THE
RADIO CONSTRUCTOR

Vol. 24 No. 6 JANUARY 1971 3/6 (17½p)

THE 'CRUSADER' COMMUNICATIONS RECEIVER

Presented for construction by the near-beginner. Pre-aligned coilpack, separate bandspread control and speaker reception

Special IN THIS ISSUE

Light-Operated Speed Control
Spark-Free Electrolytic Checker

LST ELECTRONIC COMPONENTS LTD

=BETTER QUALITY, SERVICE, PRICES & LARGEST STOCKS

AC107	7/6
AC126	5/-
AC127	5/-
AC127Z	9/6
AC128	4/-
AC176	5/-
AC187	6/-
AC188	6/-
ACY17	5/9
ACY18	4/-
ACY19	4/-
ACY20	3/10
ACY21	3/10
ACY22	3/9
ACY27	3/6
ACY28	3/8
ACY29	7/6
ACY30	7/6
ACY31	4/7
ACY34	3/5
ACY35	3/6
ACY36	3/9
ACY39	11/-
ACY40	3/-
ACY41	3/-
ACY44	8/-
AD140	11/-
AD149	11/6
AD161	7/6
AD162	7/6
ADT140	12/6
ADZ11	32/-
ADZ12	39/-
AF102	12/6
AF106	7/6
AF114	5/-
AF115	5/-
AF116	5/-
AF117	5/-
AF118	8/10
AF121	6/-
AF124	5/-
AF125	4/2
AF126	3/6
AF127	3/6
AF139	15/-
AF178	9/6
AF179	11/6
AF180	12/6
AF186	8/-
AF186W	8/-
AF186G	8/-
AF239	7/6
AFY19	22/6
AFZ11	12/6
ASY26	4/5
ASY27	6/-
ASY28	4/5
ASY29	6/-
ASZ21	7/6
AUY10	30/-
B2M	12/6
B3M	15/-
BAX13	1/6
BC113	5/-
BC125	11/-
BC126	11/-
BC147	2/9
BC148	3/3
BC149	3/-
BC154	12/-

BC171	2/-
BC182L	2/3
BC183L	1/10
BC184L	3/-
BC212L	3/4
BCY30	5/-
BCY31	5/6
BCY32	10/-
BCY33	4/-
BCY34	5/-
BCY38	6/-
BCY39	9/6
BCY40	10/-
BCY42	4/-
BCY43	4/-
BCY54	7/6
BCY70	3/10
BCY71	7/8
BCY72	3/2
BCY87	86/9
BCZ11	7/6
BD121	22/-
BD123	22/-
BD124	20/8
BDY20	20/8
BF115	5/-
BF152	13/6
BF154	9/-
BF159	15/-
BF163	9/-
BF167	5/-
BF173	6/-
BF178	10/6
BF179	12/6
BF180	7/6
BF181	7/6
BF184	5/-
BF185	5/-
BF194	3/6
BF195	3/-
BF196	4/-
BF200	7/-
BFX13	5/-
BFX29	6/2
BFX44	8/-
BFX84	5/2
BFX85	6/9
BFX86	4/11
BFX87	5/11
BFX88	5/3
BFY18	15/-
BFY50	4/6
BFY51	3/9
BFY52	4/6
BFY53	3/2
BFY90	13/6
BSX19	3/3
BSX20	3/3
BSX21	7/6
BSX60	12/7
BSX61	7/11
BSX76	4/-
BSX77	6/-
BSX78	6/6
BSY27	4/-
BSY29	5/-
BSY32	5/-
BSY36	5/-
BSY37	5/-
BSY38	4/-
BSY95	3/2

BSY95A	2/11
BTX39 600	120/-
BTX40 600	120/-
BTY87 150R	31/-
BTY95 100	162/8
BY100	4/-
BY127	4/-
BY234	5/-
BYZ10	8/-
BYZ12	6/-
BYZ13	5/-
BYZ14	33/3
BYZ15	33/3
C106F	9/-
C111	18/-
C111E	12/-
C400	9/-
C426	8/3
C444	9/8
CG50	2/6
CG61	2/6
CG62	2/6
CG62H	2/6
CG63	2/6
CG64	2/6
CG6E	2/6
CG83	2/6
CG84	2/6
CG85	2/6
CG86	2/6
CG94	2/6
CR1-051C	8/-
CR1-401C	10/-
CV2389	7/6
CV4074	7/6
CV5345	10/-
CV7021	10/-
CV7022	7/6
CV7023	10/-
CV7042	5/-
CV7065	5/-
CV7075	5/-
CV7076	5/-
CV7081	5/-
CV7086	5/-
CV7117	7/6
CV7316	7/6
CV7317	7/6
CV7318	7/6
CV7372	10/-
CV7477	10/-
CV8790	1/-
D13T1	10/-
EA403	3/6
EB383	3/6
EC401	5/-
EC402	4/8
FCH111	16/-
FCH141	16/-
FCH151	16/-
FCH201	21/7
FCH221	21/4
GET102	6/-
GET103	5/-
GET111	5/-

GET113	4/-
GET114	4/-
GET120	6/6
GET872	5/-
GET880	9/-
GET887	4/-
GET889	6/-
GET890	6/6
GET896	4/6
GET897	4/6
GET898	6/-
GEX45/1	3/-
GJ6M	4/-
MAT100	5/-
MAT101	5/6
MAT120	5/-
MAT121	5/6
ME4103	3/-
MJ480	20/6
MJ481	27/-
MJ490	22/6
MJ491	29/6
MPF102	8/6
MPF103	7/6
MPF104	7/6
MPF105	8/-
MR30	2/-
MR43	2/-
MS50	2/-
NKT11	7/6
NKT12	5/5
NKT32	6/-
NKT42	6/-
NKT43	6/-
NKT72	3/9
NKT73	3/7
NKT101	6/-
NKT102	6/-
NKT103	6/-
NKT104	6/-
NKT105	6/-
NKT106	6/-
NKT107	6/-
NKT108	6/-
NKT109	6/-
NKT121	10/6
NKT122	10/-
NKT123	9/6
NKT124	6/5
NKT125	4/6
NKT126	4/-
NKT127	10/6
NKT128	10/-
NKT129	8/6
NKT135	6/1
NKT137	6/1
NKT141	10/6
NKT142	10/-
NKT143	9/6
NKT144	8/-
NKT151	6/-
NKT153	6/-
NKT154	6/-
NKT161	6/-
NKT162	6/-
NKT163	6/-
NKT164	6/-
NKT165	6/-
NKT201	6/-
NKT202	6/-
NKT204	6/-

NKT205	6/-
NKT206	6/-
NKT208	6/-
NKT210	4/2
NKT211	3/9
NKT212	3/9
NKT213	4/7
NKT214	3/5
NKT215	3/7
NKT216	7/6
NKT217	9/-
NKT218	6/-
NKT219	4/7
NKT221	7/-
NKT222	6/-
NKT223	5/-
NKT224	3/7
NKT225	3/6
NKT226	11/-
NKT227	9/6
NKT228	6/6
NKT229	3/11
NKT231	6/-
NKT232	6/-
NKT237	5/9
NKT238	4/-
NKT239	4/-
NKT240	3/10
NKT241	3/9
NKT242	2/11
NKT243	12/-
NKT244	3/1
NKT245	3/-
NKT261	4/3
NKT262	4/3
NKT263	4/8
NKT264	4/3
NKT265	5/6
NKT270	6/-
NKT271	2/10
NKT272	2/10
NKT273	3/8
NKT274	2/10
NKT275	3/4
NKT276	3/6
NKT279A	2/6
NKT281	5/-
NKT301	18/-
NKT302	12/5
NKT303	17/6
NKT304	9/10
NKT351	10/-
NKT352	17/6
NKT361	20/-
NKT362	20/-
NKT401	14/6
NKT402	15/-
NKT403	14/9
NKT404	11/-
NKT405	11/-
NKT406	9/11
NKT420	28/11
NKT451	9/11
NKT452	9/6
NKT453	6/6
NKT603F	4/8
NKT613F	5/2
NKT654F	4/2
NKT675	6/8
NKT676	5/-
NKT677F	3/10

NKT703	8/-
NKT713	3/10
NKT717	5/10
NKT734	4/11
NKT736	6/2
NKT773	3/7
NKT774	6/-
NKT0013	6/8
NKT10339	4/7
NKT10419	3/10
NKT10439	5/5
NKT10519	4/5
NKT12329	8/5
NKT12429	10/6
NKT13329	3/11
NKT13429	3/11
NKT16229	8/5
NKT20329	6/8
NKT20339	6/4
NKT35219	15/9
OC19	5/-
OC20	19/6
OC22	8/-
OC23	10/-
OC24	10/-
OC25	7/6
OC26	6/6
OC28	12/-
OC29	15/-
OC35	10/-
OC36	12/6
OC41	5/-
OC42	4/6
OC43	4/6
OC44	3/-
OC45	3/-
OC70	2/6
OC71	3/-
OC72	4/6
OC74	8/2
OC75	4/6
OC76	5/-
OC77	8/-
OC81	4/6
OC81D	4/6
OC81Z	11/-
OC82	5/-
OC82D	3/-
OC83	4/6
OC84	5/-
OC123	7/-
OC139	5/-
OC140	7/-
OC141	12/6
OC170	5/-
OC171	6/-
OC200	7/6
OC201	9/6
OC202	12/6
OC203	7/6
OC204	8/-
OC205	9/-
OC206	15/-
OC207	15/-
OCP71	19/6
ORP12	10/-
ORP60	8/-
ORP61	8/-
ORP63	9/-
P346A	3/9
SIM	19/-

S4M	33/6
ST140	3/-
ST141	5/-
ST2	9/9
SX631	6/-
SX634	6/-
SX636	8/-
SX638	8/-
SX3826	4/-
T1407	9/8
TIC45	8/-
TIS44	1/9
TIP31A	12/4
TIP32A	14/10
V205	20/-
V405A	9/3
XA102	6/-
XA702	15/-
XB113	6/-
ZT22	19/-
ZT86	27/6
ZT2270	19/6
40250	10/9
40309	6/6
40310	9/-
40311	6/9
40312	9/6
40314	7/3
40315	7/3
40316	9/3
40317	7/3
40319	10/9
40320	7/3
40323	6/6
40324	9/3
40326	7/3
40329	4/9
40344	5/3
40347	7/6
40348	10/3
40360	8/6
40361	9/6
40362	11/6
40370	6/-
40406	11/3
40408	10/3
40462	11/3
40467	16/6
40468A	7/-
40600	11/6
40602	8/-
1BO8T10	10/-
1S100	3/2
1S101	4/-
1S105	5/6
1S107	6/6
1S130	1/6
1S410	5/1
1S410R	5/1
1S415	8/-
1S417R	9/4
1S920	1/4
1S5036	12/10
1Z20	10/-
2G301	3/9
2G302	3/9
2G306	8/6
2G339A	5/-
2G371	3/-
2G371B	3/-
2G374	5/-

2G378	7/-
2G381	5/-
2G414	12/-
2N174	16/-
2N217	7/6
2N384	17/-
2N386	12/-
2N385A/ 2N388A	15/-
2N404	4/6
2N657	20/-
2N696	3/6
2N697	3/6
2N698	6/-
2N706	2/4
2N706A	2/6
2N708	3/3
2N769	8/6
2N711	7/6
2N711A	7/6
2N715	7/6
2N716	7/6
2N743	4/6
2N744	6/-
2N753	5/6
2N911	10/-
2N914	3/11
2N918	8/5
2N929	5/3
2N930	6/-
2N996	14/10
2N1090	6/6
2N1091	6/6
2N1131	6/-
2N1132	6/-
2N1302	3/7
2N1303	4/6
2N1304	4/11
2N1305	4/11
2N1306	6/-
2N1307	6/-
2N1308	6/9
2N1309	6/3
2N1496	34/-
2N1507	4/8
2N1613	4/6
2N1617A	29/6
2N1711	5/-
2N1893	9/2
2N1896	10/-
2N2147	16/3
2N2148	12/6
2N2152	27/6
2N2160	12/6
2N2217	5/5
2N2217A	11/4
2N2218	6/5
2N2218A	8/4
2N2219	7/2
2N2219A	10/-
2N2220	5/10
2N2220A	8/-
2N2221	6/5
2N2221A	8/5
2N2222	7/2
2N2222A	10/8
2N2297	7/7
2N2243	26/-
2N2368	3/4
2N2369	3/4
2N2369A	3/11

2N2432	67/-
2N2483	6/5
2N2484	7/10
2N2613	7/6
2N2614	4/-
2N2646	10/-
2N2711	6/-
2N2712	6/-
2N2713	5/6
2N2894	9/2
2N2904	8/10
2N2904A	9/9
2N2905	12/11
2N2905A	15/1
2N2906	8/10
2N2906A	10/10
2N2923	4/-
2N2924	4/-
2N2925	3/6
2N2926 Green	2/-
2N2926 Yellow	2/-
2N2926 Orange	2/-
2N2926 Brown	2/-
2N3011	12/6
2N3036	39/-
2N3053	5/-
2N3054	12/6
2N3133	6/-
2N3135	6/-
2N3136	6/-
2N3235	28/6
2N3234	27/6
2N3242	7/9
2N3391A	6/-
2N3392	5/-
2N3393	5/-
2N3394	4/9
2N3402	5/6
2N3403	5/6
2N3404	7/6
2N3414	5/6
2N3415	6/-
2N3416	7/6
2N3436	15/-
2N3525	21/9
2N3528	19/-
2N3606	5/6
2N3607	4/6
2N3702	2/6
2N3703	2/5
2N3704	3/2
2N3705	2/8
2N3706	2/3
2N3707	2/10
2N3708	1/10
2N3709	2/-
2N3710	2/3
2N3711	2/6
2N3819	7/-
2N3820	18/9
2N3826	6/-
2N3854	5/6
2N3854A	5/6
2N3855	5/6
2N3855A	6/-
2N3856	6/-
2N3856A	6/-

2N3858	5/-
2N3858A	6/-
2N3859	5/6
2N3859A	6/3
2N3860	6/-
2N3866	25/-
2N3877	9/-
2N3877A	9/6
2N3900	10/6
2N3900A	11/6
2N3903	7/-
2N3904	7/-
2N3905	7/6
2N3906	7/6
2N4037	15/-
2N4058	3/4
2N4059	5/-
2N4060	5/-
2N4061	4/-
2N4062	4/6
2N4284	3/-
2N4287	3/-
2N4288	3/-
2N4289	3/-
2N4290	3/-
2N4291	3/-
2N4292	3/-
2N4871	6/9
2N5027	10/6
2N5028	11/6
2N5029	9/6
2N5030	8/6
2N5172	3/-
2N5174	10/6
2N5175	10/6
2N5176	9/-
2N5232	5/6
2N5305	7/6
2N5306	8/-
2N5309	12/6
2N5354	5/6
2N5355	5/6
2N5356	10/6
2S001	10/-
2S002	12/6
2S003	12/6
2S004	15/-
2S005	15/-
2S006	15/-
2S017	15/-
2S018	17/6
2S019	19/6
2S020	20/-
2S104	12/6
2S301	8/6
2S302	7/6
2S303	10/-
2S304	12/6
2S306	15/-
2S320	9/-
2S321	6/-
2S322	8/-
2S323	10/-
2S701	8/6
2S702	11/4
2S703	12/6
2S711	26/6
2S712	34/6
2S720	25/-
2S732	8/6
2S733	5/11

2S1002	10/-
2SA72	10/-
3N128	13/9
3N140	15/3
3N141	14/6
3N142	10/9
3N143	13/3
3N152	17/3
SD6	5/-
AA119	2/-
AAY11	2/-
AAY30	1/7
AAZ12	6/-
AAZ13	2/6
BA110	6/-
BA111	6/-
BA112	18/-
BA114	3/-
BA115	1/6
BA130	3/-
BY100	5/-
BYX10	3/-
BYX36/150	2/6
BYX36/300	2/10
BYX36/600	3/9
BYY21	25/-
BYY23	26/3
BYY25	31/9
BYY142	3/9
BYZ10	9/-
BYZ12	6/-
BYZ13	5/-
CG6E	4/-
CG63	2/-
EA403	3/6
EC401	5/-
GEX45/1	4/-
GJ3M	4/-
OA5	3/8
OA10	5/-
OA47	1/8
OA70	1/8
OA73	1/8
OA79	1/8
OA81	1/8
OA85	1/8
OA90	1/8
OA91	1/8
OA95	1/8
OA200	2/-
OA202	2/-
OA211	8/-
TD716	12/-
IN34A	4/-
IN60	4/-
IN64	4/-
IN82A	9/6
IN87A	4/6
IN914	3/6
IN4148	1/6
IS44	1/6
IS103	4/3
IS130	2/-
IS131	2/6
IS132	3/-
IS42OR	8/3

BC107/8/9 2/6
NPN Planar transistors
25+ **2/3** 100+ **2/-**

2N3819 7/-
Texas FET
25 **6/-** 100 + **5/3**

SILICON RECTIFIERS

1 Amp Miniature Moulded Junction Rectifiers

	PIV	1–24	25+	100+	500+
1N4001	50	1/6	1/4	1/2	1/-
1N4002	100	1/6	1/4	1/2	1/-
1N4003	200	2/-	1/9	1/6	1/3
1N4004	400	2/-	1/9	1/6	1/3
1N4005	600	2/6	2/-	1/9	1/6
1N4006	800	3/-	2/10	2/6	2/3
1N4007	1000	4/-	3/3	2/9	2/6

In the event of any 1N4000 series going temporarily out of stock we reserve the right to send higher voltage types at no extra charge. 1,000+ and over, prices on application.

ULTRASONIC TRANSDUCERS

Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive. **FREE:** With each pair our complete transmitter and receiver circuit. PRICE **£5.18.0** Pair (Sold only in pairs)

2N4871 6/9
Motorola unijunction
25 + **5/9** 100 + **4/9**

BC171A 2/-
NPN Planar
25 + **1/6** 100 + **1/-**

2N3055 15/-
115 watt silicon power transistor
25 + **13/-** 100 + **11/-**

OA91 Special Offer
Mullard Diode
25 + **9d.** 100 + **7d.**

New low integrated circuit prices Fairchild (U.S.A.) micrologic R.T.L. epoxy case T05 temperature range 15°C to 55°C.

	1–11	12–24	25–99	100+
uL 900 Buffer	8/-	7/-	6/6	5/6
uL 914 Dual 2 input gate	8/-	7/-	6/6	5/6
uL 923 J-K Flip Flop	10/6	10/-	9/6	9/-

Data and circuits article 5-page at 2/6d. Article "30 Suggested Circuits for Micrologic" at 3/-.

T05 to DIL conversion spreaders/adapters at 1/6d. each.

INTEGRATED CIRCUITS

Some R.C.A. Linear types

CA3005	23/6	CA3028B	21/-
CA3011	14/9	CA3035	24/6
CA3012	17/9	CA3036	14/6
CA3013	21/-	CA3039	16/9
CA3014	24/9	CA3041	21/9
CA3018	16/9	CA3042	21/9
CA3020	25/3	CA3043	27/6
CA3021	31/3	CA3044	24/-
CA3022	26/-	CA3045	24/6
CA3023	25/3	CA3046	15/2
CA3026	20/-	CA3048	40/9
CA3028A	14/9	CA3051	26/9

PA246 GE IC 5 Watt Amp	52/6
PA424 GE IC Zero Voltage Switch	49/6
SL403A Plessy 3 Watt Amp	42/6
SL702C Plessy Linear	29/6
TAA263 Mullard Linear	15/-
TAA293 Mullard Gen. Purp. Amp	20/-
TAA310 Record/Playback Amp	30/-
TAA320 MOS LF Amplifier	13/-
TAD100 Mullard IC receiver	39/6
3N84 GE Silicon controlled switch	26/-

Data sheets 1/- (SL403A 2/6d. IC10 data not sold separately).

PA237	37/6
TAD110	39/6

IRC20 7/-
Int. Rectifier thyristor
200 piv. 1.2 amp.
(similar C106B1)
25 - **6/-** 100 + **5/-**

TOSHIBA 20 WATT I.C. AMPLIFIERS £4.9.6d.

Special Heat Sink 9/-

Data Sheet 1/-

2N2926 2/-
NPN Planar transistor
25 + **1/8** 100 + **1/6**

BF195 2/6
Mullard Lock-Fit AM/FM input & mixer transistor
25 + **2/-** 100 + **1/9**

ZENNER DIODES

400mW 10% GLASS CASE TEXAS Mfr.

1S2036	3.6 volt	1S2082	8.2 volt
1S2039	3.9 volt	1S2100	10 volt
1S2043	4.3 volt	1S2110	11 volt
1S2047	4.7 volt	1S2120	12 volt
1S2056	5.6 volt	1S2160	16 volt
1S2062	6.2 volt	1S2180	18 volt
1S2068	6.8 volt	1S2270	27 volt
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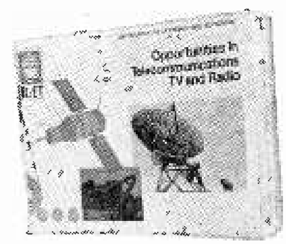

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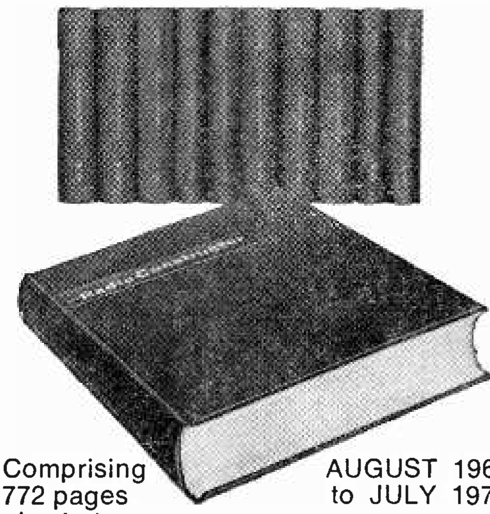

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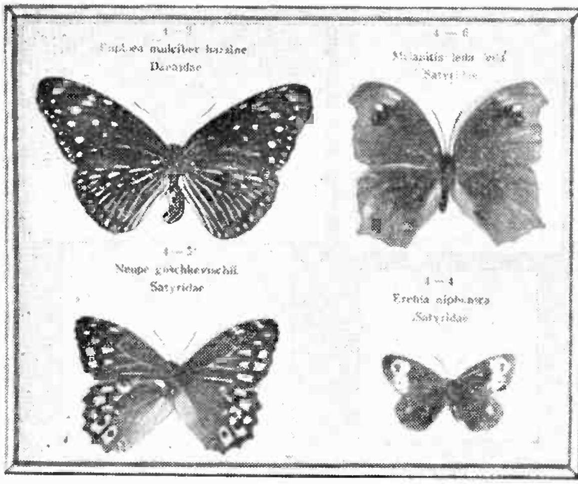

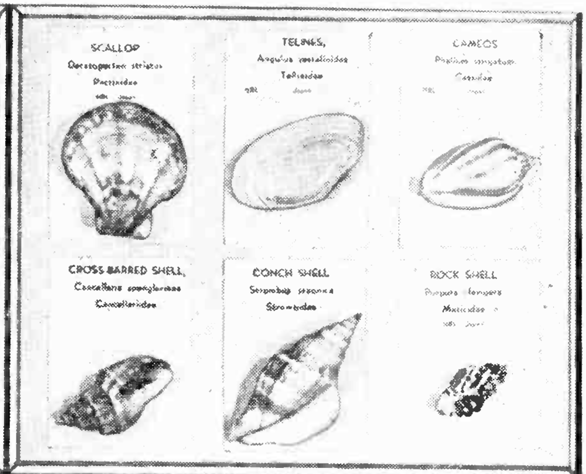

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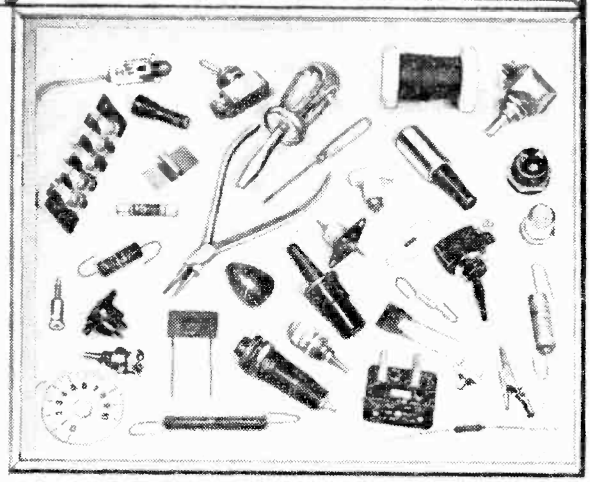

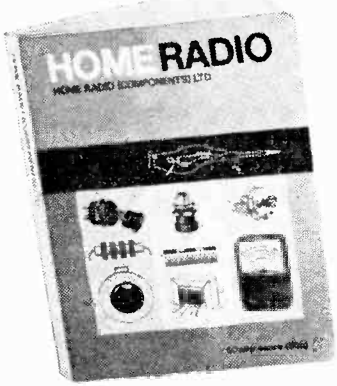

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FEBRUARY ISSUE WILL BE PUBLISHED ON FEBRUARY 1st

General purpose power supply unit

by

P. L. MATTHEWS

A general purpose low voltage power supply is always a useful item in the workshop. The simple design described here offers an output ranging from zero to 20 volts, with a current capacity of 1 amp above 6 volts

A GENERAL PURPOSE 1 AMP LOW VOLTAGE POWER unit with a stabilised output variable from 0 to 20 volts is essential for the serious constructor, and the unit to be described can be built at a cost which is well below that required for commercial equivalents. It offers currents up to the full 1 amp at all output voltages above 6 volts, the available output current being somewhat lower below this voltage. Constructional hints are given to enable it to be built inside a metal case, complete with a voltmeter.

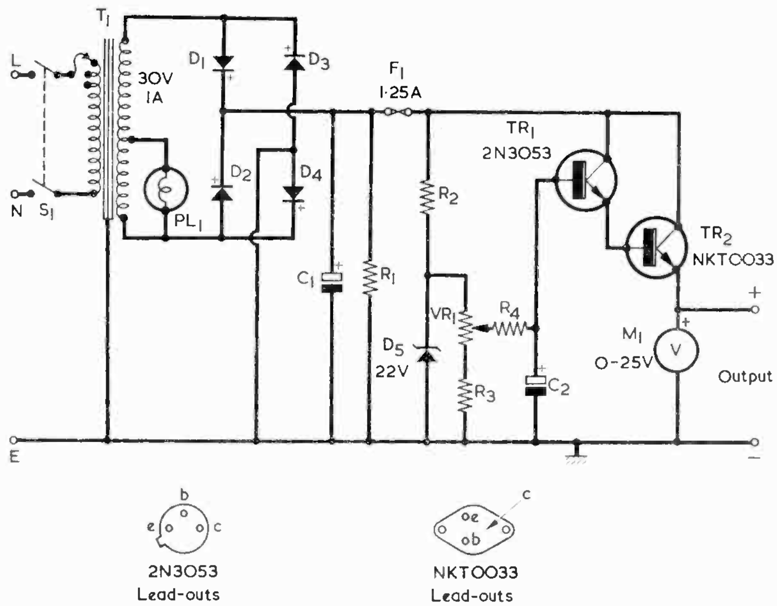
THE CIRCUIT

The circuit, shown in the accompanying diagram, should at least be vaguely familiar to most readers. A 30 volt transformer T1 feeds a bridge rectifier consisting of diodes D1 to D4, and the resultant d.c. is fed to a large smoothing capacitor C1. The author believes in removing as much hum as possible at the source, hence the large capacitance value. A 250 μF capacitor may be used if cost so dictates, but there will then be approximately twelve times as much hum at the output. At first sight R1 may seem to perform no useful function, but if the fuse F1 blows for any reason it serves to discharge C1 over a period of about a minute or two when the unit is switched off, and so lessens the risk of a high supply voltage still being available when the fuse is replaced. The fuse, incidentally, must on no account be a slow-blow' or 'anti-surge' type, neither must its value exceed 1.25 amp.

