WALLACE

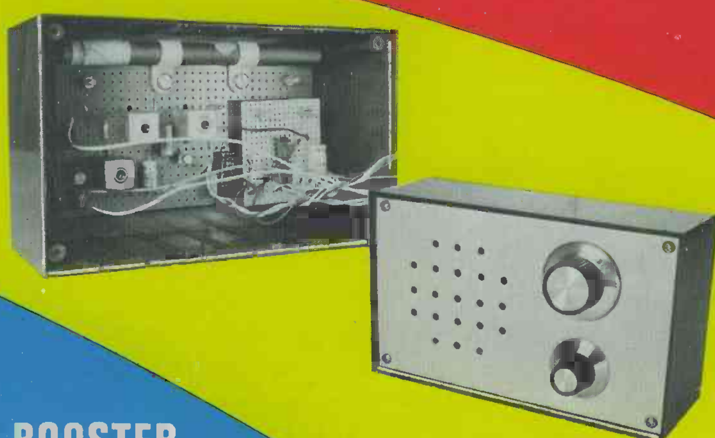
RADIO & ELECTRONICS CONSTRUCTOR

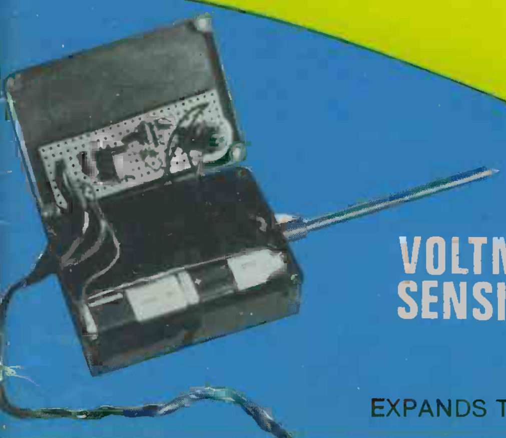
MAY 1981 60p

CRYSTAL CALIBRATOR

QUARTZ LOCKED FREQUENCY STANDARD 1 Hz to 10 MHz IN 8 RANGES

3 STAGE MW SUPERHET RECEIVER





VOLTMETER SENSITIVITY BOOSTER

EXPANDS THE CAPABILITY OF YOUR MULTIMETER

~CB~CB~CB~CB~CB~CB~CB~CB

SPECIAL SUPPLEMENT ENCLOSED

IT'S ALL AT ARROW

"Didn't know you stocked those", they said. "Oh, yes!" we said, "plus Yaesu Musen, Standard, Shure, Microwave Modules, Hi-Mound, CDE, Stolle, Vibroplex, Telecomm, Cushcraft, Swan . . .". "OK, that's enough", they said. "I'll send for your list—how much?" "FREE, of course", we said. "But a stamped addressed envelope would be nice."

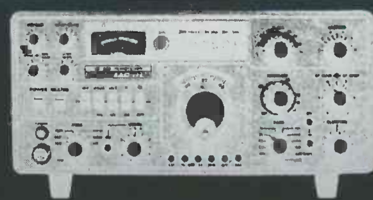
7373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373737373

TS280FM
£199.00

World's most compact 80 channel 50W 2 metre mobile rig. With auto select of repeater/simplex. Digital readout of channel.
AND NOW WITH VOLUME CONTROL ON MIC AND AUTOMATIC TONEBURST R0–R7 PLUS INPUT MONITOR CAPABILITY.
(Optional extra).
TS280LP NEW LOW PRICE £159.00
16Watt version 80Ch
NOW WITH AUTO TONEBURST R0–R7 & INPUT LISTEN.
(Optional extra).

(YM-35 Mike not included)

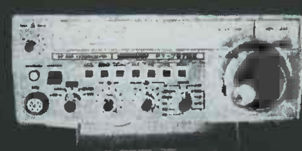
FT107 Yaesu Basic set £690.00
FT307DMS Sommerkamp with Int. PSU & DMS unit. Mic. .... POA



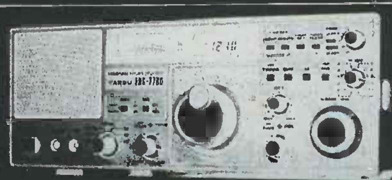
ARROW now stock 4 versions of this excellent transceiver:

FT101Z with Analogue dial £445.00
FT101ZD Digital with Fan & Mic. £515.00
FT101ZD Digital—WARC version £569.00
FT277ZD Sommerkamp Digital + WARC and all options £649.00

Two versions of the "Wayfarer" from stock.



FT707 Yaesu £529.00
FT767DX Sommerkamp with CW Filter & Mic £559.00



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R1000 Kenwood £289.00
FRG-7 Yaesu £189.00
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FRG7000 .... £259.00

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DP1— Trap Dipoles for 80/40/20/10 or 80/40/15/10 from stock £25.30

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MASPRO 7/8 wavelength 2m antennas now in £17.85

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RADIO & ELECTRONICS CONSTRUCTOR

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OUR NEXT ISSUE WILL BE PUBLISHED 15th MAY

LINEAR ICS LINEAR ICS LINEAR ICS LINEAR ICS 4000 series 4000 series TTL 'N' 'LPSN' TTL 'N' 'LPSN' TTL 'N' 'LPSN' TTL 'N' 'LPSN' MICROMARKET LEDS LEDS

LINEAR ICS

TBA120S	1.00	SL1610P	1.60
L200	1.95	SL1611P	1.60
U237B	1.28	SL1612P	1.60
U247B	1.28	SL1613P	1.89
U257B	1.28	SL1620P	2.17
U267B	1.28	SL1621P	2.17
LM301H	0.67	SL1623P	2.44
LM301N	0.30	SL624C	3.28
LM308TC	0.65	SL1625P	2.17
LM324	0.64	SL1626P	2.44
LM339N	0.66	SL1630P	1.62
LM348N	1.86	SL1640P	1.89
LF351N	0.49	SL1641P	1.89
LF353N	0.76	TDA2002	1.25
LM374N	3.75	ULN2242A	3.05
LM380N-14	1.00	ULN2283B	1.00
LM380N-8	1.00	CA3080E	0.70
LM381N	1.81	CA3089E	1.84
ZN419CE	1.98	CA3090AQ	3.35
NE544N	1.80	CA3123E	1.40
NE555N	0.30	CA3130E	0.80
NE556	0.50	CA3130T	0.90
NE560N	3.50	CA3140E	0.46
NE562N	4.05	CA3189E	2.20
NE564N	4.29	CA3240	1.27
NE565N	1.00	MC3357P	2.85
NE566N	1.60	LM3900N	0.60
NE570N	3.85	LM3909N	0.68
SL624	3.28	LM3914N	2.80
TBA651	1.81	LM3915N	2.80
uA709HC	0.64	KB4400	0.80
uA709PC	0.46	KB4406	0.60
uA710HC	0.65	KB4412	1.95
uA710PC	0.59	KB4413	1.95
uA741CH	0.66	KB4417	1.80
uA741CN	0.27	KB4420B	1.09
uA747CN	0.70	TDA4420	2.65
uA748CN	0.36	KB4423	2.30
uA753	2.44	KB4424	1.65
uA758	2.35	KB4431	1.95
TBA820M	0.78	KB4432	1.95
TCA940E	1.80	KB4433	1.52
TDA1028	2.11	KB4436	2.53
TDA1029	2.11	KB4437	1.75
TDA1054	1.45	KB4438	2.22
TDA1062	1.95	KB4441	1.35
TDA1072	2.69	KB4445	1.29
TDA1074A	5.04	KB4446	2.75
TDA1083	1.95	KB4448	1.65
TDA1090	3.05	NE5044N	2.26
HA1137	1.20	NE5532N	1.85
HA1196	2.00	SD6000	3.75
HA1197	1.00	SL6270	2.03
TDA1220	1.40	SL6310	2.03
LM1303	0.99	SL6600	3.75
LM1307	1.55	SL6640	2.75
MC1310P	1.90	SL6440	POA
MC1330	1.20	SL6690	3.20
MC1350	1.20	SL6700	2.35
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HA1388	2.75	MSL9362	1.75
TDA1490	1.86	MSL9363	1.75
MC1496P	1.25	HA11211	1.95

HA11223	2.15
HA11225	1.45
HA12002	1.45
HA12017	0.80
HA12402	1.95
HA12411	1.20
HA12412	1.55
LF13741	0.33
SN76660N	0.80

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SAA1056	3.75
SAA1058	3.35
SAA1059	3.35
11C90DC	14.00
LN1232	19.00
LN1242	19.00
MSL2318	3.84
MSM5523	11.30
MSM5524	11.30
MSM5525	7.85
MSM5526	7.85
MSM5527	9.75
MSM55271	9.75
MSL2312	3.94
SP8629	3.85
SP8647	6.00
95H90PC	7.80
HD10551	2.45
HD44015	4.45
HD12009	6.00
HD44752	8.00
MC145151	12.45
MC145156	8.75

MISC

ICM7106CP	9.55
ICM7107CP	9.55
ICM7216BP	19.50
ICM7555	0.94

4000 series

4000	0.18	4068	0.25
4001	0.18	4069	0.25
4002	0.24	4070	0.30
4007	0.30	4071	0.24
4008	0.80	4072	0.24
4008AE	0.80	4073	0.24
4009	0.58	4075	0.25
4010	0.58	4076	0.90
4011AE	0.24	4077	0.35
4011B	0.24	4078	0.30
4012	0.55	4082	0.28
4013	0.55	4093	0.86
4015	0.95	4175	1.15
4016	0.52	4503	1.15
4017	0.80	4506	0.68
4019	0.60	4510	0.99
4020	0.98	4511	1.49
4021	0.82	4512	0.98
4022	0.96	4514	2.55
4023	0.25	4518	1.03
4024	0.76	4520	1.09
4025	0.25	4521	2.36
4026	1.80	4522	1.49
4028	0.79	4529	1.61
4029	1.04	4539	1.28
4030	0.59	4549	3.50
4035	1.20	4554	1.73
4040	0.98	4560	2.18
4042	0.85	4566	1.59
4043	0.85	4568	2.18
4043AE	0.93	4569	3.03
4044	0.94	4572	0.30
4046	1.30	4585	1.00
4047	0.99		
4049	0.52		
4050	0.55		
4051	0.78		
4052	0.79		
4053	0.78		
4060	1.54		
4063	1.18		
4066	0.57		

TTL

TTL	'N'	'LSN'
7400	0.13	0.20
7401	0.13	0.20
7402	0.14	0.20
7403	0.14	0.20
7404	0.14	0.24
7405	0.18	0.26
7406	0.36	
7407	0.38	
7408	0.19	0.24
7409	0.21	0.24
7410	0.18	0.24
7411	0.26	0.32
7412	0.27	
7413	0.32	
7414	0.51	
7415		0.40
7416	0.30	
7417	0.30	
7420	0.19	0.24
7421	0.38	0.24
7423	0.27	
7425	0.27	
7427	0.32	0.35
7428	0.35	0.35
7430	0.17	0.26
7432	0.32	0.28
7437	0.40	
7438	0.33	0.35
7440	0.20	0.28
7441	0.74	
7442	0.70	0.99
7443	1.15	
7444	1.12	
7445	1.05	
7446	1.32	
7447		0.89
7448	0.56	0.99
7449		0.99
7451	0.20	0.25
7453	0.20	

TTL	'N'	'LSN'
7454	0.20	0.30
7455		0.30
7460	0.20	
7463		1.24
7470	0.40	
7472	0.30	
7473	0.35	0.45
7474	0.35	0.35
7475	0.56	
7476	0.41	0.45
7478		0.50
7480	0.52	
7481	1.20	
7482	0.75	
7485	1.04	0.99
7486		0.40
7489	2.05	
7490	0.42	0.90
7491	0.85	1.25
7492	0.50	0.78
7493	0.57	0.99
7494	0.85	
7495	0.70	1.15
7496	0.58	1.20
7497	1.85	
74107		0.45
74109	0.63	
74110	0.54	
74111	0.68	
74112		0.41
74113		0.75
74114		0.40
74118	0.85	
74120	1.15	
74121	0.48	
74122	0.46	
74123	0.73	
74124		1.80
74125	0.55	0.46
74126	0.57	0.46

TTL	'N'	'LSN'
74128	0.74	
74132	0.73	0.78
74136		0.40
74138		0.72
74141	0.75	
74142	2.65	
74143	3.12	
74144	3.12	
74145		0.97
74147	1.75	
74148	1.09	1.19
74150	0.99	
74151	0.55	0.90
74153	0.70	0.85
74154	1.30	
74155	0.75	1.10
74156	0.80	
74157	0.78	0.70
74158		0.71
74159	2.10	
74160	0.99	1.30
74161	0.99	0.98
74162		1.30
74163	0.99	0.95
74164	1.20	1.30
74165	1.20	1.45
74167	2.50	
74169		2.10
74170	2.30	2.88
74174	1.05	1.20
74175	0.87	1.10
74176	0.80	
74177	0.84	
74181	2.80	3.50
74183		2.98
74184	1.35	
74185	1.34	
74190	0.92	
74192	1.20	1.80
74193	1.42	1.80

TTL	'N'	'LSN'
74194	1.05	
74196	1.34	1.20
74197	1.10	
74198	1.60	
74199	1.60	
74247		0.93
74257		1.08
74260		0.89
74279		0.88
74283		1.20
74293		1.32
74365		0.66
74366		0.65
74367		0.64
74368		0.92
74374		1.80
74377		1.99
74379		2.15
74393		1.40

VOLTAGE REGS.

