS22	28p	74LS243	175p
74LS27	38p	74LS245	175p
74LS30	22p	74LS251	200p
74LS47	90p	74LS257	120p
74LS55	30p	74LS259	175p
74LS73	50p	74LS298	249p
74LS74	40p	74LS373	200p
74LS75	50p	74LS374	195p
74LS83	110p	81LS95	120p
74LS85	100p	81LS96	160p
74LS86	40p	81LS97	120p
74LS90	60p	81LS98	160p
74LS93	60p	8T28	230p
74LS107	45p	9301	160p
74LS112	100p	9302	175p
74LS123	75p	9308	316p
74LS132	900p	9310	275p
74LS133	60p	9311	275p
74LS138	60p	9312	160p
74LS139	60p	9314	165p
74LS151	100p	9316	225p
74LS153	60p	9322	150p
74LS157	60p	9368	200p
74LS158	120p	9370	200p
74LS160	100p	9374	200p
74LS161	100p	9601	100p
74LS162	140p	9602	175p
74LS163	100p	9603	60p
74LS164	120p		
74LS165	80p		
74LS173	110p		
74LS174	110p		
74LS175	110p		
74LS181	320p		
74LS190	100p		
74LS191	100p		

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75107	160p
75182	230p
75450	120p
75451/2	72p
75491/2	96p

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Type	Price	Type	Price
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74C04	27p	74C161	155p
74C08	27p	74C162	155p
74C10	27p	74C163	155p
74C14	90p	74C164	120p
74C20	27p	74C173	120p
74C30	27p	74C174	160p
74C32	36p	74C175	210p
74C42	110p	74C192	150p
74C48	250p	74C193	150p
74C73	75p	74C194	220p
74C74	70p	74C195	110p
74C85	200p	74C221	175p
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74C107	125p		
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4009	40p	4040	100p
4010	50p	4041	80p
4011	17p	4042	80p
4012	18p	4043	90p
4013	50p	4044	90p
4014	84p	4046	110p
4015	84p	4047	100p
4016	45p	4048	55p
4017	80p	4049	32p
4018	89p	4050	49p
4019	45p	4051	80p
4020	100p	4052	80p
4021	110p	4053	80p
4022	100p	4055	125p
4023	22p	4056	135p
4024	50p	4059	600p
4025	20p	4060	115p
4026	130p	4063	120p
4027	50p	4066	55p
4028	84p		

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*AY1-1313	668p	*MC3340	120p
*AY1-5050	212p	*MC3360	120p
*AY5-1315	600p	*MFC4000B	120p
*AY5-1317	636p	MK50398	750p
*AY5-1320	320p	NE531	130p
*CA5019	80p	*NE540	200p
*CA5046	70p	NE543K	225p
*CA3048	225p	NE555	25p
CA3080E	72p	NE556	70p
*CA3089E	225p	NE561B	425p
*CA3090AQ	375p	NE562B	425p
CA3130S	100p	NE565	130p
CA3140E	70p	NE566	155p
CA3160E	75p	NE567	175p
FX209	750p	RC4151	400p
ICL7106	925p	*SN76003N	175p
ICL8038	340p	*SN76013N	140p
LM301A	36p	*SN76013ND	120p
LM311	190p	*SN76023N	140p
LM318	200p	*SN76023ND	120p
LM324	70p	*SN76033N	175p
LM339	90p	*SP8515	750p
LM348	95p	*TBA641B11	225p
*LM377	175p	*TBA800	90p
*LM380	75p	*TBA810	100p
*LM381AN	150p	*TBA820	90p
*LM389N	140p	*TCA940	175p
LM709	36p	*TDA1022	600p
LM710	50p	XR2206	400p
LM733	100p	XR2207	400p
LM741	29p	*XR2216	675p
LM747	70p	XR2240	400p
LM748	35p	*ZN414	90p
LM3800	70p	ZN424E	135p
LM3911	130p	ZN425E	400p
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18V	7818	90p	18V	7918	100p
24V	7824	90p	24V	7924	100p
100mA	**TO-92**		**100mA**	**TO-92**	
5V	78L05	35p	5V	79L05	80p
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15V	78L15	35p	15V	79L15	80p

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AC127/8	20p	BFY51/2	22p	TIP41C	78p	2N3866	90p
AD149	70p	BFY56	33p	TIP42A	70p	*2N3903/4	18p
AD161/2	45p	BFY90	90p	TIP42C	82p	*2N3905/6	20p
BC107/8	11p	BLY83	700p	TIP2955	78p	*2N4036	65p
BC109	11p	BRY39	45p	TIP3055	70p	*2N4058/9	12p
*BC147/8	9p	BSX19/20	20p	*TIS43	34p	*2N4060	12p
*BC149	10p	*BU105	190p	*TIS93	30p	*2N4061/2	18p
*BC157/8	10p	*BU108	250p	*ZTX108	12p	*2N4123/4	22p
*BC159	11p	*BU205	220p	*ZTX300	13p	*2N4125/6	22p
*BC169C	12p	*BU208	240p	*ZTX500	15p	*2N4289	20p
*BC172	12p	*BU406	145p	*ZTX502	18p	*2N4401/3	27p
BC177/8	17p	MJ481	175p	*ZTX504	30p	2N4427	90p
BC179	18p	MJ491	200p	2N457A	250p	*2N4871	60p
*BC182/3	10p	MJ2501	225p	2N696	35p	*2N5087	27p
*BC184	11p	MJ2955	100p	2N697	25p	*2N5089	27p
BC187	30p	MJ3001	225p	2N697	45p	*2N5172	27p
*BC212/3	11p	*MJE340	65p	2N706A	20p	2N5179	27p
*BC214	12p	MJE2955	100p	2N708A	20p	2N5191	83p
BC461	36p	MJE3055	70p	2N918	45p	2N5194	90p
BC477/8	30p	*MPF102	45p	2N930	18p	*2N5245	40p
*BC516/7	50p	*MPF103/4	40p	2N1131/2	20p	*2N5296	55p
*BC547B	16p	*MPF105/6	40p	2N1613	25p	*2N5401	50p
*BC549C	18p	*MPSA06	30p	2N1711	25p	*2N5457/8	40p
*BC557B	16p	*MPSA12	50p	2N2102	60p	*2N5459	40p
*BC559C	18p	*MPSA56	32p	2N2160	120p	*2N5460	40p
BCY70	18p	*MPSU06	63p	2N2219A	20p	*2N5485	44p
BCY71/2	22p	*MPSU56	78p	2N2222A	20p	*2N6027	48p
BD131/2	50p	OC28	130p	2N2369A	16p	2N6247	190p
BDY56	200p	OC35	130p	2N2484	30p	2N6254	130p
BF200	32p	*R2008B	200p	2N2646	50p	2N6290	65p
*BF244B	35p	*R2010B	200p	2N2904/5	25p	2N6292	65p
*BF256B	70p	*TIP29A	40p	2N2906A	24p	2N128	120p
BF257/8	32p	*TIP29C	55p	2N2907A	30p	3N140	100p
BF259	36p	*TIP30A	48p	*2N2926	9p	3N201	110p
*BFR39	30p	*TIP30C	60p	2N3053	20p	3N204	100p
*BFR40	30p	TIP31A	58p	2N3054	65p	40290	250p
*BFR41	30p	TIP31C	62p	2N3055	48p	40360	40p
*BFR79	30p	TIP32A	68p	2N3442	140p	40361/2	45p
*BFR80	30p	TIP32C	82p	2N3553	240p	40364	120p
*BFR81	30p	TIP33A	90p	*2N3565	30p	40408	70p
BFX29	30p	TIP33C	114p	*2N3643/4	48p	40409	65p
BFX30	34p	TIP34A	115p	*2N3702/3	12p	40410	65p
BFX84/5	30p	TIP34C	160p	*2N3704/5	12p	40411	300p
BFX86/7	30p	TIP35A	225p	*2N3706/7	12p	40594	97p
BFX38	30p	TIP35C	290p	*2N3708/9	12p	40595	105p
BFW10	90p	TIP36A	270p	2N3773	300p	40603	58p
BFY50	22p	TIP36C	340p	*2N3819	25p	40673	90p
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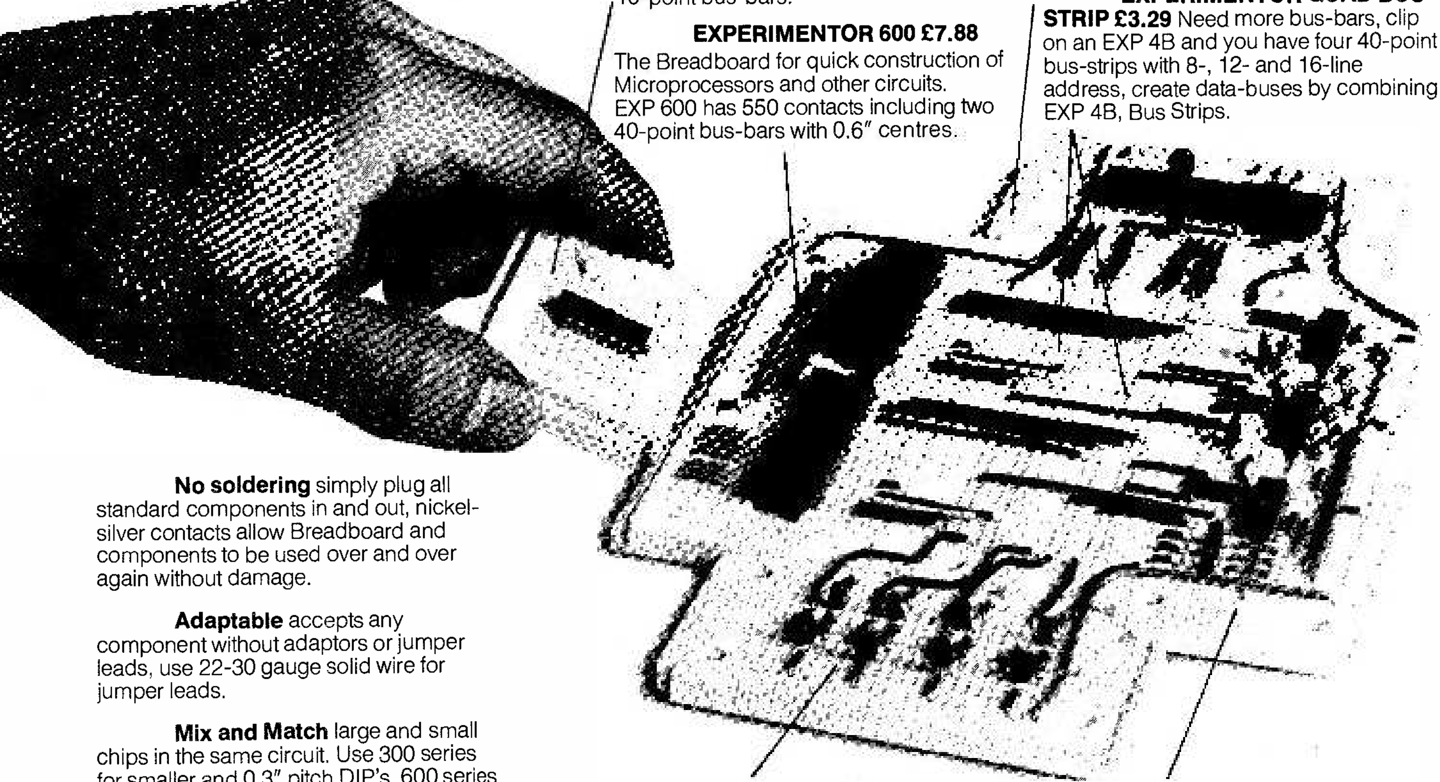