From the fuse the voltage is applied to the regulating circuit, which is really just an elaborate version of the simple emitter follower regulator. The resistor R2 biases a 22 volt zener diode D5, which should be able to dissipate at least 1.5 watts. A zener voltage other than 22 may be employed provided R2 is adjusted accordingly to give a current of 20mA or so through the diode at maximum output, and that transistor voltage ratings are not exceeded. Across the diode is connected a potentiometer VR1, to tap off a portion of the zener voltage and apply it to the base of TR1. The function of R3 is merely that of preventing the transistors from bottoming at low output voltages, and its value is not at all critical. R4 was included after measurements made on the prototype indicated that, if the output was short-circuited at the highest voltage setting, a destructive current would flow through the emitter-base junction of TR1 before the fuse had time to blow. The value of resistance specified limits this current to less than half the maximum rating while causing a minimal voltage drop. C2 serves partly to further filter out the hum and also to ensure smoother operation of the voltage control.

Transistors TR1 and TR2 are connected as a Darlington pair and as such function as a single transistor with a very high gain. The NKT0033 specified in the TR2 position is a lower cost high gain version of the 2N3054, and is particularly suitable for this circuit. The operation of two transistors as an emitter follower in this type of circuit is well known, and the base and emitter voltages show a small difference in potential between them. Consequently if, for example, VR1 is adjusted to apply 10 volts to the base of the combination, the emitter voltage present at the output terminal will be about 1.3 volts less, or 8.7 volts at a low load current. As the current is increased to the maximum the base – emitter difference rises to 1.7 volts reducing the output slightly to 8.3 volts. Thus the regulation of this simple circuit leaves a little to be desired, but it was felt that the extra cost and complexity of a feedback circuit was hardly justified in this instance. A voltmeter may be wired across the output to monitor the voltage, but if this is omitted a 0.5 watt resistor of value in the region of 20kΩ should be fitted to maintain a d.c. path.

The writer is fortunate enough to have access to an array of expensive test equipment, and the output d.c. and hum voltages were measured using a digital voltmeter. The results, given in the Table show that the performance is quite acceptable for the modest outlay required, and the low level of hum is a particular attraction. It is important to note that the power unit was designed for heavy use below 6 volts,



Circuit diagram for the general purpose power supply unit. The output voltage is continuously variable from zero to 20 volts

COMPONENTS

Resistors
(all fixed values 10%)
- R1 18kΩ ½ watt
- R2 680Ω 2 watt
- R3 47Ω ½ watt
- R4 470Ω ½ watt
- VR1 5kΩ potentiometer, wirewound

Capacitors
- C1 4,000µF electrolytic, 40V kg.
- C2 400µF electrolytic, 25V kg.

Transformer
- T1 Mains transformer, secondary 30 volts at 1 amp minimum, with tap for pilot lamp

Semiconductors
- TR1 2N3053
- TR2 NKT0033 (with mica washer and insulated mounting bushes)
- D1-D4 1 amp 50 p.i.v. rectifiers or single bridge rectifier
- D5 22 volt 1.5 watt zener diode

Fuse
- F1 1.25 amp standard cartridge fuse with panel mounting holder

Meter
- M1 Voltmeter, 25 volt f.s.d.

Switch
- S1 d.p.s.t. switch, toggle

Pilot Lamp
- PL1 Pilot lamp (to suit voltage tapping on T1) with panel-mounting holder

Miscellaneous
- 2 output terminals
- Knob (for VR1)
- Metal case

and should not be operated continuously at full load current at voltages below this to avoid overheating TR2. (It is recommended that, below 6 volts, maximum output current be derated down to 0.75 amp at zero volts. – Editor.)

COMPONENTS

Obtaining the components should not cause any difficulty, as suitable types are available through suppliers. The mains transformer should be capable of offering secondary voltage of 30 at 1 amp minimum, and a good choice is the Douglas MT3, or MT3AT, which has tapped secondary voltages of 12, 15, 20, 24 and 30 at 2 amps. Pilot lamp PL1 could then be a 6.3 volt type connected between the 30 and 24 volt taps. Diodes D1 to D4 may be individual rectifiers rated at 1 amp 50 p.i.v. minimum, or a bridge rectifier. A suitable zener diode for D5 is the ZL22 (available from Henry's Radio, Ltd.). Transistor TR2, the NKT0033, may be obtained from L.S.T. Electronic Components, Ltd. It should be purchased complete with mica washer and insulated mounting brushes. It will probably be found most convenient to make up the voltmeter from a standard low current meter and an external series resistor. This, a 0-1mA meter could be made to read 25 volts full-scale deflection by connecting a 25kΩ resistor in series with it.

TABLE

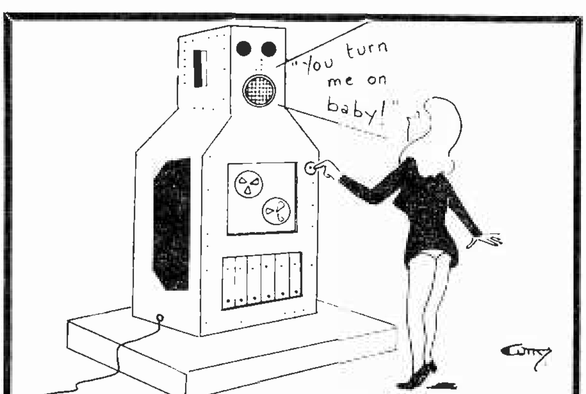
D.C. voltage for zero load	= 20.00V
D.C. voltage for 650mA load	= 19.57V
D.C. voltage for 1A load	= 19.40V
Effective source resistance = 0.7Ω approximately at 20V	
A.C. hum present at output: less than ½ mV at zero output, less than 1mV at 20V output and 1 amp current less than 5 mV for any setting of VR1 and any load	

CONSTRUCTION

Beginners may find it easier to build the power unit in several stages, each of which can be checked to reveal any faults before the next section is constructed. Suitable stages, in order of completion, are firstly the transformer and pilot lamp, then the circuit up to F1, followed by R2, D5, VR1, R4 and C2 (a variable voltage should be obtainable across C2 as VR1 is adjusted) and lastly the remaining circuitry.

The unit should be mounted in a suitable metal box, which will also act as a heat sink for TR2. The case of this transistor will need to be insulated from the box by means of its mica washer. The author's prototype was fitted in a metal box measuring about 8 by 4½ by 3in. However, the constructor should first obtain his components before making or purchasing a box, as their dimensions may differ from those employed by the writer. The box should allow adequate ventilation for the heat dissipated by the transformer and rectifier diodes.

S1, VR1 and the fuse and pilot lamp holders may be mounted on the front panel of the box together with the meter, employing any suitable layout. It is important that the mains transformer should be bolted down firmly. Since this is the heaviest component in the power supply unit it should be positioned on or near the bottom of the box. ■



Bottles and Coils

It was all very well for three budding 'wireless' enthusiasts to arrive at the inescapable conclusion that we needed more cash to finance our constructional schemes – the problem was how to raise the necessary wherewithal! Various machinations were tried to no avail, one of these being the swopping of birds eggs (we had at one time been engaged in ornithology of the worst possible kind) for wanted 'wireless' parts filched by various school chums from blissfully unaware fathers. The final outcome of our deliberations was destined to become the most successful fund raising plot that had ever soiled our sticky hands!

We set out one sunny morning complete with two sacks, one barrow, bubbling spirits and youthful zeal. The barrow had been made some time previously from an old set of pram wheels and axles purloined from an unsuspecting and long-suffering aunt; an orange box which had mysteriously vanished from the local greengrocer's yard; a length of rope for steering purposes which had somehow wafted away from the family clothes line and our sole contribution – a few odd lengths of wood. This contraption was thought to represent the very latest model among those owned by various other youthful mobile enthusiasts in the area – after all, ours at least was fitted with pram mudguards and the bodywork proudly displayed a Spanish registration for all to see!

The brain scorching scheme was to call at various selected and promising houses in the 'posh' part of the town in an effort to persuade the owners to part with unwanted jam jars and beer bottles. We had information that the local junk yard owner would part with the cash in exchange for the jars whilst the near-by hostelry would similarly cough up on production of the beer and lemonade bottles.

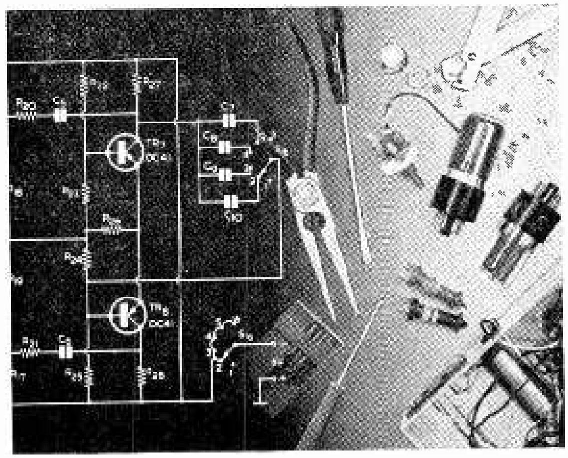
Singularly unsuccessful at first, we finally struck gold at the fifth domicile. From a dimly lit hall interior we were instructed by the major-domo to clear out the garden shed. This tall, pale, sunken-eyed individual, whose skull appeared to almost protrude through his wrinkled face, watched us continually through the kitchen window. The shed was full of various sized jam-jars and, lo and behold, beer bottles by the dozens! We joyously stuffed the sacks full and loaded them on to the barrow.

First and foremost among the myriad requirements on which the amassed wealth had to be spent was a supply of various sized coil formers and a goodly wire supply of various guages which were to be used in our latest 'scientific' research project – coil winding.

We had set ourselves the task of winding some short wave coils to complete our latest creation – a 2-valve 'straight' receiver. With most of the parts firmly screwed to a wooden baseboard, only the coil was conspicuous by its absence.

With what troubles we were later to encounter, I'll regale you next month. C.W.

Light-Operated Speed Control



by G. A. FRENCH

AT THIS TIME OF THE YEAR, during the season of parties and other festivities, the home-constructor is frequently called upon to provide electronic devices which can amuse and mystify visitors and guests.

The unit to be described falls into this category, and consists of a simple transistor circuit which enables the speed of a small electric motor to be varied according to the intensity of light falling upon a photoconductive cell. Although presented here in the form of a novelty device, the circuit is quite capable of more serious applications, since its basic function is that of controlling the amplitude of relatively heavy currents by means of a photoconductive cell or by means of any other device offering variable resistance at low power dissipation.

THE CIRCUIT

The circuit of the light-operated motor speed control appears in Fig. 1. Here, TR1 and TR2 form a multivibrator in which the time that TR1 is cut off during each cycle is controlled by R2 and C2, and the time that TR2 is cut off is controlled by R3 and photoconductive cell PC1 in series and by C1. The photoconductive cell is of the cadmium sulphide type and its resistance decreases as the light by which it is illuminated increases in intensity.

The emitter of TR2 connects directly to the base of TR3, which is a power transistor type OC26. Thus, when TR2 turns on during the multivibrator cycle, it draws its emitter current through the base-emitter junction of TR3, causing TR3 to become bottomed and to offer negligible resistance between its collector and emitter.

The collector of TR3 connects to the parallel combination of the motor and C3, and thence to the negative supply line. Circuit operation at the collector of TR3 can be explained more easily if it is temporarily assumed that the motor and C3 are replaced by a single resistor as in Fig. 2. The waveforms shown in Figs. 3(a) and (b) will then apply.

Fig. 3(a) illustrates collector current flowing in the load resistor of Fig. 2 during several cycles of multivibrator operation when PC1 is shaded and consequently offers a high resistance. Since the turn-off time of TR2, in company with TR3, is controlled by C1, R3 and PC1, TR3 is non-conductive for a relatively long period of the cycle and no current flows in the load resistor during that time. Fig. 3(b) shows the collector current which flows in the load resistor when PC1 is brightly illuminated and presents a

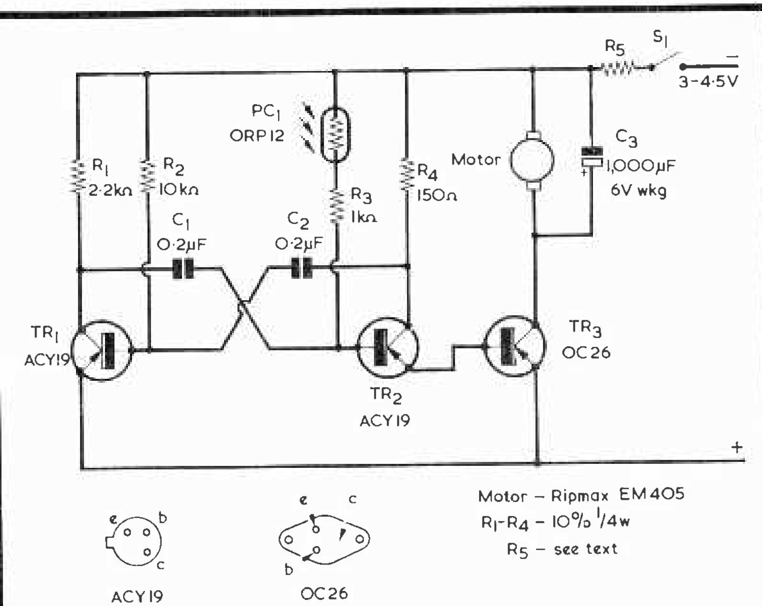


Fig. 1. Complete circuit of the light-operated motor speed control

low resistance. On this occasion, turn-off time in TR3 is short, whereupon this transistor is conductive for a much longer fraction of the full multivibrator cycle.

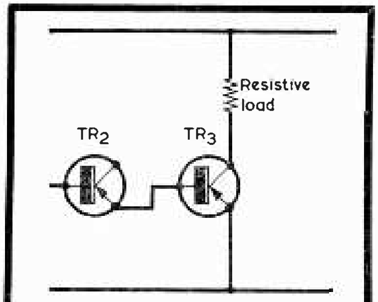


Fig. 2. Explanation of circuit operation is eased if the temporary assumption is made that TR3 has a resistive load

Figs. 3(a) and (b) also show the average current flowing in the resistor for both circumstances. As is to be expected, the average current is much higher in Fig. 3(b), where the photoconductive cell is brightly illuminated, than it is in Fig. 3(a), where the photoconductive cell is shaded. It follows that the average current flowing in the collector circuit of TR3 is therefore capable of being continuously varied by altering the intensity of the illumination incident on the photoconductive cell. When it is appreciated that the maximum average current in the resistive load of Fig. 2 can quite safely be of the order of several amps, the usefulness of the circuit for more serious applications becomes apparent. Incidentally, R5 of Fig. 1 is not required when the collector load of TR3 is resistive, and it may be omitted.

It will be seen that since the period during which TR2 and TR3 are turned off is shorter in Fig. 3(b) than it is in Fig. (3a) the overall multivibrator frequency has increased. This increase in frequency is an incidental matter and has no direct bearing on the increase in average current evident in Fig. 3(b). The current increase is entirely due to the fact that the *ratio* between turn-off and turn-on times in TR3 is less than in Fig. 3(a). In point of fact, TR3 functions as a chopper in the same manner as the chopper transistor employed in the h.t. supply circuits of some current colour television receivers*.

Let us now return to the electric motor which forms the actual collector load for TR3 in Fig. 1. As with the resistor of Fig. 2, the average collector current which flows through the motor (and which controls its running speed) varies with illumination of the photoconductive cell, and becomes greater as the cell illumination increases. However, due to the inductive reactance offered by an electric motor the resultant collector current waveforms for TR3 will not be precisely rectangular, as they were in Fig. 3, but will exhibit undershoot and other variations from the rectangular form. These variations cause no operational difficulties in the present simple circuit, but their existence would have introduced an unwanted complexity in the description of circuit operation. This was why a resistive load was assumed for purposes of explanation.

A high-value electrolytic capacitor, C3, is connected across the motor. The prototype circuit functioned adequately without this capacitor but it was found that its presence offered a marginal improvement in motor starting when the ORP12 was illuminated at low level. The electrolytic capacitor also prevented 'singing' in the motor at multivibrator frequency, which lies in the a.f. range. To be pedantic, it is not a particularly elegant design approach to fit a high-value capacitor immediately after a chopper transistor in the manner shown in Fig. 1 because a heavy charge current flows in the capacitor at each turn-on period of the transistor. However, the prototype performed perfectly well with the capacitor in circuit and so it was retained. The charge current is limited by resistor R5.

Apart from limiting charge current in C3, R5 performs a second limiting function which is of greater importance. This function is to limit the current which flows if the motor stalls, under which condition it can offer a very low resistance. If the unit is supplied by, say, lead-acid accumulators, which have a very low internal resistance, R5 should be given a value of 4Ω and should be capable of dissipating 4 watts. If the circuit is powered by a regulated mains supply having similarly very low internal resistance, R5 requires the same value. For simple unregulated mains supplies a value of 2Ω at 4 watts should be adequate. If the circuit is run from dry batteries, R5 can be omitted.

COMPONENTS

The motor employed in the circuit is a Ripmax type EM405. This is available from Ripmax Limited, 80 Highgate Road, Kentish Town, London N.W.5, or from any good model shop. Its voltage range is 1.5 to 6 volts with normal running at 3 volts, current consumption unloaded at this last voltage being 200 to 300mA.

The photoconductive cell is an ORP12. A suitable alternative, should this be difficult to obtain, is the LDR03. Resistors R1 to R4 are ¼ watt 10% types. Capacitors C1 and C2 should be paper or plastic foil components, and not ceramic.

The transistors can be the types specified or close equivalents. The OC26 is chosen because of its ability to pass high currents. One of the advantages of a chopper circuit is that the chopper transistor does not dissipate a great deal of power, since it is either in the fully bottomed state or in the fully cut-

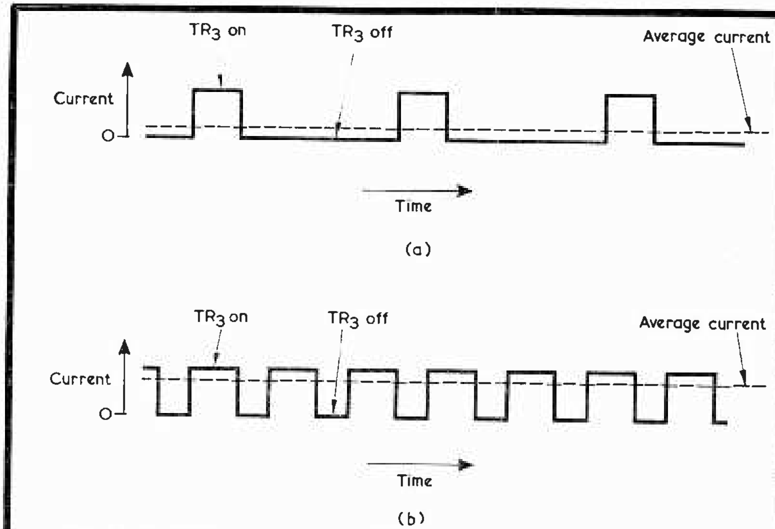


Fig. 3. Collector current in TR3 when (a) the photoconductive cell is shaded, and (b) when the photoconductive cell is illuminated

*An explanation of chopper power supplies was given in 'In Your Workshop' in the April 1970 issue.

off state, with very rapid transitions from one condition to the other. In consequence, TR3 need not be mounted on a heat sink.

THE DEVICE IN USE

It is left to constructors to choose the manner in which the circuit is employed when it is used as a novelty device. The motor develops a low torque only when, due to shading of the ORP12, it is running at slow speeds, and it is preferable to avoid having it operate any display which will load it excessively. A good plan would consist of fitting a light disc of about 3in. diameter directly to its spindle, the disc being painted with, say, a spiral line which gives the impression of 'opening out' as it rotates. This disc could appear at the front panel of a box containing the electronic components, as also could the ORP12. There is no need to provide a lens for the latter, and it should be found that the motor runs at nearly maximum revolutions if the cell is about 5ft. away from a 100 watt electric light bulb. Decreasing the cell illumination by holding a hand over it or by otherwise putting it in shadow will then cause the motor speed to reduce. It will be found helpful, when initially checking out the circuit, to connect a voltmeter across the motor, as this enables a better idea of the range between maximum and minimum light requirements to be obtained. The measured voltage across the motor drops when the ORP12 is shaded.

The question of power supplies was largely dealt with when the value required for R5 was discussed. It should be mentioned also, however, that the current drawn is relatively high so far as dry batteries are concerned, and it would be advisable to employ a mains supply or accumulators if the circuit is to be operated for long periods of time. ■

RECENT PUBLICATIONS

AMATEUR RADIO TECHNIQUES, Third Edition. By Pat Hawker, G3VA.
208 pages, 7¼ x 9½in. Published by Radio Society of Great Britain. Price £1.

"Amateur Radio Techniques" is a selection from material published in *Radio Communication*, the journal of the R.S.G.B., in a feature by Pat Hawker under the title "Technical Topics". This feature gives details of new circuit designs and techniques of interest to the radio amateur, these being culled from the technical press in this country and overseas, from manufacturers' literature and from individual amateur reports.

The present edition is a third larger than the second edition and contains nearly 500 diagrams. The book starts with an explanatory section dealing with semiconductors, this being followed by a section which discusses components and construction. Six subsequent sections are devoted respectively to receiver topics, oscillator topics, transmitter topics, audio and modulation topics, power supplies and aerial topics. The final section deals with fault finding and test units, after which an appendix lists the intermediate frequencies of commercially manufactured communications receivers. An excellent index concludes the book, and assists the reader in finding his way through the pot-pourri of individual items that it contains.

"Amateur Radio Techniques" is an up-to-date mine of information, suggestions and ideas, and provides a refreshing change from standard text-book presentation. Particularly to be commended are its considerable detail and accuracy. In addition to retail outlets, it may be purchased direct from Radio Society of Great Britain, 35 Doughty Street, London W.C.1, at its retail price of £1 plus 2s. (10p) postage.

RADIO MEASUREMENTS. By N. Livshits and B. Teleshevsky.
200 pages, 5 x 7¾in. Distributed by Central Books. Price 12s. (60p).

This book is printed in the U.S.S.R. by Mir Publishers, Moscow, and is an English translation of what is, apparently, a standard Russian text-book. It discusses the different types of measurement that are encountered in electronic work, dealing also with the units themselves and the test equipment involved. So far as the latter are concerned, it is interesting to note that items of test equipment are largely standardised in the U.S.S.R., and one encounters references to specific units such as the Soviet-made electrostatic voltmeter type C-96. Most of the Russian type numbers cannot, however, be translated directly to English characters, and they are then expressed in their original Cyrillic alphabet symbols. So also are the type numbers of the valves, semiconductors and cathode ray tubes that are referred to.

The book provides solid basic theory on electronic measurements, the subjects encountered in its thirteen chapters including voltage and current measurements, oscilloscopes, non-linear distortion, microwave measurements, and field strength and noise. The translation into English, by B. Kuznetsov, has been very well carried out, and the book is much more readable than are some recent translations of Continental technical books.

BEGINNER'S GUIDE TO RADIO, Seventh Edition. By Gordon J. King, Assoc.I.E.R.E., M.I.P.R.E., M.R.T.S.
204 pages, 4¾ x 7¼in. Published by Butterworth & Co. (Publishers) Ltd. Price £1.

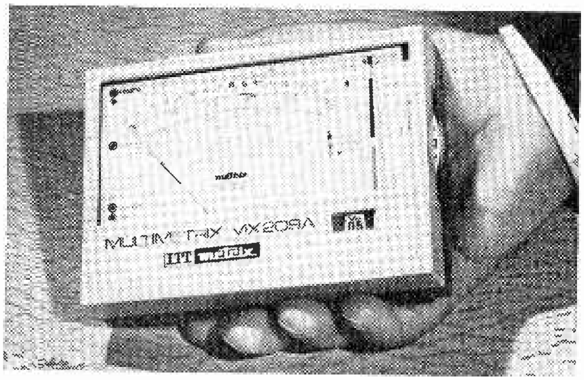
This book, originally written by the late F. J. Camm, first appeared in 1955. It is now in its seventh edition, and has been completely rewritten by Gordon J. King. The contents are fully up to date, taking in such recent developments as f.m. stereo transmission and reception, automatic frequency control and field effect transistors.

The text commences with a description of basic electricity and magnetism, then proceeds to propagation, modulation, components, loudspeakers, pick-ups and microphones. Next follow chapters on valves and transistors, aerials, transmitters, circuit principles, receivers, record players and hi-fi reproduction.

A considerable amount of information is contained in the book but nowhere is it presented in a form which will be indigestible to the complete beginner. Apart from simple equations at Ohm's Law level, the treatment is non-mathematical. The drawings are clear and easy to follow, and are backed by several photographs of oscillograms and of commercially manufactured equipment. As is its intention, the book will be particularly valuable to newcomers to radio, whether their future interests are liable to lie in the professional or in the hobbyist field.

NEWS . . . AND .

POCKET MULTIMETER FROM ITT COMPONENTS



ITT's MX 209A pocket multimeter – 'Multimetrix' – combines a high sensitivity and comprehensive measuring capabilities in a compact case

The latest addition to the range of multimeters manufactured by ITT Metrix is now available from ITT Components Group Europe. Known as the 'Multimetrix', the MX 209A is a very compact pocket multimeter having overall dimensions of only $5\frac{3}{8}$in. by $3\frac{3}{4}$in. by $1\frac{3}{8}$in.

An elastic suspended meter movement equipped with a powerful centre-pole magnet that has no external field gives the MX 209A a high sensitivity. This instrument will make the following measurements:

d.c. voltages from 0.1 to 1500V (sensitivity 20,000 ohm/V)
d.c. currents from 50μA to 5A
a.c. voltages from 5 to 1500V (sensitivity 6.320 ohm/V).
a.c. currents from 150μA to 1.5A
resistances from 2 ohm to 6 Megohm.

A total of twenty-nine ranges are provided which are selected and displayed by a thumb selector. An extensive range of accessories is available for the MX 209A including voltage dividers, a.c. and d.c. high-voltage probes, d.c. shunts and an ohmmeter adaptor.

BIG-FOUR BATTLE FOR ELECTRONIC MARKETS

Russia has joined the tough competition of the international electronic components market.

For the first time, the USSR has decided to exhibit at the 1971 International London Electronic Component Show at Olympia from May 18th to 21st.

This means that the Big Four – America, Britain, France and Russia – will be tackling world markets simultaneously at Olympia.

Though final contracts have yet to be signed, both America and France have already indicated that they intend to boost their electronic prestige at LECS with wide-ranging shows by their major component manufacturers.

The United States' stand could be one of the biggest at Olympia, embracing forty to fifty US firms in a 10,000 sq. ft. area. France is expected to take 4,000 sq. ft. for twenty of her leading companies, many of whom will be showing equipment used in one of the toughest component fields – the manufacture of integrated circuits. The Russian display will cover 1,000 sq. ft.

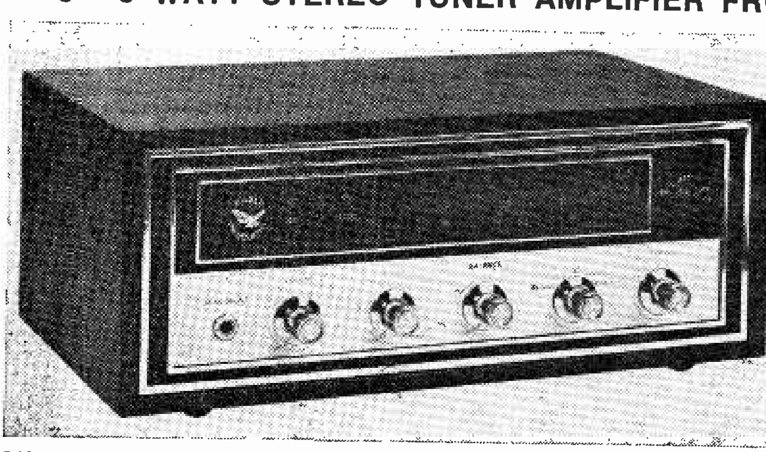
This is only the second time that the electronic component show has "gone international". The previous twenty shows were strictly British-only.

More than 20% of the exhibitors at the 1971 show will be from abroad, say Industrial Exhibitions Limited, the organisers. This compares with 17% overseas interest in 1969, the last show.

The 1971 LECS, promoted by the Radio and Electronic Component Manufacturers' Federation, will be the biggest yet staged, occupying 190,000 sq. ft. of Olympia, compared with 130,000 sq. ft. in 1969.

In connection with the exhibition an Electronic Components Conference, organised by the Electronic Components Board, will be held at the Royal Garden Hotel, Kensington.

3 + 3 WATT STEREO TUNER AMPLIFIER FROM EAGLE PRODUCTS



This new stereo tuner amplifier retails at £40 19s. 0d. Features include AM and FM MPX facilities with an FM sensitivity of two microvolts for dB quieting.