78 series	0.95
79 series	1.00
78M series	0.65
78L series	0.35
79L05	0.85
78MGT2C	1.75
79MGT2C	1.75
723CN	0.65
L200	1.95
TDA1412	0.75
NE5563N	1.25
LM317MP	1.48
LM337MP	1.48

MICROMARKET

8080A/2	7.50
8212	2.30
8214	3.50
8216	1.95

MICROMARKET

8224	3.50
8251	6.25
8255	5.40
6800P	7.50
6810	5.95
6820	7.45
6850	4.90
6852	4.85
MC2708	6.00
2114	6.50
4027	5.78
2102	1.70
2112	3.40
2513	7.54
HM4716	4.00
81LS97	1.25

LEDS LEDS

FLAT TOP LEDS:
SHAPES..............
SQUARE 3x3mm
RECT. 2.5x5mm
TRIA. 2.5x5mm
TRIA. 3x3mm
TRIA. 5x5mm
ROUND 3mm
ROUND 5mm

PRICED BY COLOUR:

Red	17p
Green	20p
Yellow	20p
Orange	26p

TRANSISTORS

BC237	8p
BC238	8p
BC239	8p
BC307	8p
BC308	8p
BC309	8p
BC413	10p
BC414	11p
BC415	10p
BC416	11p
BC546	12p
BC556	12p
BC550	12p
BC560	12p
BC639	22p
BC640	22p
2SC1775	18p
2SA872A	14p
2SD666A	30p
2SB646A	30p
2SD668A	40p
2SB648A	40p
2SD760	45p
2SB720	45p
2SC2547	19p
2SA1085	20p

LEDS

STD DOMED TYPES	
5mm RED	12p
3mm RED clr	15p
3mm RED	15p
2.5x5 RED	17p
5mm GRN	15p
3mm GRN clr	16p
3mm GRN	16p
2.5x5 GRN	20p
5mm YL	15p
3mm YL clr	16p
3mm YL	18p
2.5x5 YL	20p
5mm ORA	20p
5mm ORA clr	29p
3mm ORA	19p
2.5x5 ORA	24p
5mm Infra Rd	56p
BPW41 IF Det	1.51
IF Opto Cplr	1.44
5mm Clip	5p

TRANSISTORS

BF256	38p
2SK55	28p
2SK168	35p
J310	69p
J176	65p
40823	65p
40673 –	3SK51
3SK45	49p
3SK51	54p
3SK60	58p
3SK88	1.24
MEM680	75p
BF961	70p
BF194	18p
BF195	18p
BF224	22p
BF241	18p
BF274	18p
BF440	21p
BF441	21p
BF362	49p
BF395	18p
BF479	66p
BF679S	55p
BFR91	1.33
BFW92	60p
BFT95	99p
BFY90	90p
40238	85p
2SB753	2.34
2SB723	2.34
2SK134	3.10
2SJ49	3.10
2SK135	4.25
2SJ50	4.25
2SK227	3.55
2SJ83	3.55
VN66AF	95p
2N3866	85p

CRYSTALS

32.768kHz	2.70	10.245	2.00
100kHz	3.85	10.6985	2.50
455kHz	5.00	10.700	2.00
1.000MHz	2.95	10.7015	2.50
3.2768	2.70	11.00	2.00
4.000	2.00	11.115	2.00
4.1934	2.00	11.520	2.00
4.096	2.00	8.9985	2.00
4.032	2.00	9.0015	2.00
4.433619	2.00	21.000	2.00
4.800	2.00	24.000	2.00
5.000	2.00	25.000	2.00
6,5536	2.00	26.000	2.00
7.000	2.00	18.000	2.50
7.68	2.00		
8.000	2.00		
9.000	2.00		
10.000	2.00		
10.240	2.00		

XTAL FILTERS
10M4B1; 10.7Mhz, 15Khz BW, 8 pole. 14.50
10M22D; 10.7Mhz, 2.4Khz BW, SSB, 8 pole. 17.20

RADIO CONTROL

RC XTALS
AM TX/RX
FM RX:
3rd ot/30pF
HC25U 1.65
FMTX: Fund
20pF HC25U
½ freq 1.85
PAIRS...AM 3.10
PAIRS...FM 3.25
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35MHz: 20kHz

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This listing gives a brief insight into the wide range of active and passive components available from AMBIT. Our full catalogues & pricelist include the LARGEST STOCK RANGES OF COILS, CHOKES, CERAMIC/MECHANICAL/CRYSTAL FILTERS, all types of radio modules for AM/FM/SSB · plus the most sophisticated DIY FM tuner parts in the world. £1.85 (inc) will get you full set of catalogues (pts. 2,3 & 4) or 75p per individual section.

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- Handling all types Solid State 'Chips'.
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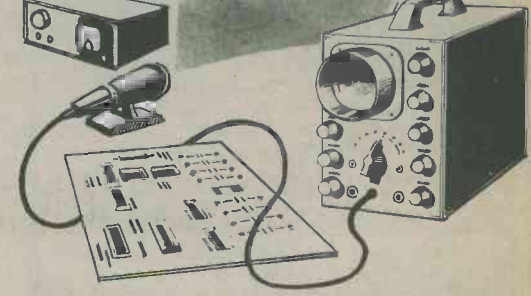

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- Special educational Mini-Computer supplied ready for use.
- Self Test program exercise.
- Services of skilled tutor available.

MASTER THE REST

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- Examination courses (City & Guilds etc.) in electronics.
- Semi-conductor technology.
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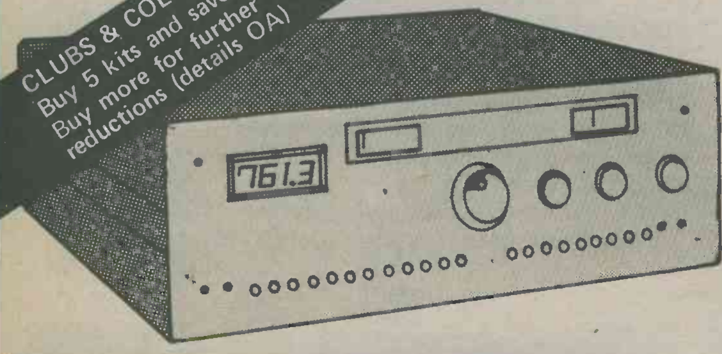

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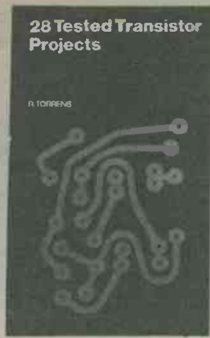

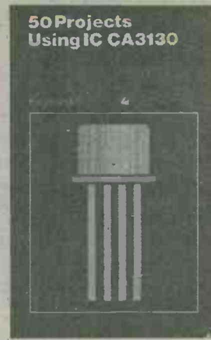

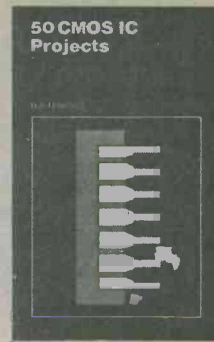

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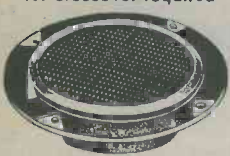

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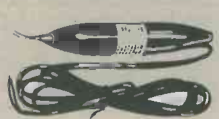

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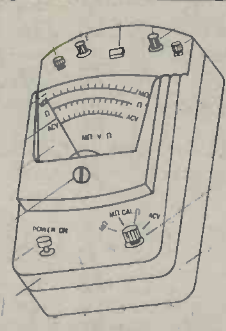

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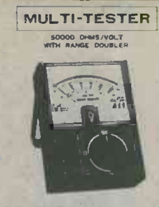

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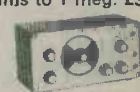

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AD164 25v 6w	40p
AD165 25v 6w	40p
AF119	35p
AF124	27p
AF126	27p
AF127	27p
AF139 22v .1w	23p
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AF180	35p
AF181	33p
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BC140 40v .7w	15p
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BC143 60v .8w	11p
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BC149/A/B/C/S	5½p
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BC158/A/B	5½p
BC159/B/C	5½p
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BC171B	4p
BC172	6½p
BC172c	7½p
BC173	4p
BC177A 45v .4w	10½p
BC178A/B/C	10½p
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BC237A 45v .3w	7½p
BC237B 50v .3w	7½p
BC238 20v .3w	5p
BC238B/C	7½p
BC239C 20v .3w	7½p
BC251	3p
BC257B	7½p
BC258B/C	7½p
BC259C	7½p
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BC304	15p
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BC308B/C 25v .3w	7½p
BC309B 20v .3w	7½p
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BC328 25v .7w	6p
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BF336 185v 3w	16p
BF355 300v 3w	15p
BF394B	3p
BF451 40v .3w	6p
BF494 20v .3w	10p
BF495 20v .3w	5p
BF595c FM/AM/GP	9½p
BF615	27p
BF617	27p
BFQ35	15p
BFQ37	16p
BFR34A 12v .2w	£1
BFR38	68p
BFR86	19p
BFS21 FET pair	£3
BFS28 DualM/Fet	50p
BFT30	15p
BFT31	15p
BFT39	15p
BFT41	15p
BFT60	6p
BFT61	15p
BFT70	15p
BFT71	15p
BFW10 FET 30v	46p
BFW11 FET 30v	46p
BFW30 20v .25w	15p
BFW31	15p
BFW57	18p
BFW58	18p
BFX12	23p
BFX29 60v .6w	11p
BFX30 60v .6w	16p
BFX37 60v .4w	16p
BFX84 100v .8w	20p
BFX85 100v .8w	14p
BFX88 40v .6w	20p
BFX89 30v .2w	20p
BFY39	20p
BFY50 35v 1wt	15p
BFY51 60v 1w	15p
BFY52 40v 1w	15p

Type	Price
BFY75	15p
BFY90 30v .2w	59p
BLY10	23p
BR101 } Prog.	20p
BRY39 } Uni-	29p
BRY56 } Junct	29p
BSV60 45v .8w	30p
BSV64 100v 1w	36p
BSV79 40v .4w	50p
BSV80 40v .4w	50p
BSV81 Dep. Mos Fet	75p
BSX19 40v .4w	15p
BSX20 40v .4w	7p
BSX21 120v .3w	10p
BSX78	8p
BSY40	30p
BSY95A 20v .3w	10p
BU105 1k5v 10w	64p
BU105/04	78p
BU204 1k3v 10w	75p
BU208 1k5v 12w	£1.05
C1544 PNP	4p
C1601 NPN	4p
D40C4 40v 8wt Darlington	22p
D40D1 30v 7wt	22p
D40D2 30v 7wt	15p
D40D4 45v 7wt	22p
D41D2 30v 7wt	22p
D43C8 60v 13wt	30p
D43C8 60v 13wt	13p
D45C2 40v. 30w 220HFE 50MHz	50p
DS70 Darl. 10wt	22p
GET102	46p
GET111	45p
GET120	30p
M103G MOSFET	30p
MA393	25p
MD7000	£2.25
ME2	13p
ME0412	14p
ME0461 60v .3w	7½p
ME6101 70v .36w	7½p
ME6102 60v .4w	7½p
ME8003	20p
MJ481 (BDY23)	25p
MJE371	40p
MJE2371	80p
MJE2901T (Higain 2955)	50p
M∩15 Russian	25p
M∩41 Russian	25p
MP8113 60v 3w	25p
MPF131 Dual MOSFET	21p
MPS 8513 60v 3w	31p
MPU131 Prog. Uni J.	15p
MRF502 Improved BFY90	50p
MST 1027 80v 100w	40p
MST1072 300v 100w	50p
MST2007 NPN	4p
MST2013 PNP	4p
MST2015 PNP TO18	4p
MST2018 PNP TO18	4p
MST 2038 100v 100w	40p
∩16A Russian	25p
∩42A Russian	25p
NKT49	23p
NKTA52	20p
NKTB54	30p
NKT152	38p
NKT153	24p
NKT154	26p
NKT251	18p
NKT775	16p
NKTME2	13p
NSD102 45v 10wt	23p
NSD129 Plastic 10wt	23p
NSD131 250v 10wt	30p
NSD134 300v 10wt	30p
NSD151 30v 10wt Darlington	22p
NSD457 160v 10wt	23p
NSD U45 40v 10wt Darlington	30p
NSD U51 30v 10wt	22p
OC41	4p
OC42	21p
OC43	55p
OC44	4p
OC45 15v .1w	13p
OC71 30v .2w	4p
OC72 32v .2w	4p
OC76	15p
OC77	46p
OC81 32v .6w	5p
OC84	30p
OC200	41p
OC201	66p
OC202	66p
OC603	50p
OC701	50p
ON222	23p

Type	Price
P77 Plastic 10wt	15p
P346A	24p
P7029	30p
PXB103	25p
RCP701A/B/D 10wT	30p
R1039 (2008B)	54p
R2008B 660v85w	£1.18
R2010B	£1.18
R2306 100v 40w	26p
R2540	£1.70
S3017	25p
SB240	26p
SFT357	26p
SL102	40p
TE886	£1
TIP29 40v 30w	22p
TIP30 40v 30w	22p
TIP30C 100v 30w	26p
TIP31C 100v 40w	26p
TIP32A 60v 40w	22p
TIP32C 100v 40w	26p
TIP41 40v 65w	15p
TIP42C 100v 65w	33p
TIP48 300v 40w	33p
TIP 110 60v 50w Darl.	30p
TIP112 100v 50w	45
TIP115 60v 50wt Darlington	30p
TIP2955 100v 90w	45p
TIP3055 100v 90w	34p
TIS44 VHF switch	9½p
TIS60GY	3p
TIS61	3p
TIS73L FET	7P
TIS90	4p
TIS91	6p
TIS92GY	14p
TIS98	3p
TK24	20p
V435	20p
U14710	20p
ZT403P	30p
ZT1486	£1.10
ZTX341	9p
2G103	33p
2G302	12p
2G309	30p
2G339A	20p
2G371	18p
2N388	7½p
2N456A	71p
2N525 45v .3w	12p
2N527 45v .2w	12p
2N597	16p
2N598	16p
2N601	£1.50
2N644	22p
2N698 120v .8w	12p
2N699 120v .6w	12p
2N706/A 25v .3w	10½p
2N708 40v .4w	9p
2N718 60v .4w	10p
2N720A 120v .5w	12p
2N720 120v .5w	12p
2N736 80v .5w	7½p
2N914	15p
2N918 15v .2w	12p
2N929 45v .3w	16p
2N930 45v .3w	7p
2N984	28p
2N987	45p
2N1091	16p
2N1132	14p
2N1302 25v .2w	16p
2N1303 30v .2w	16p
2N1395	25p
2N1484	36p
2N1485 60v 25w	36p
2N1487	90p
2N1490	£3
2N1500	30p
2N1507	18p
2N1711 75v .8w	13p
2N1716	15p
2N1724A 118wt RF 180v	£2.10
2N1748	28p
2N2192A	15P
2N2221A 40v .5w	9p
2N2222A 40v .5w	8p
2N2369 40v .4w	10p
2N2401	7½p
2N2412	27p
2N2483	28p
2N2484 60v .4w	10p
2N2586	15p
2N2614	4p
2N2887	£2
2N2894	11p
2N2904 60v .6w	9p
2N2905 60v .6w	15p
2N2906 60v .4w	9p
2N2907/A 60v .4w	9p
2N 2926Y 25v .2w	4p
2N2926 Orange 25v .2w	4p
2N3020 140v .8w	25p
2N3054 90v 30w	35p
2N3055RCA 100v 115wt	68p

Type	Price
2N3133	24p
2N3283	25p
2N3418	15p
2N3442 160v 117w	75p
2N3583	18p
2N3645	3p
2N3663 30v .2w	6p
2N3702 40v .4w	4p
2N3703 50v .3w	3p
2N3704 50v .4w	4p
2N3707 30v .3w	4p
2N3711 30v .3w	8p
2N3714 80v 150w	54p
2N3794	14p
2N3799	18p
2N3823 FET 30v	25p
2N3904 60v .3w	7½p
2N3905 40v .3w	7½p
2N3906 40v .3w	8p
2N4000	15p
2N4026	15p
2N4031 80v 1w	15p
2N4039 MOSFET	54p
2N4062 30v .4w	4p
2N4285	17p
2N4403 40v .3w	7½p
2N4891	30p
2N4918	15p
2N5058 300v .5w	11p
2N5147	15p
2N5293 80v 36w	30p
2N5294 80v 36w	30p
2N5295 60v 36w	30p
2N5296 60v 36w	30p
2N5297 80v 36w	36p
2N5449 30v .3w	3p
2N5484	37p
2N5492 75v 50w	36p
2N5915 (16068) 450Mhz 6WT R.F. 12v	£2.50
2N6028 PUJT	6p
2N6106 80v 40w	44p
2N6109 60v 40w	44p
2N6111 40v 40w	36p
2N6124	24p
2N6178 100v 25w	30p
2N6180 100v 25wt	30p
2N6181 75v 25w	30p
2N6288 30v 40w	36p
2N6290 60v 40w	30p
2N6292 80v 40w	30p
2N6385 80v 100wt Darlington	56p
2N6486 40v 75w	36p
2N6488 90v 75w	36p
2S701	18p

Type	Price
2SA12	42p
2SA50	36p
2SA80	36p
2SA83	36p
2SA141	36p
2SA142	36p
2SA234	50p
2SA236	50p
2SA354	38p
2SA360	34p
2SA367	56p
2SA518	38p
2SA634	80p
2SB75	25p
2SB77	25p
2SB135	25p
2SB136	25p
2SB156	60p
2SB175	20p
2SB176	20p
2SB457	15p
2SC1061 50v 25w	50p
2SD234 60v 25w	50p
2SD315D	80p
353-3 40v 5wt	22p
362-4 300v 6wt A/F Video Amp (BF459)	30p
868-01 Plast. 10wt	15p
1034 Plast. 10wt	15p
16120 (MPSU55/ BD238)	19p
40235	50p
40250	36p
40250VI (2N3054 + Ht. sink)	40p
40316 40v. 50w	36p
40372 (2N3054 + Ht. sink)	40p
40349v2 160v 1w	30p
40394 60v 1w	30p
40633 NPN 40w	36p
40911 (2N6261 + Ht. sink)	40p

SUPPRESSION FILTERS

0.1MFD + 100Ω 250VAC 60p

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1MFD 150v DC or 0.5MFD 150v DC Car Suppression 30p

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Transistor radio miniature can colour coded Red, Blue, White, Black or Yellow. 25p

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100 for 45p

560Ω 1/4wt 2%
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1M8 1/4wt 5%
2M2 1/3wt 5%
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7" DIAM ROTRON 'FEATHER' FAN

Lubricated for life
Thermal protection
110VAC 20Watt (2 in series for mains)
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Miniature Encapsulated
1.5μH. 10μH. 100μH. 200μH. 750μH.
1MH 15p each
.22μH 16 FOR £2.50
1 amp 5μH or 2amp 9μH 12p
5 amp 24p. 4amp 330μH 25p
R.F. pile wound 17p

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5300 ITEMS AT PRICES YOU WOULD NOT BELIEVE BEFORE INFLATION. YOUR MONEY MUST GO TWICE AS FAR. 75p PLUS 25p POST. PACKING.