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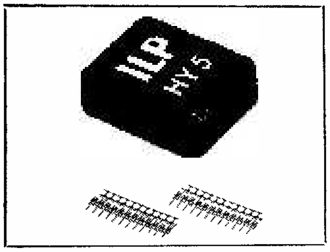
15—240 Watts!

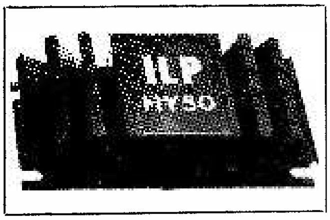
HY5
Preamplifier

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 4·7kΩ 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.

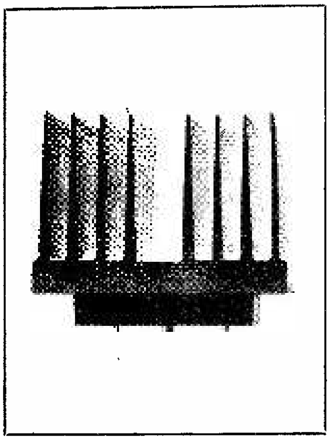


HY50
25 Watts into 8Ω

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.

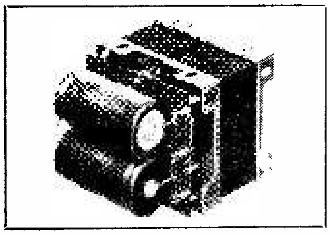


HY200
120 Watts into 8Ω

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.
PSU50 suitable for two HY50's **£8·18** plus **£1·02** VAT. P/P free.
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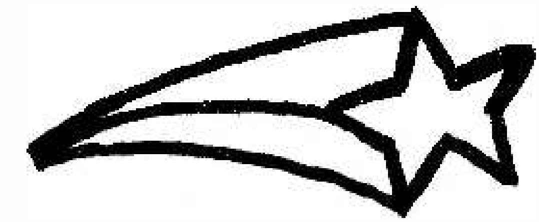

A NEW STAR ON THE WORLD'S HI-FI HORIZON.

PW

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HAVE COLLABORATED TO BRING TO PW's READERS A WORLD FIRST ON THE HOME CONSTRUCTOR HI-FI KIT SCENE.

Ted Rule, a member of the design team of T. & T. Electronics was commissioned by P.W. to design a High Fidelity Stereophonic Amplifier in a form suitable for the Home Constructor which would supersede the now ageing "Texan".

This, bearing in mind the phenomenal success story of the Texan was a daunting brief for any design team, but we are both delighted and proud to announce that Ted as well as achieving his original design brief, has far exceeded it.

Ted, (who has 30 years experience in Hi Fi design) has excelled himself in producing the P.W. WINTON amplifier, which we sincerely believe to BETTER SIGNIFICANTLY ANYTHING CURRENTLY AVAILABLE TO THE HOME CONSTRUCTOR IN THIS POWER RANGE.

The almost unbelievable specification for this design (published in full in the WINTON article) was achieved by utilising the latest "state of the art" devices available including the revolutionary POWER MOS-FETS developed by HITACHI Ltd., and BI-FET Op Amps from TEXAS.

The HITACHI research has we feel rendered the use of Bi-Polar Power Output Transistors obsolete in any design which has any pretentions towards true HIGH FIDELITY.

Because we are so excited at the performance obtainable, and to avoid disappointment caused by the use of sub-standard components, we have decided to market a complete kit of parts to ensure that the Home Constructor can achieve the same superb results.

As with Rolls-Royce quality doesn't come cheaply, and we make no apologies at all for the fact that our kit costs a bit more than the average Bi-Polar design, we firmly believe that the standard of reproduction obtainable is a reflection in part of the quality of the components used in the kit, and that discerning Audiophiles the world over will recognise the inescapable truth that today you usually get just what you pay for.

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Pack (E) Semiconductors (including HITACHI MOS Power Fets)	**£30.53**
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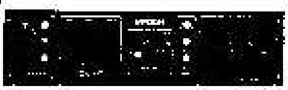

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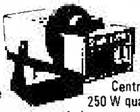

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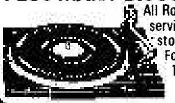

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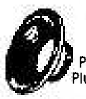

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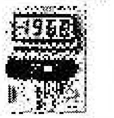

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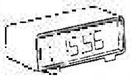

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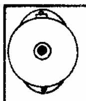

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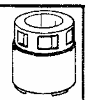

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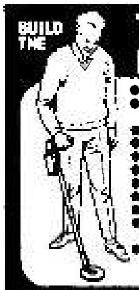

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PRIMARY 220-240 VOLTS

Ref	Amps 12V	24V	£	P & P
111	0·5	0·25	2·20	0·45
213	1·0	0·5	2·64	0·78
71	2	1	3·51	0·78
18	4	2	4·03	0·96
85	0·5	2·5	5·00	0·79
70	6	3	5·35	0·96
108	8	4	7·42	1·14
72	10	5	8·12	1·14
116	12	6	8·99	1·32
17	16	8	10·72	1·32
115	20	10	13·98	2·08
187	30	15	17·05	2·08
226	60	30	36·74	OA

30 VOLT RANGE
Pri 220/240 Sec 0-12-15-20-24-30V Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V & 15V-0-15V.

Ref	Amps	£	P & P
112	0·5	2·64	0·78
79	1·0	3·57	0·96
3	2·0	5·77	0·96
20	3·0	6·20	1·14
21	4·0	7·99	1·14
51	5·0	9·87	1·32
117	6·0	11·17	1·45
88	8·0	14·95	1·64
89	10·0	17·25	1·84

50 VOLT RANGE
Pri 220/240v Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V & 25V-0-25V.

Ref	Amps	£	P & P
102	0·5	3·41	0·78
103	1·0	4·57	0·96
104	2·0	7·16	1·14
105	3·0	8·56	1·32
106	4·0	11·41	1·50
107	6·0	15·06	1·64
118	8·0	20·26	2·08
119	10·0	24·98	OA

60 VOLT RANGE
Pri 220/240V Sec 0-24-30-40-48-60V Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V, or 30V-0-30V.

Ref	Amps	£	P & P
124	0·5	3·88	0·96
126	1·0	5·91	0·96
127	2·0	7·60	1·14
125	3·0	11·00	1·32
123	4·0	12·52	1·84
40	5·0	15·84	1·64
120	6·0	18·06	1·84
121	8·0	25·56	OA
122	10·0	29·55	OA
189	12·0	34·06	OA

MAINS ISOLATORS (SCREENED)
Pri 120/240V SEC 120/240V CT

Ref	VA (Watts)	£	P & P
*07	20	4·40	0·79
149	60	6·70	0·96
150	100	7·61	1·14
151	200	11·16	1·50
152	250	13·28	1·84
153	350	16·43	1·84
154	500	20·47	2·15
155	750	29·06	OA
156	1000	37·20	OA
157	1500	51·38	OA
158	2000	81·81	OA
159	3000	86·66	OA

Pri 0-220-240V. Sec 115 or 240V. State volts required.