BEADY EYE ON TV

"My hair prickles when I hear advertisers talk of a television set simply as a means of reaching their market. It so seldom occurs to them that the set might be their market's way of looking at them, and that the market might conceivably not like what it sees."—Northrop Frye, Professor of English at Toronto University, speaking on BBC Radio 3.

. . . COMMENT

HEADSETS FOR HEATHROW

Radio headsets meeting the specifications and special needs of the Air Traffic Control Centre at London's Heathrow Airport, are to be supplied by S. G. Brown Ltd., of Watford, Herts.

The headset was developed by S. G. Brown at the request of the Board of Trade. It is a variant of the Envoy model designed for the Ministry of Technology for use in language laboratories.

A moving coil transducer makes for excellent sound reproduction and transmission. Polyurethane foam-filled headband-cushion and earpads provide maximum comfort when the headset has to be worn for long periods. The size of the earpiece assemblies can be adjusted and the microphone can be moved to stay in any convenient position.

The headset shown in use in a language laboratory

BRITISH AMATEUR ELECTRONICS CLUB EXHIBITION ON TV

The officials of the B.A.E.C. were extremely pleased when the BBC decided to televise the electronic games on display at their annual exhibition in Penarth.

Six of the games were televised – the B.A.E.C. Rifle Range, B.A.E.C. Flasher, Nim, "One-Arm" Flasher, Reaction Timer and Bingo.

These games and the others shown at the exhibition have, or will be, described in the club's Newsletter.

From the proceeds of the exhibition and sale of raffle tickets, etc., a donation of over £200 was made to The National Kidney Research Fund and Kidney Research Unit for Wales Foundation.

2LO CALLING

BBC World Radio Club team with part of the original 2LO transmitter at Mullard's Jubilee Exhibition

Henry Hatch of the "World Radio Club" recently paid a visit to Mullard's Jubilee Exhibition and was filled with nostalgia when he saw part of the original BBC transmitter on display – which operated under the historic call sign 2LO.

When he told Doug Crawford and Marilyn Farthing, Radio Club's compere and secretary, they decided to take a look too. But to get into the mood they insisted on wearing genuine gear of the 1920's. They persuaded Henry to do the same, and here they are in the picture – Topping good fun, chaps!

"Would you please give me your opinion . . . ?" | *"Oh, Yes. Delicious Liquorice; isn't it ?"*

HIGH ACCURACY THERMOSTAT

by

H. V. MORRIS, G3TCX

By taking advantage of a differential comparator integrated circuit, this thermostat can maintain temperature control within one-seventh of one degree Centigrade. Originally intended for temperature control of photographic baths for colour printing, it has many other applications where a very close control of temperature is required

THERE HAVE BEEN A NUMBER OF electronic thermostat circuits published using a thermistor or the leakage current of a transistor as the probe. Having tried several of these and found that often the differential between switch-on and switch-off was too great, or that the ambient temperature of the instrument itself made a difference to the actual temperature of switch-on or switch-off, the author evolved the circuit described in this article.

This has an on/off differential of the order of one-seventh of a degree Centigrade and ambient temperature differences at the instrument itself over some 0°C to 30°C can be disregarded, as will be shown later.

BASIC CIRCUIT

The circuit in its simplest form is shown in Fig. 1. The integrated circuit is a Radiospares type 710-OPA. This is classed as a differential input voltage comparator and it is basically a very sensitive electronic switch. Its internal circuit and terminal layout are shown in Figs. 2(a) and (b) respectively.

Returning to Fig. 1, input 3 on the i.c. can be set to a voltage between zero and approximately 1 volt negative by potentiometer VR1. When input 4 is positive of this voltage (due to low resistance in the thermistor) the output from the i.c. at terminal 9 is −0.5 volt. Making the voltage on input 4 more negative (as a result of increased thermistor resistance) relative to that on input 3 causes the output from the i.c. to change very abruptly to a positive voltage, this being +3.2 volts with the supplies shown. The positive voltage bottoms the n.p.n. transistor, TR1, and pulls in the relay.

The operation of the circuit in practical use can be summed up in the following manner. When the thermistor temperature is lower than the reference level set up by VR1 its resistance is high, and the voltage at the inverting input of the integrated circuit is negative. The i.c. output is then positive, causing the relay to energise. The relay contacts complete a circuit to a heater which raises the temperature sensed by the thermistor. As thermistor temperature increases its resistance falls, causing the voltage at the inverting input to go positive. At the critical level this voltage is sufficiently positive to cause the i.c. output to go negative, releasing the relay. The supply to the heater is then broken, whereupon the temperature sensed by the thermistor commences to fall until its increasing resistance causes the inverting input to go sufficiently negative for the i.c. output to go positive again. The relay once more energises, completing the supply circuit to the heater. Thus, the circuit continually maintains the temperature sensed by the thermistor at the reference level. As mentioned earlier it does this with an on/off differential of approximately one-seventh of a degree Centigrade, or 0.14°C.

It should be emphasised that the

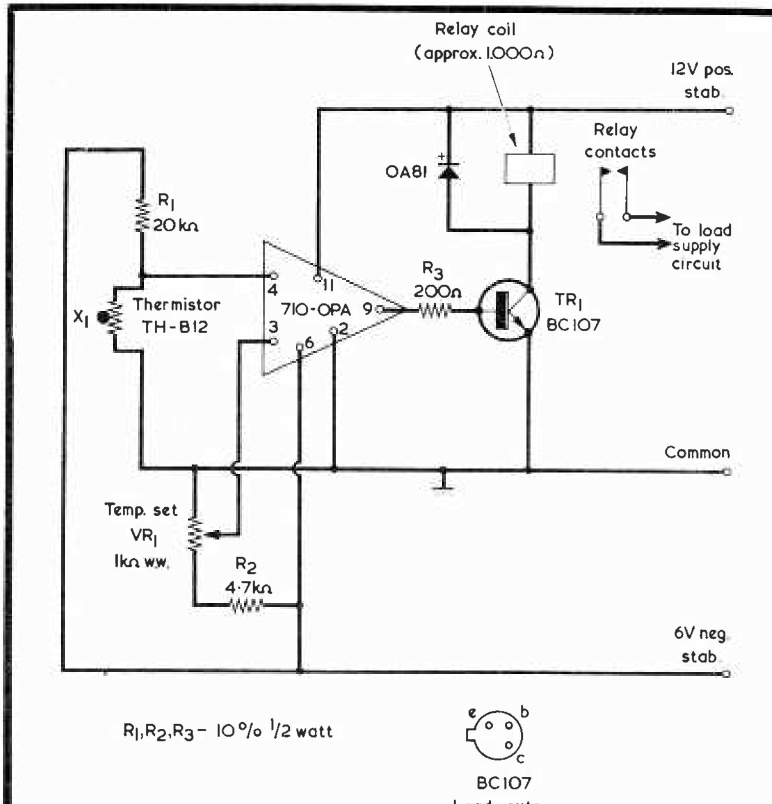


Fig. 1. The basic circuit of the electronic thermostat

710-OPA integrated circuit changes its output completely as a switch between −0.5 volt and +3.2 volts and that it is practically impossible to obtain a voltage between these. A normal operational amplifier is of no use in a circuit of this nature as the change of output would be too gradual.

The temperature sensing element, thermistor X1, is a Radiospares TH-B12 bead thermistor which has a resistance of 2,000Ω at 20°C and 1,650Ω at 25°C, i.e. a change of 70Ω per °C. This is connected as shown through a 20kΩ resistor to the 6 volt negative stabilised supply. At the junction there is then approximately 0.54 volt applied to input 4 at 20°C. The potentiometer VR1 can be set to match this and the thermostat will switch on and off at this temperature. Other temperatures can of course be set by VR1 within the limits of the thermistor (125°C maximum bead temperature is quoted by the makers). For normal applications, the thermistor should be totally enclosed in a small glass or plastic tube. If a very rapid response is required, the actual bead can protrude from the end of a plastic tube, this holding the neck of the thermistor and keeping liquid off the leads. (See Fig. 3). Araldite can be used to seal the joints.

Both the thermistor and the integrated circuit are available from Charles H. Young Ltd., 170 Corporation Sreet, Birmingham 4. In common with other Radiospares components they must be purchased through a retail source – they cannot be obtained direct from Radiospares.

The relay shown in Fig. 1 should have a coil resistance of approximately 1,000Ω and be capable of operating reliably at 12 volts. As is described later, the author employed a dry reed relay.

SELF-HEATING OF THERMISTOR

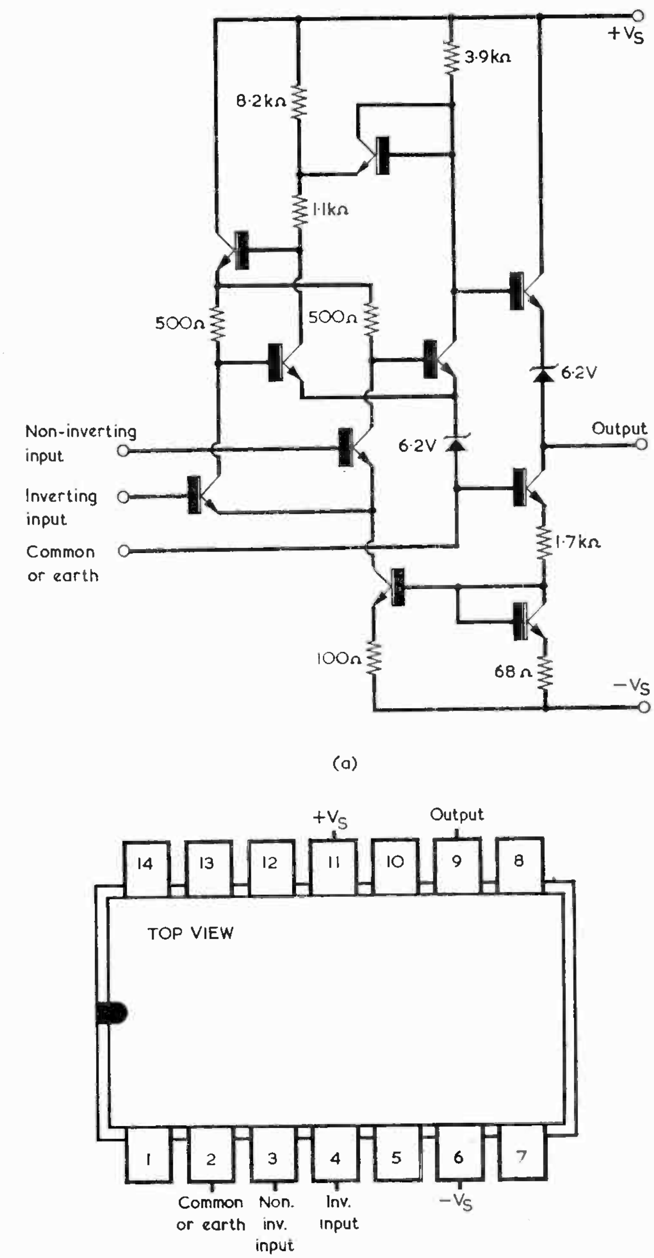
If the device is to be used to control the temperature of a liquid bath, as was the aim in the writer's case, the self-heating of the thermistor due to the current flowing through it is of little importance, but if it is in air it might cause some error.

In the circuit as shown the power in the thermistor is approximately 0.12mW (¼mA at 0.5V). As the self-heating effect is quoted by the makers as 1.2mW per degree Centigrade the thermistor will be approximately 0.1°C above the ambient temperature. This can, the author thinks, be disregarded.

AMBIENT TEMPERATURE OF INSTRUMENT

The ambient temperature of the i.c. itself (and not the probe) was next considered. This was a matter of some concern as several circuits fall down on this point. The makers' literature shows that the differential offset voltage is 1.6mV (which does not matter here as it is taken up in the calibration of the instrument) and that it *varies* 5μV/°C.

Now when it is realised that the input due to the thermistor chain varies approximately 19,000μV per degree Centigrade it follows that difference in the i.c. temperature



(b)

Fig. 2(a). The internal circuitry of the Radiospares differential input voltage comparator type 710–OPA
(b). Terminal layout of the 710–OPA integrated circuit

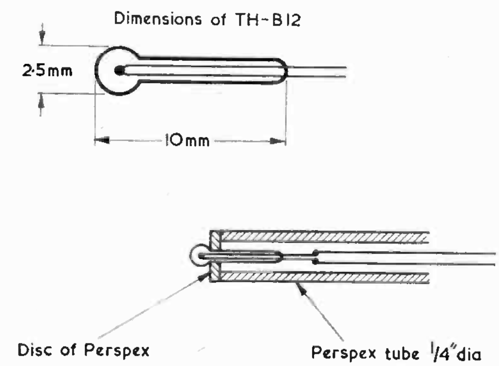


Fig. 3. Dimensions of the TH–B12 bead thermistor and a method of probe assembly which may be used when very quick response is required. The Perspex disc is drilled to take the thermistor as a push fit, and is secured to the Perspex tube with Araldite. Araldite is also used to seal the bead to the disc

will have no perceptible effect on the temperature of operation.

HIGHER POWER OPERATION

Using a conventional relay to control the load is not always the best approach, particularly when several kilowatts are being controlled. The writer devised several completely solid-state circuits to replace the relay.

However as the object in this case was to control photographic baths for colour printing, into which one was immersing one's hands, none of the circuits met the writer's idea of safety in this application. This was because the thermistor probe in all cases was connected (via various components) to one side of the mains. It is appreciated that this can be the neutral side and that the probe is insulated – *but!*

Therefore the circuit given in Fig. 4 was used. Here, the relay is replaced by a reed switch and operating coil, the switch controlling the thyristors as shown. This gives complete isolation from the mains. The circuit has been used very successfully to control immersion type heaters up to 3kW using appropriate thyristors and heat sinks. The thyristors require a p.i.v. rating of 400 volts and a current rating suitable for the load. For the 3kW load, two 400 p.i.v. 16 amp thyristors were used. The reed switch merely couples together the two gates of the thyristors, whereupon they turn completely on, giving full power (not half-wave) to the load. Gate operating conditions are controlled by the two zener diodes, which may be 1.5 watt types.

CONCLUSIONS

Several of these thermostats have been made and used, and the circuit is certainly very accurate, stable and easy to get into operation. The original prototype employed batteries for the supply but the models built for serious use have stabilised supplies obtained from a miniature mains transformer with appropriate zener diodes, as shown in Fig. 5. In this circuit, the value of R is found experimentally, and should be such that a current of 30mA flows in the zener diodes.

Construction is left to the individual as there is nothing critical in the layout. VR1 of Fig. 1 is mounted to the front panel of the unit and is fitted with a pointer and scale. It is calibrated by taking the controlled bath to the desired temperature and marking the setting of

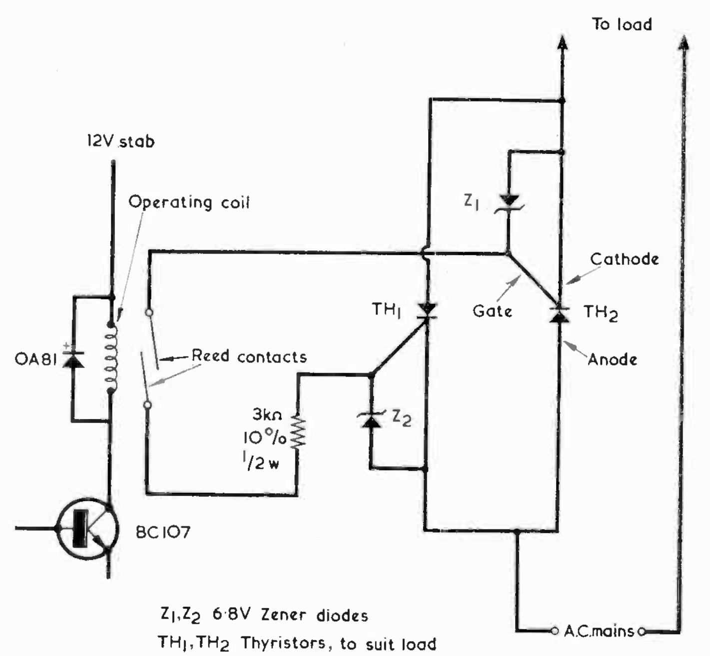


Fig. 4. Employing a dry reed switch and two thyristors to control the load

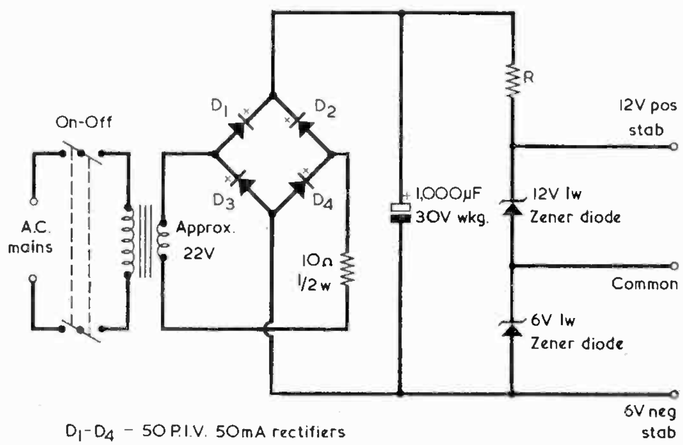


Fig. 5. The simple stabilised supply employed to power the thermostat. The lower zener diode may be 6.2V if a 6V component cannot be obtained

VR1 which causes the load switching to operate.

All safety precautions must be observed. In particular, the mains earth lead must be taken through the instrument to the load reliably. The unit should be enclosed in a metal case which is reliably connected to earth also. A useful point to note is that the terminals on the integrated circuit are an exact fit for 0.1in. Veroboard. ■

EDITOR'S NOTE

A suitable reed switch and operating coil (with a resistance of 800Ω) for the circuit of Fig. 4 are available from Home Radio (Components) Ltd. under Cat. Nos. WS122 and WS141 respectively. Mains transformers offering a secondary voltage of approximately 22 for Fig. 5 are generally available, a typical example being Home Radio Cat. No. TMM10, which offers 12–0–12 volts at 0.25 amp.

AMSAT-OSCAR-B PROGRESS

From the latest Newsletter issued by the Radio Amateur Satellite Corporation of Washington D.C., we learn that progress is being made with the next radio amateur satellite. Amsat-Oscar-B will be a small communications satellite designed to operate with radio stations in the amateur radio service. It will contain two experimental repeater packages, a multi-channel command decoder and an experimental telemetry system. The whole system will be solar powered and is planned to have a life of one year.

The first of two repeaters is being assembled by the Australian AMSAT Group in Melbourne. It will use FM techniques, 145.9MHz being used for uplink and 432.1MHz for downlink signals. Transmitter power output will be approximately one watt on each of four channels.

The second repeater is being constructed by the EURO-OSCAR Group in Marbech, West Germany. It is a linear repeater having a passband of 50kHz, using a ten watt p.e.p. power amplifier. Approximately 432.1 MHz will be used for uplink and 145.9MHz for downlink.

The command decoder is being built by the Australian Group and is an improved version of that used successfully in OSCAR 5. The new satellite will also contain an experimental telemetry system for readout on standard amateur RTTY equipment in a form suitable for processing by small digital computers.

Mechanical fabrication of the module cases and satellite structure has been completed. Solar cells and storage batteries have been acquired and are being tested. The two communication repeaters are under construction and a development prototype of the Australian repeater has been in operation from a tower in Melbourne. Development versions of the EURO-OSCAR repeater have been flown in high altitude balloons over Germany. and amateurs have been successful in communicating through this repeater during these flight tests.

AMSAT President, Perry Klein, K3JTE, states "To justify the launch of an amateur satellite as a secondary (piggyback) payload by the National Aeronautics and Space Administration. it is necessary to show that the satellite will not jeopardize the success of the primary payload, and that the proposed mission has worth-while objectives. For Australis-OSCAR-5, primary mission justification was the 10 metre beacon propagation experiment and the telemetry, command and stabilisation is its communications application".

"Specifically, the mission objectives of A-O-B include the demonstration of the feasability of using satellites for communications with small user terminals. Examples are 'bush' communications, emergency communications, communications between medical centres. . . . . . and direct satellite-to-home voice broadcasting to simple amateur receivers."

"The transmitter power output of A-O-B is expected to be sufficient to permit useful reception with ordinary amateur receivers using low-gain receiving antennas. AM, FM and SSB signals will be transmitted using the satellite linear repeater to demonstrate, for the first time, the potential of using satellites for satellite-to-home voice broadcasting directly to conventional, inexpensive receivers."

"In addition to the other mission objectives. it is anticipated that A-O-B will contribute to the advancement of education and training in satellite technology . . . . . previous OSCAR satellites were used in schools for group and individual training. Noteworthy were the efforts of the Talcott Mountain Science Centre, in Connecticut, where over 300 students were introduced to the concepts and methods of satellite tracking using real-time passes of Australis-OSCAR-5." A.C.G.

NOW HEAR THESE

Times = GMT *Frequencies = kHz*

● **BRAZIL**

Radio Universitaria Santos Dumont may be heard on **17725** around 0200.

ZYZ20 Radio Relogio, Rio de Janeiro has a 24 hour schedule and can be heard on **4905** (5kW) from around 2330.

● **CUBA**

Radio Havana can be heard on **9525** (50kW) around 0100 and also to Europe, in English, from 2010 to 2140 on **17705** (100kW).

● **CANARY ISLANDS**

Centro Emisor de Atlantico de Radio Nacional de Espana can be heard from 2000 to 0500 with a service to Latin America on **11800** (50kW) and on **15360** (50kW).

● **CHINA (TAIWAN)**

The Voice of Free China, Taipei, may be heard, in English, from 1800 to 1900 on **9765** (100kW).

● **INDONESIA**

RRI (Radio Republic Indonesia) Djambi can be heard from around 1530 to 1600 sign-off on **4927**. Banda Atjeh has been logged, at 1600 sign-off, on **4954**. Medan may be heard after 1600 on **5084**.

● **GHANA**

Ejura can be heard on 3350 (20kW) at 2015 with light music and a talk in English. providing conditions are suitable.

● **REPUBLIC OF CONGO**

A nearby transmission to the above, in terms of frequency, is that of Radio Brazzaville on **3232** (1.5kW). logged with African drums and music at 2020.

● **REPUBLIC OF NIGER**

Whilst tuning around the above two channels, also try **3260** (4kW) for Radio Niger, heard recently with African chants and music.

● **UPPER VOLTA**

A further African transmitter to log is that of Ouagadougou on **4815** (4kW). Listen for the French announcements at 2030.

● **UGANDA**

Still dealing with African transmitters, Kampala can be heard on **4976** (3/8kW) around 2100, often with English songs and announcements.

● **FEDERAL REPUBLIC OF CAMEROON**

The final African station to which attention is drawn is that of Radio Yaounde on **4972** (30kW). It can be heard around 2100 or so with announcements in French.

● **COLOMBIA**

HJAG Barranquila may be logged on **4906** (1kW) around 0230 or so. Heard recently with Latin American music and identification as "Emisora Atlantico" at 0302.

● **BOLIVIA**

To log this country, listen around 0230 on **4832** (1kW) for CP70 Radio Grigota, Santa Cruz. Announcements are made in Spanish.

● **ECUADOR**

HCHE4 La Voz Esmeraldas on **4875** (5kW) has been logged at 0233 with light music and station identification.

Acknowledgements to our own Listening Post and SCDX. ■

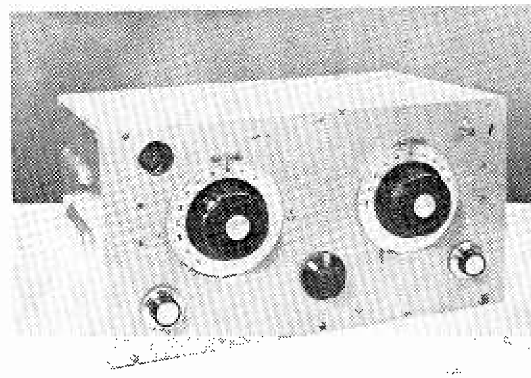
Cover Feature

THE 'CRUSADER' SIMPLE SUPERHET

(Part 1)

by

F. A. BALDWIN



This receiver design is presented as an exercise in superhet construction for the beginner who has previously built the simpler 'straight' or t.r.f. receiver and who now wishes to delve into more complex designs. It should not, however, be undertaken by the beginner as a first attempt at receiver construction. The design has been kept as simple as possible, consistent with efficient operation over its wide frequency range

As a first exercise in receiver construction, the 'Crusader' is strongly recommended to beginners. Both design and construction have been kept simple, the inclusion of an assembled and pre-aligned coilpack considerably assisting in this respect. Additionally, three tagstrip sub-assemblies containing many of the smaller components may be wired up prior to their being fitted to the chassis, this making the wiring-up process a simpler task. The three tagstrip sub-assemblies are shown in the wiring diagrams to be published next month. The smaller components not shown in these diagrams are wired direct to the respective valve-holder and i.f. transformer tags etc., as described in Part 2.

All the components used in this design should be of the best quality. They are specified in the Components List.

A fully shrouded double-wound mains transformer is incorporated, thereby providing complete isolation from the mains supply. The transformer used should be that specified.

The nominal coverage offered by the coilpack is: SW2, 18.75 to 6MHz (16 to 50 metres); SW1, 6 to 1.85MHz (50 to 160 metres); MW, 1,546 to 545kHz (194 to 550 metres); and LW, 375 to 150kHz (800 to 2,000 metres). It will be noted that the use of the coilpack offers the advantage that medium and long wave reception is available, both for entertainment purposes and for Dx work (a considerable interest is centred these days on medium wave Dx). The fact that the *'Crusader'* incorporates bandspread tuning causes the ranges provided by the receiver to be slightly altered from the nominal figures. There is still an adequate degree of overlap between short wave ranges but the highest frequency on each range is a little lower than the figure just quoted. It may be mentioned at this point that both the coilpack and the i.f. transformers are supplied pre-aligned, whereupon reception is possible as soon as construction has been completed. A very small amount of lining-up, to take up varying stray capacitances in individual receivers, is required, but this process can be carried out with received signals and there is no necessity for a signal generator. The settings of trimmers and iron-dust cores in the coilpack and i.f. transformers must *not* be altered before or during construction, or the advantage given by the use of pre-aligned components will be lost.

The design incorporates the following stages: frequency changer; intermediate frequency (i.f.) amplifier; detector and automatic gain control (a.g.c.) diode; first a.f. amplifier; a.f. output stage; and power supply. The coilpack employed has a fifth position on its range switch which disables the r.f. circuits and allows an a.f. input, applied to a socket on the rear of the chassis, to be coupled to the first a.f. amplifier stage for subsequent reproduction by way of the receiver loudspeaker. This input signal may be pro-

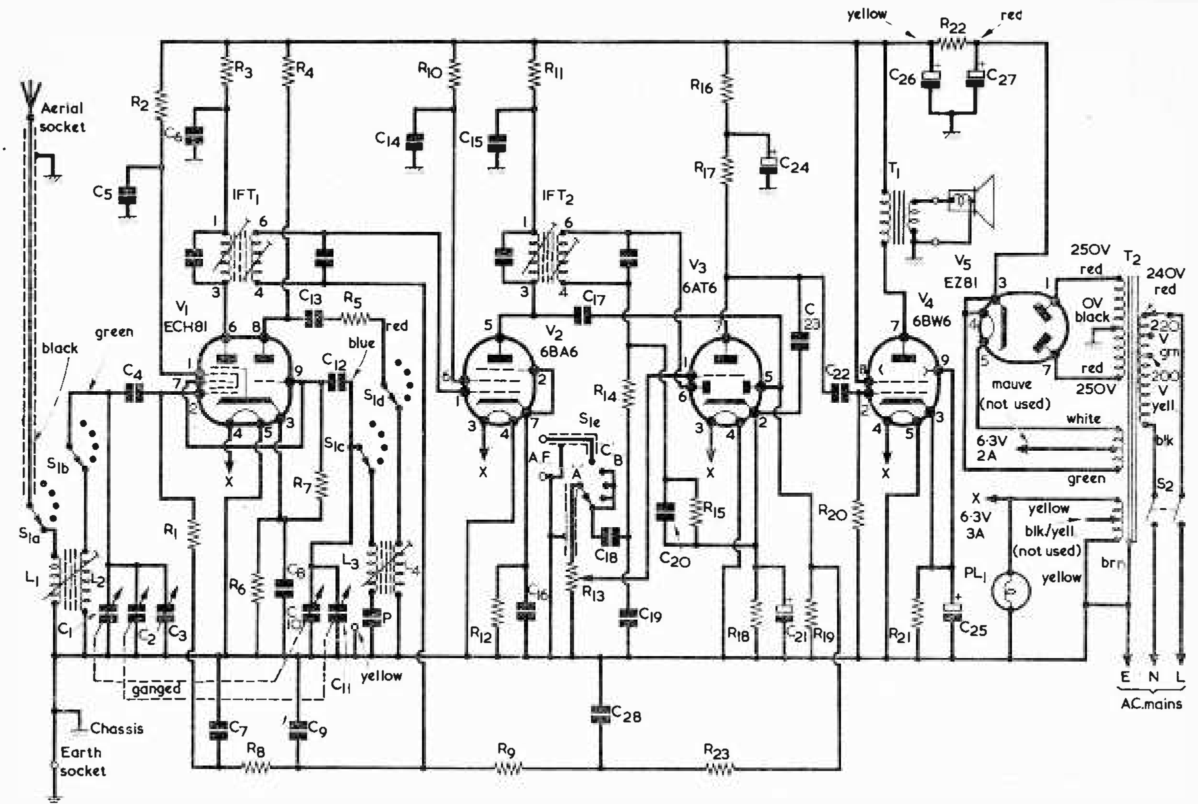


Fig. 1. The circuit of the 'Crusader' superhet receiver. The colours shown around V1 apply to the coilpack connections. Switches S1(a) to S1(e) are integral with the coilpack

vided by a gramophone pickup or tape recorder, or by any similar source of audio frequency.