TRIACS

Amp	Volt	Type	Price
0.1	40	7W84	4p
2.5	600	2N5757	44p
3.5	400	T2710D	58p
4	400	T2716D/40730	74p
6	200	T2500B/41014	54p
8	400	T2850D	72p
8	500	BT137-500	72p
12	500	BT138-500	90p
25	100	BTX94-100	£2.25
25	200	TIC256	£1.05
25	1200	BTX94-1200	£5

HUGHES

MICRO ELECTRONICS 400MW ZENER DIODES 200 IN CLEAR PLASTIC HINGED LID COMPONENT BOX £2.40

3V, 3.6V, 3.9V, 4.3V, 4.7V, 11V, or 13V.

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Photo Diodes: 30F2, 31F2, 32F2, 33F2, BPX40, BPY10, BPY68, BPY69, BPY77, CQY17, CQY77. All types 38p
Wire end neons 5p.
Photo transistor: BPX43, BP103, 2N5777, Darlington 36p; LED's (Mullard Siemens) Red 5mm 8p. 3mm 13p; Green 5mm 13p, 3mm 13p; Yellow 5mm 13p, 3mm 13p, micro LD481 8p
PHOTO SILICON CONTROLLED SWITCH BPX66 PNPN 10 amp 36p.
CA3062 Photo Detector and power amp. £1.05p

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.3" Red com. anode 81p
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5082-7653 Red com. cath
5082-7600 Yellow com. anode.
H.P. Highbrilliance .43" 72p

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3 Digit HP5082 7413 45p
4 Digit HP 5082 7414 45p
5 Digit HP 5082 7415 45p
Infra red transmit diodes CQY11B or LD271 High power 1.6-2v or 3-3.5v Pulse 32p
LD242 36p
H15B Photon coupled Isolator I.R. diode and NPN Photo-Darlington amp 26p
CNY17/1 opto coupler 70p
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200, 220, 300, 500, 1000pF 7p
2N2, 4N7 8p
.02, .068 MFD 13p
.033 MFD Pack of 3 39p
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3.3, 3.9, 6.8, 22, 39, 47, 50, 56, 68, 82, 100, 220, 470, 2,200pF 8p
0.1 MFD 2p

900 VOLT
0.1, 0.22 MFD 15p

1000 VOLT
150pF, 1N 2N, 2N2 10p. 3N3 9p, 3N, 4N7, 5N 11p. .01 9½p, .022, .047, 7½p .05 16p. 0.1 16p. .22 17p. .5 30p. 1 MFD 36p.

1250 VOLT
1N 10p. .02 4p. .022 10p. .1 17½p.

1500 VOLT
150pF 12p. 4N7 9p. .01 7p, .033 19p. .068 12p.

2000 VOLT
15, 25, 82, 270, 390, 2000pF 12p. .025 MFD 35p

2500 VOLT
1000pF 16p
.01, .03, .05 30p

3000 VOLT
470pF 2p
150, 300, 1800pF 17p
.012 MFD 22p

4000 VOLT
330pF 18p 1000pF 22p

DIODES

*Germanium: rest silicon

• AA118 90v 50ma	4p
• AA119 30v 35ma	7p
• AA133 100v 50ma	9p
• AA144 100v 5ma	4p
• AAZ15 100v 250ma	15p
B1	11p
BA101B varicap	10p
BA116 20v 100ma	30p
BA127 60v 100ma	3p
BA128 50v 100ma	2½p
BA145 350v 10ma	2½p
BA148 350v 400ma	12p
BA182 Varicap	6p
BAX 13 50v 150ma	3p
BAX14 40v 350ma	2½p
BAX20 25v 115ma	3p
BAX21 50v 120ma	3p
BAX22 100v 120ma	3p
BAX54	8p
BAY36P 30v 3ma	2½p
BAY44 50v 250ma	4p
BAY68 25v 115ma	3p
BAY72 100v 400ma	4p
BB103 Varicap	24p
BB104 Varicap	16p
BB109 Varicap	24p
BB110B Varicap	24p
BB113 3x Varicap	43p
BB139 varicap	£1
BR100 Diac.	15p
BY206 300v 400ma	7½p
BY207 600v 400ma	23p
BY402 100v ½A	2½p
BY403 200v ½A	2½p
Centercell	3p
CG651	9p
CR HG/3	10p
CSD117YLZ	40p
CV7095	2½p
CV7098	2½p
D3202Y Diac.	11p
DC2845 Microwave	20p
DOG53	11p
FSY28A	40p
• HG1005 100v 45ma	3p
• HG1012 50v 50ma	10p
MPN3401 VHF switch	30p
• OA5 100v 115ma	25p
• OA7 25v 50ma	25p
• OA10 25v 110ma	25p
• OA40 40v 50ma	4p
• OA47 30v 150ma	7p
• OA51 50v 50ma	4p
• OA70 22v 50ma	10p
• OA75 40v 50ma	11p
• OA79 45v 35ma	11p
• OA81 115v 150ma	3½p
• OA90 30v 45ma	4p
• OA91 115v 150ma	6p
• OA95 115v 150ma	6p
OA200 50v 250ma	2½p
IGP7	11p
IGP10	11p
IN63 100v 40ma	4p
IN337 200v 200ma	4p
IN447 40v 25ma	3p
IN604 400v 300ma	4p
IN662 80v 40ma	2½p
IN916 75v 300ma	2½p
IN3062 75v 20ma	3p
IN3063 (BAV10)	6p
IN3064 75v 10ma	2½p
IN4009 25v 75ma	2½p
IN4148 75v 200ma	1½p
IN4149 100v 200ma	3p
IN4150 50v 200ma	2½p
IN4151 50v 200ma	2½p
IN4152 40v 200ma	3p
IN4446 100v 200ma	2½p
IN4449 100v 200ma	2½p
IN5154 25v 30ma	3p
IN5456	15p
IS922 150v 200ma	4p
IS940 30v 50ma	3p
5082 2900 RF Schotky Barrier	50p

RECTIFIERS

Type	Volt	Amp	Price
BY126	650	1	5p
BY127	1250	1	5p
BY212	15kv	500ma	6p
BY235	600	1½	7½p
BY236	900	1½	7½p
BY264	300	3	9p
BY265	600	3	11½p
BY266	900	3	15p
BY274	300	5	14½p
BY275	600	5	19½p
BY277	1200	5	27p
BY1202	2kV	10mA	6p
BYW55	800	2 (Oxide bead)	15p
BYW56	1000	2 (Oxide bead)	18p
BYX20-200	200	25	72p
BYX22-200	300	1½	25p
BYX38 300R	300	6	48p
BYX38 600	600	6	52p
BYX38 900	900	6	60p
BYX38 1200	1200	6	65p
BYX42 300	300	12	36p
BYX42 600	600	12	46p
BYX42 900	900	12	92p
BYX42 1200	1200	12	£1.07
BYX46 300R	300	15 Avalanche	£1.19
BYX46 400R	400	15 Avalanche	£1.75
BYX46 500R	500	15 Avalanche	£2.00
BYX46 600	600	15 Avalanche	£2.30
BYX48 300R	300	6	47p
BYX48 600	600	6	60p
BYX48 900	900	6	70p
BYX48 1200R	1200	6	92p
BYX49 300R	300	6	35p
BYX49 600	600	6	42p
BYX49 900R	900	6	47p
BYX49 1200	1200	6	60p
BYX52 300	300	48	£2.05
BYX52 1200	1200	48	£2.90
BYX70	500	1	4p
BYX72 150R	150	10	42p
BYX72 300R	300	10	52p
BYX72 500R	500	10	65p
BYX94	1250	1	6p
E250C50	250	¼	14p
KS11394	800	3	23p
LT102	30	2	15p
M1	68	1	5p
MR856	600	3	24p
MSR5	800	3	12p
OA210	400	5	33p
RAS3 1OAF	1250	1½ Avalanche	48p
RAS508AF	1250	1½ (Avalanche)	50p
REC53A	1250	1½ Pack of 4	66p
SKE4G	200	6	22p
SR100	100	1½	9p
SR400	400	1½	10p
SR1825	100	50	75p
IN3254	400	1	4p
IN4002	100	1	4p
IN4004	400	1	4½p
IN4005	600	1	6p
IN4006	800	1	6p
IN4007	1250	1	6p
IN5059	200	1½	10p
IN5401	100	3	12½p
IN5402	200	3	11p
IN5406	600	3	15p
IN5408	1000	3	19p
IS027	800	1½	11p
IS138	800	1	2½p
25G100	100	60	£4.35
3052	200	3	11p
16094P	900	2	15p
16492	700	1½	9½p

BRIDGE RECTIFIERS

½AMP	60VOLT	BC30 C350	23p
½	1,600	BYX10	34p
0.6	110	EC433	20p
1	100V	B40C800	12p
1	140	OSH01-200	25p
1	400V	MDA104	29p
1½	50V	WO05	27p
1½	75V	IBIBY234	11½p
1½	150V	IBIBY235	15p
1½	200V	WO2 Ex Equip	15p
1½	400V	WO4	28p
1½	400V	UE4R1	12p
1½	800V	WO8	27p
1½	1000	W10	36p
2½	100	I.R.	40p
2½	350V	9F2	53p
2½	500V	9E4	85p
3	50	KBS005	30p
3	100	KBS01	30p
3	200	KBS02	30p
3	400	KBS04	30p
3	600	KBS06	30p
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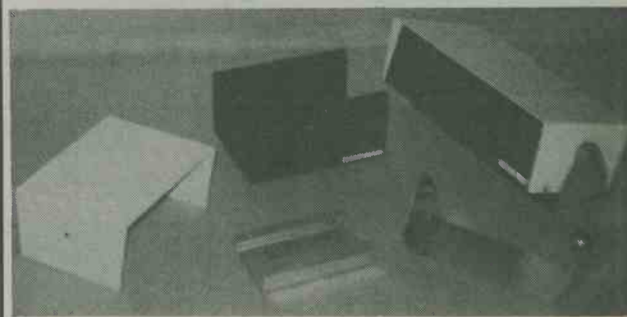

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5	BC160 TO39 Metal	PNP
5	2N3055 TO3 Metal	NPN
2	BD312/MJ2955 TO3 Metal	PNP
5	TIP29-31 TO220 Plastic	NPN
2	TIP30-32 TO220 Plastic	PNP
10	OC71-76 Germanium	PNP
5	AC128-188 Germanium Metal	PNP
5	AC127 187/176 Germanium Metal	NPN
5	OC44-45 Germanium	PNP
5	TIS43-UT46 Unijunction Plastic	
5	2N3819 F.E.T.	
2	MEL11 Photo Transistor Plastic	
2	BD131 TO126 Plastic	NPN
2	BD132 TO126 Plastic	PNP
100	TOTAL	

ALL devices – brand new and full spec as per device coding. Data and lead out details included in pak.
Normal Retail Value £23.00
Our Special Offer Price £15.00

Beginners Pak: no. 2 – 100 Rectifiers, SCR's, Triacs, Diodes.

20	IN4001-IN4007 1 Amp Silicon Rectifier
20	IN5401-IN5407 3 Amp Silicon Rectifier
20	IN4148 Fast switch diodes Silicon
10	OA200 BAX13-16 General Purpose Diode Silicon
5	C106D Thyristor 400v TO202 Case
2	10Amp Triacs 400v TO220 Case Isolated Tab
2	4Amp Triacs 400v TO220 Case Non-Isolated Tab
10	Assorted 3Amp Thyristors 50-600 volts TO64-TO66 Case
5	Assorted 1Amp Thyristors 50-600 volts TO39 Case
6	OA81-91 General Purpose Germanium Diodes
100	TOTAL

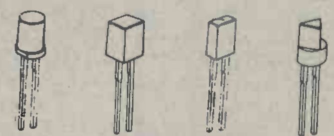
ALL devices brand new and full spec. Data and lead out details included.
Normal Retail Value £17.00
Our Special Offer Price £11.00

UNTESTED SEMICONDUCTOR PAKS

U1	150 germ Gold Bonded Diodes OA47	£1.00
U2	150 germ Point contact Diodes OA81	£1.00
U3	150 Silicon G.P. 200mA Diodes OA200	£1.00
U4	150 Silicon Fast Switch Diodes IN4148	£1.00
U5	25 Stud type Silicon Rectifiers up to 10A	£1.00
U6	10 SCR's 5Amp TO66	£1.00
U7	40 Sil Trans NPN TO18 Case BC107/8/9	£1.00
U8	40 Sil Trans PNP TO18 Case BC177/8/9	£1.00
U9	40 Sil Trans NPN TO18 Case 2N706/8	£1.00
U10	40 Sil Trans NPN TO5/39 2N697/2N1711	£1.00
U11	40 Sil Trans PNP TO5/39 2N2905/1132	£1.00
U12	30 Sil Trans NPN TO39 BFY51-BC141	£1.00
U13	30 Sil Trans PNP TO39 BC160-161 etc	£1.00
U14	10 Sil Trans NPN TO3 2N3055	£1.00
U15	10 Sil Trans NPN TO220 TIP29-31-33	£1.00
U16	10 Sil Trans PNP TO220 TIP30-32-34	£1.00
U17	30 Sil Trans NPN TO39 High Vlts. BF258/115	£1.00
U18	40 Sil Trans TO92 BC237/8	£1.00
U19	40 Sil Trans TO92 BC251	£1.00
U20	40 Sil Trans NPN TO92 BC183-4	£1.00
U21	40 Sil Trans PNP TO92 BC257 BC212L	£1.00