AUTO TRANSFORMERS

Ref	VA (Watts)		£	P & P
113	15	0-115-210-240V	2·48	0·71
64	75	0-115-210-240V	4·01	0·96
4	150	0-115-200-220-240V	5·35	0·96
67	500	0-115-200-220-240V	10·99	1·84
84	1000	0-115-200-220-240V	18·76	2·08
93	1500	0-115-200-220-240V	23·36	OA
95	2000	0-115-200-220-240V	34·82	OA
73	3000	0-115-200-220-240V	59·21	OA
80s	4000	0-10-115-200-220-240V	76·86	OA
57s	5000	0-10-115-200-220-240V	89·50	OA

HIGH VOLTAGE ISOLATORS
Pri 200/220V or 400/440V.
Sec 110/120V CT or 200/240CT

Va	Ref	£	P & P
60	243	6·70	1·32
350	247	16·43	1·84
1000	250	37·10	OA
2000	252	61·81	OA

CASED AUDIO TRANSFORMERS
240V cable in 115V USA flat pin outlet

VA	£	P & P	Ref
75	7·73	1·14	64W
150	10·01	1·14	4W
200	9·92	1·45	65W
250	10·49	1·45	69W
500	19·17	1·64	67W
750	23·41	1·76	83W
1000	27·88	OA	84W
1500	26·02	OA	93W
2000	49·97	OA	95W

SEND 15p FOR CATALOGUE

Prices correct 21-11-78. Please add VAT after P & P.

SCREENED MINIATURES

Ref	mA	Volts	£	P&P
238	200	3-0-3	2·57	0·55
212	1A, 1A	0-6, 0-6	2·85	0·78
13	100	9-0-9	2·14	0·38
235	330, 330	0-9, 0-9	1·99	0·38
207	500, 500	0-8-9-, 0-8-9	2·77	0·71
208	1A, 1A	0-8-9, 0-8-9	3·53	0·78
236	200, 200	0-15, 0-15	1·99	0·38
214	300, 300	0-20, 0-20	2·80	0·78
221	700 (DC)	20-12-0-12-20	3·41	0·78
206	1A, 1A	0-15-20-0-15-20	4·63	0·96
203	500, 500	0-15-27-0-15-27	3·99	0·96
204	1A, 1A	0-15-27-0-15-27	6·04	0·96
239	50	12-0-12	2·57	0·38

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65 ½W Metal Oxide Resistors.
65 ¼W Metal Oxide Resistors.
150 Mixed Value Capacitors.
10 Reed Switches.
50 Wire Wound Resistors.
10 3000 F30V Capacitors.
25 Assorted presets.
50 3 tag terminal strips.
Hardware. 8A nuts, bolts.
200 Mixed Resistors.
Each pack **70p.**
P&P 40p. VAT 12½%.

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100V	100A*	£2·10
200V	2A	£0·45
400V	4A	£0·85
400V	6A	£1·25
500V PM7A6	12A*	£2·85

VAT 12½% 15p P&P *VAT 8% *66p VAT 8%

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AVO 71 **£33·50**
AVO 73 **£44·20**
AVO MM5 **£28·66**
Wee Megger **£66·90**
EM272 **£53·70**
DA116 digital **£102·00**
AVO TT169 in circuit Transistor Tester **£34·75**
P & P £1·15. VAT 8%.

Meggar BM7 battery **£45·15**
U4315 Budget Meter 20KΩ/V Ranges to 1000V, 2·5A AC/DC 500KΩ. In steel case **£15·85**

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DC-1000V AC-1000V DC-100mA Res-150kΩ 1000Ω /V Bargain **£7·20.** VAT 8% P & P 62p.

20,000 ohm/V Multimeter, mirror scale. Ranges AC/DC to 1000V DC current to 250mA Resistance to 3 Mohms. 5" × 3½" × 1¾". **£14·36.** VAT 8%. P & P **£1·05.**

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Ref	Price	P & P
3A	14·70	1·48
4A	18·77	1·84
5A	26·64	2·15

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43mm × 43mm		82mm × 78mm	
0-50μA	£6·20	0-50μA	£6·70
0-500μA	£5·95	0-500μA	£6·70
0-1mA	£5·95	0-1mA	£6·70
0-30V	£5·95	0-30V	£6·70

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	L	W	H	
B1	5¼	2¼	1½	62p
B2	4	4	1½	62p
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Home electronic teacher. Start simply and progress to a TRF radio or electronic organ. No soldering, all parts included in presentation box, full instructions. **£8·29** + 96p P & P. VAT **8%.**

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*PB4	215mm × 130 × 85	£2·54

P & P 29p *66p. VAT 8%.

15V RANGE
0-C.T. 15V.

Ref		Price	PP
171	500 mA	2·09	·45
172	1A	2·96	·78
173	2A	3·59	·78
174	3A	3·75	·86
175	4A	5·73	·96

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BE6 Pri 0-220V Sec 4500V 10mA **£4·50** P & P £1·00.
BE7 0-110-120-220V Pn 240V sec 20V 1 amp **£1·50** P & P 30p.
BE8 0-240 15-0-15V 2A **£1·50** P & P 70p.
Ref 30 240-240 isolator 200Va **£4·20** P & P 96p.
Ref 59 0-240V 25-0-25V 4A **£6·25** P & P £1·50.
BE9 Miniature Pri. 0-240V SCR Sec 12-0-12V 50mA P & P 38p. **90p**

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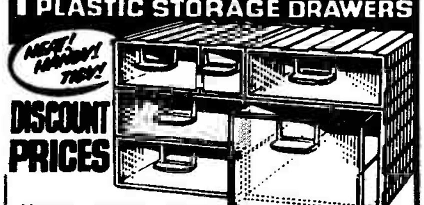

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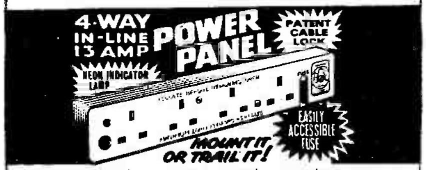

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Send S.A.E. for illustrated relay list.

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64 big pages with 50p discount vouchers + qty prices for bulk buyers + reply paid envelope—All this for just **45p** inc. post.

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Illustrated list of types from 30p in our Bargain List No. 6—Send S.A.E.

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7-seg display, (as above) Futaba type DG-10Q1 0·3" char. **70p** with data.

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Selection of boards containing many different 74 series IC's. 20 for **£1;** 50 for **£2·20;** 100 for **£4.**

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All mains primary: 12-0-12V 50mA **85p;** 100mA **95p;** 1A **£2·50.** 6-0-6V 100mA **85p;** 1½A **£2·40.** 9-0-9V 75mA **85p;** 1A **£2·10.**
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All prices include VAT—Just add 25p post

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(Continued from opposite side)

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AA119 15
AA129 25
AAY30 25
AAZ15 15
BA100 10
BY100 24
BY126 12
BY127 12
CR033 148•
OA9 75
OA47 12
OA70 12
OA79 12
OA81 15
OA85 12
OA90 6
OA91 6
OA95 8
OA200 9
OA202 8
IN914 4
IN916 5
IN400/2• 5
IN4003• 6
IN4004/5• 6
IN4006/7• 7
IN4148 4

•BRIDGE RECTIFIERS (plastic case)
1A/50V 20
1A/100V 22
1A/200V 25
1A/400V 29
1A/600V 34
2A/50V 35
2A/100V 44
2A/200V
2A/400V 53
2A/600V 65
4A/100V 72
4A/200V 75
4A/400V 79
4A/600V 105
4A/800V 120
6A/100V 73
6A/200V 78
6A/400V 85
BY164 56
VM18 DIL 40

ZENERS
Rng: 2V7-39V 400mW 9p
Rng: 3V3-33V 1·3W 17p

VARICAPS
MVAM115 120
BA102 25
BB104 40
BB1058 40
BB106 40

Noise Diode
Z5J 160

S44 20
3A/100V• 18
3A/400V• 20
3A/600V• 27
3A/1000V• 30
6A/600V 65

SCR's• Thyristors
1A50V 38
1A100V 42
1A200V 47
1A400V 52
1A600V 70
5A300V 35
5A600V 43
8A300V 48
8A500V 58
8A600V 85
12A300V 59
12A500V 92
C106D 38

ALUM. BOXES with lid
3×2×1" 48
2¼×5¼×1½" 68
4×4×1½" 68
4×2¾×1⅛" 64
4×5¼×1⅛" 78
4×2½×2" 64
5×4×2" 82
6×4×2" 88
7×5×2½" 114
8×6×3" 148
10×7×3" 172
10×4½×3" 142
12×5×3" 165
12×8×3" 220

SPEAKERS
8Ω 0·3W 2"; 2½" 65
2·5; 3" 58
40Ω 2·5" 65
64Ω 2·5" 65
8Ω 5W 7"×4" 190
8Ω 3W 6"×4" 160

TRIACS•
3A/100V 48
3A/400V 50
8A/100V 54
8A/400V 64
8A/800V 108
12A/100V 60
12A/400V 70
16A/100V 95
16A/400V 105
25A/800V 295
40669 95

DIAC•
ST2 25

VEROBOARD•

	0·1 (copper clad)	0·15 (copper clad)	0·1 (plain)	0·15 (plain)
2½×3¾"	46p	39p	31p	24p
2½×5"	55p	50p	—	31p
3¾×3¾"	55p	50p	—	—
3¾×5"	62p	67p	50p	43p
2½×17"	169p	135p	—	92p
3¾×17"	218p	180p	141p	120
4¾×17"	280p	—	—	183p

Pkt of 36 pins 85p
Spot face cutter 120p
Pin insertion tool 99p

VERO WIRING PEN• + Spool 325p
Spare Wire (Spool) **80p**; Combs **7p** ea.