The Circuit

The circuit diagram is given in Fig. 1. S1(a) to S1(e) are sections of the range switch already fitted in the coilpack. For simplicity, only the coils for one range are shown. The coilpack circuit around S1(a) to S1(d) connects into circuit via four coloured tags and a flying lead, the colours being indicated in the diagram. The yellow tag connects the coilpack to chassis. At S1(e) connections are made by way of switch tags identified as 'A', 'B' and 'C' respectively.

The aerial signal is fed, via S1(a), to the selected primary of L1 and is then coupled to its secondary winding L2. L2 is tuned by bandset variable capacitor C1, bandspread variable capacitor C2 and aerial trimmer capacitor C3. C1 is ganged with the oscillator bandset variable capacitor, C10, and C2 is ganged with the oscillator bandspread variable capacitor, C11. C3 is a separate control, secured to the front panel.

The selected signal is now passed to the signal grid (pin 2) of the heptode section of V1 via a.g.c. blocking capacitor C4. An a.g.c. voltage is fed to this grid via resistor R1 from the a.g.c. line. Positive h.t. potential is supplied to grids 2 and 4 (pin 1) via resistor R2, these grids being bypassed to chassis by capacitor C5. The anode of the heptode (pin 6) couples to the primary winding of IFT1, the anode circuit being decoupled by R3 and C6. The two capacitors conected to the windings of IFT1 are an integral part of the i.f. transformer and are fitted inside its can by the manufacturer. The same applies, incidentally, to IFT2. Grid 3 (pin 7) of the heptode section is connected, externally, direct to the triode section grid (pin 9).

The triode anode (pin 8) is connected to the h.t. positive line via resistor R4, and to the selected oscillator coil secondary winding via C13, R5 and switch S1(d). The triode has grid leak bias due to C12 and R7, R7 being returned to the triode cathode (pin 3). Cathode bias for the heptode section is supplied by R6 and C8. The triode grid couples to L3 via C12 and S1(c), the coil being tuned by C10 (bandset) and C11 (bandspread). Padding capacitor P is an integral part of the coilpack and is not fitted by the constructor. R5 is included in the oscillator feedback circuit from the anode to ensure that squegging (excessively heavy oscillation resulting in a loud hissing from the speaker) does not occur, and it allows an adequate oscillation amplitude to be available over the whole range of frequencies covered by the receiver.

Due to mixing in the heptode section of V1, an intermediate frequency signal, equal to the difference between signal and oscillator frequencies, becomes available at the heptode anode and is fed to IFT1. Both the primary and secondary of this transformer (and those of IFT2) are tuned to the intermediate frequency. Most of the adjacent channel selectivity

COMPONENTS

Resistors
(All fixed values ½ watt 10% unless otherwise stated)

R1 1MΩ
R2 33kΩ
R3 10kΩ
R4 33kΩ
R5 150Ω
R6 220Ω
R7 47kΩ
R8 220kΩ
R9 470kΩ
R10 47kΩ
R11 10kΩ
R12 270Ω
R13 1MΩ pot, log track, with S2
R14 47kΩ
R15 270kΩ
R16 39kΩ
R17 220kΩ
R18 2.2kΩ
R19 1MΩ
R20 470kΩ
R21 240Ω 1 watt
R22 2.2kΩ 10 watt
R23 220kΩ

Capacitors

C1, C10 490pF variable, 2-gang type ME (Jackson Bros. Ltd.)
C2, C11 25pF variable, 2-gang type C808 Jackson Bros. Ltd.)
C3 25pF variable, type C804 (Jackson Bros. Ltd.)
C4 100pF silver mica
C5 0.1μF, tubular, Mullard, 400V wkg.
C6 0.1μF, tubular, Mullard, 400V wkg.
C7 0.047μF, tubular, Mullard, 125V wkg.
C8 0.01μF, tubular, Mullard, 125V wkg.
C9 0.047μF, tubular, Mullard, 125V wkg.
C12 50pF silver mica
C13 200pF silver mica
C14 0.1μF, tubular, Mullard, 400V wkg.
C15 0.1μF, tubular, Mullard, 400V wkg.
C16 0.01μF, tubular, Mullard, 125V wkg.
C17 30pF silver mica
C18 0.01μF, tubular, Mullard, 125V wkg.
C19 200pF silver mica
C20 200pF silver mica
C21 25μF electrolytic, 6V wkg.
C22 0.01μF, tubular, Mullard, 400V wkg.
C23 100pF silver mica
C24 4μF electrolytic, 350V wkg.
C25 50μF electrolytic, 25V wkg.
*C26 32μF electrolytic, 450V wkg.
*C27 32μF electrolytic, 450V wkg.
C28 0.047μF, tubular, Mullard, 125V wkg.

*Contained in single can, complete with mounting clip.

Valves

V1 ECH81
V2 6BA6
V3 6AT6
V4 6BW6
V5 EZ81

Coilpack

Coilpack type CP3F/G (Denco)

I.F. Transformers

IFT1, IFT2 I.F. Transformer type IFT11/465 (Denco)

Transformers

T1 Output transformer type OPT289 (H. L. Smith & Co. Ltd.)
T2 Mains transformer, secondaries: 250-0-250V 75mA, 6.3V 3A, 6.3V 2A. Type 3104A (H. L. Smith & Co. Ltd.)

Valveholders

3 – B9A
2 – B7G

Socket Strips

1 – Aerial-Earth socket strip (Home Radio Cat. No. Z101A)
1 – A.F. input socket strip (engraved 'PU') (Home Radio Cat. No. Z101B)
1 – Loudspeaker socket strip (Home Radio Cat. No. Z101C)

Dial and Drive

2 – Ball Drive Dials, Pt. No. 4489 (Jackson Bros. Ltd.)

Tagstrips
(All tagstrips are available from H. L. Smith & Co. Ltd.)

1 – 8-way, tags 3 and 6 earthed (see Fig. 7)
1 – 6-way, tags 1 and 4 earthed (see Fig. 8)
1 – 5-way, tags 1 and 4 earthed (see Fig. 9)
2 – 4-way, end tags earthed (see Figs. 3 and 4)

Knobs

3 – Knobs (H. L. Smith & Co. Ltd.)

Speaker

3Ω speaker

Pilot Lamp

PL1 Type LES, 6.5V, 0.15A (H. L. Smith & Co. Ltd.)

Chassis

14 x 8¾ x 3in. (H. L. Smith & Co. Ltd.)

Side Brackets

2 — 2¾ x 2¾in. (H. L. Smith & Co. Ltd.)

Cabinet

15 x 9 x 8in. grey hammered finish, complete with front panel (H. L. Smith & Co. Ltd.)

Miscellaneous

Grommets (3-off ⅜in. 7-off ¼in.), 3-core power lead, solder tags (5 off 6BA), '*Crusader*' motif (see text), 'Systoflex' sleeving, coaxial cable, wire, nuts, bolts, etc.

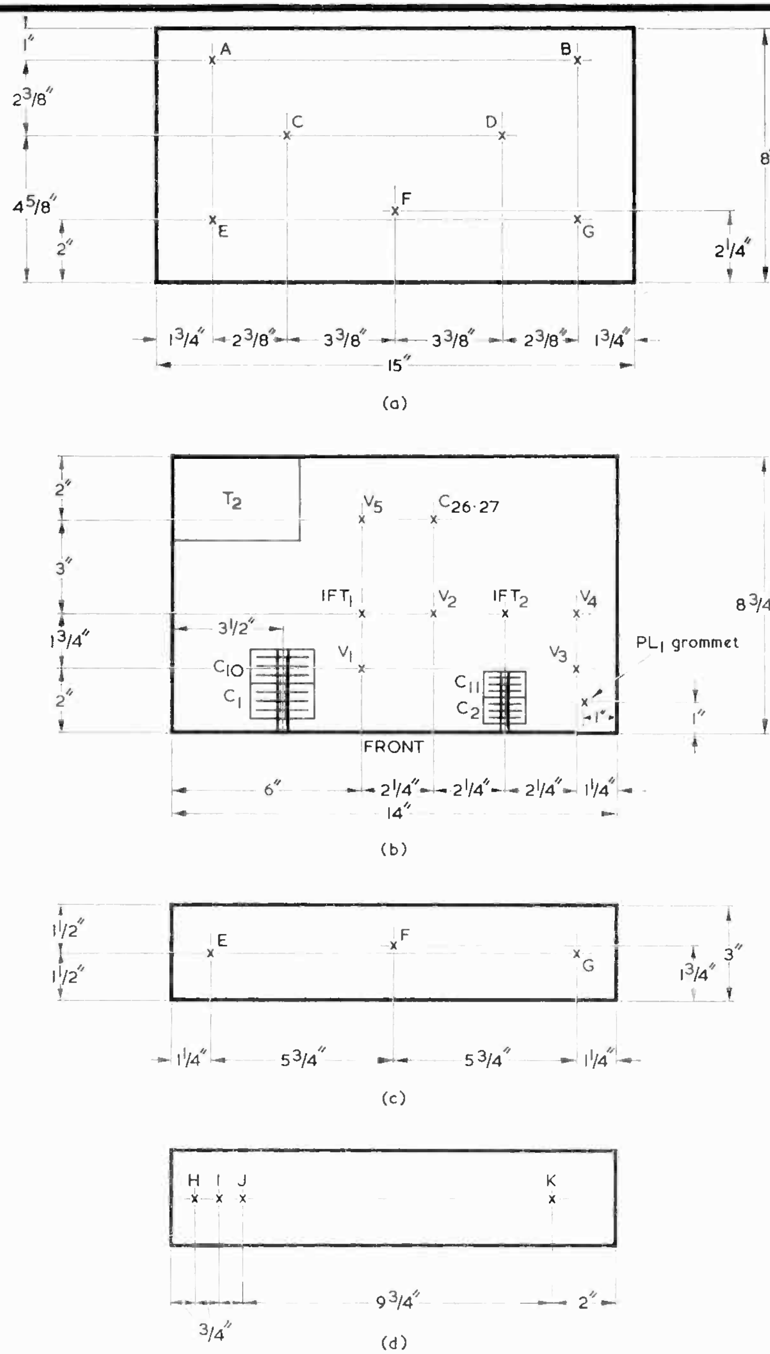


Fig. 2(a). Drilling measurements for the front panel. 'A' is for the decorative motif, 'B' the panel lamp, 'C' the bandset capacitor, 'D' the bandspread capacitor, 'E' the aerial trimmer, 'F' the wavechange switch, and 'G' the combined a.f. gain control and on-off switch
(b). Top view of the chassis deck showing the centres of major components
(c). The chassis front apron. Holes 'E', 'F' and 'G' correspond to the similarly lettered holes in the panel
(d). The chassis rear apron. 'H' indicates the position of the loudspeaker socket strip, 'I' the aerial/earth socket strip, and 'J' the a.f. input socket strip

offered by the receiver is, in fact, provided by the tuned circuits in IFT1 and IFT2.

The i.f. signal from IFT1 is next passed to the signal grid (pin 1) of i.f. amplifier V2. An a.g.c. voltage is applied to this grid via the secondary winding of IFT1. Grid 2 (pin 6) couples to the h.t. supply via R10, C14 being the bypass component. Bias voltage for the cathode (pin 7) is provided by R12 and R16. Grid 3 (pin 2) couples externally to the cathode. The amplified i.f. signal at the anode (pin 5) is fed to the primary of IFT2, R11 and C15 providing decoupling.

The secondary of IFT2 connects to the detector diode anode (pin 6) of V3 and to the diode load, R15. The detected a.f. signal across R15 is then applied, first by way of the i.f. filter given by R14 and C19, then via blocking capacitor C18, to switch tag 'B' of the coilpack. When either SW2, SW1, MW or LW is selected by this switch, the detected a.f. signal is passed to a.f. gain (volume) control R13. The desired amount of a.f. signal is then tapped off by the slider of R13 and fed to the triode grid (pin 1) of V3. This triode amplifies, giving an amplified a.f. signal at its anode (pin 7). The anode load resistor is R17, with R16 and C24 providing decoupling. C23 is included to bypass any remanent i.f. signal which might still be present at the anode.

When the switch in the coilpack is set to its fifth position, contact 'A' connects to contact 'C'. Any signal applied to the a.f. input socket is then passed to a.f. gain control R13, and thence to the grid for further amplification.

The a.g.c. diode anode (pin 5) of V3 receives an i.f. signal from the anode of V2 via C17. However, the diode load, R19, is returned to chassis instead of to the cathode of the valve, with the result that the a.g.c. diode cannot rectify until the signal amplitude from V2 exceeds the cathode bias voltage dropped (due to anode current in the triode section) across R18. Thus, no a.g.c. voltage is developed for low i.f. amplitudes at V2 anode, with the consequence that the receiver always offers maximum sensitivity for very low signal levels. This method of operation is described as 'delayed a.g.c.', the term 'delay' applying to signal voltage and not to time. The a.g.c. voltage produced by signals overcoming the delay is negative of chassis and is applied, as a grid bias voltage, to the signal grids of V1 and V2 via the filter network given by R23, C28, R9, C9, R8 and C7. The a.g.c. voltage is proportional to the strength of the received signal, with the result that an increase in signal strength causes a corresponding reduction in gain in V1 and V2. The receiver, therefore, automatically adjusts its own sensitivity to match the strength of the signal being received, and the audible output from the loudspeaker tends towards a constant level despite very wide variations in the strength of received signals. The a.g.c. circuit also compensates for fading. When a fading signal falls in strength, the sensitivity of the receiver increases to counteract the effect, and vice versa.

The amplified a.f. signal at V3 anode is next passed to the signal grid (pin 2) of V4. V4 is the power output valve and it drives the speaker by way of output transformer T1. Grid 2 (pin 8) of V4 connects direct to the h.t. positive line, and the beam plates (pin 9) couple externally to the cathode (pin 3). Cathode bias is provided by R21 and C25.

The power supply incorporates the full-wave rectifier V5, the two outer ends of the h.t. secondary of mains transformer T2 connecting to its anodes (pins 1 and 7). A rectified h.t. positive potential appears at the cathode (pin 3), this being fed to the reservoir capacitor, C27, and smoothing components, R22 and C26. The smoothed h.t. supply is then available for the signal-handling stages of the stages of the receiver.

The mains transformer has two 6.3 volt secondaries, one rated at 2 amp and the other at 3 amp. The 2 amp winding is used for the rectifier, V5. Since one side of V5 heater is made common with the cathode, this 6.3 volt secondary is at h.t. potential and cannot be used to supply any other heaters in the receiver. The remaining 3 amp secondary is employed for the heaters of V1 to V4 inclusive and for the pilot lamp PL1. The heaters of V1 to V4 have one side common to chassis, the circuit being completed by connecting together all the points designated 'X'. The 6.3 volt 3 amp secondary is provided with a centre tap, and the 2 amp winding with a 5 volt tap. Neither of these are used in the present circuit. Each of the tap leads is taped up *separately*, to ensure that it makes no contact with chassis or any other connection.

A final point is concerned with the dual electrolytic capacitor C26, C27. This is specified as 450V wgk., although a working voltage of 350 is adequate for present circuit requirements. However, the choice of the higher working voltage ensures that there is a good safety margin 'in hand'. It may be found, also, that 32+32μF electrolytic capacitors are more easily obtainable in the higher working voltage.

Construction

Fig. 2 gives drilling dimensions for the various items of metalwork. The front panel is shown in (a), the chassis deck in (b), the front chassis apron in (c) and the rear chassis apron in (d). It is assumed that the constructor has acquired sufficient experience to be able to undertake the metal-working required for the '*Crusader*' without the necessity for instructions.

Commence first with the panel shown in Fig. 2(a). Drill hole E for variable capacitor C3, and hole G for a.f. gain control R13. Drill hole F for the coilpack mounting bush. This last hole is a little higher than holes E and G, in order to allow sufficient clearance for the coilpack trimmers when the chassis and panel assembly is fitted in the cabinet.

Next drill hole A ¼in. to take the 'Challenger' motif. The motif may be purchased at the button counter of a Woolworth's store. The ¼in. hole accepts the button eye, and the button is secured in position by adhesive after the receiver metalwork and assembly have been completed. Drill hole B ⅜in. for panel light PL1. Holes C and D are not drilled at this stage.

Turn to the chassis deck shown in Fig. 2(b) and cut out the main holes and mounting bolt holes for the valveholders. V1 valveholder (B9A — ¾in. chassis cutter) has pin 6 nearest the rear chassis apron. V2 valveholder (B7G — ⅝in chassis cutter) has pin 7 nearest the rear chassis apron. V3 valveholder (B7G) has pin 6 nearest the rear chassis apron. V4 valveholder (B9A) has pin 9 nearest the rear of the chassis apron. V5 valveholder (B9A) has pin 2 nearest the rear chassis apron. The valveholders are not mounted yet.

(To be continued)

SECRET SWITCH

by

L. MORRIS

A neat method of immobilising low voltage equipment

It is an easy matter to add a "secret" on–off switch to low voltage battery-operated transistor equipment, the only proviso being that the equipment must be housed in a wooden cabinet. The writer fitted such a switch to the family transistor radio, after his youngsters had devised a game which involved switching on the set, then leaving it at full volume – slightly off-tune! After the switch had been fitted they were unable to get the set to function, whereupon they turned their attention to other pursuits which were somewhat less nerve-racking.

THE SWITCH

The "secret" switch is provided by a magnetic dry reed switch mounted inside the cabinet of the radio or other controlled equipment, this being wired in series with the battery supply. It is actuated by a magnet placed in an appropriate position outside the cabinet.

The scheme is illustrated in Figs. 1(a) and (b). The dry reed switch is held in place on the inside of the cabinet wall by two small clamps made out of tinplate. A layer of black insulating tape is wound over the glass of the switch at the appropriate points to prevent the metal clamps making direct contact with the glass. Each clamp is secured by means of a cheese-head 2BA steel bolt. Before being fitted, the heads of these bolts are filed down so that they provide a flat surface which is approximately $\frac{1}{16}$in. proud of the outside surface of the cabinet, as shown in Fig. 1(b). They are spaced apart such that the dimension shown as "X" is equal to the length of the magnet to be used.

To actuate the switch, the magnet is placed, outside the cabinet, on the filed flat surfaces of the two 2BA bolt heads, whereupon its own magnetism holds it in place. The bolts and tinplate clamps carry the field to the dry reed switch which then closes and allows the radio, or other controlled equipment, to be operated. If the magnet is later removed the dry reed switch opens, and the equipment cannot then function. The magnet can be carried in one's pocket when not employed for switching on the equipment, or kept in a safe place, according to individual requirements.

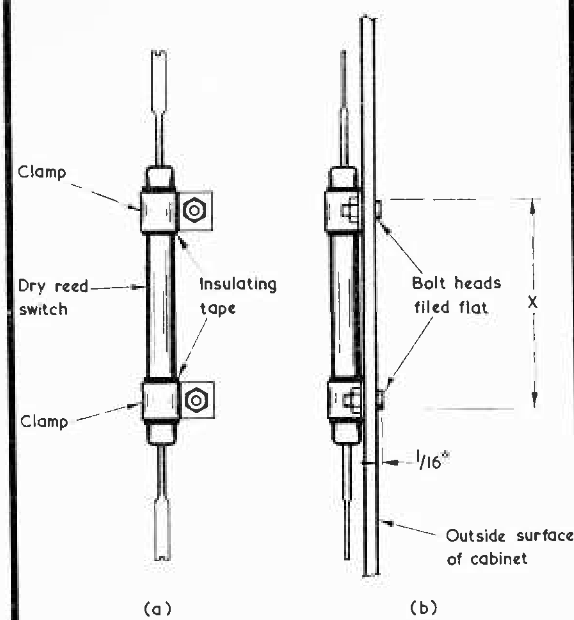


Fig. 1(a). How the dry reed switch is mounted inside the cabinet
(b). Detail giving a side view of switch mounting with the cabinet side in section, and showing also the filed-down bolt heads

If the wooden cabinet on which the dry reed switch is mounted has a thin wall, it will probably be possible to use aluminium clamps to secure the dry reed switch instead of tinplate, since sufficient field to operate the switch will be available via the steel bolts on their own combined with the physical presence of the magnet itself on the outside of the cabinet. A little experiment will soon determine which metal can be employed for the clamps. It is essential, of course, for the bolts to be steel as the magnet will not, otherwise, remain in position on the outside of the cabinet.

POSITIONING

The magnet and securing bolts can be fitted to the top, front, back or any side of the cabinet, as convenient. Dry reed switches and magnets are available from most electronic component retailers and any type will be suitable for the present application.

It has to be remembered that dry reed switches are rated at rather low contact currents. In the present scheme the switch should not be directly interposed between the battery and the large-value electrolytic capacitor which normally appears across the supply rails of a radio or other transistor equipment. If the switch were so connected, the switching-on surge given by applying the battery suddenly to the discharged electrolytic capacitor could exceed the current rating of the switch, and its contact life would be reduced accordingly. The switch must, therefore, be inserted into circuit *after* the large-value electrolytic capacitor, as shown in Fig. 2.

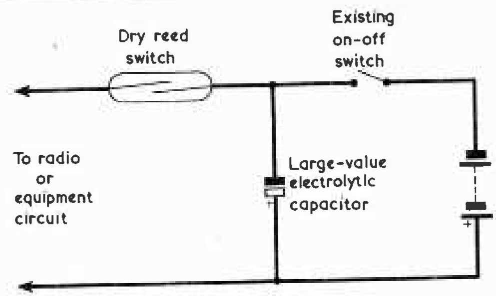


Fig. 2. The dry reed switch must be inserted in circuit after the usual large-value electrolytic capacitor across the supply rails, in the manner shown here

This means that, when the equipment is switched on with the "secret" switch open, the battery will connect to the electrolytic capacitor but will not be applied to the remaining circuits of the equipment being controlled. There will, in consequence, be a discharge from the battery into the leakage resistance of the electrolytic capacitor; but this should be very small in practice. In the writer's case, the discharge current into the electrolytic capacitor (a 100μF component) was found to be less than 10μA.

A small price to pay for domestic peace! ■

Obituary

R. N. L. CAWS, F.C.A., G3BVG

Norman Caws, a former President and Honorary Treasurer of the RSGB, died on 2nd November at the age of 69.

Educated at the City of London School, he qualified as an incorporated accountant in 1926 and as a chartered accountant in 1960. He and his brother were partners in a firm of accountants, and from 1937 to 1967 he was director and secretary of a public company. He retired in 1967.

He first became interested in amateur radio in 1923, joined the RSGB in 1946 and became licensed in 1947.

His services to the Society began in 1958, when he was appointed Honorary Treasurer, serving also on the Finance and Staff and VHF Committees. His next appointment was to a special committee established to organise the Golden Jubilee celebrations. Norman had to forego his duties as Honorary Treasurer in 1963, the year of the Jubilee, when he was elected President of the Society.

He was closely involved with the purchase of 35 Doughty Street as the Society's new headquarters, and his skill as an accountant was invaluable in the intricate business of the financial arrangements involved. He was a director and secretary of the Lambda Investment Company, the Society's property-owning subsidiary.

In token of its appreciation of all his arduous work, often carried out under difficult circumstances, the Society's Council recently elected him an Honorary Member, an honour which was to have been formally announced at the next Annual General Meeting of the Society.

The funeral took place on 9th November at Mortlake Crematorium.

We extend to his widow and family our sincere sympathy.

INEXPENSIVE BURGLAR ALARM

by

A. G. WOOD

Use this simple low cost alarm to defend your premises against intruders. A special feature is a third wire which, when short-circuited to the switch wiring, also triggers the alarm

A VERY SIMPLE TYPE OF BURGLAR ALARM IS SHOWN in Fig. 1. Here switch S, with normally open contacts, is fitted to the door or window which is to be protected, and it closes when the door or window is opened. One disadvantage of this system is that if the wires are discovered and cut by an intruder the alarm will fail to operate. Another disadvantage is that it is often easier to fit, at the door or window to be protected, a switch which is normally closed rather than one which is normally open.

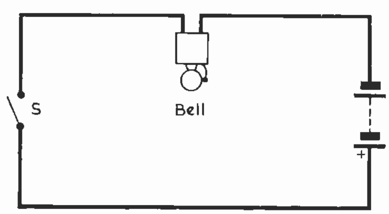


Fig. 1. A very simple form of burglar alarm

Fig. 2 shows a somewhat improved alarm. In this circuit the bell is arranged to ring when the relay is not energised, S being now normally closed. With this circuit the alarm will sound if the wires to the switch are cut but it still has disadvantages. The main disadvantage is that the life of the battery will be short because of the current which must flow all the time to keep the relay energised. The battery could be replaced by a mains supply unit, but the alarm would then be dependent upon continuous availability of the mains supply. Again, the alarm is still very easy to defeat. Nowadays many people know that alarm circuits are not likely to be as simple as the one shown in Fig. 1 and that cutting the wires would probably cause the alarm to sound. This alarm can, of course, be prevented from operating by short-circuiting the wires to the switch.

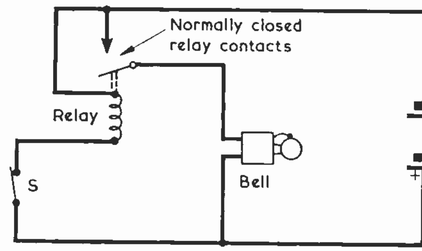


Fig. 2. In this system, switch S is normally closed until the associated door or window is opened. The relay contacts are shown in the energised condition

TRANSISTOR ALARM

By making use of five resistors and two transistors a more effective alarm may be constructed. The circuit for this improved alarm is shown in Fig. 3. Wires 1 and 2 are normally short-circuited together by 'switches' on doors and windows, etc. Any number of 'switches' (which need not be actual switches but could be suitable lengths of fine wire, as described later) may be employed, all connected in series. Wire 3 follows the same route as wires 1 and 2 but is not connected to anything outside the alarm unit. TR1 is biased off by R3 as long as wires 1 and 2 are short-circuited together or provided there is a fairly low resistance between them. If any one of the switches opens, or if either wire 1 or 2 is cut, TR1 and hence TR2 conducts and the bell is activated. Wire 3 is carried along with 1 and 2 to make it more difficult to defeat the alarm; if wire 3 is short-circuited to 1 or 2 the alarm sounds.

Hence, the alarm will sound if:

1. one of the switches on a door or window opens;
2. all three wires are cut; or
3. all three wires are short-circuited together.

In practice it is possible to run two wires from one switch to the next if the system is arranged in a loop, as shown in Fig. 4. This is the recommended way of setting up the alarm, and it is quite difficult to defeat the system provided the alarm unit itself is in an inaccessable position.

The current taken from the battery is very low except when the alarm is activated. The life of the battery should be several months, but would be greatly reduced if the bell were allowed to ring for any length of time.