Code No's mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

NEW SHAPE LEDs



1561	£0.26	3mm Cylindrical LED Red
1562	£0.26	3mm Square LED Red
1563	£0.26	3mm Triangular LED Red
1564	£0.26	5mm Rectangular LED Red
1565	£0.26	5mm Cylindrical LED Red
1566	£0.26	5mm Square LED Red
1567	£0.26	5mm Triangular LED Red
1568	£0.28	3mm Cylindrical LED Green
1569	£0.28	3mm Square LED Green
1570	£028	3mm Triangular LED Green
1571	£0.28	5mm Rectangular LED Green
1572	£0.28	5mm Cylindrical LED Green
1573	£0.28	5mm Square LED Green
1574	£0.28	5mm Triangular LED Green
1575	£0.28	3mm Cylindrical LED Yellow
1576	£0.28	3mm Square LED Yellow
1577	£0.28	3mm Triangular LED Yellow
1578	£0.28	5mm Rectangular LED Yellow
1579	£0.28	5mm Cylindrical LED Yellow
1580	£0.28	5mm Square LED Yellow
1581	£0.28	5mm Triangular LED Yellow

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MC1 40 miniature ceramic capacitors: 5 of each value: 22pf, 27pf, 33pf, 39pf, 56pf, 68pf, 82pf. £1.00
MC2 40 miniature ceramic capacitors: 5 of each value: 100pf, 120pf, 150pf, 180pf, 220pf, 270pf, 330pf, 390pf. £1.00
MC3 40 miniature ceramic capacitors: 5 of each value: 470pf, 560pf, 680pf, 820pf, 1000pf, 1500pf, 2200pf, 3300pf. £1.00
MC4 35 miniature ceramic capacitors: 5 of each value: 4700pf, 6800pf, .01uf, .015uf, .022uf, .033uf, .047uf. £1.00

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1901	Dome Tweeter 3¼" 8ohms 50w	£3.20
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1903	Flared Horn Tweeter 8 ohms 30w	£3.80
1904	2 way crossover 15w 8ohms	£1.24
1905	2 way crossover 40w 8ohms	£2.70
1906	3 way crossover 60w 8ohms	£3.50
1907	Piezo Tweeter	£5.20
1914	70mm 80 ohm speaker	£1.20
1915	70mm 8 ohm speaker	£0.95
1916	56mm 8 ohm speaker	£0.65
1917	2¼" 8 ohm speaker	£0.75
1918	2¼" 64 ohm speaker	£0.82
1919	5¼" whoofer 4ohms 10w	£3.90
1920	5¼" whoofer 8ohms 10w	£3.90
1921	5¼" Dual cone wide tange 8ohms	£5.80
1922	8" Dual cone long throw 8ohms 15w	£4.84
1923	8" whoofer dual 4 plus 8ohms rubber edge 20w	£7.80

DIL SOCKETS

DIL SOCKETS:					
1601	8 Pin	0.09	1605	20 Pin	0.20
1602	14 Pin	0.11	1606	22 Pin	0.24
1603	16 Pin	0.12	1607	24 Pin	0.28
1604	18 Pin	0.18	1608	28 Pin	0.32
			1609	40 Pin	0.36

Late additions – High Current TRANSISTORS

		VCEO	VCBO	I.C. Max
BFT32	£0.60	60	80	3A
BFT33	£0.62	80	100	3A
BFT34	£0.65	100	120	3A
BFT37	£0.95	100	120	3A

RPYY76A Infra Red Detector £0.65

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500	Solid State Buzzer 4-25v	£0.75
501	Crystal Earpiece	£0.42
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1548	£0.15	LED Plastic clips .125"	
1549	£0.18	LED Plastic clips .2"	
1550	£0.26	LED Housing (nickel plated) .125"	A
1551	£0.22	LED Housing (nickel plated) .125"	B
1552	£0.37	LED Housing (matt black) .125"	C
1553	£0.31	LED Housing (matt black) .125"	D
1554	£0.34	LED Housing (nickel plated) .2"	E
1555	£0.28	LED Housing (nickel plated) .2"	F
1556	£0.44	LED Housing (matt black) .2"	G
1557	£0.36	LED Housing (matt black) .2"	H

BULBS AND NEONS

1534	£0.24	LES Bulb 6v 0.36w
1535	£0.24	LES Bulb 6.5v 1w
1536	£0.24	LES Bulb 14v 0.75w
1538	£0.24	MES Bulb Round 6v .04A
1539	£0.20	MES Bulb Round 6.5v .15A
1540	£0.20	MES Bulb Round 6.5v .3A
1541	£0.20	MES Bulb Round 12.0v .1A
1542	£0.20	MES Bulb Round 12.0v 2.2w
1543	£0.34	Neon Red Round 240v
1544	£0.34	Neon Red Rectangular 240v
1545	£0.34	Neon Orange Rectangular 240v
1546	£0.34	Neon Green Rectangular 240v
1547	0.18	MES Batten Holder

CARBON FILM RESISTOR PAKS

These paks contain a range of Carbon Film Resistors, assorted into the following groups:

R1	80 Mixed ¼w 100ohms – 820ohms	£1.00
R2	80 Mixed ¼w 1Kohms – 8.2Kohms	£1.00
R3	80 Mixed ¼w 10Kohms – 82Kohms	£1.00
R4	80 Mixed ¼w 100Kohms – 1M	£1.00
R5	60 Mixed ½w 100ohms – 820ohms	£1.00
R6	60 Mixed ½w 1Kohms – 8.2Kohms	£1.00
R7	60 Mixed ½w 10Kohms – 82Kohms	£1.00
R8	60 Mixed ½w 100Kohms – 1M	£1.00

TANTALUM BEAD CAPACITORS

401	0.1uF	16v	0.11	414	47.0uF	16v	0.55
402	0.22uF	16v	0.11	415	100uf	10v	0.62
403	0.33uF	16v	0.11	416	.1uF	35v	0.12
404	0.47uF	16v	0.11	417	.22uF	35v	0.12
405	0.68uF	16v	0.11	418	.33uF	35v	0.12
406	1.0uF	16v	0.11	419	.47uF	35v	0.12
407	2.2uF	16v	0.12	420	.68uF	35v	0.12
408	3.3uF	16v	0.13	421	1.0uF	35v	0.12
409	4.7uF	16v	0.14	422	2.2uF	35v	0.13
410	6.8uF	16v	0.15	423	3.3uF	35v	0.15
411	10.0uF	16v	0.16	424	4.7uF	35V	0.18
412	22.0uF	16v	0.28	425	6.8uF	35v	0.30
413	33.0uF	16v	0.50	426	10.0uF	35v	0.38

ELECTROLYTIC PAKS

A range of paks each containing 25 first quality, mixed value miniature electrolytics.

EC1	Values from .47mFD – 10mFD	£1.00
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EC3	Values from 100mFD – 1000mFD	£1.00

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137	AC–DC Adaptor 6, 7½, 9 & 12 volts	£3.75
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139	Teak 30 Case	£7.00
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2202	3.5" x 3.75" 1 copper	£0.66
2203	2.5" x 17" 1 copper	£2.28
2204	3.75" x 5" 1 copper	£0.86
2205	3.75" x 3.75" 1 copper	£0.76
2206	3.75" x 17" 1 copper	£2.96
2207	4.75" x 17.9" 1 copper	£3.90
2208	2.5" x 1" 5 in pack	£0.92
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2213	vero pins Single sided .040mm .1" (in 100's)	£0.52
2214	DIP Breadboard	£3.26
2215	Vero Cutter	£1.06
2216	Insertion Tool 1	£1.46
2217	PCB Transfers	
2218	12 volt mini drill	£7.00

BREADBOARD

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2196	EXP350	£3.62
2197	EXP650	£4.14
2198	EXP300	£6.61
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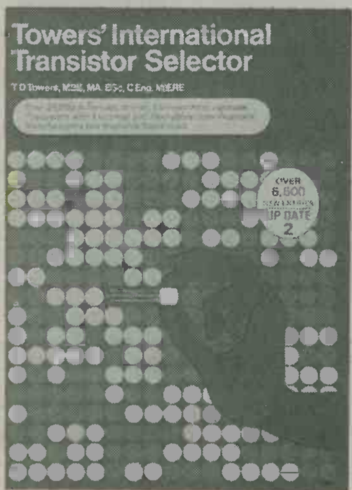
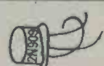
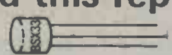


This is dead!



Would this replace it?



If it takes you longer than 1 minute to find out all about these transistors then you need a copy of TOWER'S INTERNATIONAL TRANSISTOR SELECTOR. It's one of the most useful working books you will be offered this year. And probably the cheapest!

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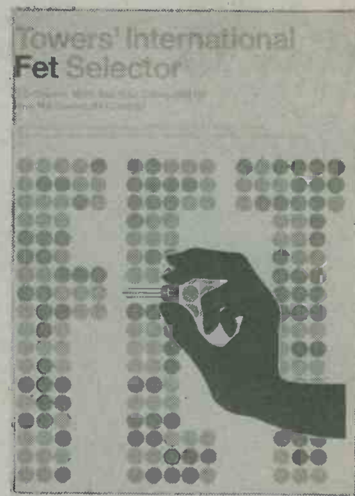

If you deal with field effect transistors, or fet's — whether as a student, a hobbyist, a circuit engineer, a buyer, a teacher or a serviceman — you often want data on a specific fet of which you know only the type number.

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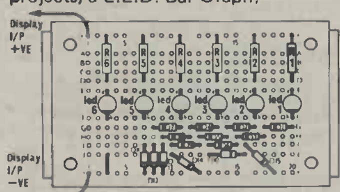

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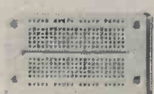
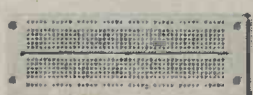
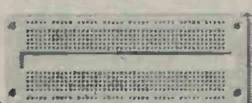
EXP 325 £1.60 The ideal breadboard for 1 chip circuits. Accepts 8, 14, 16 and up to 22 pin ICs. Has 130 contact points including two 10 point bus-bars.



EXP 350 £3.15 Specially designed for working with up to 40 pin ICs perfect for 3 & 14 pin ICs. Has 270 contact points including two 20 point bus-bars.

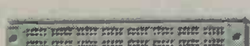


EXP 300 £5.75 The most widely bought bread-board in the UK. With 550 contact points, two 40 point bus-bars, the EXP 300 will accept any size IC and up to 6 x 14 pin DIPS. Use this breadboard with Adventures in Microelectronics.



EXP 600 £6.30 Most MICROPROCESSOR projects in magazines and educational books are built on the EXP 600.

EXP 650 £3.60 Has ·6" centre spacing so is perfect for MICROPROCESSOR applications.



EXP 4B £2.30 Four more bus-bars in "snap-on" unit.

The above prices are exclusive of P&P and 15% VAT.

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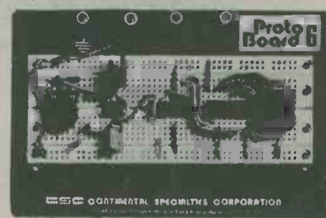

PB6 Kit, 630 contacts, four 5-way binding posts accepts up to six 14-pin Dips.

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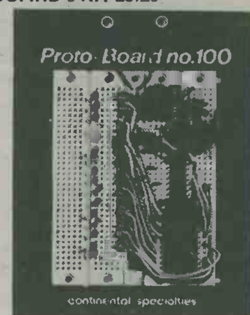

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NEWS ... AND

BOOKMAKERS BACK THE CHIP

Mr Charles and family of Bridlington, who own a small chain of betting shops, are well aware of the extent to which the chip – in the shape of an amazingly fast and efficient little machine called the "Ecstacy Settler" – has benefited their private lives.

For the Charles family, the busy holiday season used to mean that at the end of a day's racing a large number of holidaymakers' betting slips would remain to be settled. This highly skilled and very time-consuming process used to keep the couple busy until late into the evening while they endeavoured to ensure they were completely up-to-date for the following day.

Some two years ago they purchased from Efficient Computing Systems Ltd of Douglas, Isle of Man, their first Ecstasy Settler – a machine capable of settling even the most difficult bets within seconds. Its effect has been to transform completely the couple's social life.

Now even on the busiest Saturday, they have finished as early as 6pm and – armed with the machine – they are now able to accept the various speciality bets favoured by holidaymakers from different regions which they previously might have had to turn down.

The Ecstasy Settler is based on the Texas Instruments TI-59 and PC100C print cradle. It has a special Ecstasy Settler program chip to enable it to work out the various bets and combinations and a special keyboard to make it especially easy to operate. The printer confirms details of the bet being worked out and the results of the calculation.

Pictured is the Ecstasy Settler which is based on the TI-59 and PC100C print cradle. It has a special Ecstasy Settler program chip to enable it to work out the various bets and combinations and a special keyboard to make it especially easy to operate. The printer confirms details of the bet being worked out and the results of the calculation.

TOKO 7ES AND 7TS MINIATURE COILS

The rapidly diminishing dimensions of portable radio equipment for both entertainment and communications has spawned a new series of coils and filters from TOKO – amongst which are the 7ES and 7TS, only 6.2mm tall, but pin compatible with TOKO's existing 7mm coil series. Both are capable of being wound in primary/secondary and a primary tap configurations.

The 7ES is intended for applications requiring inductance in the range 1–500μH, with an operational frequency range of 100kHz to 15MHz in a variety of RF and IF signal processing applications. An internal capacitor in the range 18pF–47pF is available for FM IF applications, or 180pF/1500pF for AM IF applications. Stability and 'Q' are not sacrificed despite this compact design, with typical 'Q' values of 100 being achieved at both 455kHz and 10.7MHz.

The 7TS is an adjustable high inductance miniature coil occupying the same space as the 7ES, and offering frequency coverage to 2MHz with a maximum inductance of 15mH. Applications include lowpass filters, multiplex filters, phase correction networks, etc.

. . . COMMENT

ELECTRONIC AID FOR THE DISABLED

In this the International Year of Disabled People it is particularly pleasant to learn of electronic aids which can be effective in helping people. One such, which assists elderly folk, was recently reported in the BBC World Service.

A system is being pioneered, at the Clinical Research Centre in London, for an emergency alert designed to make much more effective use of existing telephone networks.

Primarily intended for old people living on their own, those taking part in the experiment are equipped with a personal transmitter about the size of a packet of ten cigarettes. If there is an accident and the individual concerned is unable to use the telephone they can activate the transmitter by pressing a button. A matching receiver unit, fitted to the old person's telephone, receives the signal and operates the phone which automatically dials the number of a central computer. During the call a series of electronic pulses is transmitted which positively identifies the source of the alarm.

Having received the call the computer then proceeds to ring the telephone number of a person nominated by the elderly person. If that person is not available the computer then proceeds to dial the next number on its list and if that person is not available it dials the switchboard of the local hospital, or some other emergency service.

Radio and Electronics Constructor has been published since 1947 – first as the 'Radio Constructor' – but latterly under the present heading. In that relatively brief span of 34 years, electronics has made the most enormous advance in terms of its own technology and sub-technologies (computing, satellite communications, TV etc).

The past five years of the 'hobby' side of electronics has tended to highlight computing – especially since the consumer goods offered from the Orient and elsewhere drained off much enthusiasm for DIY in the audio and radio field. Amateur radio has been a recent casualty of the 'buy it, plug it in, switch it on' syndrome, as can readily be seen by the dearth of practical skills within the fraternity.

R&EC is now planning for the next 34 years, starting with a very comprehensive reader survey that endeavours to find out exactly what you want from an electronics magazine. The next issue will contain this 4 page survey – but we would be pleased to supply advance copies to anyone who would like to give us the benefit of their ideas in the meantime (SAE please). For this help, we are offering £1 off the 12 issue postal subscription rate of £9.50 for orders submitted with this form.