FERRIC CHLORIDE•
1lb bag Anhydrous **65p** + 30p p. & p.

DALO ETCH RESIST PEN•
Plus spare tip 75p

COPPER CLAD BOARDS•

Fibre Glass	Single-sided	Double-sided	SRBP 7·5"×7"
6"×6"	75p	90p	60p
6"×12"	130p	175p	

SOLDERCON PINS•
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OPTO ELECTRONICS•
LEDS + Clip
TIL209 Red 13
TIL211 Grn 18
TIL212 Yellow 22
0·2" Red 15
0·2" Yellow, Grn, Amber 19
ORP61 84
ORP12 63
2N5777 45

OPTO ISOLATORS
TIL111/2 85
TIL114 95
TIL117 110

7 Segment Displays
LS400 255
TIL307 675
TIL321 ·5" C.An 115
TIL322 ·5" C.th 115
DL704 ·3" C.Cth 99
DL707 ·3" C.Anod 99
DL747 ·6" An 180
FND357 120
MAN3640 165
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LM323K 598
MVR5 or 12 150
1A —ve: 5V, 12V 220

Plastic Case: +ve
0·1A (TO92) 5V, 6·2, 8·2V, 12V, 15V 30
1A (TO220) 5V, 12V, 15V, 18V, 24V 85

Plastic (TO220) case
—ve 0·5A: 5V, 6·2V, 8·2, 12, 15V 86
—ve 1A 5V, 12V 110
LM320-12 —ve 99
LM320-15 —ve 165
LM341-15 +ve 99
Variable Type
723 +2 to +37V 45
LM304H 0 to +40V 240
LM317H +1·2—37 100
LM317K +1·2 to 37 350
LM325N ±15V 240
LM326N ±12V 240

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SPST 28
DPST 34
DPDT 38
4 pole on off 54

SUB-MIN TOGGLE
SP changeover 59
SPST on off 54
SPST biased 85
DPDT 6 tags 70
DPDT C/OFF 79
DPDT Biased 115

SLIDE 250V
1A DPDT 14
1A DPDT C/O 15
½A DPDT 13
4 pole 2-way 24

PUSH BUTTON
Spring loaded
Latching
SPST on off 60
SPDT C/over 65
DPDT 6 Tag 85

MINIATURE
Non Locking
Push to make 15
Push Break 25

ROCKER: (Black) on/off 10A 250V 23

ROCKER: (white) 5A 250V SP change-over centre off 30

ROCKER: (illuminated, red) Chrome Bezel 5A 250V SP 52

ROTARY: "Make-A-Switch" Make your own multiway Switch. Adjustable Stop Shafting Assembly, Accommodates up to 6 Wafers 69
Mains Switch DPST to fit 34
Break Before Make Wafers. 1 pole/12 way, 2p/6 way, 3p/4 way, 4p/3 way, 6p/2 way 47
Spacer and Screen 5

ROTARY: (Adjustable Stop)
1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way 41

ROTARY: Mains 250V AC, 4 Amp 45

PW PROJECTS
General Coverage Receiver, Chromachase, 24hrs. Digital Clock, 'JUBILEE' Electronic Organ, General Purpose SW Receiver, Gas & Smoke Sensor Alarm, Metal Locator, 'PURBECK' Oscilloscope, Audio Distortion Meter, 'AVON' 2m FM Transmitter. Acoustic Delay Line.
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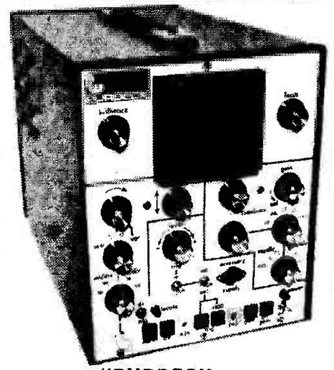

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74LS01 13	74LS48 120	74LS124 180	74LS174 106	74LS253 142	74LS365 65
74LS02 14	74LS49 120	74LS125 60	74LS175 110	74LS257 110	74LS366 65
74LS03 14	74LS51 24	74LS126 60	74LS181 398	74LS258 110	74LS367 65
74LS04 14	74LS54 28	74LS132 95	74LS183 298	74LS259 160	74LS368 66
74LS05 23	74LS55 30	74LS136 55	74LS189	74LS261 450	74LS373 180
74LS08 22	74LS63 150	74LS138 85	74LS190 140	74LS266 52	74LS375 160
74LS09 22	74LS73 46	74LS139 85	74LS191 140	74LS273 244	74LS374
74LS10 20	74LS74 41	74LS145 108	74LS192 132	74LS275 250	74LS377 212
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74LS33 39	74LS109 55	74LS165 75	74LS244 155	74LS326 294	74LS490 180
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					74LS674 1450

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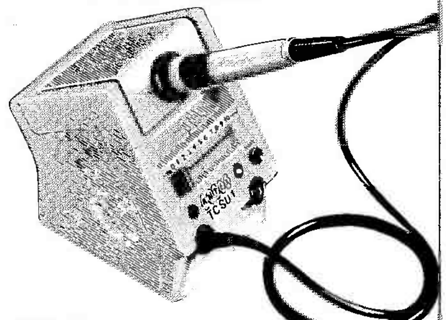

CTC 35 watt —

The TCSU1 soldering station with either the XTC 50 watt — 24/26 volt soldering iron or the CTC 35 watt — 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 **£ 38.10** XTC and CTC irons **£14.85** inclusive of VAT and P.&P.

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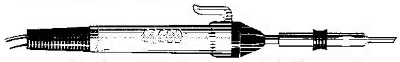

... a miniature iron with the element enclosed first in a ceramic shaft, then in a stainless steel. Virtually leak-free. Only 7½" long. Fitted with a 3/32" bit **£4·37** inclusive of VAT and P.&P. Range of 5 other bits available from ¼" down to 3/64".

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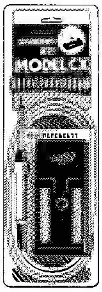
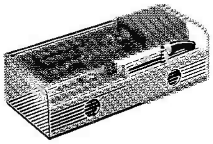


Contains both the model CX230 soldering iron and the stand ST3. Priced at **£6·21** inclusive of VAT and P.&P. It makes an excellent present for the radio amateur, modelmaker or hobbyist.

Model SK4 Kit

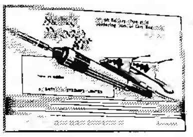
With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£6·21** inclusive of VAT and P.&P.

Model SK1 Kit



This kit contains a 15 watt 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.

Model MLX Kit



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.

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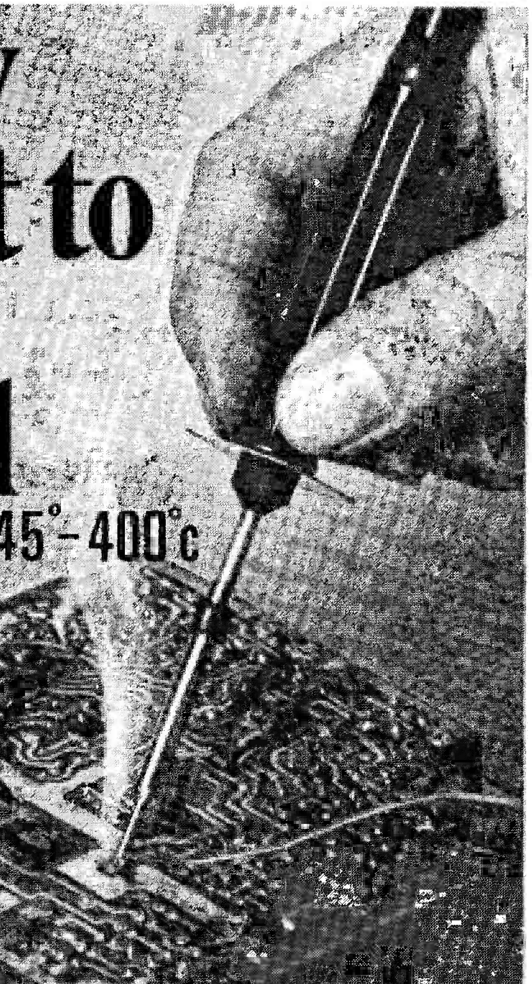

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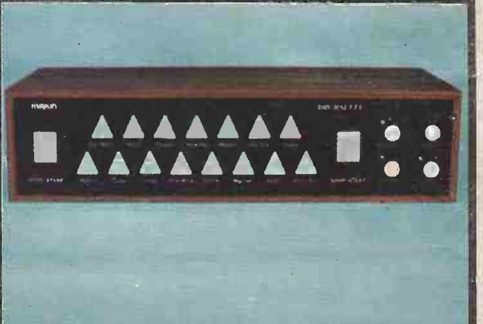

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PW 379

★ special feature

8-PAGE SUPPLEMENT

hints & tips for constructors

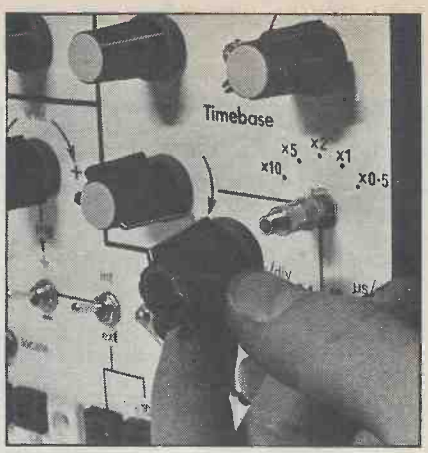
Practical Wireless

March 1979

contents

Finishing it off

Give your project a really professional appearance



A growing number of home constructors seem to be aiming to finish their projects in a more professional manner. There is a growing interest in using better looking and better finished cases and cabinets and the days of the old tobacco tin seem, fortunately, to have passed.