SUITABLE SWITCHES

The switches used to protect doors or windows could be made from a few pieces of brass strip, but the most reliable type to use are magnetic reed switches. A reed switch is mounted on, or in, the door frame and a magnet is positioned on the door so that when the door is closed the magnet comes near enough to the reed switch to cause its contacts to make. When the door opens the magnet moves away from the switch, which then opens and causes the alarm to sound. The same scheme is used with a window, the reed switch being mounted on or in the window frame. In the case of steel door or window frames, the reed switch and magnet should be mounted on small blocks of wood to prevent the

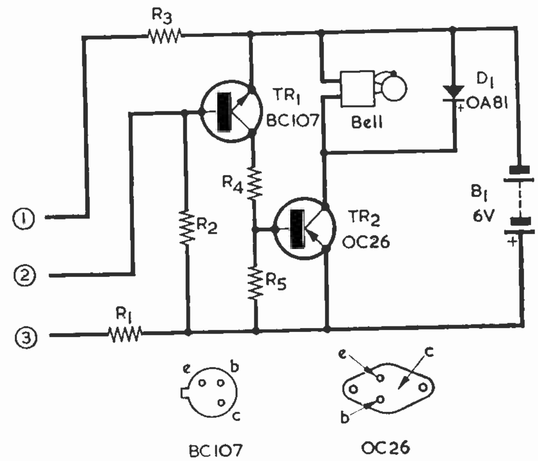


Fig. 3. The circuit of the transistor alarm unit described in this article

metal frame from interfering with the operation of the switch. (Suitable dry reed switches and magnets are available from Home Radio (Components) Ltd., under Cat. Nos. WS119 and WS124 respectively.)

To protect a room, attic or cellar temporarily, a length of fine copper wire (about 40 s.w.g.) may be included in the series circuit of switches. This wire can be strung across the room or doorway at a height of about 9in. above the floor. Even during the day such a wire would be almost invisible and would not be noticed. It breaks very easily, and as soon as somebody walks into it the alarm will be triggered.

If for any reason it is necessary to make use of normally open switches, these may be connected between wires 2 and 3 or between wires 1 and 3.

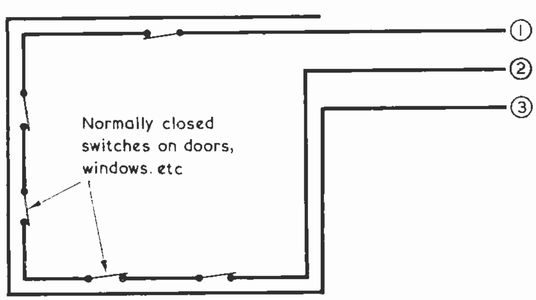


Fig. 4. The recommended method of wiring up the switches in the burglar system

CONSTRUCTION

The alarm unit may be constructed in any convenient case. One unit was fitted under the plastic cover on the bell. It is important that TR2 should have low leakage, and the standing current for the unit should be less than 0.5mA. For the unit just referred to it was 300μA. If the current is higher than 0.5mA it indicates that either there is an error in the wiring or TR2 has a rather high leakage. In the latter case the alarm should still function but the battery life will be reduced. (Be careful not to set off the alarm when measuring the standing current. A 0–1mA meter will object to having half an amp passed through it!)

The bell should be a good quality low voltage type which draws a low operating current. The inexpensive types available on the electrical counters of chain stores tend to draw excessive current and should not be used. That employed by the author drew a current of 0.5 amp, and no heat sink was required for the OC26. Also, do not use a heavy duty bell or this will overload the OC26. Diode D1 is included in circuit to protect the OC26 from high voltage back–e.m.f. 'spikes' generated in the bell. Take care to connect D1 into circuit with correct polarity.

When the unit is completed check that the bell rings when the circuit between wires 1 and 2 is broken, or when wire 3 is short-circuited to 1 or 2. The unit should be tested from time to time to determine whether the battery is still in good order. ■

COMPONENTS

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(All resistors ½ watt 10%)

R1	470Ω
R2	47kΩ
R3	3.3kΩ
R4	220Ω
R5	220Ω

Semiconductors

TR1	BC107
TR2	OC26
D1	OA81

Battery
B1 6-volt 'Lantern' battery type 996 (Ever Ready)

Miscellaneous
Electric bell
Door and window switches, as required
Connecting wire

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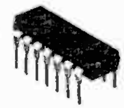

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500	3/-	6/-	8/6	30/-
600	3/3	6/9	9/-	37/-
800	3/6	7/6	11/-	40/-
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V_{BOM} = Blocking voltage in either direction.

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2 OC22 Power Trans. Germ........	10/-
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4 AC128 Trans. PNP HighGain.....	10/-
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2N3707	3/9	40632	14/-
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SPARK-FREE ELECTROLYTIC CHECKER

by

R. B. DEAN

This simple and inexpensive test unit provides a quick and reliable check, without sparks or current surges, of smoothing and reservoir capacitors

When hum becomes evident in a mains-driven sound radio, record-player or TV receiver, the first components to come under suspicion are the reservoir and smoothing electrolytic capacitors. The usual test procedure employed here consists of applying a good capacitor across each electrolytic capacitor in turn. If the hum disappears when one of the electrolytic capacitors in the receiver (or record-player) is bridged by another in this manner, then the faulty capacitor has been located.

AVOIDING SURGES

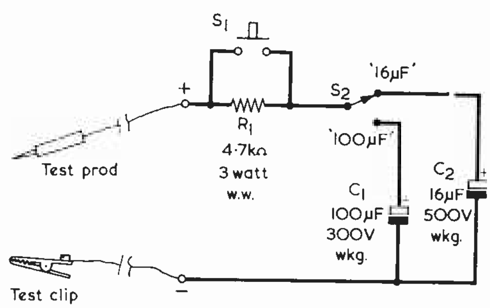
To carry out this bridging test correctly the receiver under test should be switched off whilst the external bridging capacitor is connected across that in the receiver. The receiver is then switched on again and the effect of the added capacitor checked.

However, such a procedure takes time and, so far as valve radio receivers and record-players are concerned, a busy service engineer may connect the external electrolytic capacitor across each internal capacitor in turn with the set switched on, regardless of the sparks and current surges which result when the connection is initially made. Carrying out the test in this manner is bad practice and can lead to such eventualities as the early failure of the associated h.t. rectifier. So far as TV sets are concerned, the process of adding extra capacitance to the h.t. circuits of the set when it is switched on is even more to be condemned. Should a large-value capacitor, of the type employed in TV receivers, be connected uncharged across, say, an existing TV h.t. reservoir capacitor when the set is turned on, it is quite probable that definite damage will result.

Another reason why the application of an external capacitor across an existing one in a switched-on receiver represents bad practice is that the consequent surge can result in a temporary 'cure' of an intermittent fault. An electrolytic capacitor internal foil connects to its terminals by rivetted joints, or by joints which similarly hold the two connecting metals together under pressure. Should such a joint develop resistance, the capacitor may cause hum to appear in the receiver in which it is fitted. But, if an uncharged capacitor is connected across the faulty capacitor whilst the associated set is switched on, the resultant current surge may make the high resistance joint temporarily good again, whereupon the hum remains cleared after the bridging capacitor has been removed. The service engineer could be tempted to leave matters in this state and refrain from replacing what has apparently become a serviceable capacitor, but the internal capacitor joint is almost certain to go faulty again at some future time. The fact that a faulty capacitor has started to function correctly could even give rise to error. There is the possibility that the capacitor which has resumed correct operation is not the one that has been bridged, but is, instead, a capacitor connected to the bridged component by a low value smoothing resistor.

TEST UNIT

For the servicing of valve radios, record-players and TV receivers, all these problems can be banished at a single stroke by the use of the simple test unit whose circuit is given in the accompanying diagram,



The circuit of the electrolytic capacitor test unit. This allows external capacitance to be connected across an h.t. reservoir or smoothing capacitor without sparks or current surges

and which is employed with the set under test turned on. To use the unit, the crocodile clip is coupled to the h.t. negative rail of the set under test. Normally, this will be its chassis. If the set is a sound radio or record-player, switch S2 is set to the '16μF' position. With a TV receiver, S2 is set to the '100μF' position. The positive test prod is next applied to the positive terminal of the capacitor to be checked then, after about half a second with the radio or record-player, or after about three seconds with the TV receiver, push-button S1 is pressed. Whichever capacitor was previously selected by S2 will now be nearly fully charged to the receiver h.t. voltage via R1, and the resultant current surge will be negligibly low. If the hum clears when S1 is pressed, the faulty capacitor has been located.

It can be assumed that a capacitor becomes nearly fully charged via a series resistor after a time equal to about five times the time constant of the two. The time constant (given by farads times ohms, or microfarads times megohms) for a 4.7kΩ resistor and a 16μF capacitor is 0.075 seconds. With a 4.7kΩ resistor and a 100μF capacitor it is 0.47 second.

Thus, the minimum waiting time for the capacitor in the test unit to charge is approximately 0.4 second with S2 in the '16μF' position, and approximately 2.5 seconds with S2 in the '100μF' position. After using the unit, the test prod and clip should be short-circuited together for the appropriate time to discharge the capacitor in the test unit. This can usually be done by merely applying the prod to the chassis of the receiver just checked before removing the clip. Remember that it is possible to obtain an unpleasant shock from the test prod and clip if the capacitor in the unit is not discharged.

The components for the unit may be assembled in any small insulated case from which protrudes the two test leads. C2 is given a working voltage rating of 500 volts, and will cope with all standard valve radio or record-player h.t. voltages likely to be encountered. C1 is a high-value electrolytic capacitor of the type specifically intended for use in TV receivers. Push-button S1 should be a heavy-duty component, as there will still be a small surge current when it is closed, and heavy-duty contacts will have longer life. A suitable type is the Bulgin S365, available from Home Radio under Cat. No. WS92. S2 can be any s.p.d.t. toggle switch with insulation suitable for h.t. voltages.

BROADCAST NEWS

● INDONESIA

Our Listening Post reports logging Radio Angkatan Udara (Air Force Radio) on the unlisted channel of **11322kHz** from 1330 to close down at 1401GMT. Sign-off is made with announcements in Indonesian and a Polynesian-type melody (not 'Love Ambon' as with other Indonesian stations).

The power is 7.5kW, reports in English are wanted and the address is – Radio Angkatan Udara, 51 Djalan Tjipinang, Tjempedak I, Polonia Djatinegara, Djakarta, Indonesia.

RRI (Radio Republik Indonesia) Djakarta has been heard on **7270kHz** at 1356GMT with announcements in Indonesian and Arabic-style songs and music. The power is 50kW.

● SOUTH VIETNAM

Saigon, reports our Listening Post, has been heard on **7245kHz** (20kW) from 1315 to 1330GMT. with announcements in Vietnamese and with Asian-style songs and music.

● SOLOMON ISLANDS

The Solomon Islands Broadcasting Service, Honiara, has been logged on **7235Hz** (5kW) from 1100 to 1130GMT. Announcements by male and female speakers followed by short melody on flute-like instrument at 1130 sign-off.

CURRENT SCHEDULES

Times = GMT *Frequencies = kHz*

★ AUSTRALIA

Radio Australia now broadcasts to Europe in English from 0645 to 0745 on **15330**, this replacing the **9730** channel. The **11710** channel is used in parallel. At 0745 to 0915, these two outlets join the South Pacific Service in English. The General Asian Service, in English, can be heard from 1430 to 1730 on **9550** and from 1500 to 1700 on **11740.** The morning broadcasts to Eastern USA and Canada are from 1115 to 1215 and from 1215 to 1315 on **9580** and **11710.**

★ FINLAND

The English and Finnish Service to North America is now from 0200 to 0300 on **9585**.

★ MALI

Radio Bomako can now be heard from sign-on at 0600 (sign-off 2300) on **5995, 7110 and 9710**. The **9710** channel signs-on one hour earlier at 0500.

★ JAPAN

Radio Japan now broadcasts to Europe from 0645 to 0845 on **17825** and **21535** and from 1930 to 2100 on **9735** and **11950.** The service for North and Central America and the Hawaiian Islands is now aired on **17825** and **21640.**

★ SWEDEN

The current schedule of Radio Sweden, in English, is as follows – from 1230 to 1300 on **9715** (Far East) and **21690** (Africa); from 1400 to 1430 on **15240** (South Asia) and **21585** (Eastern North America); from 1600 to 1630 on **6065** (Europe) and **11930** (Middle East); from 1900 to 1930 on **11780** (Middle East) and **15240** (Africa); from 2045 to 2115 on **6065** (Europe) and **9715** (Far East); from 0030 to 0100 on **5990** (Eastern North America); from 0200 to 0230 on **5990** (Eastern North America); from 0330 to 0400 on **9725** (Western North America) and from 0515 to 0545 on **11895** (Australia, New Zealand) and on **17840** (South Asia).

★ MONGOLIA

Radio Ulan Bator is now scheduled, in English, from 1220 to 1250 on **15440** and **17780** and from 2200 to 2230 on **9540** and **11860**. Radio Ulan Bator can also be heard on **5054** around 1600.

★ NEPAL

The External Service of Radio Nepal is now broadcast on Tuesdays and Saturdays from 1250 to 1320 on **7165** and **11970**.

★ USSR

Radio Vilnius can be heard, in English, from 2230 to 2300 on **7290** and **9685** on Fridays and Sundays.

★ HUNGARY

Radio Budapest now radiates an English programme at 2130 on **6025** for Europe and to the Far East, Oceania and Asia on Wednesdays at 0800 and on Fridays at 1015 on **11910, 17160, 17800** and **21685.**

Acknowledgements to our own Listening Post and SCDX.

THE 'VENTURER' TRANSMITTER
PART 2

by

J. BROWN, G3LPB

Concluding details on this comprehensive c.w./a.m. design, which covers all bands from 10 to 160 metres with switched band change

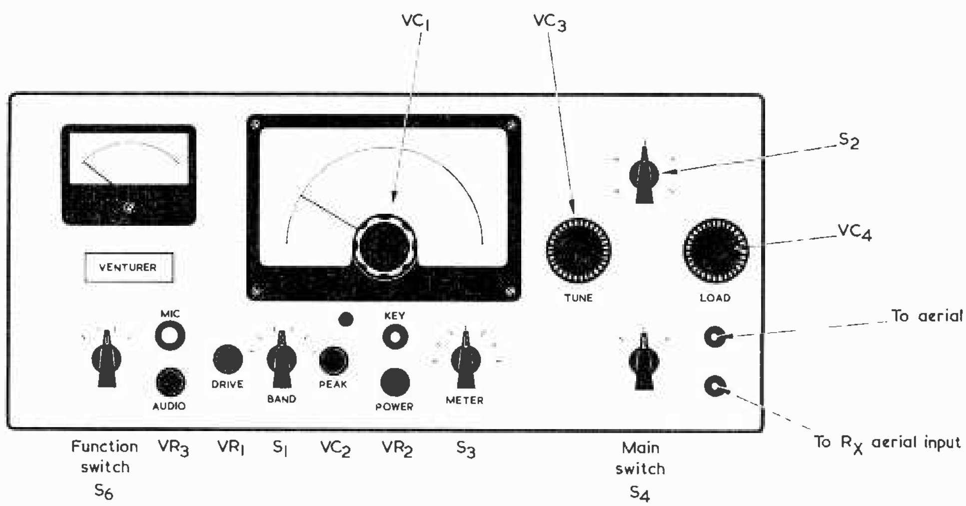


Fig. 10. Front panel layout of the transmitter

LAYOUT

The layout of the transmitter components can be judged from the photographs and the panel layout shown in Fig. 10. The front panel is 16in. by 7½in. and the chassis is 11in. by 6½in. by 2½in. If desired, the constructor could employ dimensions which allow the transmitter to fit direct into a TU5 case. In the photograph showing the view looking down at the top of the chassis, the pi output circuit components can be seen mounted directly to the panel. Next to them, on the chassis, are the two TT11's and the 6AQ5, after which can be seen the extension shaft and coupler for the v.f.o. tuning capacitor. On the other side of this shaft are the two square cans for L4 and L5, the v.f.o. and driver valves, and the single square can for RFC2.

The three square cans in line near the front of the panel contain L6 to L11. After these are the modulator valves, consisting of 12AX7 nearest the panel, 12AU7 and the two EL84's. The stabiliser tube and relay are at the rear, near an octal power socket mounted on the rear apron of the chassis.

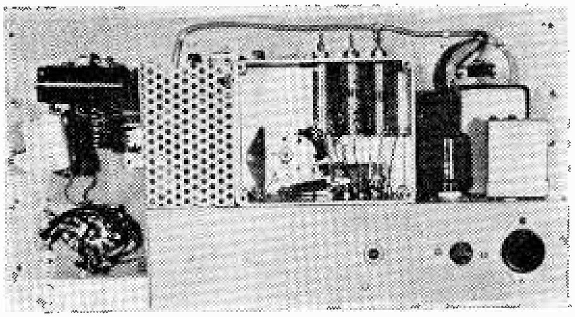
The three v.f.o. grid coils and the v.f.o. tuning capacitor fit in an Eddystone die-cast box measuring 4½in. by 3½in. by 2in. (Home Radio Cat. No. E650).

The only component under the chassis requiring special mention is the range switch. This was made up with three 6-way 2-pole wafers (Electroniques Code No. TSW6/2), a 10in. shaft (Electroniques Code No. TSW/SH/10/2) and two 12in. lengths of 6BA studding (Electroniques Code No. TSW/ST/6/12). Spacers are required to give spacings of ¾in., 1¼in. and 3in. respectively, working from the front of the switch. The end of the shaft is steadied by a bush fitted to the rear apron of the chassis.

POWER SUPPLIES

The power requirements for the transmitter are 33 to 41mA for the v.f.o. and driver (current varies according to valves and tuning), 70mA for the modulator, and up to 90mA for the p.a. stage. All these currents are at an h.t. voltage of approximately 250. With no drive, the p.a. stage clamps at 30mA current.

These requirements are fairly modest and constructors should have no difficulty in making up the requisite supply unit, if they do not have one already available. A satisfactory circuit is illustrated in Fig. 11. In this diagram, the transformer h.t. secondaries are rated at 120mA, which gives a good safety factor. The chokes can be smoothing chokes taken from



Rear view, illustrating v.f.o. assembly with the cover of the v.f.o. tuned circuit box removed. When this photograph was taken the v.f.o. coils were wound on non-standard formers

discarded TV receivers. The supply unit is built separate from the transmitter, coupling to it by way of the power socket at the rear of the transmitter. It will be noted that the circuit of Fig. 11 also gives provision of a low voltage supply for the relay. The heater current required by the modulator is 2.2 amps and that required by the p.a. and v.f.o. stages is 3.5 amps.

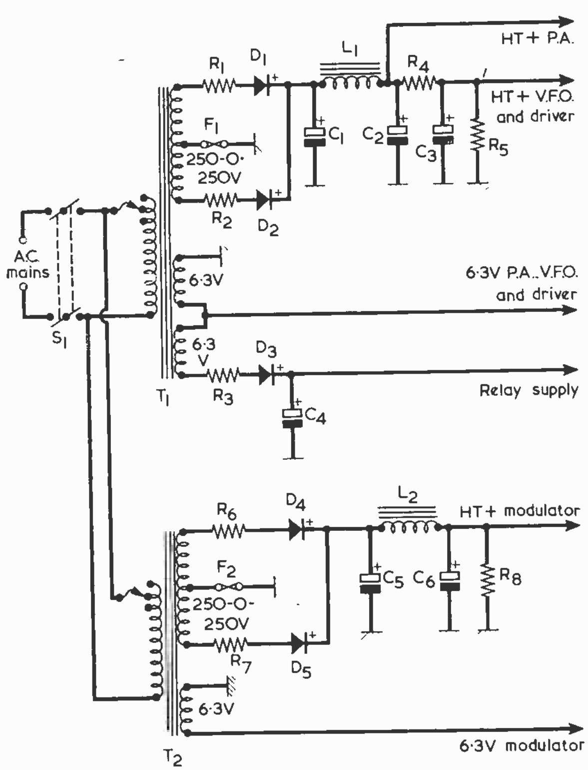


Fig. 11. A suitable power supply unit

TUNING UP

After checking for faulty wiring, etc., the transmitter can be tested and tuned up. Note that the stabiliser tube (see Fig. 1 of last month's article) can be either an OA5 giving 150 volts, or an 85A2 giving 85 volts, the value of R4 being chosen accordingly. It will be best to commence with an 85A2, then change to an OA5 if experience with the transmitter indicates that the higher voltage is preferable.

Apply h.t. to the v.f.o., set the receiver to mid-band on 160 metres, and tune the core of L1 for the required beat note with VC1 at its central setting. Carry out the same procedure with L2 for 80 metres, then with L3 for 40 metres. Let the v.f.o. and receiver run for some time to check for any drift or instability.

After checking the v.f.o. on 160 metres and ensuring that the v.f.o. covers the band, seal the core of L1 by lightly fitting a 6BA lock-nut on its adjusting screw. Similarly check and seal the cores of L2 and L3 for 80 and 40 metres respectively. Switch the function switch to 'Net', switch the meter to read p.a. grid current, and tune L6 for maximum meter reading. This reading is dependent on the setting of the drive control. The peak control, VC2, should be set at mid-capacitance for this and all subsequent adjustments, as also should VC1.

COMPONENTS

Resistors
(All resistors 1 watt 10% unless otherwise stated)

- R1 22Ω
- R2 22Ω
- R3 47Ω
- R4 1kΩ 5 watts
- R5 220kΩ
- R6 22Ω
- R7 22Ω
- R8 220kΩ

Capacitors
(all capacitors are electrolytic)

- C1 8μF 350V wkg.
- C2 16μF 350V wkg.
- C3 16μF 350V wkg.
- C4 500μF 20V wkg.
- C5 8μF 350V wkg.
- C6 16μF 350V wkg.

Inductors

- T1 Mains transformer; secs. 250–0–250V 120mA, 6.3V, 6.3V (see text for current at 6.3V)
- T2 Mains transformer; secs. 250–0–250V 120mA, 6.3V 2.5A
- L1, L2 Smoothing chokes (see text)

Rectifiers

- D1, D2 BY100
- D3 DD000
- D4, D5 BY100

Fuses

- F1, F2 500mA cartridge fuses and holders

Switch

- S1 d.p.s.t., toggle

Switch to 80 metres and peak L7 for maximum reading in the meter. Next, switch to 40 metres and peak L8 and L4 for maximum meter reading. Make no subsequent adjustment to L4; this is peaked mid-band and then left alone.

Switch to 20 metres and peak L9 for maximum meter current, then switch to 15 metres and similarly peak L10.

Switch finally to 10 metres and peak L11 and L5 for maximum meter reading. Like L4, L5 is peaked once at mid-band and is not then touched again.

All peaking adjustments should be carried out with an insulated trimming tool or a plastic knitting needle filed to operate as a screwdriver.

Once set up, all cores are left alone. With this transmitter the anode coils of the driver can be peaked by the panel control so that optimum drive is available at all times. Such is not always the case with wide-band couplers, in which the best compromise setting still results in lack of drive at one or the other ends of the band.

AIRING THE TRANSMITTER

After all necessary tests have been carried out using a dummy load and all is found to be well, the transmitter is ready for testing on the air.

The following is the correct procedure. Switch on the power supply and allow time for the valves to warm up. Select the band required and switch the function switch to 'Net'. This allows h.t. to be applied to the v.f.o. and driver stages only. Select the desired frequency in the band, making sure that this is a clear channel and there is no risk of ruining someone else's QSO. Increase the drive and adjust the peak control until the meter, switched to read p.a. grid current, indicates about 4mA. Set the p.a. band selector switch to the required band, switch the meter to read p.a. current and set the function switch to 'C.W.'. Turn the main switch to 'Transmit'. Tune VC3 through its travel until the meter reading dips. This is the resonant setting, and it will change when VC4 is adjusted. Adjust VC4 for about 80mA p.a. current, readjust VC3 for the dip, then set up VC4 once more for 80mA. Repeat this procedure until the 80mA current is achieved with VC3 at a maximum dip setting. It cannot be too strongly emphasised that the combined adjustment of VC3 and VC4 must be carried out as described. Their settings will vary with different aerials.

It should be pointed out at this stage that these pi output circuits will match into a wide impedance range, from some 50Ω to as high as 300Ω. Hence, a pi circuit will match into many types of aerial. However, if an attempt were made to feed the transmitter into, say, a dipole, the 'unbalanced' output of the transmitter would be feeding into a 'balanced' aerial, and it would be necessary to interpose some form of tuning unit such as a 'Z match'. This is really an impedance matching device – hence the term 'Z' – and it ensures an impedance match which gives maximum transfer of energy to the aerial. The standing wave ratio indicator, or s.w.r. indicator, should also be mentioned. This instrument enables both forward and backward energy in a feeder system to be checked, the aim being to obtain maximum forward and minimum backward energy. A further device, the low pass filter, prevents harmonics above some 30MHz getting into the aerial, and thereby obviates the risk of TV interference. It is advisable to use an aerial tuning unit as, in many cases, this helps towards giving a decent transfer of energy at the correct impedance. Also, it would be of no use whatsoever trying to feed a 75Ω low pass filter into, say, a long wire end-fed aerial. The set-up for using these items is shown in Fig. 12.

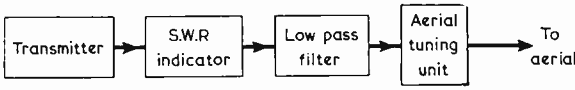


Fig. 12. Incorporating suitable ancillary equipment between the transmitter and the aerial increases efficiency and reduces TVI

The added items remain in circuit when receiving, and offer the further advantages of terminating the aerial at the correct impedance for the receiver input.

After loading has been carried out, it can be assumed that all is well. The main switch is turned to 'Receive' and the operator next tunes around to find a QSO with which he can break in. After netting it is only necessary to turn the function switch to 'A.M.', set the audio gain to about half-way, and turn the main switch to 'Transmit'. The receiver is then muted and the transmitter is energised, ready for its first a.m. test. If the meter is switched to read p.a. current, peaks of speech should just slightly increase the meter reading. If the increases are too intense the transmitter is overmodulating. This spreads the audio around the band and offends other operators.

Summing up, what is aimed at are: p.a. grid current at approximately 4mA; anode current of approximately 80mA for 80 metres to 10 metres and 40mA for 160 metres; and slight upward kicks in meter reading during modulation.

For c.w., however, the above figures, apart from that for 160 metres, can be increased. On 80 to 10 metres the p.a. can be loaded even to 90mA with safety, as the r.f. is not continual since it is being keyed. The clamper valve ensures that there is a hold on the p.a. to keep it to a low level of anode current when the key is up. If excessive grid current is used on c.w. with some transmitters, chirp takes place because the grid current pulls the oscillator frequency. Chirp has not been experienced with the present design, the oscillator remaining clean at all times.

MEASURED OUTPUT

20 watts in a dummy load were given with drive figures on 160 metres of 10mA, of 9mA at 80 metres, 8mA at 40 metres, 8mA at 20 metres, 7mA at 15 metres, and 6mA at 10 metres. These figures were obtained using the 85A2 stabiliser tube. If the OA2 is used as the stabiliser, there will be an excess of drive available. Remember that overdriving causes TVI and harmonic radiation.

All reports on the prototype have been good, including good speech quality. With a VS1AA 67ft. aerial and a simple aerial tuning unit, the transmitter loads easily on all bands, and has a decent standing

Concluded in next column

NEW PRODUCT

The Sorrento Record Player

ANOTHER NEW RECORD PLAYER IN THE NEW ELIZABETHAN RANGE

Lee Products (GB) Limited, a member of the John E. Dallas Group of Companies, have recently launched another smart record player to their new Elizabethan range.

A little more conservative than the Astronaut, the new Sorrento is designed to appeal to a slightly older age group. Its simple functional design is emphasised by its reliable performance yet brightened by the popular red case.

The BSR turntable with its four speeds reproduces the sound by way of sapphire stylus, transistorised amplifier and high-flux speaker. The controls for volume and tone are accessible when the lid is closed.

THE 'VENTURER' TRANSMITTER

(Continued from page 362)

wave ratio performance (although the latter was a little poor on 160 metres, which could be expected). During tests, stations worked were G stations on 160 metres; G, GW, GI, GC, GD, EI on 80 metres; EA, F, DJ on 40 metres; DJ, DL, I, OE, even a W4 on 20 metres; CR7, LA, SM on 15 metres; and UA, DJ, I, ZS on 10 metres.