R–EC's new editorial team will be phasing in new features and ideas over the next few months, so your comments and observations would be most welcome. Our basic aim is to make *R&EC* intelligible to the newcomer, but not condescending to the experienced or 'professional' reader – whilst trying to revive some of the practical and constructive instincts that have been surpressed by the ready availability of (mainly) imported equipment.

We want to retain *R&EC's* reputation for accuracy and thoroughness – but at the same time we are introducing many innovations in the shape of our own lab and technical facility equipped with £40,000+ worth of the most up-to-date analytical equipment for radio and electronics. Projects from this facility are already on the stocks, including a 1.5dB NF 70cms converter. A 16 channel VHF FM scanning receiver, mods to make the R1000 tune to 40kHz – and *much, much more! !*

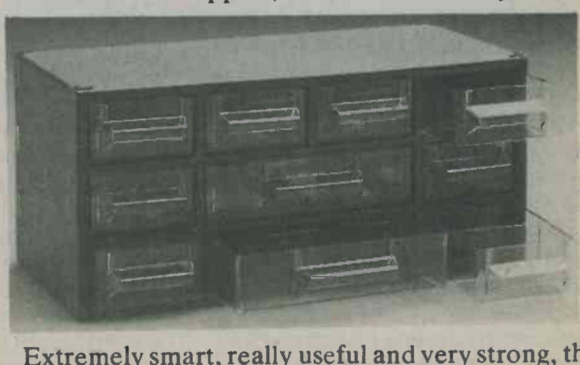
SPACE SAVERS

Just one item from an exciting new range of space-saving storage cabinets and cases available from Edward Roland Ltd., of 215 Putney Bridge Road, London SW15 2NY, this 10 drawer cabinet is designed to store odds and ends of almost any description. Provides tidy storage for needlework and craft hobby accessories – in fact, any bits and pieces that need keeping somewhere safe. Also useful for keeping everything ship-shape in the garage, workshop or garden shed.

Certainly no eye-sore, this lightweight but very strong cabinet is of durable all-plastic construction and boasts a dark brown outer with one row each of see-thru green, amber and yellow drawers. A combination of drawer sizes and compartments has been cleverly designed to store items of varying sizes.

With practicality in mind, these cabinets are designed so that they can be stacked two or more on top of each other without slipping and also have the facility for fixing to the wall.

Attractive see-thru drawers for fast content identification can be left in a partly or fully extended position without support, or removed for easy access.



Extremely smart, really useful and very strong, this cabinet represents good value for money at £7.75, inclusive of postage and packing in the UK.

SUGGESTED CIRCUIT

BURGLAR ALARM WITH ENTRANCE DELAY

By G. A. French

In the June 1980 issue the author described a "Robust Burglar Alarm" which had relatively low impedance alarm switching and yet consumed an extremely small supply current from its battery. The alarm was self-latching and it included a time delay after switch-on which allowed the occupier of the protected premises to leave before the alarm was fully armed. It was accepted that the alarm would sound for a brief period when the occupier returned before he could switch it off.

The circuit seems to have been well received by readers, and several have asked for a more comprehensive design which gives instant warning for all entrances and points of access other than the front door. The alarm circuitry for the front door should incorporate a short delay which would enable the occupier to enter and switch off the circuit before the alarm started.

In consequence of these requests, a modified burglar alarm circuit has been designed, and this is presented here. As before there is a time delay after switch-on and this applies to all guard switches. At the end of the delay all switches except that at the front door give immediate warning when actuated. The switch at the front door gives warning after a short delay.

FULL CIRCUIT

The full circuit of the burglar alarm is given in Fig. 1. The components around IC2, including C2 and C3, and R6 to R9 inclusive, are in the same circuit as the one previously described. This will now be dealt with quickly.

When S3(b) is in the "Off" position, capacitor C2 is discharged via the current limiting resistor, R9. Setting S3(b) to "On" takes the short-circuit off the capacitor and connects up the 9 volt battery.

IC2 consists of four 2-input NAND gates. Immediately after switch-on C2 is discharged, whereupon the input to inverting gate G4 is high and the gate output is consequently low. This low is passed to pin 5 of gate G5, whose output then has to be high regardless of the voltage on its pin 6. Gates G5 and G7 form a latch, and this takes up the state where the output of gate G7 is low, this output being coupled back to pin 6 of gate G5 via resistor R8. The high at G5 output is also passed to the input of inverting gate G6, the output of which is consequently low. Emitter follower TR2 is cut off and no current flows through the relay coil in its emitter circuit.

S2 is an immediate warning guard switch and it closes if entry is attempted at the point where it is positioned. When it closes, it takes pin 6 of gate G5 high, but this has no effect on the output of G5 when the pin 5 input of G5 is low. After switch-on, C2 commences to charge via R6 until, after a period roughly equal to 1 minute, the input of G4 goes sufficiently negative for the G4 output to go high. The alarm is then armed. If S2 is now closed, it takes pin 6 of G5 high whereupon G5 output goes low and G7 output goes high. G5 and G7 latch into this new state and maintain it until the whole alarm circuit is switched off at S3(b). Only a momentary closure is required in S2 for G5 and G7 to latch up to the new state, and any subsequent opening or closure in S2 has no further effect. Since G5 output has been taken low the output of gate G6 goes high, taking with it the base of TR2. Nearly the full supply voltage appears across the relay coil, the relay contacts change over and the bell (or other warning device) sounds. The bell will be turned off only when S3(b) is put to the "Off" position.

An important feature of the alarm circuit is that the impedance at the guard switch, S2, is of the order of 3kΩ only. At the instant of closure of this switch a current pulse of the order of 3mA is drawn from the output of gate G7 via R8. It is this relatively high switching current which enables the alarm circuit to be termed

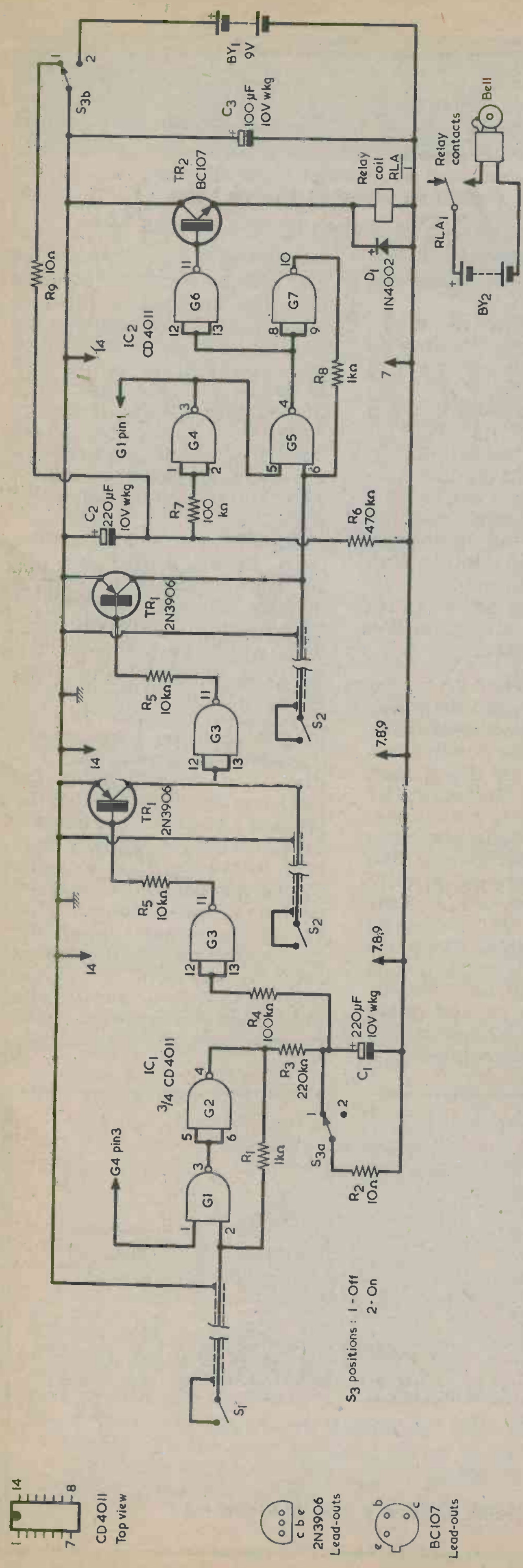


Fig. 1. The full circuit of the burglar alarm. After switch-on there is a time delay of about 1 minute when all guard switches are inhibited. If guard switch S2 is then closed the alarm sounds immediately. Guard switch S1 is mounted at the front door and there is a delay of about 30 seconds after this closes before the alarm is triggered. Quiescent current consumption from the 9 volt battery is a matter of microamps only.

"robust". After the 3mA pulse no further current flows in the S2 circuit because the output of gate G7 then goes high.

The guard switch closes when an attempt at entry is made and, in the interests of battery economy, this method of working has been chosen in preference to the more usual "fail-safe" method in which a guard switch opens at intrusion. In the second method a continual current flows through the guard switch, and the alarm sounds not only when the switch opens but also when the wires to the switch are cut. However, for reliable operation the continual current in the guard switch circuit has to be at least 1mA and even this relatively low current would mean fairly frequent battery replacement. With the circuit described here the quiescent battery current is a matter of microamps only, and the battery has a very long life. The present circuit also offers a high degree of protection against wire cutting because the connection to the guard switch is made by way of screened audio cable in which the screening is braided rather than lapped. It is virtually impossible to cut a cable of this nature without at least momentarily short-circuiting the screening to the centre conductor. Such a short-circuit is sufficient to trip the G5, G7 latch and cause the alarm to sound continually.

FRONT DOOR DELAY

The front door latching and delay circuit takes in three NAND gates of a second CD4011, these gates being G1, G2 and G3. The fourth gate is not used, and its inputs are taken to the negative supply rail. The front door delay components are R3 and C1, the capacitor being short-circuited through current limiting resistor R2 when S3(a) is in the "Off" position. S1 is the guard switch installed at the front door.

G1 and G2 form a similar latch to that given by G5 and G7. Pin 1 of G1 connects to pin 3 of G4 so that, after switch-on and during the initial delay period imposed by C2 and R6, this input pin is low and the output of gate G1 is high. The occupier should have left and closed the front door during the initial delay period whereupon, after the end of the period, S1 will be open and the pin 1 input of G1 high. G1 and G2 are now latched in the state where the output of G2 is low, as also is the pin 2 input of G1. Since pin 4 of G2 is low no charging current is available for C1 through R3. The low voltage is passed through R4 to the input of inverting gate G3, whose output is consequently high.

If, after the end of the initial delay period, S1 is closed (or the wiring to S1 is cut) even if momentarily only, the G1, G2 latch changes state, with the output of G2 going high. C1 now commences to charge via R3, and the positive-going voltage on its upper terminal is applied through R4 to the input of gate G3. When this input has gone sufficiently positive the output of G3 goes negative and turns on transistor TR1. This transistor takes pin 6 of G5 high, giving the same effect as if S2 had been closed, and causes the alarm to sound. The front door delay time is about 30 seconds.

S3(a)(b) is a d.p.d.t. toggle switch. R4 and R7 have no effect on circuit operation and are merely current limiters. It is possible under certain conditions that, when S3(a)(b) is taken from "On" to "Off", there could be an instant when the supply voltage falls very rapidly whereupon, without R4 and R7 in circuit, high discharge currents could flow from C1 and C2 into the internal protective diodes of G3 and G4.

The relay recommended for RLA is the "Open" type with 410Ω coil and changeover contacts which is available from several suppliers including Maplin Electronic Supplies. D1, across the coil, is the usual diode which suppresses high back-e.m.f. voltages when the relay releases. Battery BY2 has a voltage suitable for the particular bell employed. A separate battery is used, and this ensures that high bell transient voltages are kept away from the electronics.

If S2 happens to be closed at the end of the initial delay period given by C2 and R6 the alarm will at once be triggered. Should S1 be closed at the end of the initial delay period, the G1, G2 latch will be triggered and the alarm will sound after the front door time delay has elapsed.

The current drawn from the 9 volt battery after switch-on rises to a momentary peak of slightly more than 1mA when gate G4 input passes through the centre of its transfer characteristic. The current then falls slowly as C2 continues to charge and finally settles to a very low value indeed. With the prototype circuit, quiescent current some ten minutes after switching on was only 3μA. The current rises to some 20mA when the alarm is triggered and the relay energised.

CONSTRUCTION

The alarm may be assembled in a metal case which is made common with the positive rail, as is indicated by the chassis symbol in Fig. 1. The leads to S1 and S2, as already mentioned, consist of screened audio cable with braided screening. The screened wires should be terminated inside the case, and the screening will, of course, be common with this. There will almost certainly be only one front door switch, but it may be desired to have several guard switches in the S2 circuit. The extra switches are connected in parallel with S2, as shown in Fig. 2. At each parallel connection, the braiding of the two leads is connected together, as are the two centre leads. It is important that the centre lead of one wire is not connected to the braiding of the second wire. Apart from giving protection against wire cutting, the screening also ensures that the centre wire cannot pick up noise and static.

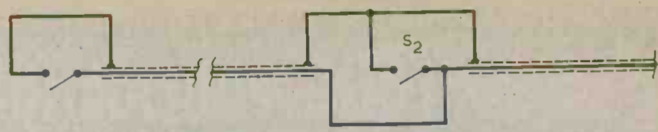
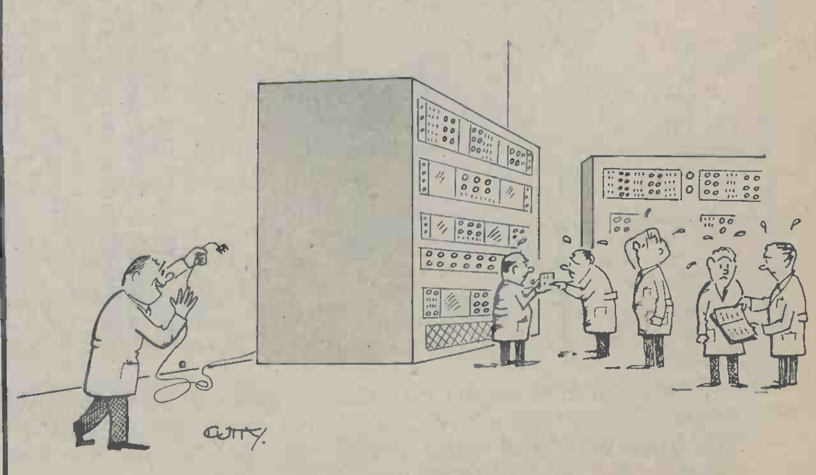


Fig. 2. When further guard switches are connected in parallel with S2 they should be wired as shown here.

Constructors will have their own ideas about simple switches which close when a door or window is opened. A suitable choice for many positions would be a microswitch with an extended operating lever. A dry reed switch with changeover contacts and a bar magnet can be used where there are wooden surfaces. The dry reed switch can, for instance, be mounted on the jamb of a door and the magnet affixed to the door surface close to it. When the door is closed the magnet causes the dry reed switch to be actuated. The switch is released when the door is opened and the magnet taken away from it. All the guard switches should be positioned inside the protected premises, and not out of doors. ■



"Relax lads, it's not plugged in!"

RECENT PUBLICATIONS

THE ART OF ELECTRONICS. By Paul Horowitz and Winfield Hill. 733 pages, 250 x 175mm. Published by Cambridge University Press. Hard cover ISBN 0-521-23151-5, price £35.00. Paperback ISBN 0-521-29837-7, price £12.50.