The choice of cases available to the home constructor has improved in recent months and several companies have made some of their professional cases available on the amateur market.

In most projects presented in *Practical Wireless* the decision as to the type and style of case to be used has already been taken. A lot of thought goes into the choice of case for each project, bearing in mind such parameters as price, the use to which the project will be put, availability and styling.

Simple Boxes

Some simple projects can be adequately housed in a simple plastic box if electrical screening is not required, or in the traditional diecast aluminium box if it is needed. Plastic boxes have been developed by several makers into quite sophisticated units offering many advantages for the amateur user. They are relatively inexpensive and can be easily drilled for controls using only simple hand tools, although some degree of care is needed if the smooth polished surfaces are not to be marked. A wide range of sizes and styles are available and several types have mounting facilities for printed circuit boards moulded into the box, simplifying construction.

The diecast box in its simplest form has been around for several decades and there are probably more pieces of electronic equipment built into one of these than into any other type, with the possible exception of the infamous tobacco tin. It has several disadvantages for the amateur, being quite difficult to work on with simple hand tools and having a rather indifferent appearance in the 'as bought' state. Versions are available with a respectable gloss painted finish, but these are very expensive and unless the electrical screening properties of the diecast box are really needed then the plastic versions are better, and cheaper.

The plain simple aluminium box with removable lid offers a stark and cheap housing without any pretensions as to style or elegance.

Test Gear

When it comes to projects such as test equipment, domestic audio or amateur radio projects, some respectable form of housing becomes essential.

Test equipment should be built to be used, and must offer reliability and confidence and it cannot really give of its best housed in a piece of bent aluminium. The case design chosen must be mechanically robust, easily worked and allow the controls to be ergonomically positioned. If the instrument is intended to be used in the workshop then allowances should be made for maximum utilisation of bench or shelf space. Take a look at what the commercial instrument makers use and don't be ashamed to take the best ideas from all of them. Don't be tempted to use a case that is so small that the controls have to be cramped together making the instrument awkward to use. You should be proud of the finished instrument and not be ashamed to leave it permanently on the workshop bench where it will get maximum use.

Audio equipment tends to be rather fashion conscious and so the cases and cabinets used for amplifiers and tuners change styles rapidly. Because this type of project is on show to anyone who enters your home it is very important to ensure that the workmanship put into the cabinet and front panel of any audio project is of the very best. Probably the easiest way to achieve this is to build from a complete kit where the cabinet is provided. However, if you are designing your own circuits or insist on making the entire unit yourself then there are a few recent additions to several makers' case ranges which would lend themselves to audio equipment.

For the amateur radio enthusiast the need is for a functional but still attractive case at a respectable price and it also probably needs to be all metal as well.

Metalwork

Although very respectable work can be turned out on the kitchen table using nothing more than a pair of scissors, an old file and a simple hand drill if you have the patience, it is very much easier with a few basic tools.

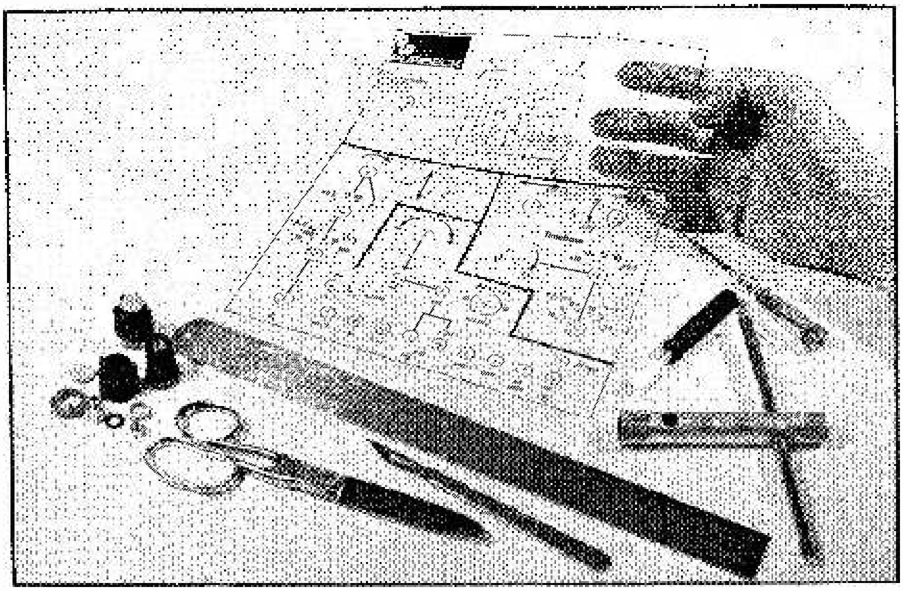
The home constructor needs to be able to drill holes in metal or plastic panels, file rectangular holes for meters or plugs, cut pieces of metal to size and shape and bend them into simple shapes such as brackets. To perform these operations a few basic tools are essential and you must learn how to use them properly.

Some means of holding the work is essential if painted or polished surfaces are not to be scratched.

Ensure that your cutting tools and drills are all kept sharp and in tip-top condition. Blunt and rusty tools do not

Drilling sizes

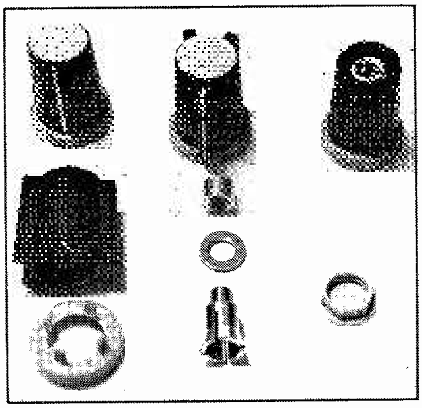
Thread	Clearance	Tapping
OBA	6·10mm	5·10mm
2BA	4·80mm	4·00mm
4BA	3·70mm	3·00mm
5BA	3·30mm	2·65mm
6BA	2·85mm	2·30mm
8BA	2·25mm	1·80mm
10BA	1·80mm	1·40mm
12BA	1·40mm	1·05mm



A professional look can be achieved with the *PW* Front Panel Overlay System. This picture shows the overlay for the *PW* Purbeck oscilloscope. The overlay can be used over a plain white card panel or over a coloured one if preferred. A thin Perspex sheet can be fitted over the film to protect it and hold it firmly in place

help to make a good job. Mark out the positions of the holes and cut-outs accurately, paying particular attention to ensuring that groups of holes are correctly positioned relative to each other. Centre-pop each hole before drilling a small diameter pilot hole first then following up with the correct size drill. Rectangular cut-outs are made by drilling holes at each corner and using an Abrafile fitted in the hacksaw frame cut along the four sides. Use a suitable file to finish the cut-out to size.

Wherever possible try to use components that have some sort of bezel to cover up the holes. This gives you much more leeway with your metalwork.



Collet type knobs provide a firm fastening together with ease of positioning on the shaft. These are Sifam knobs and the various component parts can be seen

Front Panels

Lettering on the front panel can make or mar a project. Although press down letters and numerals can be used with good effect they are not as easy to use properly as is widely imagined and unless they are carefully fixed with special varnishes they tend to rub off quickly in use.

A system to enable constructors to produce professional looking hard wearing front panels for many *PW* projects has been evolved.

This uses a photographically produced transparent film of the front panel which can be carefully cut out and placed over the main panel. A thin sheet of Perspex can be placed over the film to hold it flat, the "sandwich" being held in place by the controls.

A further stage in the production of front panels is to use the film overlay as a photographic master to make a thin metal panel which is then stuck onto the main front panel. This method produces superb panels but does require the use of ultra-violet lamps, specially sensitised metal sheet and the appropriate chemicals.

Knobs

To complement the front panel design you should choose suitable knobs, bearing in mind the use to which the unit is to be put. For test equipment where ease of use is vital it is difficult to better a collet type of knob. These fit tightly onto the control shaft by a simple collet action and do not require a flat on the shaft for a grub screw.