Which is not bad for 20 odd watts, plus an operator who operates very little. ■

S.E. Asian Quest (3)

In this short series the author has presented information about some of the stations that may be heard, the countries making up this part of the world and an outline of their broadcasting systems. In this, the last of the present series, some tips on S.E. Asian reception are discussed for the benefit of beginners

FEW THINGS ARE MORE EXCITING IN THE BROADCAST band listening world than the reception of a low-powered transmitter from the S.E. Asian area. On October 3rd last year, quite early in the 'season', the writer logged and taped Djambi, Indonesia, from 1545 to 1600GMT sign-off on 4927kHz. The closing 'ceremony' – that is the best way to describe it – begins at 1550 with an Arabic-like wailing, plaintive song. This is followed by announcements in Indonesian and the station closes with one of the most haunting melodies ever heard by the writer, rendered on a Hawaiian guitar. The whole episode is nothing if not colourful.

AERIAL

For the maximum results with respect to reception of this part of the globe, the aerial should ideally be oriented such that it is broadside on to the required direction. Most SWL's use the 'Inverted L' long wire type of aerial and it is assumed here that this is the case with the reader. Aerials are a subject in themselves and space is not available here to deal in any great length with the advantages and disadvantages of various types.

Very satisfactory for general short wave coverage, the 'Inverted L' type of aerial should, where possible, have a total length of 66ft, including down-lead. The 'top wire' should *ideally* be erected in a straight line such that it takes the direction NNW–SSE. With this orientation, the aerial will be broadside on to the target area, thereby exhibiting directional properties favourable for S.E. Asian reception.

For those who care to purchase an inexpensive compass, the 'top wire' direction should be along the line 170°–350° magnetic bearing (162° to 342° true bearing). For aerial alignment purposes the annual magnetic variation can be ignored.

Should the reader not be in the fortunate position to comply with the ideal, then the closest approach possible should be adopted.

For those considering the erection of an aerial for the first time, it is worth noting that for maximum general world coverage, the 'Inverted L' should be oriented along the line 75° to 255° true bearing (82° to 263° magnetic).

WHEN TO LISTEN

The best times to listen for signals from the lower powered Asian stations on the l.f. bands is when the signal path from the transmitter to the reception point is mostly, or wholly, in darkness. During this period, the ionospheric reflecting layers are lower and denser than in the case when the path is mostly in daylight. Being removed from the effects of direct sunlight, a large proportion of the radiated r.f. energy is refracted back to the surface of the earth.

LATE AFTERNOON

During this month (January) most of the signal path from S.E. Asia to the U.K. is in darkness from 1500 to 2400GMT. One must remember however that the low powered stations on the l.f. bands are serving local communities only and therefore close down and sign-on at suitable local times.

During the time period mentioned above, this is what happens, for instance, to most of the Indonesian transmitters. Most of them sign-off at 1600GMT, roughly corresponding to their midnight local time. The best time to listen for Indonesian stations signing off is therefore from 1555 to 1600GMT.

Listening to stations closing down has the advantage that identification is made much easier by virtue of the fact that place names (invariably the last word in the announcement in the case of Indonesian transmitters) are mentioned.

Under good conditions, it is possible to hear stations from S.E. Asia as early as 1430GMT. As a general rule, however, listen from 1500 to 1630GMT.

A good pointer for Asian reception is All India Radio, Hyderabad, on 4800kHz (10kW) with the South Regional Service. If this station is coming through with a good signal strength it is often the case that S.E. Asian signals will also be heard about the same time or a little later.

LATE NIGHT

At the other end of the 1500 to 2400GMT time period, some of the stations sign on around 2200 GMT, corresponding to their *local* time of 0600. However, during this late night period for us in the U.K., proceedings can be sometimes made a little difficult by the South American stations coming through at the same time! Life is not all honey for the broadcast bands SWL!

Past experience has shown that Saturdays and Sundays are the best days for listening on the l.f. bands around 1500 to 1600GMT, for the reason that some of the utility stations which cause interference to broadcast reception on these bands are silent.

Summing up therefore on S.E. Asian reception, Saturdays and Sundays between 1500 and 1600GMT are the most likely periods – provided propagation conditions are favourable.

WHICH FREQUENCIES?

For the beginner equipped with a reasonably accurately calibrated communications receiver probably the easiest station to receive would be Penang, Malaysia, on 4845kHz (50kW), by virtue of its relatively high power.

The lower powered Indian transmitters should also prove of interest to the broadcast bands beginner. Try VUB Bombay on 4840kHz (10kW) or VUM Madras on 4920kHz (10kW).

A further S.E. Asian station of note for the beginner would be Radio Singapore on 5052kHz (10kW). Try to log the six 'pips' followed by station identification in English and newscast in English at 1530GMT.

It is hoped that this series will have spurred many SWL's to 'have a go' and take part in the S.E. Asian Quest. ■

NEWS FROM ITA

TRAINING ITV ENGINEERS

The ITA announces that the Plymouth Polytechnic is to be the main centre for formal training courses for the Authority's engineering staff. The Polytechnic will also be used by the ITV programme companies for training courses for their own engineers and technicians.

The first student engineers from ITA started at the Polytechnic on September 20th. Altogether there are 21 ITA students on this first course, seven being shift engineers from ITA transmitters, and the rest junior engineers-in-training. There are also two engineers from the programme companies on the course.

The course at Plymouth is a new one in Advanced Television Engineering. It is in three parts, each of 11-12 weeks duration and concerned with a main subject area. The first part, dealing with Electronic Fundamentals and Pulse Technique, started on the 20th September and finished on 10th December. The second part, Television Engineering, begins after Easter 1971 and occupies the Summer Term at the Polytechnic. The students will return in September 1971 for the third part devoted to Television Transmission and will complete the course in December 1971.

The Plymouth Polytechnic has a large Electrical/Electronic Department with considerable experience in running courses in advanced electronic subjects and in particular in television. The Polytechnic also provides the television studio and transmission equipment for the Plymouth Educational Television Service.

The Authority made available for courses in the past a considerable quantity of transmitting and test equipment for teaching purposes. This equipment, which includes a complete UHF transmitter, a standards converter and many other items, is worth more than £100,000. It has now been transferred to the Plymouth Polytechnic.

In addition to the Advanced Television Course which is directed primarily towards the needs of the Authority's engineers, the Polytechnic have a number of shorter television engineering courses for engineers and technicians from the ITV Programme Companies. There are currently available courses (in two five-week parts) in Television Engineering orientated mainly towards studio equipment and also short intensive three week courses on the basic principles of colour television.

Accommodation

The provision of a number of courses on a full-time basis for students from the ITA calls for appropriate residential accommodation. Earlier this year Plymouth Corporation bought the Hoe Club, a former NAAFI residential club in Plymouth. These premises are ideally situated for ready conversion into a high-quality residential hostel of university standard and also the conversion of some of the public rooms to television studios and laboratories.

The Authority is helping towards the cost of this project by making a capital contribution, equivalent to the interest on a loan of £20,000, towards the purchase of the Hoe Club. In return, the Authority will have the right to use for its students at the Polytechnic 20 single study-bedrooms to be created in the new hostel.

The Authority's Director of Engineering, Mr. Howard Steele, has recently been appointed a Governor of the Polytechnic, and a member of its Electrical Engineering Advisory Committee.

FURTHER STAGE COMPLETED OF ITA TOWER AT EMLEY MOOR

The ITA announces the successful completion of the lifting of the 180ft. steel lattice top section of the new Emley Moor aerial support tower. This 50-ton section, carrying the UHF transmitting aerial panels, was assembled at the base of the 900ft. concrete tower – the tallest structure of its type in the United Kingdom – and has been lifted up through the tower and now fixed into position. It is believed to be the first time such a lifting operation has been attempted. The ITA hopes to bring the new UHF aerials into operation early next Spring.

ELECTRO-LUMINESCENT DEVICES

by

J. B. DANCE, M.Sc.

Electroluminescent devices are assuming a continually increasing importance in the world of electronics. In this article our contributor reviews current applications and developments

THE PHENOMENON OF ELECTROLUMINESCENCE OCCURS when a semiconductor material emits light under the influence of an electric field. There are two main types of electroluminescent device, namely electroluminescent panels and light emitting diodes (including laser diodes).

The light is emitted when free charge carriers formed by the electric field recombine. However, the physics of these processes is not very simple and readers requiring more details are therefore referred to the book by Thornton[1].

ELECTROLUMINESCENT PANELS

The construction of an electroluminescent panel is shown in Fig. 1. The phosphor film (which emits the light) is placed between two electrodes, one of which must be transparent to allow the light to escape. The whole is attached to a metal or glass supporting base sheet. A suitable alternating potential applied between the electrodes results in the emission of light.

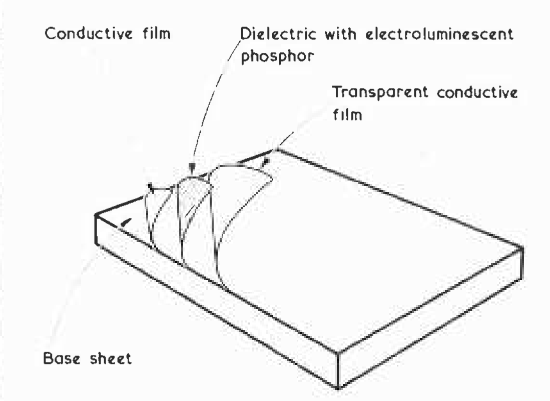


Fig. 1. The construction of an electroluminescent panel

The phosphor layer normally consists of activated zinc sulphide particles embedded in a plastic material such as polystyrene, although more robust panels can be constructed using the same particles embedded in a ceramic material. A small amount of activating impurities determines the colour of the light emitted by the zinc sulphide crystals.

The light is emitted by each crystal each time the applied voltage changes in polarity. The amount of light therefore increases with the frequency of the applied field up to frequencies of a few kHz, after which it falls with increasing frequency. The amount of light also increases with the applied voltage, provided the latter is not so great that the dielectric breaks down. The life of the panels decreases with increase of the applied frequency, but is believed to be little affected by the value of the applied voltage provided that the latter is not high enough to cause breakdown.

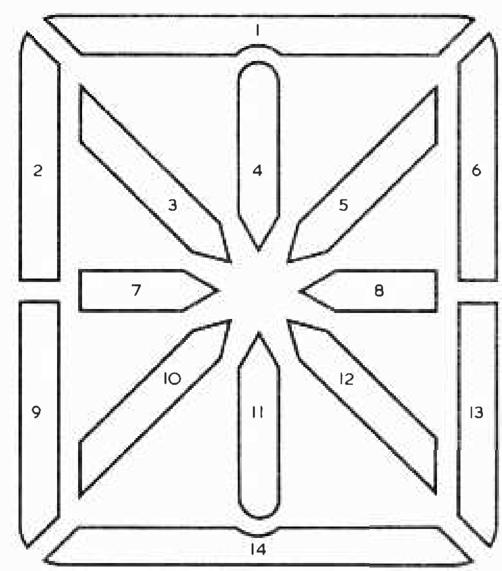


Fig. 2. A readout device using a segmented electrode

APPLICATIONS

At one time great interest was shown in electroluminescent panels, since it was hoped that they would offer an economical means of providing shadow-free lighting in rooms. However, the amount of light emitted by panels of a reasonable size is too small for this purpose and the main applications have been in display and readout devices where the amount of light required is relatively small.

A device to display any digit or letter of the alphabet may be made by dividing the back electrode of an electroluminescent panel into the pattern shown in Fig. 2. If an alternating potential is applied between the single front electrode and segments 1, 5 and 10 of the back electrode, the digit '7' is indicated. Similarly, if segments 2, 9, 14, 13, 6, 11 and 4 are used, the letter 'W' is displayed. Indicators of this type can be used in counting instruments, digital voltmeters, etc., for displaying the desired information. They have the advantages over cold cathode tube and tungsten filament lamp displays that they are much thinner and dissipate considerably less heat. However, they require a high frequency power supply (typically 250V, 500Hz) and the logic requirements tend to be more complicated than those used with other types of indicator.

The dimensions of electroluminescent panels can vary widely. In general, the 50Hz supply does not produce sufficient brilliance and a higher frequency must be employed. They do not show sudden failure (as is the case with tungsten filament lamps), but their brilliance gradually decreases with use. A life of over 10,000 hours is normal.

Large display boards containing electroluminescent panels fixed to them have certain industrial and educational uses. For example, a display panel of this nature can be used to depict the processes taking place in an industrial plant and, if fed with suitable signals from transducers, will indicate the location of a fault occurring in the plant operation. They can therefore be used to reduce the number of maintenance engineers required to operate the plant. The boards can display a variety of colours for clarity. Animation can be provided by a sequential switching device which illuminates small segments of a line in turn and gives the impression of a liquid flowing through a pipe. In another industrial application an electroluminescent panel display has been used to show the position of a crane over objects to be unloaded.

In the field of education, electroluminescent panels have applications in teaching machines. A large display board manufactured by F. W. Hopwood Developments Ltd. of Nottingham has been designed to train people to operate the Olympus fuel control system. Very thin lines of light from electroluminescent strips are used to make up graphs of the display and these graphs change as the student operates the controls.

Polycrystalline phospors are used in solid state image intensifiers[2,3] and in image retaining panels. The development of practical large, thin television screens employing electroluminescent materials still seems to be far in the future, however.

ELECTROLUMINESCENT DIODES

Electroluminescent diodes are semiconductor p.n. junctions which emit light when they are suitably biased. The colour of the light is determined by the semiconductor material used. Interest in this phenomenon was not great until Keyes and Quist found that forward biased gallium arsenide junctions would emit in the infra-red region at about 9000 Angstroms[4]. Other materials, such as gallium phosphide, emit visible light.

As shown in Fig. 3, little current will flow in a forward biased gallium arsenide junction until the bias voltage exceeds the forward breakdown potential of about 1.2V. At higher applied voltages, the output of infra-red radiation is almost proportional to the current flowing through the device. The maximum output is normally limited by the need to keep the thermal dissipation to a suitable maximum limit, but it can often be increased by mounting the device on a heat sink.

Only a very small proportion of the light generated in the gallium arsenide junction is usually able to escape from the crystal, since the material has a very high refractive index and this results in total internal reflection taking place. The overall efficiency ('external quantum efficiency') may be as low as 0.1% in a simple device. It can, however, be con-

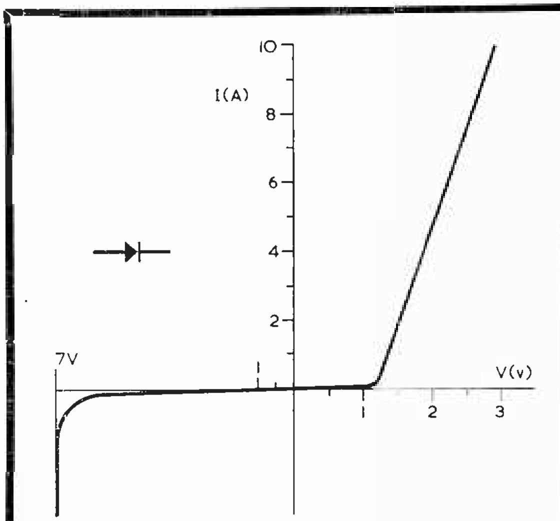


Fig. 3. The current/voltage characteristic curve of a gallium arsenide diode

siderably increased by incorporating the junction in a hemispherical crystal so that the radiation strikes the surface of the crystal normally and total internal reflection does not occur. Alternatively the device may be cooled in liquid air, at which temperature the material absorbs much less of its own radiation. The more sophisticated devices offer external quantum efficiencies of well over 10%, but are considerably more expensive to produce.

Gallium arsenide infra-red emitting diodes can be used in communications networks. When compared with a normal radio network, infra-red communication has the disadvantages of being affected by heavy rain or thick fog and of being limited to line-of-sight distances. On the other hand, advantages include absence of interference (partly due to the increased directionality), simplicity and low weight. They may be used in space communication or for the rapid transfer of information between points in a computer.

The circuit of a simple infra-red transmitter is shown in Fig. 4. The sound waves which strike the microphone result in the current through the emitting diode being modulated and hence the intensity of

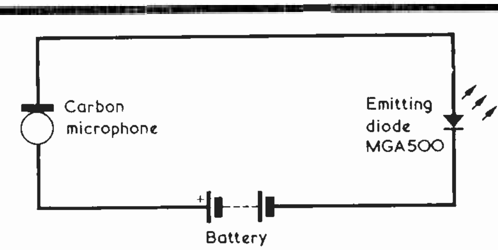


Fig. 4. The circuit of a very simple infra-red transm. 'er

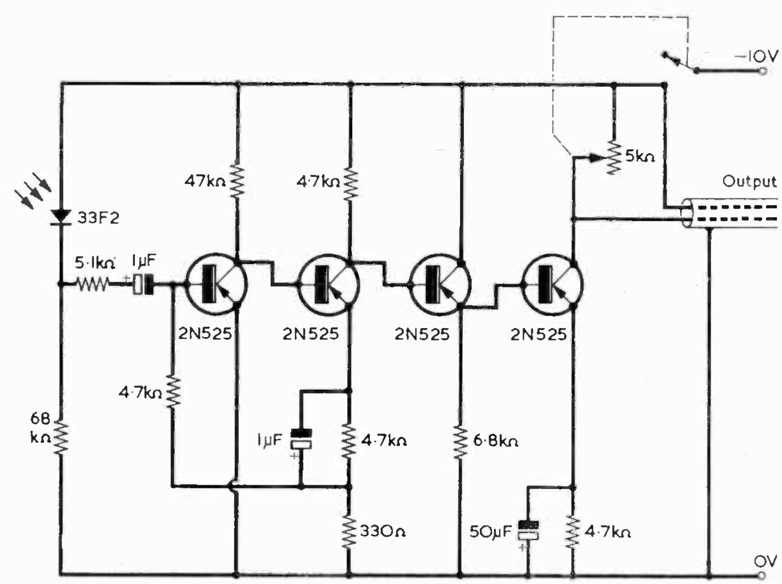


Fig. 5. An infra-red receiver for audio modulated signals

the output radiation is modulated. More complicated circuits offer a better performance. A simple infra-red receiver is shown in Fig. 5[5]. It consists of a suitable silicon diode and a transistor amplifier. A suitable lens should be used to focus the light from the transmitter into a beam, whilst a similar lens should be used at the receiver to focus the light onto the detecting diode. The modulation frequencies used need not be limited to the audio range; bandwidths up to at least some hundreds of MHz can be obtained in a well designed system which can therefore be used as a television link[6]. (The GaAs radiating diode type MGA500 and the silicon diode type 33F2 are both available from M.C.P. Electronics Ltd., Alperton, Wembley, Middlesex.)

Suitable gallium arsenide diodes can be used as lasers at currents exceeding the laser threshold value. The writer has already covered lasers in detail in this journal[7] and therefore little will be repeated here on laser diodes. Gallium arsenide laser diodes can be used in communications networks under pulsed conditions at room temperature or under continuous conditions at liquid air temperatures. At room temperature a current exceeding the laser threshold current will produce excessive thermal dissipation if continuous operation is attempted.

Gallium arsenide diodes may also be used with a silicon photodiode as coupling devices. When a control current flows through the gallium arsenide diode, the resulting current flowing through the silicon photodiode can be used to control another circuit. The two diodes are connected by a light pipe and are placed in a light-tight enclosure; they may be connected in circuits which have a potential of 100kV or more between them. Such techniques therefore provide a convenient means of controlling a circuit which is at a high potential.

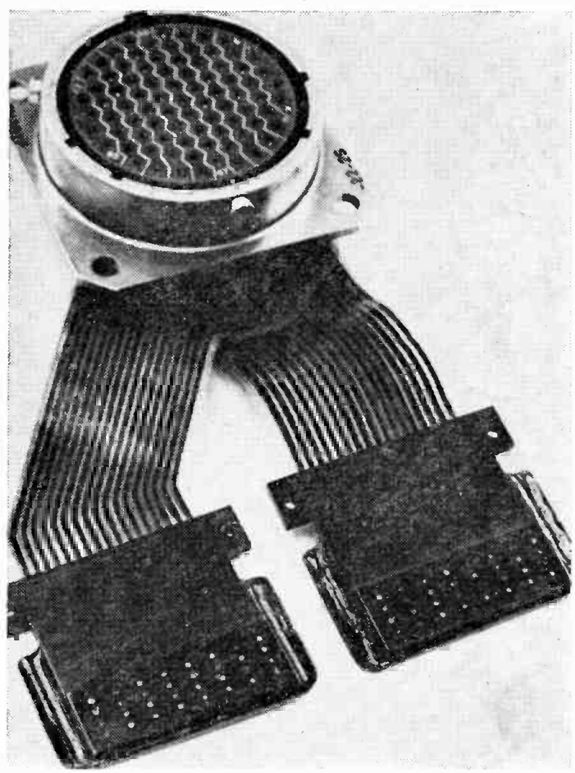


Fig. 6. The Ferranti XPA95 array of gallium phosphide lamps which are intended for use with aerial reconnaisance films.
(Courtesy: Ferranti Ltd.)

GALLIUM PHOSPHIDE

Suitable forward biased gallium phosphide diodes emit visible light. The colour of the emitted light varies with the doping impurities present in the gallium phosphide. Zinc and sulphur impurities can produce green light, whilst zinc and oxygen can produce red light.

Gallium phosphide lamps are used for placing digital information on the edge of a photographic film. For example, the array of lamps shown in Fig. 6 may be used for placing an array of dots on an aerial reconnaisance film, the position of the dots conveying information about the position and the height of the aircraft at the time the photograph was taken. Gallium phosphide lamps are used in a variety of other applications[8], such as f.m. tuning indicators, indicators for showing the state of logic circuits, etc.

GALLIUM ARSENO-PHOSPHIDE

Single crystals of gallium arseno-phosphide can be used in the form of junctions as emitters of visible radiation. The formula is GaAs P x (1–x). If the value of x is small, the material behaves like gallium phosphide, whilst if x is nearly unity, the material emits in the infra-red region like gallium arsenide. If x is suitably chosen, a red emitting material can be formed which offers an efficiency considerably greater than that of gallium phosphide.

A digital indicator employing gallium arseno-phosphide is shown in Fig. 7. The lower part of the photograph shows an array of 28 diodes which are indicating the digit '8'. Any other digit can be indicated by a suitable selection of the diodes which are illuminated. The diode on the lower left-hand side is offset and is used to indicate a decimal point when a number of these digital indicators are placed side by side. The input to these decoders is in binary-coded decimal form (in which each decimal digit is represented by a group of four binary digits) and is fed to the integrated circuit decoder shown in the upper part of the photograph. The power supply required is 5V at a maximum of 500mW per digit. The power consumption is approximately equally divided between the integrated circuit decoder and the luminescent diodes.

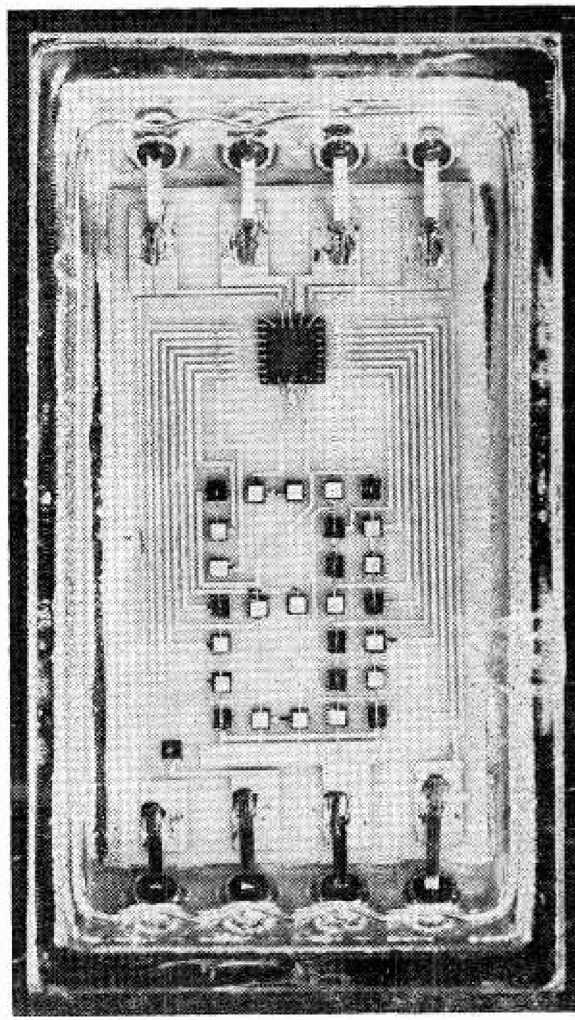


Fig. 7. The interior of a solid state indicator employing gallium arseno-phosphide light emitting diodes. The diode array in the lower part of this photograph is showing the digit '8'. (Courtesy: Hewlett-Packard Ltd.)

OTHER DEVICES

The efficiency of gallium phosphide diodes is not great enough for them to be used as lasers, but laser action has been found in a variety of materials such as indium phosphide, indium arsenide, etc.

Silicon carbide can emit light in a variety of colours – a fact which was known as long ago as 1923[9]. However, the efficiency is rather low and few applications have been found for this material.

Gallium phoshide avalanche diodes are operated in the reverse biased mode. They can provide light pulses of a rise time less than 1 nanosecond and are therefore used in the testing of fast light detectors, such as photomultipliers.

CONCLUSIONS

Electroluminescent devices have a very wide variety of applications, especially in readout circuits. They are more expensive than tungsten filament lamps, but they are used where a fast, low-power device of the greatest possible reliability is required. ■

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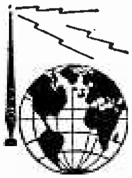

QSX

by

FRANK A. BALDWIN

● AMATEUR BANDS

Activity on these bands has been very high in recent weeks with the advent of various contests. These contests invariably bring a whole host of Dx stations on the air within a comparatively short space of time, the fun being fast and often furious.

At the time of writing, a lot more contests are yet to take place and the writer, in company with many other SWL's, will be eavesdropping for at least some of the time on the appropriate frequencies.

1.8MHz

The level of CW activity has most certainly risen on this band in recent weeks, the following being heard between about 2130 to 2230.

CW: DJøMR, DL1VW, DL9KRA, EI9BG, EI9H, GI3VGZ, GM3IKD, GW3KGD, OE3HSA, OK1ARA, OK1JCC, OK1JIH, OK1JIR, OK1KRS, OK2BNZ, OK2PDJ, OK2PDN, OK2SFP, OK2TOA, OK2VX, OK3YBQ, OK3YCF, OK5KUF, OK5KVG, OL5ALY, OL5AXQ, OL6ANS.

7MHz

Only two short sessions were spent on this band owing to limited time and the attractions of other bands.

CW: KP4DFA, PY1DDI, VE3DAO, YN1CW (**7035kHz** at 0320), 7XøRW (**7010kHz** at 0325).

14MHz

As is usual throughout the year, this band continued to provide much of the Dx fare, the past few weeks being no exception to the general rule.

CW: AX3YD, AX4TY, CE2PN, CE8AA, CO3VM, CR6AL, CR7FM, HC6CL, LU8DSA, LU8FBH, PZ1AV, TU2CX, VK2BWC, VK7KB, ZLøPH, ZL1PH, ZM3VZ, ZM4HZ, 6W8GE, 8R1X.

SSB: CE6GB, CR4BC, ET3DS, HP1JI, JA3ERG, KP4DGK, KZ5EE, LU8FT, PJ2HT, PY8MG, PZ1AV, PZ1CL, TR8JM, VK2XG, VR2CC, ZP5CE, 8P6CC, 8R1U.

21MHz

Activity on this band has been at a high level during late afternoons and early evenings for those who could spare the time to listen in – this not being the case here unfortunately!

CW: JA1XOL, JA9ZZV.

SSB: CR6GA, EL2BV, FB8XX, JA3MTV, JA3TPG, JA3WQQ, JA4PUR, JK1KRV, VP9DX, 9J2PV.

28MHz

This band is usually 'dead' or conversely 'wide open'. Of late several 'wide open' conditions have fortunately coincided with listening sessions, using the SSB mode.

CW: JW5NM, 9J2JY.

SSB: AX6CT, CR6CA, CR6HH, CR7IK, CW8CZ, FG7XT, KP4AST, MP4BBA, MP4BHL, PJ8AR, TA3HC, VP9DX, VU2BEO, ZE1BP, ZS5XA, 5J3CC, 9C9DX, 9C9TW, 9E3USA, 9J2DT.

● BROADCAST BANDS

The 'season' for best reception of Asian stations on the LF bands is now at its height. Some of those logged to date are listed below.

● ASIAN STATIONS

3200kHz 2025 Peking, China, with talk in Chinese vernacular.

3400kHz 2005 Fukien, China, talk in local dialect (?) and music.

4823kHz 1456 Hanoi, North Vietnam, discussion (?) in Vietnamese.

4845kHz 1520 Penang, Malaysia, with songs and music in Asian style.