In their preface the authors of this book state," . . . the treatment in this book reflects our philosophy that electronics, as currently practiced, is basically a simple art, a combination of some basic laws, rules of thumb, and a large bag of tricks." Not only does this explain the reasoning behind the preparation of the book but it also gives an idea of the enthusiasm and informal approach of its authors. "The Art of Electronics" must surely become a classic in the electronic literature, following in the footsteps of Henney, Terman and Langford-Smith.

Paul Horowitz is at Harvard University, Winfield Hill is with Sea Data Corporation, Massachusetts, and the book is printed in USA. Most of the text is 2-column but this is occasionally interrupted by a short section printed across the width of the page giving information which, though pertinent, is incidental to the main theme. Thus, in the chapter dealing with operational amplifiers, we find a section which describes the design by Bob Widlar at Fairchild of the famous 709. This was the first viable op-amp and it paved the way for the even more successful 741. The work contains very many diagrams, some of which show the wrong way of doing things. Also to be found are reproductions of manufacturers' data sheets. Virtually everything in modern electronics is covered in this block-buster of a book. The style is as readable as a good novel but this book has more words than have many modern novels. At a rough estimate the text approaches half a million words!

"The Art of Electronics", particularly in its paperback version, offers almost incredibly good value for money.

PRACTICAL ELECTRONICS HANDBOOK. By Ian R. Sinclair. 192 pages, 215 x 130mm. Published by Newnes Technical Books. ISBN 0-408-00447-9. Price £3.95.

Ian Sinclair is no stranger to the readers of this magazine, and his popular series on programmable calculators and on microprocessors have been well received and praised. He has the ability to clearly explain electronic circuits and their operation, and this factor is at once apparent to anyone reading the book under review.

After an introductory note on basic mathematical conventions the book proceeds to the first chapter, which is devoted to passive components. These include resistors, thermistors, capacitors, inductors and quartz crystals. The second chapter discusses active discrete components and deals with diodes, l.e.d.'s, bipolar transistors, field-effect transistors, negative feedback, heatsinks and switching circuits. Discrete component circuits form the subject of the third chapter, and these consist of amplifiers, tone controls, filters, output stages, oscillators, r.f. stages, modulators, power supplies and stabilizers. In the fourth chapter the reader is taken on to linear i.c.'s, and this chapter gives details of bias methods, op-amp circuits, phase-locked loops, voltage stabilizers and timers. The fifth and final chapter covers digital i.c.'s and provides information on basic logic, Boolean algebra, sequential logic, displays and decoders, MOS circuits and the microprocessor. The fifth chapter also includes pinout diagrams for a very wide range of t.t.l. and CMOS devices. The book closes with two appendices giving a standard metric wire table and bibliography, followed by a comprehensive index.

"Practical Electronics Handbook" goes into considerable detail on the subjects it deals with and gives practical values of components where these are of importance. The book will be of value not only to the beginner but also to the reader who is well advanced in electronics.

CRYSTAL CALIBRATOR

By T. J. Johnson

Eight frequency decades — 1Hz to 10MHz.

Harmonic-rich square wave outputs.

What is probably the most useful addition to any short wave listening station is a crystal calibrator, and its prime use it to check the frequency of any radio station being received. The calibrator does not actually measure the frequency but, instead, compares it with its own internal standard.

In its simplest form a crystal calibrator, sometimes called a marker generator, consists of a very stable and accurate crystal controlled oscillator. A number of frequencies can be derived from this standard frequency by division, usually by a factor of 10, by means of a series of frequency dividers. These frequencies are then selected by a switch and passed to the aerial input of the receiver, whereupon a number of calibration points appear as very strong signals at the corresponding points on the receiver dial. The basic frequency and the divided frequencies also produce harmonics, which further augment the number of checking points produced by the calibrator.

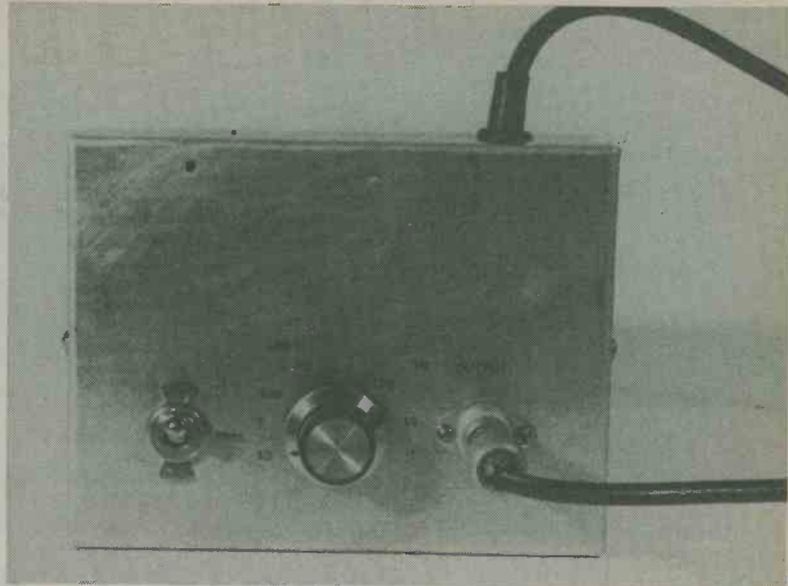
CIRCUIT DESIGN

The usefulness of the calibrator depends entirely upon the accuracy and stability of the crystal used. Best results are given with a crystal which is intended as a "Frequency Standard". With such a crystal, in the oscillator to be described, a short term accuracy of + 5Hz in any period up to eight hours can be expected. The long term accuracy has not been checked, but it is safe to assume that the initial starting frequency will not vary by more than 50Hz over an extended period of intermittent use. If the frequency does drift, it is quite easy to bring it back to its correct value.

The calibrator has been designed with two purposes in mind. As well as a receiver calibrator it can also be employed with digital equipment as a Standard Timebase. It can, for example, be an accurate source of clock pulses for a frequency counter. Since the lowest frequency provided by the calibrator is 1Hz, it will be seen that it offers a wide range of applications in digital design and circuitry.

When employed as a calibrator the following results were observed with respect to harmonics. Very strong signals were given up to 100MHz, at times with no connection to the receiver. A direct connection to the receiver was required in the range of 100 to 200MHz, but signals were still strong. Weak but useful signals were provided from 200 to 400MHz, with harmonic strength then falling very rapidly. These tests were made both with a receiver covering the appropriate range and with a spectrum analyser.

The completed calibrator in its aluminium case. Panel legends are taken from "Panel-Signs" Set No. 4.



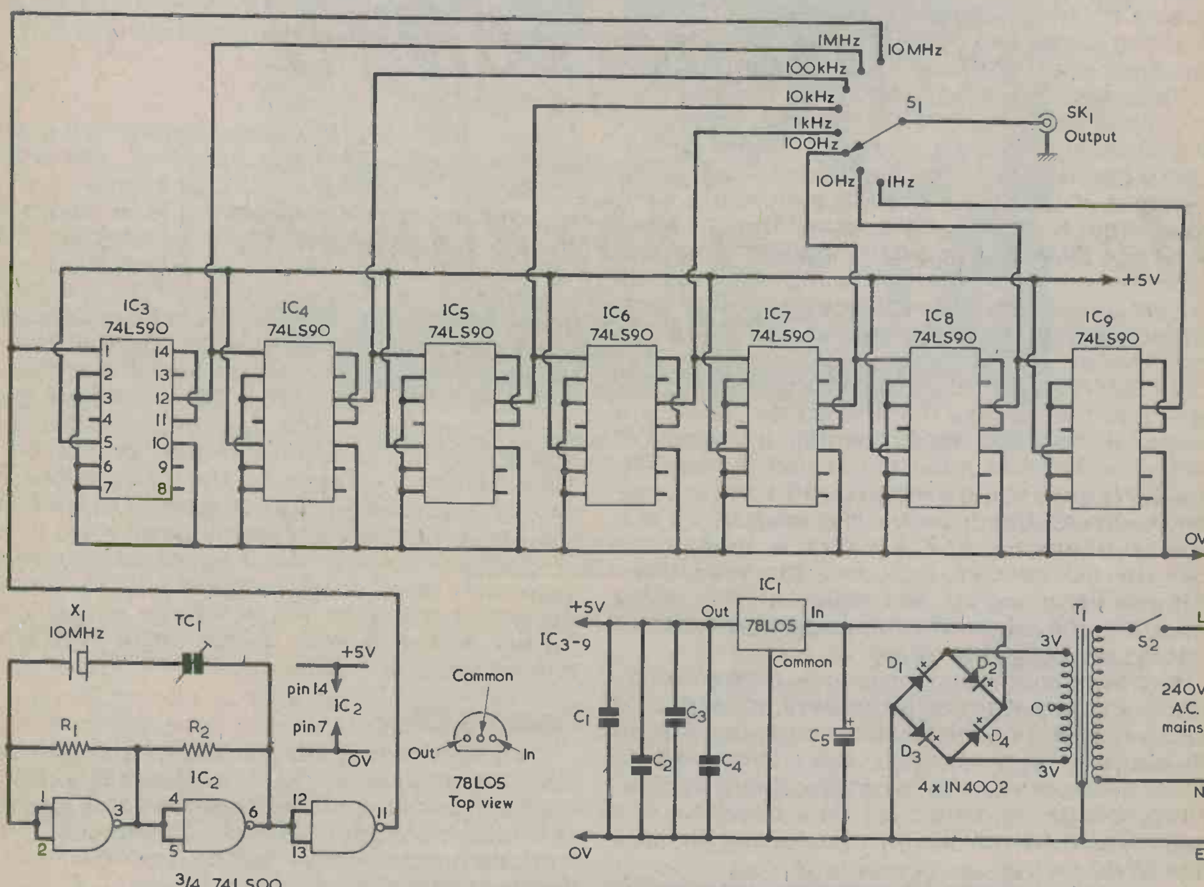
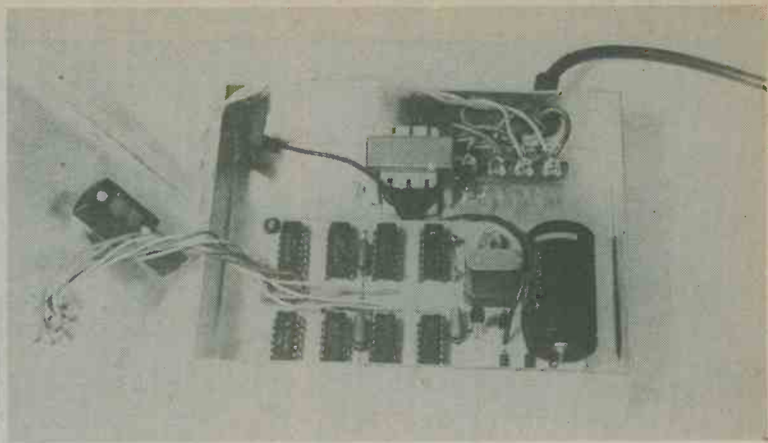


Fig. 1. The circuit of the crystal calibrator. Two gates of IC2 function as a 10MHz crystal controlled oscillator, with the third gate squaring up the output. Each 74LS90 acts as a decade divider.

CIRCUIT DESCRIPTION

The full circuit of the crystal calibrator is given in Fig. 1, and it can be considered as having three sections: the power supply, the oscillator and the dividers. The oscillator is quite conventional for t.t.l. circuits and consists of two NAND gates connected as inverters and forming a single amplifier. R1 and R2 bias the gates onto a linear part of their operating characteristic.

The frequency determining components, crystal X1 and trimmer TC1, are connected between the output (pin 6) and the input (pins 1 and 2) of the two NAND gates. The crystal exhibits a very low impedance at its resonant frequency, where-



The internal layout inside the case.

upon positive feedback and oscillation occurs at this frequency. In the present design this is 10MHz. The trimmer enables the oscillation frequency to be set to precisely the nominal figure for the crystal. A third NAND gate, also connected as an inverter, couples to the oscillator output and squares up the oscillator sine wave so that the following stages can operate cleanly. No connections are made to the fourth NAND gate of the i.c.

The series of seven dividers form the next section, these being IC3 to IC9 inclusive. These are 74LS90 decade dividers, and each divides the frequency applied to its pin 1 by a factor of 10, giving an output at pin 12. Division is symmetric, with each output being a square wave. Thus, if a frequency of 1MHz is applied to a divider input, the output frequency is 100kHz. It is important to note that, for correct operation, the input signal to each divider should be a square wave of reasonably good shape.

The 10MH z signal from the oscillator section is applied to the input of the first divider, IC3. Here the signal is divided by 10, resulting in a signal of 1MHz. This is then applied to the next divider, IC4, where it is once again divided by 10. Each successive i.c. divides the previous frequency by 10, and the final frequency, at IC9 output, is 1Hz.

All the frequencies, including the original 10 MHz oscillator signal, are taken to the rotary switch S1, the wiper of which selects the output frequency which is required.

The power supply section is quite conventional. The mains transformer secondary voltage of 6 volts is rectified by the bridge consisting of D1 to D4, causing approximately 8 volts to appear across the reservoir capacitor, C5. This is applied to the voltage regulator, IC1. The regulator is a small 3-terminal device which gives a stable 5 volts at its output.

A very large value of reservoir capacitor is required to prevent any hum appearing on the supply lines and modulating the oscillator. If hum should be found to be a problem, then increasing the value of C5 will cure it. Indeed, it may be wise to have a large value fitted at the outset. A capacitance as high as 2,200pF would be suitable, provided there is room in the case. The four remaining capacitors, C1 to C4, are connected across the supply lines at various points on the printed board to prevent r.f. from modulating the supply and affecting lower frequency outputs.

As the circuit uses low power (LS) i.c.'s, it may be thought that a mains power supply is unnecessary and that a battery could be used instead. However, the digital applications required by the author mean that the calibrator is switched on for long periods, whereupon battery operation would be uneconomic. A battery may of course be used, nevertheless, and details of how it can be connected to the calibrator are given at the end of this article.

COMPONENTS

There are no critical components in the circuit, all being easily obtained. However, the crystal needs special mention. Surplus crystals are not recommended and it is advisable to obtain the crystal from a manufacturer of crystals, who advertises it as a frequency Standard, if the accuracy mentioned earlier is to be given. The crystal used in the prototype is available from Quartslab Marketing Limited, P.O. Box 73, Summit House, London, SE18 3LR. The crystal socket may also be obtained from this source. TC1 must be a good quality component and the author employed a miniature film dielectric trimmer, as retailed by Maplin Electronic Supplies. The rotary switch, S1, should be a good quality component as well. This is a 1-pole 12-way switch with only 8 ways used.

The mains transformer is specified as having a secondary rated at 3-0-3 volts at 100mA .No connection is made to the centre-tap and a transformer with a 6 volt 100mA secondary could alternatively, of course, be used.

CONSTRUCTION

Construction is straightforward and should present no difficulties. The calibrator should be housed in a small aluminium box capable of taking all the components, and that employed by the author measured 5 by 4 by 1½in. The lid is used as the front panel.

The oscillator, divider stages and the power supply (apart from the mains transformer) are assembled on a small printed board. It is not essential to use a p.c.b. but it is preferred. Other forms of assembly, such as using a plain perforated board may be used. Veroboard, with copper strips, is not suitable.

Details of the printed board are given in Fig. 2, in which both sides of the board are reproduced full size. The author used printed circuit transfers for the i.c. pads and other connection points, a Dalo etch pen then being used to connect the pads.