For audio units more fashionable knobs can be chosen but remember that good knobs cost more than poor ones. ●

Wire sizes

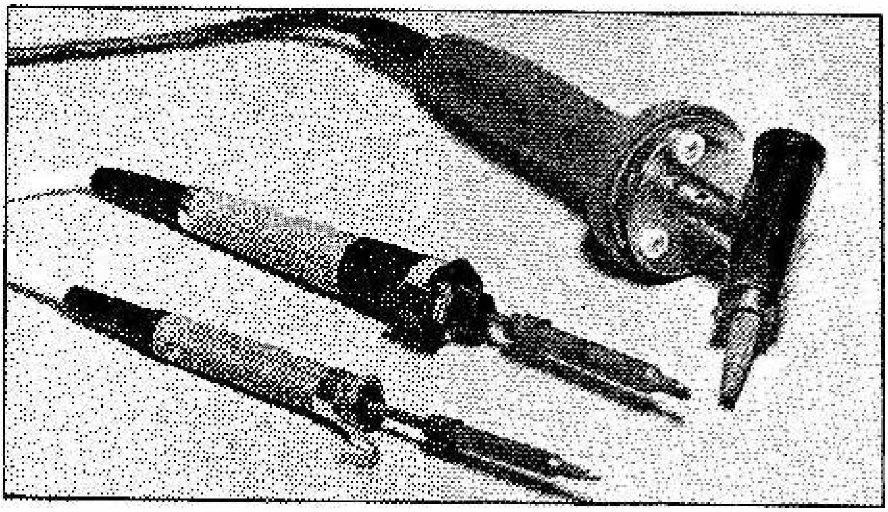
s.w.g.	dia. mm	s.w.g.	dia. mm
10	3·251	30	0·315
12	2·642	32	0·274
14	2·032	34	0·234
16	1·626	36	0·193
18	1·219	38	0·152
20	0·914	40	0·122
22	0·711	42	0·102
24	0·559	44	0·081
26	0·457	46	0·061
28	0·376	48	0·041

Basic tool kit

Hand drill with $\frac{3}{8}$ inch chuck
Drills 1mm, $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$ inch diameter, countersink bit
Junior hacksaw
Abrafiles (to fit hacksaw)
Centrepunch
Small ballpein hammer
Small files including round, half-round and three square
Steel rule, 12 inches long
Small engineer's square
Scalpel and blades (also use as scriber for marking out)
Small vice
Screwdrivers
Pliers, small and large
Sidecutters
BA spanners
Soldering irons 15W, 30W

The mystic art of soldering

Assemble your projects correctly



The absolute success of any electronic or wireless project lies with the workmanship put into the construction. This applies especially to the quality of the soldering. One dry joint and the entire project is likely to fail to work, causing despair to the beginner.

It is simply not sufficient to assume that a project can be thrown together anyhow, the solder blobbed onto the joints, the power switched on and it will work. With modern circuits and exotic components this is just not the case. The would be wireless constructor should aim to master the various constructional techniques used.

The basic art which must be perfected before starting any constructional project is the technique of soldering.

A soldered joint is used for two purposes in electronics. The first is to provide a mechanical fastening for the various electronic components.

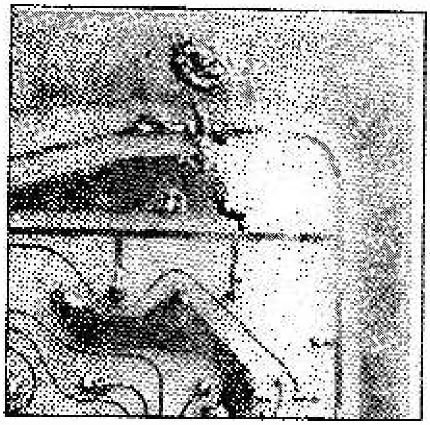
The second and main purpose of the solder is to provide a low resistance electrical path between the leads of the components. It can only do this if the solder "wets" each lead to be connected.

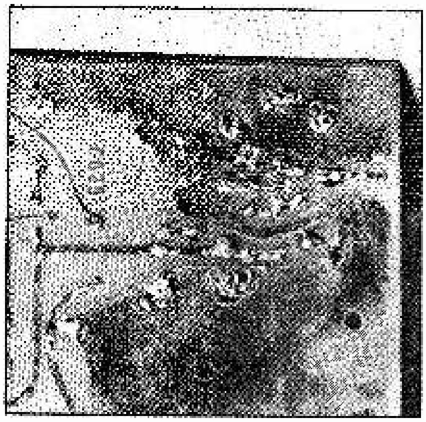
The art of good soldering is not difficult to master and requires the joint to be clean and free from greases, the iron to be really hot and perfectly clean and the correct grade of solder to be used.

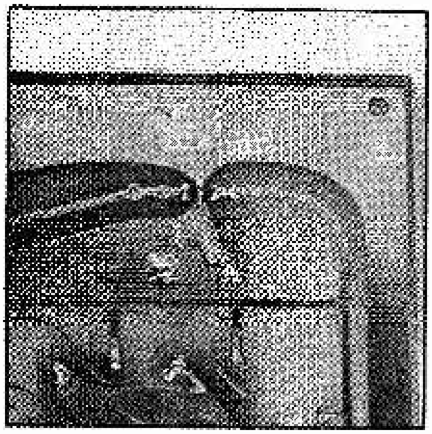
Choice of Iron

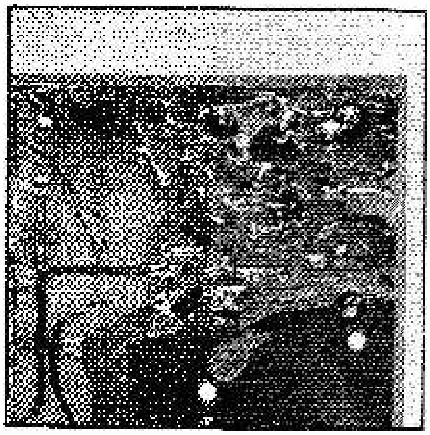
Let us discuss the choice of iron first as this has a direct bearing on how easily you can make a given joint. The only purpose of the iron is to heat the metals to be soldered to the correct temperature so that the solder flows properly. It is not intended to be used as a means of carrying the solder to the joint or as a tool for bending lead ends over. The iron should ideally be matched to the joint being made so that the temperature is neither too hot nor too cold. If the temperature is too hot it is probable that the more delicate components might be damaged while if it is too cold the solder will not melt properly and the joint will be dry.

Soldering irons are available in a wide variety of sizes and shapes. The first figure to be quoted when talking about irons is the wattage of the element and these vary from about 10W up to about 240W—ideal for soldering the seams on your car radiator. For our purposes a 15/17W miniature iron with an iron plated copper bit of about 2·3mm diameter is ideal for modern p.c.b. work







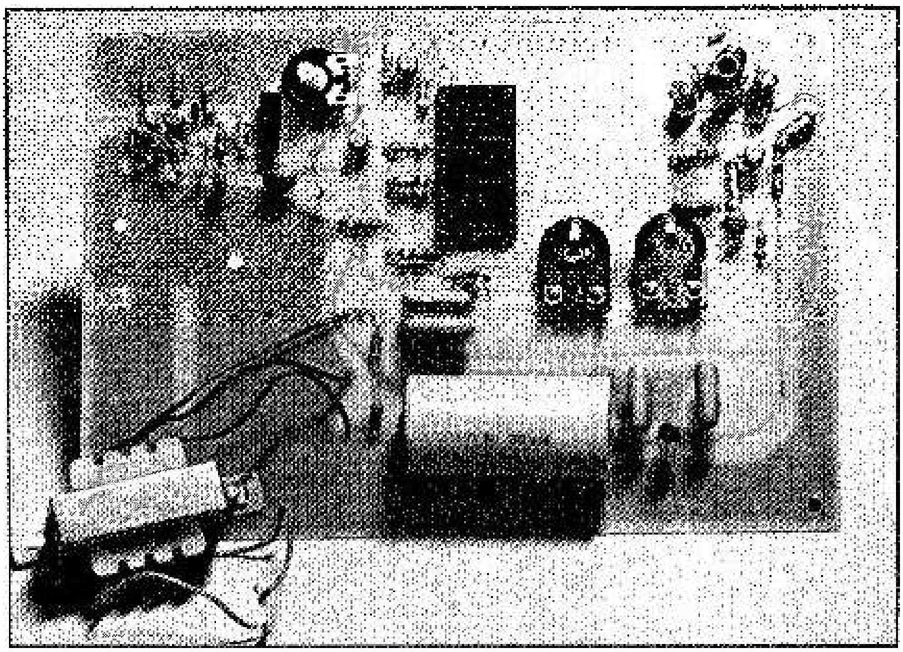


Top left is a badly made soldered joint on a p.c.b. probably made with an iron that was cold and dirty. Too much solder has been used and has bridged across the three pads. Below it is the same area of the board after the excess solder had been removed and the joint made with a clean hot iron. Top right shows a solder bridge across two adjacent pads. Below are the same joints properly made. The heading picture shows a Stiron 75W iron and Antex 30W and 17W miniature irons