4865kHz 1540 Peking, China, programme of Chinese songs and music.

4907kHz 1502 Radio Cambodia, Phnom-Penh, radiating a drama interspersed with the sounds of gongs and clashing cymbals.

4915kHz 1507 Quetta, Pakistan, radiating the local news in English. Quetta is in West Pakistan, being situated at the end of the Bolan Pass on the road to Kandahar.

4954kHz 1525 Banda Atjeh, Indonesia, talk and announcements in Indonesian followed by music in European style. Female announcer.

5084kHz 1537 Medan, Indonesia, programme of songs in Arabic style by female singer. This station was heard continuously from 1537 to 1615 when the writer went QRT. Most Indonesian stations close at 1600 but this one is presumably an exception. Medan is the capital of East Sumatra.

5052kHz 1532 Radio Singapore broadcasting the news in English, read by female announcer. At 1530 there are six 'pips' and the station identification, in English, can be heard.

● LATIN AMERICAN STATIONS

3380kHz 0502 OAX10 Chiclayo, Peru, programme of Andean music and closing. No National Anthem.

4772kHz 0235 YVQE Ciudad Bolivar, Venezuala, Latin American style music followed by station identification 'Radio Bolivar'. Ciudad Bolivar is a seaport on the River Orinoco in the state of Bolivar. An earlier name for C. Bolivar was Angostura.

4790kHz 0510 HCVP2 Emisora Atalaya, Ecuador, with a 'futebol' commentary. Extended schedule.

4830kHz 0215 YVOA San Cristobal, Venezuala, with station identification 'La Voz de Tachira'. San Cristobal is the capital city of the state of Tachira.

4840kHz 0220 YVOI Radio Valera, Venezuala, station identification followed by newscast in Spanish.

4870kHz 0155 YVKP Radio Tropical, Caracas, Venezuala, programme of typical Latin American music and station identification.

4910kHz 0530 HCMJI Emisora Gran Colombia, 'futebol' commentary, on extended schedule.

4917kHz 0225 HCAH3 Radio El Trebol, Zaruma, Ecuador, programme of Latin American songs and music.

4923kHz 0244 HCRQ1 Radio Quito, Ecuador, with opera selections.

5010kHz 0530 HIMA Radio Cristal, Santo Domingo, Dominican Republic, with full station identification and closing with National Anthem.

6082kHz 0305 OAX4Z Radio Nacional, Lima, Peru, with newscast in Spanish.

● BEGINNERS CORNER

If you are just beginning with Broadcast bands listening, try the following relatively 'easy-to-get' stations.

11900kHz 2030 Johannesburg, S. Africa, English programme.

15155kHz 2030 Windward Islands Broadcasting Service, Grenada, English programme.

15325kHz 2100 Radio Canada, English programme.

● LATE NEWS

Reader B. Walsh of Romford, Essex tells me that he has heard R. Lebanon with a programme in English which is beamed to Africa every evening from 1830 to 1900 on the unlisted channel of **11705kHz.**

Just for a change, try the 'offbeat' frequency of **11322kHz,** where Angkatan Udara can be heard closing at around 1400. ■

FIRST MOBILE RADIOTELEPHONES FOR LONDON BUSES

The 'Star' radiotelephone is mounted in the driver's cab, with the loudspeaker at about ear level. Extraneous noises from the traffic and the engine are suppressed to a large degree by the noise-cancelling microphone

THE BENEFITS TO BE DERIVED FROM THE USE OF mobile radiotelephone communications are nowhere more apparent than with road passenger services. There can be little doubt that some form of instant communication between service vehicles and a control centre would go a long way towards easing operator's problems. Faced with the perennial situation of growing traffic density, and the inevitable fluctuations in passenger load factor, an increasing number of passenger transport authorities are beginning to recognise that here is an invaluable aid to operational efficiency.

With a radiotelephone in his cab a driver is no longer dependent upon roadside telephones if he needs to communicate with base – to exchange operational information or receive instructions from area control, and to report incidents or emergencies that might affect efficient operation.

Two-way radio communication is already gaining popularity on the Continent, where already many bus services have had the system installed. Stockholm's fleet of 700 buses, for example, all carry radiotelephones. In the UK a number of operators are at present conducting trial programmes.

After an extensive period of trials, London Transport have chosen STC's 'Star' equipment for a pilot scheme involving the first regular in-service use of radiotelephones in London buses, enabling drivers to communicate directly with the route controller located at Mansion House, in the City.

The base radio station situated on Highgate Hill is in a commanding position for the whole of London.

Twenty-five vehicles operating on routes 74 (between Camden Town and Putney Heath) and 74B (between Camden Town and Hammersmith Broadway) have had the equipment fitted. The radiotelephone is mounted in the driver's cab with the loudspeaker unit at about ear level. The equipment will be used by the driver only when the bus is stationary, either at normal stopping points or, in special circumstances, when he has brought the bus to a stop.

This pilot scheme will enable London Transport to assess the benefits to be derived from the wider use of two-way radio communications in control situations throughout the whole London area.

Operation in the u.h.f. band ensures maximum signal penetration in areas that, because of fading, are notoriously difficult for radio communication at lower frequencies – under bridges, in underpasses and in the radio 'shadow' of large metal-framed buildings. With the base station aerial suitably positioned, Star u.h.f. equipment will maintain clarity of signal throughout the whole of any major city. The very small aerial needed at these frequencies can be mounted on the bus roof without risk of damage.

The noise-cancelling microphone again proves particularly effective in the cab, reducing the level of traffic and engine noise relative to the driver's voice. – *STC Quarterly Review.* ■

In your workshop

This month, as is fitting at the start of a New Year, Smithy turns his attention to the more elementary aspects of servicing, dealing in particular with simple servicing aids which can be home-constructed

"WHY," COMPLAINED DICK plaintively, "does the New Year always have to start on January the First?"

"Because there's no alternative, you great twit," snorted Smithy irritably. "How on earth can the New Year start on any other day?"

"Well, I think it's a rotten arrangement," commented Dick moodily. "Like everybody else, I have my celebrations on New Year's Eve with the result that on January the First, I'm completely clapped out. I should be at my *best* at the start of a New Year, not at my worst."

Smithy turned a jaundiced eye at his assistant, who was sagging listlessly on his stool.

"I'll certainly agree," he remarked unkindly, "that you aren't, this New Year's morning, at the highly improbable condition which you refer to as your best. At the same time, though, you don't appear to be much below your normal general run of mediocrity."

"Well, I like that," retorted Dick, stung. "Anyway, what about *you*? Nobody would say that you represent a prime example of sprightliness and efficiency."

SERVICING AIDS

"That," returned Smithy sternly, "is not the way to talk to your guv'nor. However, I will concede that, like you, I did stay up a little later than usual last night because it was New Year's Eve. And I must confess, also, that I'm suffering a wee bit this morning in consequence. Anyhow, seeing that we've both been in the Workshop for at least ten minutes or so and have had a chance to discuss our various indispositions, I would suggest that we next get down to a spot of work."

"There isn't any," replied Dick promptly. "We cleared out the last set yesterday evening. Don't you remember?"

"Why of course, so we did," said Smithy, visibly elated at this item of news. "Then, perhaps, this might be a good time to have a discussion on odd items of test gear which we can use for future jobs in the Workshop."

"Do you mean testmeters and things like that?"

"I wasn't thinking of manufactured stuff," replied Smithy "What I had more in mind was home-made gear. It's surprising how many items of home-made equipment can be used to supplement the standard test gear employed for servicing."

"I think I can see what you're getting at," said Dick, brightly. "You're referring to things like our Heater Checker Box, aren't you?"

It was obvious that the prospect of a technical discussion had caused Dick to discard his previous gloomy mood.

"That's right," confirmed Smithy. "That Heater Checker Box is an excellent example of a really useful bit of home-made gear. We've been using it for ages now and it must have repaid the small amount of time expended on its construction over and over again. Its main purpose is, of course, to check the heaters of individual valves in open-circuit TV heater chains. As you know, it consists merely of a 0-10mA meter, a 910Ω resistor and a PP3 9-volt battery, all of these being fitted inside a wooden box with a B7G, a B9A and a B10B valveholder mounted on the front. The pins of the valveholders which are normally used for heater connections are connected in parallel, with the resistor, meter and battery in series." (Fig. 1).*

"I must say," returned Dick warmly, "that it's just the job for finding which heater has burnt out in a TV heater chain. All you've got to do is bung each valve into its appropriate socket on the box and see whether the meter gives a reading or not. It takes ages, otherwise, checking for open-circuit heaters with a testmeter when you're holding its test prods against the heater pins of each valve."

TUNING WAND

"True," agreed Smithy. "And, to round off the story, we added the B10B socket to the box after the PFL200 double pentode started appearing in British TV sets. Anyhow, that's *one* little item of home-made test gear, and it's one which is well worth putting together by anyone who does a lot of TV servicing. Another handy little gadget, which can be used both for TV and radio, is the tuning wand."

"Tuning wand?"

"Tuning wand," repeated Smithy. "I used to have a tuning wand in the Workshop, but it seems to have got lost. It wouldn't be a bad idea if, at some time, you knocked up another one."

"What exactly *is* a tuning wand?"

"It consists," replied Smithy, "of

*Smithy's Heater Checker Box was previously mentioned in the July 1967 issue—Editor.

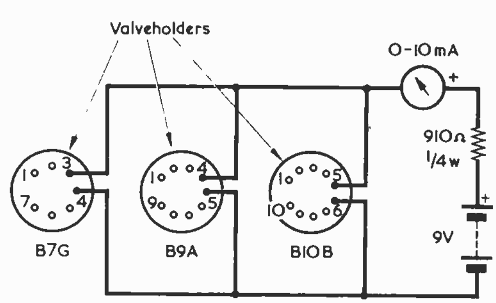

Fig. 1. The circuit of the Heater Checker Box employed in the Workshop. This enables the heaters of individual valves in an open-circuit TV series heater chain to be quickly checked. The meter can be an inexpensive surplus type

a round stick of insulating material, with a brass cylinder fixed to it at one end and a piece of iron-dust material of similar shape fixed to it at the other. Like this."

Smithy drew out his pen and sketched the outline of a tuning wand on his note-pad. (Fig. 2.)

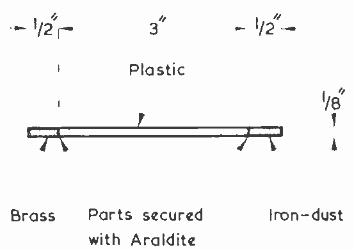

Fig. 2. A tuning wand suitable for most present-day coils. This is circular in section along its whole length. The dimensions given are not critical

Dick carried his stool over to Smithy's bench, then gazed interestedly at the Serviceman's pad.

"There you are," said Smithy, returning the pen to his pocket. "That's what a tuning wand looks like."

"What's it used for?"

"To check the condition of tuned circuits which are suspected of being off-resonance," replied Smithy. "A typical instance occurs when you have a sound radio i.f. coil which you think may be a little out of alignment. What you do first of all is to tune the receiver to a weak signal which will not produce a high a.g.c. voltage, then insert the iron-dust end of the tuning wand into the coil former. (Fig. 3.) If the signal level increases when the wand is inserted then the appropriate i.f. tuned circuit wants a little more inductance or parallel capacitance to bring it on to the correct frequency. If the signal level goes down, then the tuned circuit doesn't require increased inductance or capacitance."

"That seems to be easy enough," responded Dick "What about the brass end of the tuning wand?"

"If the process of inserting the iron dust end into the coil merely caused a reduction in signal strength," said Smithy in reply, "you then insert the brass end. The piece of brass reduces the effective inductance of the coil whereupon, if signal level increases when the brass end is inserted, this means that the tuned circuit requires reduced inductance or capacitance to bring it on to the correct frequency. On the other hand, if inserting the brass end merely causes signal level to fall, this shows that the tuned circuit is spot on tune, because the previous check with the iron-dust end also caused the signal level to fall. The main disadvantage with the tuning wand is that the brass end usually causes a much smaller change in inductance than does the iron-dust end, so that the wand doesn't always give you conclusive results. This is particularly true if the iron-dust core of the coil you're checking is so positioned that it prevents the brass end getting close to the winding. Nevertheless, a tuning wand can be a really useful gadget once you've got used to how it works. It's particularly good for locating false central peaks."

"What are they?"

"They're the peaks you get if a core is dead central in its coil," said Smithy, "and when the tuned circuit still wants a little more inductance or capacitance to become resonant at the right frequency.

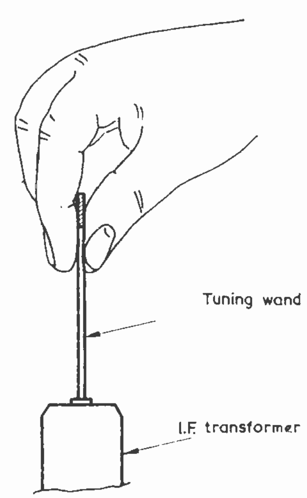

Fig. 3. Inserting the iron-dust end of the tuning wand into an i.f. transformer. This causes the inductance of the coil into which it is inserted to be increased

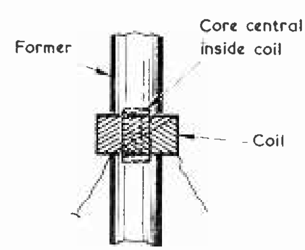

Fig. 4. If a core is centrally disposed inside a coil which requires just a little more inductance or parallel capacitance to be resonant at a desired frequency, it may give the effect of a 'false peak'

(Fig. 4.) Since the coil is passing the maximum signal of which it is capable when the core is adjusted to the central position, it is possible to obtain the impression that the core is at a true resonant peak. Inserting the iron-dust end of the tuning wand will soon indicate the presence of the false peak, because it will cause an increase in signal strength."

"I think I'll make up one of these wands," said Dick. "What materials should I use?"

"The insulated centre section," replied Smithy, "can consist of a piece of plastic knitting needle of about the diameter I've shown in my sketch. You can make the brass bit by cutting off and filing down the shank of a brass bolt of suitable size. The iron-dust piece is given by filing down an iron-dust core. The parts are then all stuck together with Araldite, being held in place whilst the adhesive sets by laying them in a fold in a piece of corrugated paper. The paper will stick to the Araldite but it can soon be removed afterwards by a judicious touch of the file. Assembling a tuning wand is rather a fiddling process, I'm afraid, but the results it offers are well worth the trouble. By the way, the dimensions I put on my sketch are only approximate, and you don't have to stick closely to them."

FERRITE AERIALS

"It looks," said Dick enthusiastically, "as though I've got myself a little job to do in the future. I've got a plastic knitting needle of just about the right thickness knocking around which I use for poking at things inside sets. I could spend my next bit of spare time in making up a tuning wand."

"It would be more to the point," retorted Smithy testily, "if you devoted the time to taking our Christmas decorations down."

A little wearily, the Serviceman looked around the Workshop. The decorations in question, so enthusiastically put up by Dick on Christmas Eve, were still in place and gave the Workshop a raffish appearance which ill befitted the proper dignity which should appertain to an electronic servicing establishment. Smithy's eye fell on the large red balloon at the centre of the ceiling. Due to gradual deflation this was now beginning to assume a shape of disturbing grotesqueness.

"What?" queried Dick incredulously, as he leaped to the defence of his beloved decorations. "Take them down already?"

"Of course," returned Smithy irritably. "Blimey, it's New Year's Day now."

"But," retorted Dick, shocked, "you must never take down Christmas decorations until Twelfth Night."

"Twelfth Night?" repeated Smithy, bemused at this unexpected avenue of argument. "When's Twelfth Night?"

"It's the eve of Twelfth Day, which is twelve days after Christmas."

Smithy sighed.

"I'm afraid I don't feel in the mood for counting the days from Christmas."

Dick rose, walked over to his bench, and rummaged in a drawer.

"Hang on a jiffy," he called out. "I'll tell you the exact date in a moment."

After further searching, Smithy's assistant pulled out a large calender which he next proceeded to consult.

"Twelfth Night," he pronounced, as he counted the dates, "is on January the 5th."

Now that the preferred date at which Christmas decorations should come down had been established, Smithy turned to his assistant, who was in process of hanging the calendar on the wall over his bench. At sight of the calendar, Smithy's jaw sagged.

"What d'you think of it?" said Dick proudly.

Speechlessly, Smithy gazed wide-eyed at the large picture which graced the upper part of his assistant's calendar. The lady who prevailed over the dates of January 1971 could certainly be described as being of generous disposition. Furthermore, the reproduction on the calendar clearly demonstrated the excellent craftmanship of the modern colour printer so far as the rendering of flesh tones over large areas is concerned. To borrow from the phraseology of both the mechanical engineer and the present-day film director, it could also be stated that the lady had adopted a pose equivalent to 180° orientation from full frontal nudity.

"Bit of all right, isn't it?"

"It's disgusting," snorted Smithy, as he finally recovered his voice. "You surely don't think you're going to put *that* picture up here, do you?"

"Of course I'll put it up. We needed a calendar for 1971 and this is it."

"Much as I appreciate your generosity in providing the calendar," returned the deeply perturbed Serviceman, "I hardly feel that the picture it displays is in keeping with the character of our calling."

"You've not seen anything yet," replied Dick cheerfully. "This is only the January picture. Wait till you see the one for December!"

Smithy winced at the thought of revelations to come. Had he been in more robust mood he would have returned immediately to the attack, both with respect to the calendar and to the decorations. But he was weakened by his activities of the night before, and he decided to retreat to a world where he was more in command of events.

"Let's get back," he said hastily, "to the checking of resonant circuits."

"As you like," replied Dick equably. "Have you got any more gen on tuning wands?"

"I've finished on that subject," said Smithy, as he collected his sadly scattered wits. "Now, let me think for a moment. Ah yes! I'll carry on next to a simple dodge which enables the resonant frequency of a ferrite rod aerial in a transistor superhet to be checked. This uses roughly the same basic principle that is employed by the tuning wand."

"Does this dodge require making up any test gear?"

"Not a great deal," replied Smithy. "All you need basically is a spare ferrite rod and a bit of tinned copper wire soldered to itself in the form of a shorted turn. We'll start by considering the ferrite aerial in the receiver first. This will normally consist of a ferrite rod with separate medium and long wave coils on it or, perhaps, just a medium wave coil on its own. The ferrite rod tuned coil in use is connected to the signal frequency section of the receiver two-gang tuning capacitor and is intended to be resonant at the frequency being received. This necessitates two alignment adjustments. At the high frequency end of the band being received, a small trimmer across the coil and tuning capacitor is adjusted for maximum signal strength. At the low frequency end, the inductance of the coil is similarly adjusted for maximum signal strength. The ferrite rod aerial coil should then track with the oscillator tuned circuit over all the band in between."

"That inductance adjustment," observed Dick, "is, of course, carried out by sliding the coil along the ferrite rod."

"Exactly," confirmed Smithy. "Moving the coil towards the centre of the rod increases the inductance, and moving it away from the centre decreases it. Now, you sometimes encounter a receiver in which the coil or ferrite rod is mounted in an awkward position or where the coil is very tight on the rod and is difficult to move."

"I've had some of those," broke in Dick. "They're a menace, because you can't always be certain that the coil is in exactly the right position on its rod for correct tracking. Unless you're prepared to go to a lot of trouble, you just have to assume that the coil has the proper inductance."

"Well, you don't have to make any such assumption," said Smithy, "if you follow the little dodge I'm now going to describe. When you have a receiver of the nature we're discussing, you first tune it at the low frequency end of the band to a weak signal which hasn't sufficient strength to cause the appearance of a large a.g.c. voltage. If you can't find a signal that is weak enough, you tune in a strong signal and make it weaker by suitably rotating the receiver. You then bring a spare ferrite rod up to the rod in the set, holding it so that the two rods are parallel (Fig. 5 (a).)

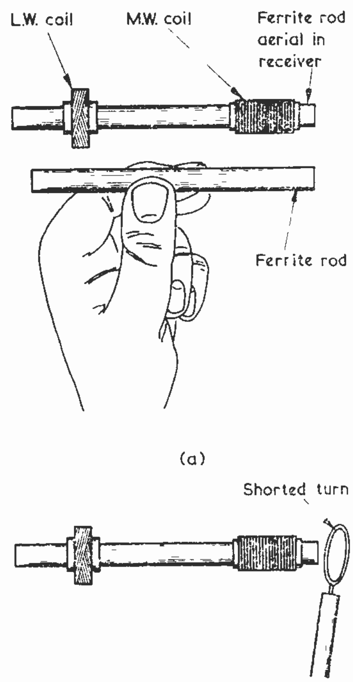

Fig. 5(a). Bringing a second ferrite rod up to the ferrite rod aerial of a receiver causes the inductance of all coils on the rod to be increased
(b). The inductance of a ferrite rod coil can be reduced by bringing a shorted turn close to the end nearer the coil. Here, the inductance of the medium wave coil is being reduced

If signal strength increases as the spare rod approaches the one in the set then the ferrite rod aerial coil requires more inductance and needs to be shifted towards the centre of its rod. If signal strength merely decreases, then you know that the ferrite rod tuned circuit doesn't, at least, require more inductance. After that, you remove the spare ferrite rod and take up a shorted turn of wire, the turn having a diameter of about three-quarters of an inch. Bring this up to the end of the receiver ferrite rod which is nearer the coil being checked. (Fig. 5(b).) If signal strength increases as the shorted turn approaches the end of the rod then the receiver coil requires less inductance and needs to be shifted towards the end of the rod. If signal strength merely decreases, this check, combined with the previous one, then assures you that the ferrite rod coil has exactly the correct inductance and doesn't require adjustment."

"Blimey," remarked Dick, impressed. "That *is* a knobby idea."

"It's an idea which works surprisingly well in practice," said Smithy. "In fact even with receivers where the coil is readily accessible and free to move along its rod it's frequently quicker to use this method of checking than it is to actually move the coil. I'd advise you to practice with the method on several serviceable receivers to get the feel of it before using it for actual servicing. Try the effect of the rod and the shorted turn after you have deliberately misplaced the coil being checked."

"I'll do that," confirmed Dick. "What's more, I think I'll make up the shorted turn on the end of an insulated handle."

"You could do that," agreed Smithy. "A thin handle about four inches long would be just the job and would enable you to poke the shorted turn into awkward corners." (Fig. 6.)

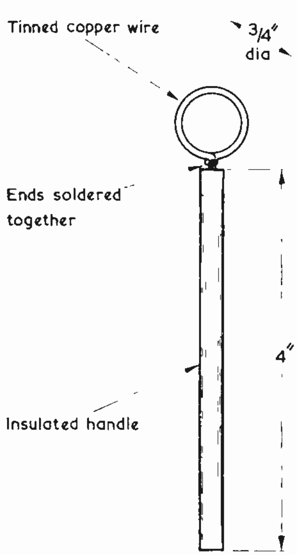

Fig. 6. It is helpful to have the shorted turn mounted on an insulated handle, as shown here. The dimensions are approximate only

VOLTAGE MONITOR

"Are there any other items of home-constructed test gear you can think of?" queried Dick.

"There are quite a few," replied Smithy. "For instance, there are more complex things, such as grid-dip oscillators and signal tracers. However, we haven't got time to discuss these today. Another useful gadget, and one that is more simple, is a voltage monitor for intermittent faults. If an intermittent snag causes a change in voltage this can be detected by the monitor, which then gives you warning that the fault has appeared. Funnily enough, I knocked up just such a gadget during the quiet spell we had immediately after Christmas."

Smithy leaned over and pulled out a small piece of apparatus from the rear of his bench. Dick returned to Smithy's bench and looked at Smithy's handiwork with interest. The voltage monitor was assembled on a small plywood baseboard. On this stood a family of Ever Ready batteries and a groupboard carrying four transistors and two resistors. A small metal front panel was screwed to the baseboard and on this were mounted a two-way rotary switch and two wirewound potentiometers fitted with pointer knobs. There were also two small pilot lamps fitted in white bakelite holders, the latter indicating a recent visit by Smithy to the electrical counter of the local Woolworth's. As was to be expected, the layout of the monitor was very well balanced, and the neat wiring had the impeccable soldered joints which proclaimed the hand of the Master.

"Very smart," commenced Dick. "How does it work?"

"I'd better show you the circuit," said Smithy, taking from his drawer a sheet of paper on which the circuit diagram had already been drawn. (Fig. 7.) "Here it is."

Dick gazed blankly at Smithy's drawing.

"I'm a bit lost here," he remarked eventually. "What, for instance, are those two pots for?"

"They're for setting up the monitor to the voltage you're checking," replied Smithy. "Let's assume that you've got a faulty transistor receiver which occasionally ceases to work due to a snag in the i.f. or mixer-oscillator stages. You can't hang around for long periods of time waiting for the fault to appear and it would be irritating to have the set continually playing whilst you concentrated on other work. So what you do is to couple the input terminals of this voltage monitor to

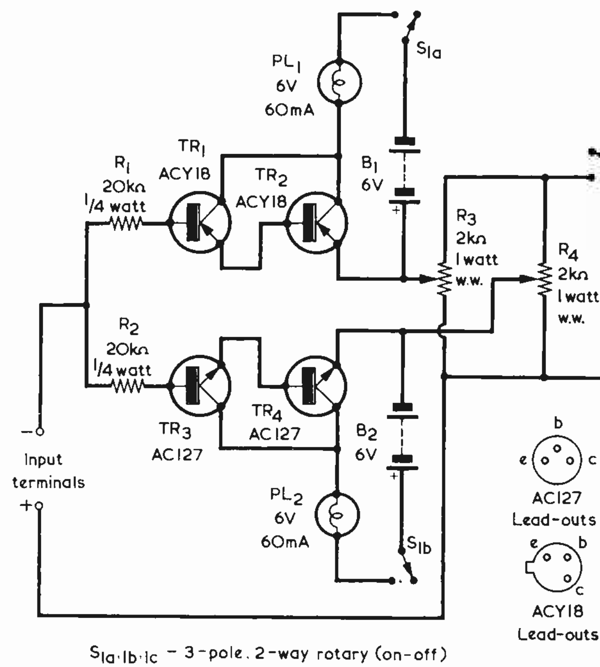

Fig. 7. The circuit of Smithy's voltage monitor, which is intended for use with transistor circuits. The two pilot lamps are available from Home Radio under Cat. No. PL7

the receiver chassis and a.g.c. line, observing correct polarity. You next tune in a signal which causes the appearance of, say, about one volt positive of chassis on the a.g.c. line, then turn down the volume on the receiver. The monitor is then switched on and set up, the two pots being adjusted so that both the bulbs are just short of glowing."

"What happens then?"

"Nothing," replied Smithy, "until the fault in the set comes on. If it does, and the a.g.c. voltage falls, the potential on the negative input terminal of the monitor approaches that on the positive input terminal, whereupon the Darlington pair given by TR3 and TR4 become conductive and pilot lamp PL2 lights up to provide warning that the fault in the set has appeared. It's possible that the intermittent snag could consist of self-oscillation in the r.f. or i.f. stages, whereupon the a.g.c. voltage would *increase*. This time the negative input terminal of the monitor goes more negative with respect to the positive input terminal. The Darlington pair given by TR1 and TR2 then conduct and pilot lamp PL1 lights up."

"Stap me," said Dick, as realisation flooded in, "this monitor works in *both* directions. It gives you warning when the monitored voltage decreases and also when it increases."

"That's right," said Smithy. "TR1 and TR2 are a pair of p.n.p. germanium transistors whilst TR3 and TR4 are n.p.n. germanium transistors. To take another example, let's say that the voltage applied to the two input terminals is 4.5, which is just half the voltage across the two potentiometers. If we take R3 slider down to the positive end of its track, both TR1 and TR2 come on and PL1 lights up. The slider of R3 is then taken slowly upwards. As it closely approaches the centre of the track PL1 will begin to dim, and will extinguish when the slider is tapping off a voltage which is about 0.3 volt positive of the potential on the negative input terminal. This 0.3 volt is given by the drop in the base-emitter junctions of TR1 and TR2. TR3 and TR4 work in the opposite direction and cause PL2 to light up when the slider of R4 is at the *top* of its track, at the negative end. As the slider of R4 is gradually brought down its track, PL2 will begin to dim at a position close to the centre, and will finally extinguish when the slider of R4 is about 0.3 volt *negative* of the voltage on the negative input terminal."

"I can see it all now," exclaimed Dick. "When you've got the pots set up in the manner you've just described, it only needs the negative input terminal to go a little further negative for PL1 to light up. Or to go a little positive, whereupon PL2 lights up. One thing that puzzles me, though, is why you used two pots. Couldn't you have joined the emitters of TR2 and TR4 together and connected them to the slider on just one pot?"