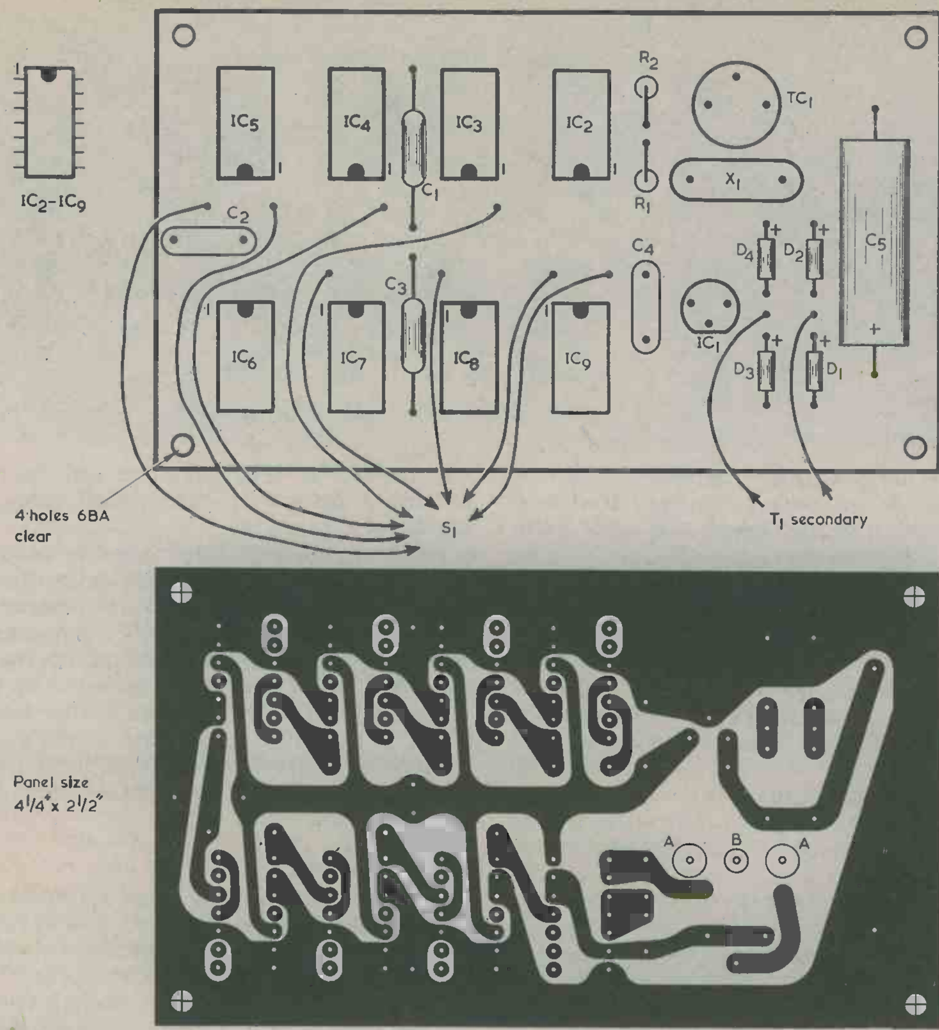


Fig. 2. The component and copper sides of the printed circuit board. This is reproduced full size.

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 560Ω
R2 560Ω

Capacitors
C1-C4 0.01μF polyester, type C280
C5 470μF electrolytic, 10V. Wkg. (see text)
TC1 2-22pF trimmer (see text)

Transformer
T1 mains transformer, secondary 3-0-3V at 100mA (see text)

Semiconductors
IC1 78L05
IC2 74LS00
IC3-IC9 74LS90
D1-D4 IN4002

Switches
S1 1-pole 8-way rotary (see text)
S2 s.p.s.t. toggle

Crystal
X1 10MHz Frequency Standard crystal, HC6/U, (see text)

Socket
SK1 coaxial socket

Miscellaneous
Metal case (see text)
Crystal holder, HC6/U
4-way tagstrip (see text)
Control knob
Printed circuit board
3-core mains lead
Nuts, bolts, wire, etc.

All the integrated circuits and most of the remaining components are assembled on a printed circuit board.

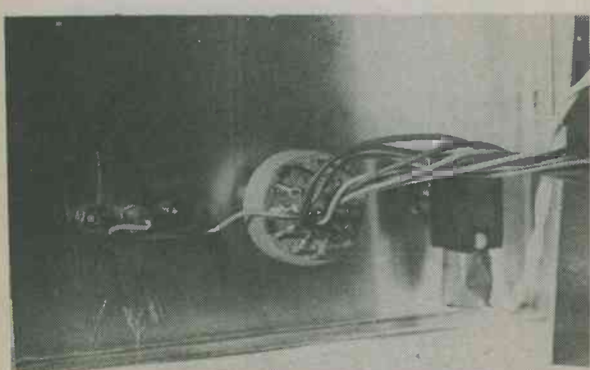
Although some of the tracks are very thin and close to others there should be no difficulty if the constructor is careful.

The spacing for the two holes marked "A" is ½in., with the fixing hole "B" positioned centrally between them. The crystal holder is inserted through the top of the board and its tags carefully bent over to touch the adjacent copper pads. The tags are then soldered to these pads. This procedure explains why there are no holes in the pads. Take care when soldering in trimmer TC1 as excessive heat could incur the risk of its body melting. A heat shunt is advised when fitting IC1. The wires going to the rotary switch should be stranded and about 5in. long.

In the prototype the board is mounted close to one long edge of the case, leaving sufficient space for the mains transformer and a 4-way tagstrip (1 tag earthed) to be bolted to the case bottom. The board underside is held clear of the inside surface of the case by metal spacing washers on the mounting bolts. These provide a chassis connection to the board. The remaining wiring between the board and the other components is shown in Fig. 3. The mains lead passes through a grommet in the case side and should be secured inside the case by a plastic or plastic-faced clamp. Take care to ensure that all mains connections are made correctly and that the metal case is reliably earthed.

After the wiring to the range selector switch S1 was completed with the prototype, the switch tags were bent over to bring them nearer the switch body. This was done because there was a possibility of the tags touching the i.c.'s. Also, the tags of switch S2 and the three non-earthy tags of the 4-way tagstrip were covered with insulating tape.

The front panel was given a rub-over with fine steel wool and left in its natural state. Lettering and numbers on the front panel were taken from "Panel-Signs", Set No. 4.



The wiring to the rotary switch. In the prototype the tags were bent inwards after soldering to avoid fouling the integrated circuits. The tags of S2 are covered with insulating tape to reduce the risk of shock when setting up or testing the calibrator.

CALIBRATION

Once all wiring has been completed and the board checked for mistakes, the crystal may be plugged in. Do **not** solder the crystal in. After switching on, allow about an hour for the circuit to settle down. Set the range switch to the 10MHz position and connect a coaxial lead of about 18 in. to the output. Since the case lid will be removed to allow access to TC1, it should be temporarily connected to the body of the case to provide an earth connection for the output socket.

If a digital frequency counter is available the trimmer is simply adjusted until this reads 10MHz. It should be found that the initial frequency is already close to that required. If a counter is not available, as will probably be the case, then another method will have to be used.

Since the calibrator is intended for use with a communications receiver, the latter should be able to pick up a standard frequency transmission at 10MHz. Perhaps the strongest signal will be WWV. This transmission will be heard as a carrier modulated with a seconds beat which is just audible as a faint ticking, similar to that of a clock. Using the b.f.o. on the receiver, adjust this for zero beat. Place the coaxial lead from the calibrator close to the receiver aerial input. A beat note should be heard, indicating that the calibrator is working but is not on frequency. Trimmer TC1 is adjusted until zero beat is once again obtained.

To check calibrator stability, it may be left on and checked a regular intervals against the standard frequency transmission. If a receiver covering 10MHz is not available, then the Radio 4 signal on 200kHz can be used. In this case the calibrator is switched to 100kHz and the second harmonic employed.

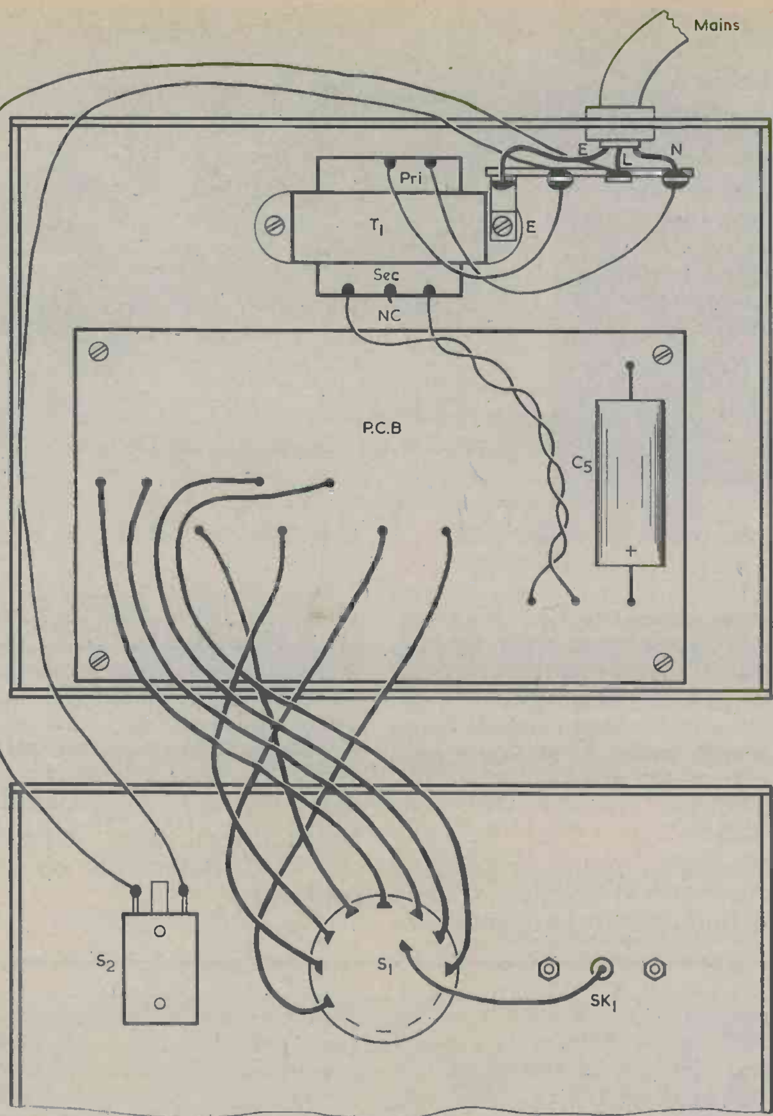


Fig. 3. The mains input wiring and the external connections to the printed circuit board.

USING THE CALIBRATOR

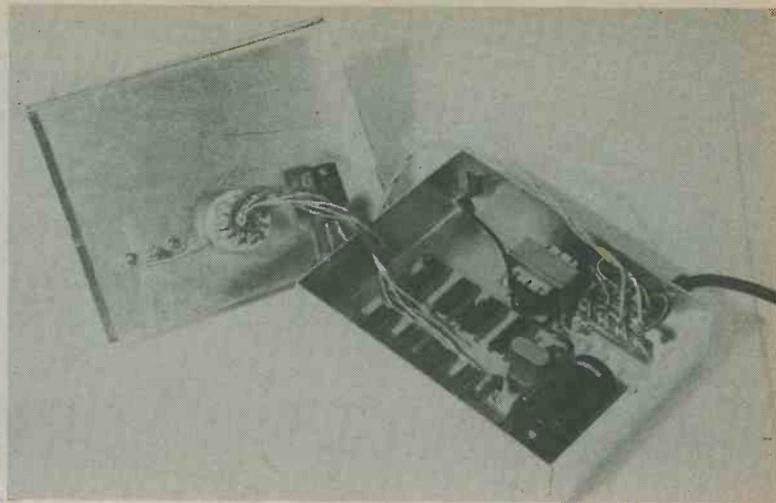
For normal use with a receiver only a short "aerial" is required, say about 12 in. of wire laid close to the aerial input socket of the receiver. With v.h.f. receivers a direct connection will need to be made to the aerial socket. Experience with the particular receiver or receivers which are employed will soon show the types of coupling which are required.

Using the calibrator to check the frequency of a station is quite simple. First it is assumed, with a short wave station, that the receiver scale is sufficiently well calibrated for the megahertz value to be known. Let us say that this is 12MHz. The calibrator is switched to give a 1MHz output and the receiver tuning adjusted around the 12MHz position to pick up its harmonic. The calibrator is next switched to 100kHz, and the receiver tuning adjusted towards the station. At the last 100kHz point nearest the station a note is made of how many 100kHz points were passed. Let us say that there were six. The receiver tuning is left at the last 100kHz setting and the calibrator switched to 10kHz. The tuning is again taken towards the station, the number of 10kHz points passed being noted.

The station may or may not coincide with a 10kHz point. If it doesn't the nearest point is then noted. Let us say that four 10kHz points were passed. Adding up the findings we have a frequency of 12MHz plus 6 times 100kHz plus 4 times 10kHz. This equals 12.64MHz or, more generally, 12,640kHz. If the receiver has a bandspread control, then the 1kHz range could be used. Note that with this method we are completely disregarding the calibration of the receiver which, in many cases, would not be accurate to such fine limits.

When used with digital circuitry the Calibrator

The wires from the printed board to S1 should be long enough to allow the front panel to be swung reasonably clear of the case.



provides an output which is at t.t.l. levels. The waveshape is good when observed on an oscilloscope, although the higher ranges are slightly modulated by the lower two ranges. This is unavoidable and is due to the lack of isolation between outputs. No difficulties were experienced when using the calibrator with sensitive digital equipment.

BATTERY OPERATION

Finally, if the unit is only going to be used occasionally it is quite simple to modify the circuit for battery operation. Should there be no intention to use a mains supply at any future date, the calibrator can be built with D1 to D4 and transformer T1 omitted. A 9 volt battery is then connected, with correct polarity, across C5.

If it is intended to have mains operation at a future date the calibrator can be assembled as described in this article. The two leads from T1 secondary are then removed from the printed board and the 9 volt battery connected to the board in their place. Since D1 to D4 are still in circuit, the battery can be connected with either polarity.

TV PROGRAMMES BY FIBRE OPTIC CABLE

Strands of glass fibre, no thicker than a human hair, will be relaying television and radio programmes to 18 households in Milton Keynes by the end of this year.

The rental houses, at Oldbrook 1 near the city centre, have been chosen by British Telecom for their first public trials of transmitting TV programmes by fibre optic cable.

Electrical signals, converted into pulses of light, will be carried over one optical fibre cable from the receiving station at Linford Wood to a distribution point near the houses.

From that point, smaller optical fibre cables will be laid to each house where the signals will be converted back into an electrical form suitable for reception on ordinary TV sets and radios.

A single fibre optic cable can carry the same amount of information as a conventional copper co-axial cable but it is physically much smaller and many such fibres can be run in the same space.

In the long term, fibre optic systems offer significant prospects of economic and technical improvements in running and extending the nation's telecommunications services as a whole.

The basic raw material, glass, is cheap and in abundant supply, unlike the imported copper used in conventional cables. Optical cables are also more compact than existing types and are immune to crosstalk and electrical interference.

The trial will be monitored by British Telecom for at least one year and there will be no additional costs involved for either the Milton Keynes Development Corporation or the residents.

The usual copper cable will also be installed providing a final choice of systems for the residents.

Ducting for the cable has been laid and the houses are now under construction. Cabling will run concurrently with the building and completion is expected in October.

Since the first practical demonstrations of the principle ten years ago, countries with advanced communication needs such as USA, Japan and Britain have been researching optical fibre technology, resulting in rapid and continuing improvements in its performance.