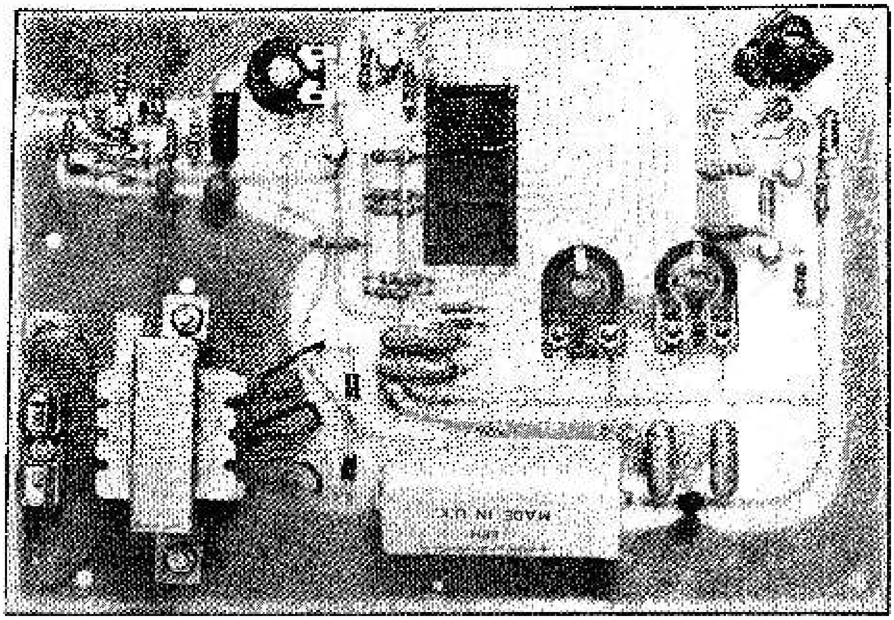
and will cope with most joints to be found on *PW* project boards.

However where large diameter earth wires, metal screens and components with heavy gauge wires are met with then such a small iron will not be capable of supplying enough heat to bring the metals up to soldering temperature rapidly enough and a poor joint will be the result. For this type of work and also for older projects such as those using valves a 25/30W iron with a bit of around 3·2mm diameter is needed.

If you want to go in for some really heavy brass metal chassis bashing then you will need at least a 60W iron with a large bit and you might even find that a small propane gas blowtorch is better.



These two pictures show a TV game p.c.b. as built by a novice (above) and after rebuilding correctly (below). Note how the components are poorly formed and placed in the upper picture with the transformer hanging on one small screw. All components should be neatly formed and positioned with great care and precision to obtain maximum reliability



Preparation

When preparing the components for soldering ensure that the leads are clean and, if necessary, tin them by applying the hot iron to the leads together with a resin cored solder so that the lead is completely covered by a thin layer of solder.

The leads should then be carefully bent so that the component fits into place without any strain on its leads. Place the hot iron onto the joint and immediately apply resin cored solder to the joint. The solder should flow easily and quickly to completely cover the joint, when the solder and iron can be removed and the joint allowed to cool. It is very important that the components are not allowed to move during the cooling down period as this will affect the quality of the joint.

When it has cooled down and the solder solidified the joint can be inspected. The solder should completely surround the joint and be bright and shiny. If the joint is dull or crystalline in appearance the joint is "dry" and must be remade. Likewise any small blowholes or areas where the solder has not "wetted" the leads means that the joint is suspect.

One very common fault is to use far too much solder on each joint. Only enough solder should be applied to the joint to completely cover it. An excess of solder is not only untidy, and could cover a bad joint but it is also expensive.

If you find that you have to remove a component from a p.c.b. at any time this can be easily done by using a de-soldering braid. This braid is placed on the joint and a clean iron applied. The solder melts and is literally sucked into the braid by capilliary action. A clean piece is used for each joint, of course.

The soldering iron bit must be kept clean and this is best achieved by using a damp sponge and wiping the hot bit with it after each joint is made. Several stands are available to hold the iron when it is not in use and these usually incorporate the sponge in their bases. Remember to keep the sponge damp though.

Never use any other solder than a resin cored variety which has been specially formulated for electrical and electronic work. Fluxes such as Baker's Fluid or other highly active varieties must never be allowed to get anywhere near an electronic component, the results will definitely prove disastrous for the component as well as shortening the life of your soldering iron bit. Leave these corrosive fluxes to the plumbers.

Identifying components

The resistor and capacitor colour code explained

Although there are some minor differences in specific capacitor ratings, both resistors and capacitors follow the same colour code. In the case of resistors, where the colour code is in use, it refers to a nominal value in ohms, the unit of resistance. There are of course other types of resistor which do not utilise a colour code, such as wirewound types (high current or high stability) and some which simply have the resistance value written as a figure on the resistor body itself, but the vast majority of carbon, metal oxide, and thick film types use the colour code.

The way in which the code works is very simple, the colours being read off from one end of the resistor to the other, beginning at the end where the colours are concentrated. The first ring of colour indicates the first digit, the second ring the second digit, and the third indicates the multiplier or number of zeros in use. The fourth colour indicates the tolerance over the stated range, brown indicating 1%, red 2%, gold 5%, and silver 10%.

A typical resistor might read yellow, purple (or violet if you prefer), red, and gold. This indicates 4700ohms, variously written as 4·7k, 4·7kΩ, or 4k7, and a tolerance of 5% over that range. It is important to appreciate that the third colour (the multiplier) actually denotes the number of zeros, thus a 47Ω resistor would appear as yellow, purple, black, with a tolerance band following, indicating that there are *no* zeros in the multiplier.

In general, the colour code is restricted to carbon or metal oxide types, and these resistors will of course be suitable for all types of circuit application. On the other hand, wirewound types, which normally have their value stamped or printed on the body of the resistor, will possess inductive properties, which may render them unsuitable for r.f. circuits.

The stability and tolerance of a particular resistor is to a great extent dictated by the materials of which it is made, as is the inherent electrical noise which it produces. High stability items are typically constructed from carbon film (5% tolerance) or metal oxide (2% tolerance) cermet ("thick film") also 2% tolerance, but precision items are of course wirewound, giving a rated tolerance of 0·1%.

In the case of power dissipation, wirewound forms are inevitably the favoured construction, giving a dissipation in specific items up to about 50W commercially, but once again, fairly high levels of dissipation can be managed with moulded carbon compound types, up to about 2W.

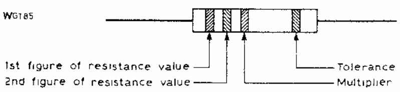
Where low noise levels are concerned, metal oxide and thick film types are used.

Capacitor Markings

Although the colour code is the same as that for resistors, it is generally restricted to ceramic disc, tantalum bead, and some moulded or dipped types. In the case of capacitors, there is some extra information necessary, notably the working voltage. The general code is read in the same way as with resistors, beginning at one end and moving towards the wire ends, the last line of colour indicating the working voltage. In the most common form, the polyester dipped type, red = 250V and yellow 400V. In these types a white tolerance band indicates 10% and black 20%.

Caution must be exercised where colour bands are similar to the colour of the capacitor body, as for example, a 2200pF (2·2nF or 2n2) polyester dipped type might well appear as a totally red item, made up from red = 2 (first digit), red = 2 (second digit or tens), and red = 2 (multiplier or number of zeros).

Tantalums are usually low voltage types and the code, again, is read from the free end, away from the wire ends. The first colour is the first digit, the second the tens in the figure, the next the multiplier, and the final colour the working voltage. These voltage bands follow a colour code, black indicating 10V, yellow 6·3V, green 16V, blue 20V, grey 25V, white 30V and salmon pink 35V.



COLOUR	1st & 2nd BAND	MULTIPLYING FACTOR	TOLERANCE
BLACK	0	1	—
BROWN	1	10	±1%
RED	2	10^2	±2%
ORANGE	3	10^3	—
YELLOW	4	10^4	—
GREEN	5	10^5	—
BLUE	6	10^6	—
MAUVE	7	10^7	—
GREY	8	10^8	—
WHITE	9	10^9	—
SILVER	—	10^{-1}	± 5%
GOLD	—	10^{-2}	±10%

Table of Multipliers

(referring to all electrical functions—current, voltage, resistance, inductance, frequency, power, and time)

p = pico = $\times 10^{-12}$
n = nano = $\times 10^{-9}$
μ = micro = $\times 10^{-6}$
m = milli = $\times 10^{-3}$
k = kilo = $\times 10^{3}$
M = mega = $\times 10^{6}$
G = giga = $\times 10^{9}$

Applications

The non-electrolytic categories, such as silvered mica, ceramic, paper, polyester and polycarbonate are highly suitable in all signal processing applications, both audio and radio, with the principal restriction being each type's working voltage and temperature capabilities. Ceramics are normally used in situations where their good temperature characteristics are an advantage, such as tuned circuits. Polyester, paper and polycarbonates are universally useful in high voltage situations where good insulation resistance is required such as pulse circuitry in television, and general signal and power stages in radio and audio circuits. In the main, coupling in transistor a.f. stages etc. utilises specific polyester items, due to their smaller physical size and good tolerance.

Electrolytics are used where high capacitance values are needed, and in the de-coupling of power supplies, where hum and ripple may be a problem. ●

Component buying

How and where to purchase those elusive parts

"Where can I buy the components for the *PW* 'Whathaveyou' project?" is one of the commonest queries received. This article will try to explain the pitfalls of purchasing electronic components, and show how to overcome them.

Unless you can buy a complete kit for a project it is quite probable that you will have to undertake some detective work to uncover the relevant suppliers.