"I could have done," said Smithy, "but the monitor would then have been less sensitive. This is because the voltage being monitored could change by at least 0.3 volt in either direction before even the base-emitter drops in the associated pair of transistors were overcome. With the present arrangement the bulbs light up to *full* brightness for a voltage change of only some 0.5 volt in either direction. If you like, you can increase sensitivity by initially adjusting R3 and R4 so that the bulbs are just visibly glowing. They'll achieve full brightness then for a change in voltage of about 0.3 volt only."

BATTERIES

Dick looked critically at the monitor.

"It needs rather a few batteries, doesn't it?"

"It does rather," admitted Smithy, "but they should have a long life. Negligible current is drawn from batteries B1 and B2 when the pilot lamps are not illuminated, and these could be Ever Ready type PP1 or similar. A current of 9mA is drawn from battery B3, and I've used two 4.5 volt bell batteries in series here. These are Ever Ready type 126, which is the long rectangular type with two brass terminals on the top. Incidentally, the monitor doesn't need to have batteries permanently fitted. Since it will only be employed occasionally, it could have batteries connected to it just when it was actually being used."

"Wouldn't it be better to use a stablised mains supply instead of B3? After all, B3 *does* provide the reference voltage."

"You could use a mains supply if you like," agreed Smithy, "but I think it would add too much complication to a simple device. A battery should be adequate enough for the infrequent periods when the monitor will be used."

"What about pilot lamps PL1 and PL2?"

"Those are 6 volt 60mA types," replied Smithy. "Bulbs drawing higher currents shouldn't be used as they'd cause rather more dissipation in TR2 and TR4 than is desirable. With the circuit as it stands TR2 and TR4 don't need heat sinks."

"Fair enough," said Dick. "Well, that monitor certainly looks like being a useful item of equipment."

"I must hasten to point out," stated Smithy, "that it has one or two limitations. For instance, it will only monitor voltages between about 0.6 and 8.4 volts if you want to provide a check for voltage change in both directions. Also, it is necessary to avoid applying voltages to its terminals which would cause the maximum reverse emitter-base potentials of the transistors to be exceeded. With the ACY18 the maximum reverse emitter-base voltage is 12, and with the AC127 it's 10. Also, although the monitor draws negligible current from the circuit being checked when the voltage is correct, it does require a small current, of about 20μA, from that circuit if the appropriate lamp is to light up under fault conditions. In consequence, the circuit being monitored should be of the medium to low impendance variety."

"So far as I can see," said Dick, "those limitations will only be serious if you use the monitor with valve circuits. They shouldn't matter a great deal if you use it to check transistor circuits."

"That's correct," agreed Smithy. "And it was for use with such circuits that I dreamed the design up."

EARLY ENDING

Smithy rose and yawned. His eyes fell once more on the garish calendar over Dick's bench.

"I still don't consider," he remarked irately, "that a calendar like that is at all suitable for a place which carries out radio and TV servicing."

Dick grinned.

"Take a closer look," he invited, "at the bottom."

"I most certainly shall not," retorted Smithy, clearly outraged. "I wouldn't *dream* of doing such a thing."

"I mean the bottom of the picture. The name of the firm who distributed the calendar is printed there."

Smithy walked over to Dick's bench and, suitably averting his eyes, peered at the point described by Dick. He read the name of a well-known manufacturer of electronic products.

"Well, I'm blessed," he breathed wonderingly. "I would never have believed it possible."

"There you are," replied Dick in a triumphant tone. "You can't say now that that calendar doesn't fit in with radio and TV, can you?"

The crestfallen Smithy turned to another point of attack.

"At any rate," he snorted, "I can say that those Christmas decorations don't fit in here. They really *must* come down."

"Don't worry about them," said Dick soothingly. "January 5th, we said."

It was plainly not Smithy's morning.

"Oh, all right then," he conceded. "Well, there's no point in our hanging around here any longer. I'm going to lock up the Workshop and we can both take the rest of the day off."

"That," remarked Dick, getting up and putting on his raincoat, "is a bit more like the old Smithy I used to know, way back in 1970. A Happy New Year to you, Smithy!"

The sudden thought of a further twelve brand-new months stretching out before him caused Smithy to forget his present irrations, and he grinned cheerfully back at his assistant.

"And a Happy New Year to you too, my boy."

R.S.G.B. EXHIBITION

The Editor

Radio Constructor

Sir—Whatever happened to the Radio Hobbies Exhibition? All the periodicals including your own are bemoaning the fate of the Amateur Radio Exhibition (as it is now called).

Many years ago we used to have a stand there; it was always packed both the stand and the exhibition and it was great fun. Then it moved to Seymour Hall and it was even bigger and better (we could then, I regret to say, only be spectators). Then came the decline. I thought last year's exhibition so poor that I never imagined another would be attempted. This, in spite of the fact that, based on our yearly figures, the electronics hobby is growing at a tremendous rate. It seems a pity that this exhibition should disappear, and I would like to make the following suggestions:–

(1) Widen the scope to include something for *everyone* whose hobby is electronics (even include some hi-fi). When we had a stand at the exhibition we displayed electronic components generally and certainly did not confine ourselves just to the items that would interest the "Ham" fraternity. We even had crystal sets for schoolboys.

(2) Hold it every other year.

(3) Hold it later in the year, say October or November.

(4) Could it not be sponsored by all the leading journals, i.e. *Wireless World, Radio Constructor, Practical Wireless, Practical Electronics, Radio Communication and Short Wave Magazine.* Even if each journal just gave some free publicity that would guarantee success!

How about it, Mr. Thorogood?

Yours faithfully,

A Sproxton, director,
Home Radio Components Ltd.

A number of letters in the same vein were received by the Radio Society of Great Britain. A reply in the following terms was published in their journal, *Radio Communication*:–

A word of explanation about the present arrangements may not come amiss. For many years the RSGB ran the exhibition at the Royal Hotel, until it outgrew the available space. With the expansion of the exhibition and the necessary move to larger premises, the Society was not able to accept the financial risk or provide the necessary staff and facilities. At that time, professional exhibition organizer Phil Thorogood G4KD, offered to organize the exhibition on a commercial basis, and make a payment to the RSGB in recognition of the Society's sponsorship. Since then the exhibition has survived many larger contemporaries in other fields and achieved a good deal in presenting amateur radio to the public and the radio amateur. The RSGB has always been a primary exhibitor, taking stand space at the regular rates, but with the advantage of considerable voluntary help. Indeed, without voluntary helpers the Society could not have hoped to participate at all. The economics of running an exhibition in London (or anywhere else) do not favour the small operator—in fact, from the Society's point of view the amount of voluntary effort required would make it difficult to go outside London.

It may be difficult for some to appreciate the many difficulties, both economic and practical, which face the organizer and the Society. Nevertheless it would be wrong to disregard any reaction from the membership, and foolish to imagine that all is perfect. Of the criticisms made, may we reply briefly to two of them.

(1) Content of Exhibition. *The old proverb which begins, "You can lead a horse to water . . ." is appropriate here. The exhibition is a commercial enterprise requiring that exhibitors justify the expense of their attendance—we cannot make people exhibit.*

(2) Lack of home-constructed equipment on display. *People often complain about the lack of home-constructed equipment shown, but we are mindful of the reply given by the late C. H. L. Edwards, G8TL, who, when presented with this complaint at an exhibition in the early 'sixties, enquired, "And where is your piece of equipment?"*

Exhibition Committee.

Radio Topics

By Recorder

LIFE IS FULL OF SURPRISES. After completing a little repair job the other day I was just clearing up the bench when I happened to pick up two ends of my testmeter probe leads. The testmeter needle at once rose to about a sixth of full-scale deflection.

SACRIFICIAL PROTECTION

'Well,' I can hear you say, 'what's so surprising about that? You must have left the meter switched to a resistance range with the result that it was reading the resistance of your body between your two hands.'

But I hadn't left the meter on a resistance range, I'd left it on a *current* range instead. It was switched to read 0–50μA and by merely holding the probe lead terminations I was causing it to indicate about 8μA.

After a little head-scratching I realised that I was seeing an example of the effects involved in what is known as the 'sacrificial' method of protecting metals from corrosion. One way of stopping iron boilers from rusting inside, for instance, consists of suspending a piece of zinc in the water. The zinc, which is the sacrificial metal, then corrodes away instead of the iron. For similar reasons, sacrificial metals are fitted to the hulls of small boats or are buried in the earth alongside pipe lines. There is an electrical reason for the sacrificial metal corroding instead of the metal which is being protected, and the two metals are looked upon as forming the plates of a cell.

The positive lead of my testmeter is terminated in a brass probe whilst the negative lead is terminated in a crocodile clip which, so far as I can ascertain, is nickel-plated. So there was I, providing the electrolyte for a brass-nickel cell having a current capability of 8μA!

Since then I have checked several pairs of other commonly encountered metals to see how well they work in a 'human cell'. For best results they need to be in sheet or plate form; one can then place one hand flat on each metal to obtain maximum contact area and, in consequence, maximum current. The two metals were connected to the terminals of the 0–50μA meter.

Aluminium (negative) and cadmium (positive) gave a current of 5μA, whilst cadmium (negative) and tin (positive) produced a current of about 10μA. The best so far has been aluminium (negative) and tin (positive) which knocked up more than 20μA. Both the tin and cadmium, incidentally, were in the form of tinplate and cadmium plated steel respectively. Other pairs of metals, as checked by myself, did not give such high currents.

If you don't believe me, try these effects for yourself. But don't forget that you need a sensitive meter whose f.s.d. is, at most, 100μA.

PROBLEMS WITH POTS

Potentiometers can give rise to quite a few design problems, this being particularly true when they are required to dissipate powers in excess of 1 watt or so. What tends to be forgotten is that the nominal dissipation figure for a potentiometer normally applies over the *whole* of its track.

To take a numerical example (and one having nice easy figures) let us assume that we have a 100Ω linear wirewound potentiometer whose nominal power rating is 4 watts. If we pass 200mA through the whole track we will drop 20 volts across it, whereupon the dissipation is acceptable, at 4 watts. So far, so good. If, next, we set the slider to a central position on the track we will have a resistance between the slider and one end of the track of 50Ω. But we would be guilty of a technical misdemeanour if we now passed a current (actually 283mA) through the 50Ω section of the track which once more resulted in a dissipation of 4 watts. Matters would be even worse if we selected a quarter of the track and again (this time with a current of 400mA) caused this section to dissipate 4 watts.

The reason why these last two situations represent unsound practice is that the mechanical design of the potentiometer is such that it is only intended to dissipate 4 watts over the whole of its track, whereupon *all* the resistance wire of the track attains an increased temperature which is considered safe. If we dissipate 4 watts over a half, or over a quarter, of the track, then it is obvious that the section of resistance wire dissipating this power will rise to a higher temperature than that deemed desirable by the manufacturer of the potentiometer. It will have been noted that the current required for 4 watts dissipation in half the track is not a very great deal larger than that needed for 4 watts dissipation in the complete track, but it causes what is effectively a 2 watt resistor to be called upon to dissipate twice that power!

As may be seen, the wattage rating of a potentiometer also defines the maximum current that may flow through any section of its track.

In its 'classical' application, a potentiometer passes a relatively high current and allows voltages at lower currents to be tapped off it. If these lower currents are very much smaller than the standing high current in the potentiometer they may be ignored, and it then becomes correct to specify a potentiometer whose wattage rating is applicable to the standing high current. But potentiometers are often used as variable resistors, whereupon connection is made to the slider and one end of the track only. Under such conditions a potentiometer can be used to limit the flow of current in a circuit, and may pass quite high currents when set to insert low values of resistance. The proper design approach here is to initially determine the total resistance required in the potentiometer and the maximum current it will be called upon to pass. The requisite wattage rating for the potentiometer can be calculated from I^2R, and a component of the correct rating may then be employed. In many cases it will be possible to use a potentiometer of quite low wattage rating if a fixed external resistor is inserted in series to limit the maximum current that can flow in the circuit containing the potentiometer.

THE ELECTRET

One of the newer devices appearing on the electronic scene is the 'electret'. For those who may not have heard about it yet, an electret consists of a piece of insulating material which is capable of holding an electrostatic charge permanently, in much the same way that a permanent magnet is capable of holding its magnetism.

Not all insulating materials are capable of functioning as electrets. Many of the more modern plastics, such as nylon and polyester do, however, have the ability to act as electrets, and some of these have the advantage that they may be produced in the form of a thin film exhibiting a positive charge on one surface and a negative charge on the other. Electrets are activated by being heated in a strong electrostatic field; on cooling they then retain the charge acquired from the field. A thin film electret may be charged by being placed between two metal sheets across which a high voltage is applied.

The most useful application for electrets, so far, is as microphone diaphragms. An electret microphone is basically the same as a capacitor microphone except that no external polarising voltage is required. One surface of the electret diaphragm is metallised and provides one terminal of the microphone. The other side of the electret diaphragm is then positioned very close to a perforated flat metal disc which forms the other terminal of the microphone. Diaphragm vibrations are translated to changes of voltage which may be amplified in the same way as with a capacitor microphone. At the same time, the electret provides its own polarising voltage.

Electret microphones have quite a promising future, and are already beginning to appear with some tape recorders. Research work has been carried out on the use of electret microphones instead of carbon units in telephone handsets. The electret microphone requires an amplifier to convert its high impedance output to an amplitude and impedance suitable for telephone circuits, but such an amplifier can be readily provided with the aid of standard semiconductor techniques. The advantages claimed for the electret version are its cheapness and robustness, plus the fact that, even with its amplifier, less line current is necessary than is required with a carbon microphone.

There don't seem to be any other major applications for the electret at the time being, but these are early days yet. A device which is virtually the electrical analogue of the permanent magnet should soon find its way into other fields as well as that of sound pick-up.

HEAT FIN

Necessity is the mother of invention which, as proverbs go, is a bit nearer the truth than most of them. Necessity certainly caused me to dream up a little idea the other day which, as you may similarly find it of help, I shall now pass on to you.

I was playing around with an experimental circuit when I noticed that a 1.5 watt metal-cased zener diode was warming up rather more than was good for it. There was nothing wrong with the circuit or the diode; it was merely that I was expecting it to dissipate a wee bit more power than it could cope with on its own.

Some form of heat sink was required but, after a quick hunt through my odds and ends, I just couldn't find anything that would fit properly over the zener diode case. It was then that Necessity did her mothering bit, and I suddenly remembered a tin in which I keep valve top cap connecter clips. One of these proved to be just what was required. I quickly soldered a piece of thin brass sheet measuring about ½ by 1 inch to the clip tag to which the wire would normally have connected, ensuring that the solder ran on to the outside of the clip itself in order to provide good thermal conduction. I then fitted the clip-cum-fin over the diode, and that clip gripped as snugly on its case as though it had been designed for the job. Although not exactly a thing of beauty, this extemporised heat fin kept the diode really cool, and I was able to proceed with the rest of my work on the circuit.

That tin of top cap connector clips has now been promoted from the 'valve shelf' of my cupboard to the 'semiconductor shelf'! ■

R.A.F. EQUIPS WITH EMI RECONNAISSANCE POD

The EMI airborne reconnaissance pod, designed for the Phantom FGR Mk. II aircraft, has now entered service with the Royal Air Force. One of the first RAF units to be equipped with the EMI pod is No. 228 O.C.U. based at RAF Coningsby, Lincolnshire. This is an operational conversion unit which carries out Phantom aircrew training.

Full production of the equipment is under way at EMI's Radar and Equipment Division at Hayes, Middlesex, and deliveries will continue throughout 1970 and 1971.

This revolutionary surveillance system comprises sideways-looking radar, infra-red linescan and optical cameras fitted to a 23ft. 9in. (7.24 m) long external pod. It provides the RAF with the capability of carrying out high quality reconnaissance in all types of weather during day or night. The pod, which can be fitted to the aircraft within an hour, eliminates the need for specially-built aircraft which were previously used for reconnaissance duties alone.

The pod is similar in size to the Phantom's 600 gal. external fuel tank and is carried in a central position underneath the fuselage. When fully equipped, it weighs 2,300 lb. (1043.25 kg).

A fan of five optical cameras – four F95's and one F135 is fitted for daylight photography in good conditions. At night, four F135 cameras are used in conjunction with electronic flash.

Sideways-looking radar points downwards and sideways on either side of the aircraft. It has a fixed beam and scans the ground through the forward movement of the aircraft. Its results are recorded on film which is processed to provide a radar map of the terrain.

The linescan consists of an infra-red detector that scans the ground beneath the aircraft at an extremely rapid rate. It records what it sees on film. It detects temperature differences and is used for making accurate maps of the ground. It is particularly valuable for identifying camouflaged objects which cannot be readily observed by cameras.

LATE NEWS

Times = GMT *Frequencies = kHz*

★ AMATEUR BANDS

● VATICAN CITY

HV3SJ has been heard on **14155** SSB at around 1840.

● TRUCIAL STATES

MP4TDA heard on **21282** SSB at 0832 and on **21380** SSB at 1307. Other stations from this area heard on the same band are MP4BBA and MP4BHL.

● LAOS

XW8BX has been heard, using SSB, on **21308** at 1431.

● BRITISH VIRGIN Is.

VP2VI logged when using SSB on **14180** at 2230. Also reported on **28585** SSB at 1234.

● SAO TOME

CR5SP reported on **21235** SSB at 1720 and also on **21240** at 1656.

● CAMEROON REPUBLIC

TJ1AW has been reported on **14205** SSB at 2250, on **21285** SSB at 1103 and on **21348** SSB at 2240. TJ1AZ reported using **14205** SSB at 2315, on **21310** SSB at 1501, on **28550** SSB at 0920 and 1416 and on **28572** SSB at 1657.

● GABON REPUBLIC

TR8DG reported using **7090** SSB at around 2200 often and also on **28583** SSB at 1523. TR8MC heard using SSB on **14175** at 2020.

● LESOTHO

7P8AB has been heard on **21315** SSB at 1730 often and also on **21320** SSB at 1835.

★ BROADCAST BANDS

● FIJI ISLANDS

Suva has been reported on the new outlet of **5955.** In the announcements at 1030, this frequency was not mentioned.

● WINDWARD ISLANDS

The Windward Islands Broadcasting Service transmitter has been logged with record requests in their English programme. Frequent references to addresses in Grenada are made. Listen on **15155** from 2015.

● IRAQ

Radio Baghdad has been heard on a new channel of **15245** with the English programme from 1930 to 2020. This is followed by the German programme from 2020 to 2110.

● SWAZILAND

It is reported that a short wave station will be in operation in mid-1971. The power is expected to be 10kW. Trans-World Radio is a partner in the project.

● VENEZUALA

YVLM Radio Rumbos, Caracas, has been reported on **9650** with schedule from 1000 to 0600. The **4970** channel, according to the report, has now been vacated.

● INDIA

Hyderabad can often be heard on **4800** at 1530 with local weather forecast in English.

Acknowledgements – Our Listening Post ISWL and SCDX. ■

CHINESE STATIONS

The British Association of Dxers (BADX) issued with their fortnightly 'Bandspread' (No. 2) a masterly survey of Chinese stations – the most up to date information available at the present time.

Our Listening Post currently reports Chinese stations on the following l.f. channels – 3200, 3,400, 4815, 4865, 4905, 4960, 4990, 5030, 5145 and 5320kHz.

Most of these are listed as Peking transmitters but others operate from regional areas, some belonging to the PLA (People's Liberation Army).

Clearly, as stated in the BADX review, more research is required into Chinese transmissions.

LAST LOOK ROUND

TOP BAND TRANS-ATLANTIC TESTS

For those interested, the remaining Top Band Tests are as follows:–

W/VE – EUROPE

December 27th	January 24th
January 10th	February 14th

0500 to 0730GMT. W/VE East Coast stations 1800 to 1820kHz, West Coast 1975 to 2000kHz. Europeans 1823 to 1830kHz. Call "CQ DX Test" and listen alternate five minute periods, W/VE starting off at 0500.

TOP BAND TRANS-PACIFIC TESTS

The JA/EU Tests take place on the same date as for the JA/W Tests:– JA/EU Test times are 2030 to 2200GMT.

December 5th	January 16th
December 19th	February 6th
January 2nd	February 20th

Other Top Band activities are:– ARRL Contest December 13th and *CQ* Contest January 30th from 0000 to 1500GMT on 31st.

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FOR SALE: New P.S.U.'S, Roband etc., ⅓rd list. Other bargains. S.A.E. Lists. Don Smith, 12 Channel Heights, Bleadon, Weston-Super-Mare, Somerset. Telephone: Bleadon 672.

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(Continued on page 385)

SMALL ADVERTISEMENTS

(Continued from page 383)

WANTED: Books, brochures, pamphlets, etc. re FAX. Any information of interest. G2UK, "East Keal", Romany Road, Oulton Broad, Suffolk.

"MEDIUM WAVE NEWS" Monthly during Dx season —Details from: K. Brownless, 7 The Avenue, Clifton, York.

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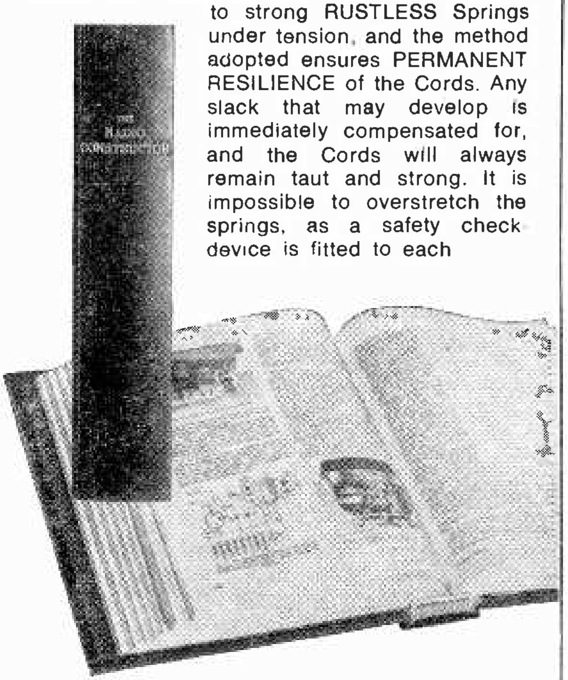

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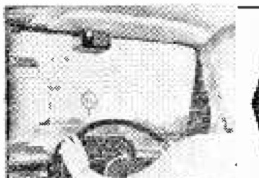

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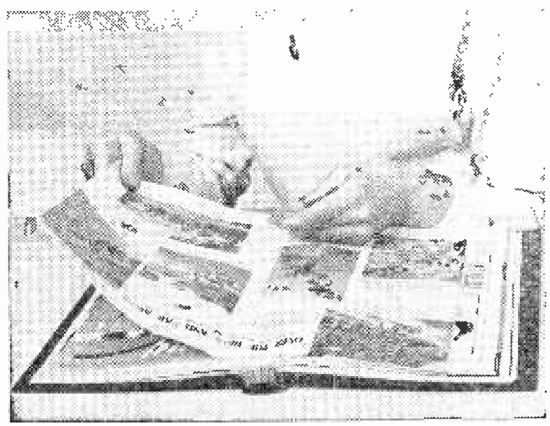

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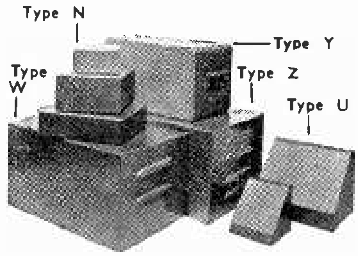

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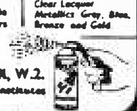

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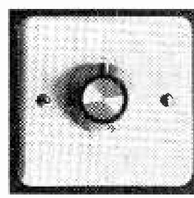

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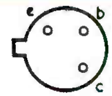
P.N.P. Transistor Lead-outs



The Table lists commonly encountered p.n.p. transistors in TO-5, TO-18 or TO-39 encapsulations whose lead-outs conform to the layout in the accompanying diagram. The letter in brackets after each type-number indicates whether the device is germanium or silicon.

ACY17 (G)	BCY32 (S)	BFX38 (S)	GET896 (G)	NKT165 (G)	V405A (S)	2N711A (G)	2N3133 (S)	2S305 (S)
ACY18 (G)	BCY33 (S)	BFX39 (S)	GET897 (G)	NKT221 (G)	V410A (S)	2N711B (G)	2N3134 (S)	2S306 (S)
ACY19 (G)	BCY34 (S)	BFX40 (S)	GET898 (G)	NKT222 (G)	V721 (S)	2N726 (S)	2N3135 (S)	2S307 (S)
ACY20 (G)	BCY38 (S)	BFX41 (S)	HKO41P (S)	NKT223 (G)	V723 (S)	2N727 (S)	2N3136 (S)	2S3010 (S)
ACY21 (G)	BCY39 (S)	BFX48 (S)	NKT0003 (S)	NKT224 (G)	V741 (S)	2N1131 (S)	2N3250 (S)	2S3020 (S)
ACY22 (G)	BCY40 (S)	BFX87 (S)	NKT0007 (S)	NKT225 (G)	V743 (S)	2N1132 (S)	2N3250A (S)	2S3021 (S)
ACY39 (G)	BCY49 (S)	BFX88 (S)	NKT0017 (S)	NKT226 (G)	V745 (S)	2N1303 (G)	2N3251 (S)	2S3030 (S)
ACY40 (G)	BCY54 (S)	BFY64 (S)	NKT121 (G)	NKT227 (G)	V761 (S)	2N1305 (G)	2N3251A (S)	2S3040 (S)
ACY41 (G)	BCY70 (S)	BSX29 (S)	NKT122 (G)	NKT228 (G)	V763 (S)	2N1307 (G)	2N3304 (S)	40362 (S)
ACY44 (G)	BCY71 (S)	BSX36 (S)	NKT123 (G)	NKT237 (G)	V765 (S)	2N1309 (G)	2N3576 (S)	
AFY19 (G)	BCY71A (S)	BSY40 (S)	NKT124 (G)	NKT238 (G)	2G101 (G)	2N2303 (S)	2N3798 (S)	
ASY26 (G)	BCY72 (S)	BSY41 (S)	NKT125 (G)	NKT239 (G)	2G102 (G)	2N2411 (S)	2N3799 (S)	
ASY27 (G)	BFW20 (S)	GET880 (G)	NKT126 (G)	NKT240 (G)	2G103 (G)	2N2412 (S)	2N3829 (S)	
ASZ21 (G)	BFW21 (S)	GET881 (G)	NKT127 (G)	NKT241 (G)	2G104 (G)	2N2894 (S)	2N3962 (S)	
BC139A (S)	BFW22 (S)	GET882 (G)	NKT128 (G)	NKT242 (G)	2G110 (G)	2N2904 (S)	2N3963 (S)	
BC143 (S)	BFW23 (S)	GET885 (G)	NKT129 (G)	NKT243 (G)	2N404 (G)	2N2904A (S)	2N3964 (S)	
BC177 (S)	BFW43 (S)	GET887 (G)	NKT141 (G)	NKT244 (G)	2N404A (G)	2N2905 (S)	2N3965 (S)	
BC178 (S)	BFW44 (S)	GET888 (G)	NKT142 (G)	NKT245 (G)	2N524 (G)	2N2905A (S)	2N5333 (S)	
BC186 (S)	BFX12 (S)	GET889 (G)	NKT143 (G)	NKT261 (G)	2N525 (G)	2N2906 (S)	2S301 (S)	
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BCY30 (S)	BFX30 (S)	GET892 (G)		NKT264 (G)	2N705 (G)	2N2907A (S)	2S303 (S)	
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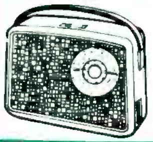

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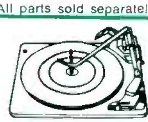

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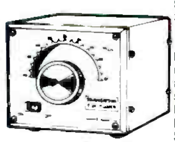

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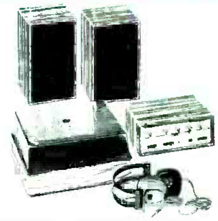

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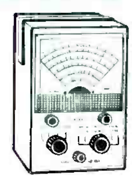

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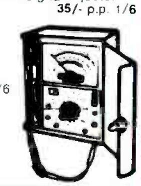

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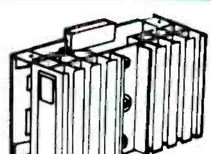

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PA25 **£7.10.0** PA50 **£9.10.0** MU442 **£6** p.p. 4/6 each

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