The first thing that any serious home constructor needs is a library of catalogues from various suppliers of components. A run through the adverts in *PW* will indicate who produces a catalogue and you really cannot have too many of them. Using your library you can select the appropriate supplier for most components. You can compare prices for various components to try to obtain the best deal if this sort of exercise takes your fancy.

Exotic projects

Consulting your favourite supplier's catalogue is all right for the common or garden components such as resistors, capacitors and semiconductors, but what about the special items often specified for the more exotic projects?

Often these are available only from one source and where this is so the source is given in the components list or in the text of the article describing the project.

One name that keeps appearing in component lists is that of RS Components. This company is a component distributor who produce a comprehensive catalogue widely used in industry. All the components sold by RS are "own brand" and they only sell to *bona fide* trade customers. Because of their rapid service and well-produced technical catalogue, their components are used widely by authors when preparing projects, and the staff of *PW* also use them for similar reasons.

This leads to complications when a components list calls for an RS Components part number as many readers will find it difficult to obtain them. One way out is to befriend your local radio and TV repair shop who will certainly have an account with RS. It must be remembered that the prices given in their catalogue are not retail prices, and do not include VAT either, so be prepared to have to pay around 50% above catalogue price.

Up until recently RS Components' sister company Doram supplied to the amateur market but this service has been withdrawn. However several of the regular advertisers in *PW* will obtain any RS Components part on request.

By the way, try and persuade your friendly repairman to let you have an old issue of RS Components' catalogue, it is a mine of valuable information on components, giving such information as sizes, connections and specifications.

Cases and cabinets

When it comes to the cabinet or case to fit the project, these are usually available from several advertisers, most of whom carry a range from two or three manufacturers. In most projects the actual case style is a matter of personal choice and the one used by the author need not be copied. However, some projects are built using specially designed cases or utilise some particular feature of a case, and then it is important that only that case is used.

If you are the type who enjoys making your own chassis and cases then you will need to find a supplier of raw materials. This is not always easy and it pays in this case to have a copy of *Whiston's Catalogue* (K. R. Whiston Ltd., New Mills, Stockport SK12 4PT). This lists small quantity sizes of aluminium, brass, steel, etc., and is available for an s.a.e.

Printed circuit boards for *PW* projects should be obtainable from advertisers, but, individual readers can, if they have the equipment, make their own boards from the copper track patterns given full-size in the magazine. Another way is to take the track pattern to your local printed circuit board company and get them to make you a board. This is likely to be expensive as they will have to make you a photographic master from the drawing first (note that this must only be made for you and boards must not be made for resale by this method without obtaining permission and paying royalties to the copyright holder). You can find the address of p.c.b. makers in your local *"Yellow Pages"*, which can also prove useful in locating component stockists, metal stockists, etc.

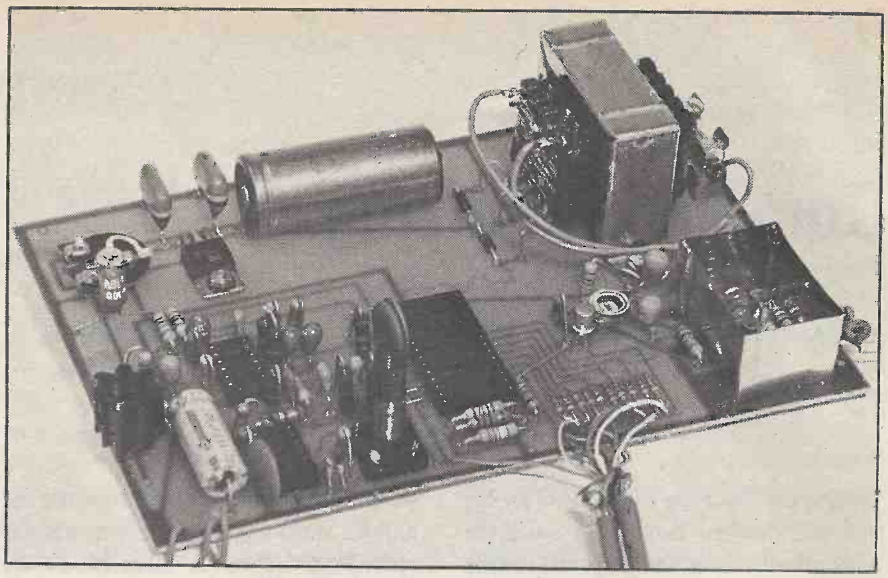
Semiconductors

When buying semiconductors for a project you will have to make up your own mind as to whether you risk using cheap unmarked types or spend out more money for guaranteed ones. Most suppliers will honour the maker's warranty and change faulty i.c.s or transistors so long as they have not been soldered into a circuit. With c.m.o.s. types, do not be tempted to take them out of their packaging to look at them. They are very prone to damage from static which builds up on all humans these days. Leave these i.c.s firmly in their conducting foam or silver foil wrappers until you are ready to insert them into their sockets. If you are supplied with c.m.o.s. not protectively wrapped in foil, conducting foam or a special housing, get in touch with the supplier immediately. If possible it is best to buy such components only from suppliers who are recognised or franchised by the manufacturer.

Finally, if you have exhausted all the above possibilities and feel that you simply must ask the magazine staff, please enclose a s.a.e. and don't expect miracles, and please, oh please, only after you really have tried yourself!

Handling c.m.o.s.

Avoid killing your i.c.s with static



As it should be, neat and tidy.

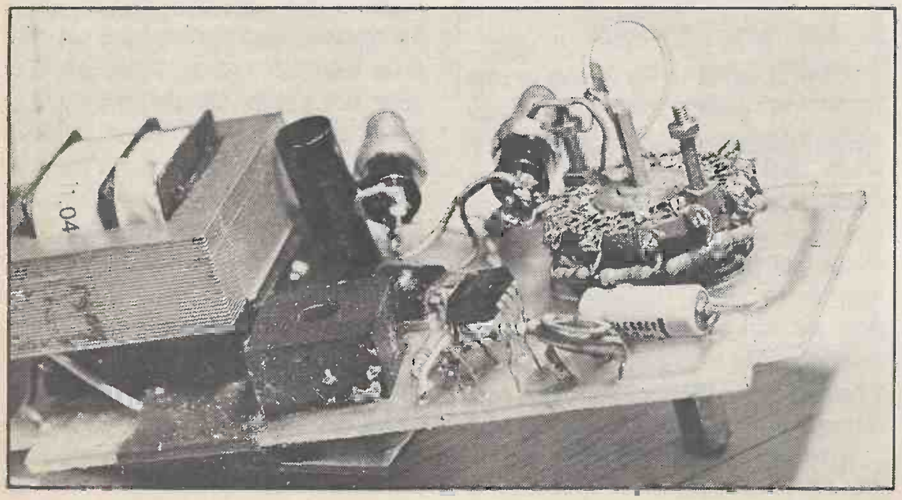
Unlike t.t.l. (transistor-transistor logic), c.m.o.s. (which stands for "complementary metal oxide semiconductor") devices are very prone to damage if handled or fitted into circuits without due precautions having been taken.

It is true that one or two digital c.m.o.s. devices are fairly robust, and can usually only be destroyed by reversing polarity of the supplies or by feeding a high signal at low impedance into the inputs while the device is without a supply, but general c.m.o.s. "chips" for use in the audio, video, music and radio fields are highly susceptible to static charges and extremes of temperature.

A great deal has already been written on somewhat amusing lines concerning the wearing of nylon clothing while working on such devices, but the basic facts are quite simple and need no "scripting" in order to emphasise the requirements.

1) Unused inputs should always be tied to ground or positive supply, depending upon requirements.
2) Polarity of supplies *must* be carefully checked before any connections are made.
3) Low impedance sources, including charged electrolytic capacitors, must not be connected directly to the input terminals, especially in the case of logic "chips". It is essential to use a surge limiting resistor in such cases of at least 1000Ω.
4) Input terminals must not be allowed to "float" and must be, like unused inputs, tied to ground or positive via a high resistance.
5) Where devices are supplied in packages of conductive foam, conducting foil, or the specialised conducting tubes which are becoming typical of c.m.o.s. packaging, they should not be removed until the very last moment in order to avoid the effects of any local static charges.
6) It is as well to avoid wearing nylon shirts or similar synthetic fibre clothing while working on these "chips", and the same point applies to plastic coverings for bench tops, which should be removed.
7) Where possible, the device should be inserted directly into the i.c. holder without any actual contact being made between operator and device.
8) In extreme cases, the body can be earthed via a loose chain on the wrist, this technique being used with operatives during manufacture. A metal-covered bench is also used.
9) The pins of the device should not be touched with the fingers.
10) The device must not be disconnected or otherwise removed from the associated circuitry while it is functioning.
11) When soldering to such devices, an earthed bit must be used.

Care taken in handling, or not handling, c.m.o.s. components will greatly increase the reliability of projects which use this type of integrated circuit. Properly used c.m.o.s. offers a lot of advantages for the hobbyist and attention to the advice given above will ensure your confidence in the finished project. ●



How not to build your project. This untidy "heap" shows many faults such as trying to fit an 8-pin d.i.l. package i.c. into a p.c.b. designed for a TO99 circular package by tacking short lengths of wire to each lead to extend it