Fail-Safe

By

P. Jenner

Maintaining constant surveillance in security systems

It is obviously desirable that security systems, including burglar and other anti-theft alarms, be designed to have economic running costs. For this reason, such systems are commonly powered by the public electricity supply. To guard against power cuts and deliberate tampering with the mains, it is also necessary for a system to revert to battery operation when the mains supply is interrupted.

BATTERY SWITCHING

What is probably the "cleanest" method of automatic mains-battery switching is provided by a relay with changeover contacts, as shown in Fig. 1(a). In this diagram the relay contacts are shown in the de-energised position.

When the mains supply is present, the d.c. output of the mains power supply unit is applied across the relay coil and causes the relay to energise. The relay moving contact then changes over to the energised position, connecting the mains power supply output to the surveillance equipment. If there is any interruption in the mains supply the relay de-energises and the relay contact moves back to connect the battery to the equipment. As soon as the mains supply is available again the relay energises once more, reconnecting the mains supply unit to the equipment.

Relay operation has the great advantage that the battery is completely out of circuit when the mains supply is present. As opposed to solid-state switching circuits, there are in consequence no problems with semiconductor leakage currents. On the other hand, the relay switching circuit has the disadvantage that the supply voltage is momentarily absent during the changeover period when the relay moving contact is between the two fixed contacts.

If this momentary lack of supply is important the situation can be alleviated by connecting a high value electrolytic capacitor across the equipment supply rails, as illustrated in Fig. 1(b). The capacitor is charged before the changeover and supplies current to the surveillance equipment during the brief instant when the supply is interrupted. A 4.7Ω current limiting resistor is inserted in series with the electrolytic capacitor. This low value of resistance has negligible effect on circuit operation, and it reduces sparking at the relay contacts and extends their life. It is extremely unlikely that the battery voltage will be precisely the same as the mains power supply output voltage, with the result that a capacitor charge or discharge current will flow at any relay changeover.

The value of the electrolytic capacitor can be calculated by assuming that the supplied equipment is a fixed resistor, and by giving this assumed

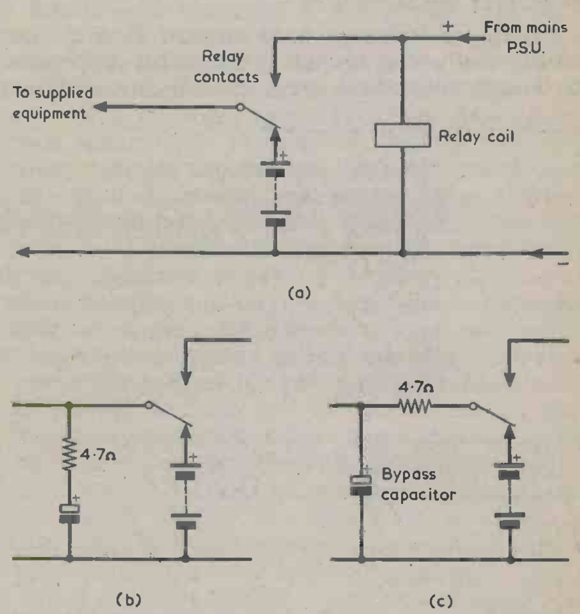


Fig. 1(a). Relay circuit which gives automatic transfer to battery operation when the mains supply fails. The relay moving contact is shown in the de-energised position.

(b). Adding a high value electrolytic capacitor to prevent voltage interruption during a changeover.

(c). If the equipment already has a high value bypass capacitor across its supply rails a current limiting resistor should be inserted as shown here.

resistance and the electrolytic capacitor a time constant of an arbitrarily chosen relatively long time, such as 2 seconds. Time constant, in seconds, is equal to ohms multiplied by farads, or megohms multiplied by microfarads. If, as an example, the surveillance equipment draws 2mA at 9 volts, it can be looked upon as a 4.5kΩ (9 divided by 2) resistor. This is 0.0045MΩ and the calculated capacitance required for a time constant of 2 seconds is 444μF. In practice, 470μF would be suitable and the electrolytic capacitor could have this nominal value.

In some cases the surveillance equipment may already have a high value electrolytic capacitor connected across its supply rails for bypass purposes. This capacitor may well be adequate to maintain the supply during relay changeover, but it is still desirable to have a current limiting resistor in the circuit to reduce relay contact sparking. In this case, a 4.7Ω resistor can be inserted in series with the relay moving contact, as shown in Fig. 1(c).

STEERING DIODES

A circuit which causes no interruption of the supply when changing from mains to battery, and vice versa, is shown in Fig. 2. This employs steering diodes and functions by reason of the fact that the voltage available from the mains power supply is purposely made higher than the battery voltage.

When the mains supply is present this higher voltage flows to the supplied equipment through diode D1. Diode D2 is reversed biased and no current (apart from leakage current in the diode) flows in the battery circuit. If the mains supply turns off, current flows from the battery to the equipment through D2, whilst D1 now prevents any current from the battery flowing to the mains supply components. Should the mains supply become available again the system returns to its previous state, with the equipment being fed by the mains power supply through D1, as before.

A supply voltage is always available for the equipment and there are no interruptions whatsoever. The supply voltage is lower when the battery feeds the equipment, and in most practical instances this should not cause any difficulties. The output from the circuit can, in any case, be applied to a voltage regulator if the equipment requires a stabilized supply. The two diodes can be any small silicon rectifier, such as the 1N4001.

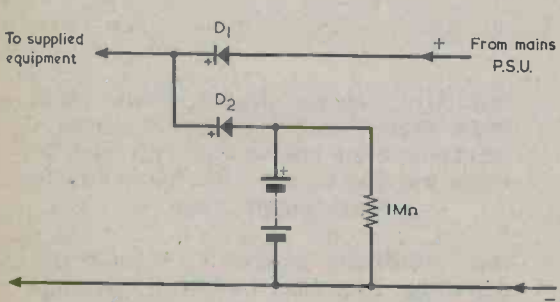


Fig. 2 Automatic changeover to battery operation is given by the two steering diodes. The mains supply voltage is higher than the battery voltage.

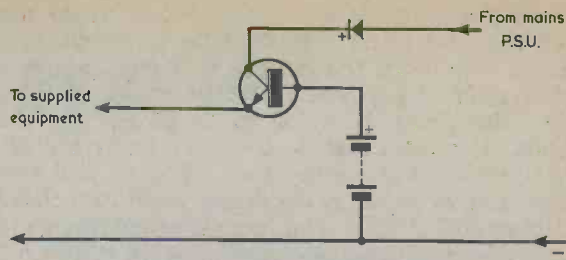


Fig. 3. Another solid-state circuit which gives automatic changeover.

A disadvantage with the circuit is that, when the mains supply is present, a leakage current flows through D2 into the battery. This current is effectively a charging current and could conceivably cause the release of gases in the battery if this is a zinc-carbon dry type. The leakage current will normally be a matter of microamps only, and the 1MΩ resistor across the battery should pass a higher current level. The resistor will cause a very slow discharge of the battery, which means that battery voltage should be checked from time to time, even when there have been no interruptions in the mains supply.

TRANSISTOR CIRCUIT

The circuit shown in Fig. 3 ensures a continual supply with no significant change in voltage when changing from mains to battery or from battery to mains. The mains supply voltage is significantly higher than the battery voltage.

When the mains output voltage is available the transistor acts as an emitter follower, and the battery voltage, less a base-emitter drop of about 0.6 volt, is applied to the equipment. If the mains supply is turned off, current from the battery flows through the forward biased base-emitter junction of the transistor with, again, a 0.6 volt drop in this junction. The diode, which can be a 1N4001 or similar, prevents current from the battery flowing through the base-collector junction into the mains power supply components.

With this circuit a discharge current always flows from the battery. When the mains supply is absent this current is the full current required by the equipment. The battery current reduces to the much lower base current required by the transistor as an emitter follower when the mains supply is present. The circuit is very simple, but it is necessary to check the battery voltage at regular intervals.

The transistor must have a base current rating in excess of the maximum current likely to be drawn by the equipment. This rating is only rarely specified in manufacturers' literature but, working from the few instances in which it is quoted, can be assumed to be one-tenth of the maximum collector current rating.

VOLTAGE READINGS

It is necessary to have some means of checking battery voltage in mains-battery surveillance systems, and the voltage monitoring circuit should impose as low a drain on the battery as is possible.

The easiest approach towards keeping battery current drain at a minimum is to have the voltage checking circuit turned on by a push-button, whereupon current is drawn only when the voltage is being checked. An example is given in Fig. 4(a). In this circuit the l.e.d. lights up, when the push-button is pressed, only when the battery voltage is above a predetermined level selected by the choice of zener diode. This level, referred to as "Vmin" in the diagram, is approximately equal to zener voltage plus 1.5 volts. Let us say that we have a 9 volt battery and we want to discard it when its voltage falls to about 7.5 volts. The nearest zener voltage to the calculated value of 6 volts is 6.2 volts. With a 6.2 volt zener diode the l.e.d. will light up for battery voltages above about 7.7 volts and will fail to light for battery voltages below this level. The function of the 270Ω resistor is to bring the zener diode on to the flatter part of its characteristic when the button is pressed, and thereby reduce the range of voltage between bright illumination of the l.e.d. and a just perceptible glow.

If there is a wide difference, say more than 3 volts, between maximum battery voltage and the acceptable minimum voltage, a fairly high current can flow in the l.e.d., 100Ω resistor and zener diode when the battery is at its top voltage level. This situation can be alleviated by inserting a constant current device in circuit, as in Fig. 4(b). The resistor across pins 1 and 3 of the LM334Z ensures that maximum l.e.d. current does not exceed about 10mA. With this circuit Vmin is approximately equal to zener voltage plus 2.6 volts. If, as in the previous example, Vmin is 7.5 volts, the nearest zener voltage to that required is 5.1 volts, giving a calculated Vmin of 7.7 volts.

The zener diode can be selected from the BZY88C series for the Fig. 4(b) circuit. A BZY88C diode can also be employed in the Fig. 4(a) circuit provided its dissipation will not exceed 400mW. The LM334Z constant current device is available from Maplin Electronic Supplies. In both circuits the l.e.d. is a red type.

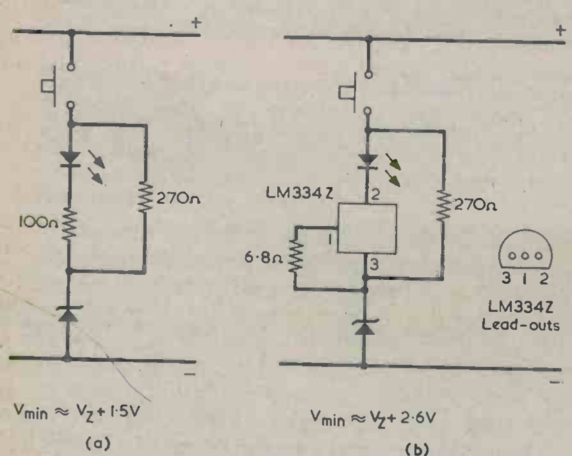


Fig. 4(a). If the l.e.d. in this circuit fails to light when the push-button is pressed the supply voltage is below the Vmin level.

(b). Employing a constant current device to limit l.e.d. current.

CONSTANT MONITOR

A voltage monitor which can be permanently connected across a battery supply is shown in Fig. 5.

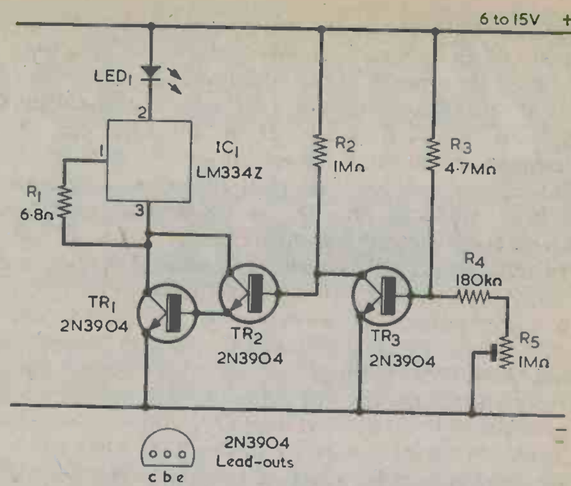


Fig. 5 This circuit is permanently connected across the supply rails and draws a very low quiescent current. The l.e.d. lights up for supply voltages lower than Vmin

This draws a very low current until the supply voltage falls below a predetermined value, whereupon it causes a constant current of 10mA to flow through the light-emitting diode. The circuit gives warning of excessively low battery voltage by the illumination of the diode. This can, incidentally, be any colour.

The supply voltage is applied to the series resistors R3, R4 and R5, the last being set up such that TR3 is turned on for all voltages above the Vmin level. The collector voltage of TR3 is then below the 1.2 volt base voltage (0.6 volt drop in TR2 plus 0.6 volt drop in TR1) required for TR2 and TR1 to turn on. In consequence, the l.e.d. is extinguished. When the supply voltage falls below Vmin TR3 turns off, allowing base current to flow through R2 to TR2. The very high current gain of the two transistors in combination then allows 10mA to flow through the LM334Z and the l.e.d. The circuit action is quite sharp, and the range of supply voltages between a just perceptible glow and full illumination in the l.e.d. is small.

The current which flows when the l.e.d. is extinguished is comprised of the current flowing in R2 plus that in R3 and transistor leakage current. The prototype circuit drew about 18μA from a 9 volt supply. The high values of R2 and R3 produce base currents in the order of microamps only. These are rather small for bipolar transistors, although the circuit works well in practice. However, care should be taken to keep all base component wiring short and well clear of hum radiation from mains wiring.

After the circuit has been assembled, the Vmin voltage is applied to the supply rails and R5 is adjusted so that the l.e.d. is just on the point of extinction. The Vmin voltage can be anywhere between 6 and 15 volts. There is a slight risk that, with some transistors in the TR3 position, the required setting in R5 may be outside its range of adjustment for Vmin voltages close to 6 volts or close to 15 volts. Should this occur, the values of R4 can be increased or decreased as required.

In all the circuits shown in this article the fixed resistors can be ¼ watt 5% up to 1MΩ and ½ watt 10% above 1MΩ. ■

Make-Before-Break

By R. F. Peters

Fig. 1 shows a very simple variable voltage mains power supply circuit which could be employed to provide output currents up to, say, 100mA maximum. A mains transformer having a tapped secondary is used and the rotary switch, S2, can select secondary voltages of 10, 12, 15 and 17 volts. The off-load rectified voltages appearing across C1 are of the order of 1.4 times the a.c. secondary voltage selected by S2, and are 14, 17, 21 and 24 volts respectively.

There are two resistors in the circuit. R1 is a current limiting resistor and prevents sparking at the switch contacts when S2 is moved to a higher voltage. Without R1 there could be a heavy surge current when C1 charges to the higher voltage. The function of R2 is merely to cause C1 to discharge when switching to a lower voltage with no output load connected. The time constant of R2 and C1 is 4.7 seconds, so the fall in voltage across C1 when S2 selects a lower voltage is rather leisurely, but it is better than no fall at all.

SWITCH SPECIFICATION

In consequence, we have a variable voltage power supply with a not particularly brilliant performance. However, the design is so basic in character that there is surely nothing that could possibly go wrong with it.

Isn't there?

Let's see what could happen if we used a miniature wafer switch of the wrong type for S2. Many of these rotary switches haved fixed and moving contacts like those shown in the side view of Fig. 2(a). When the switch is set in a position its moving contact sits firmly on the centre of the fixed contact which has been selected. But when, as in Fig. 2(b), the switch is moved to the next contact there is an instant when the moving contact is touching both the fixed contact it is leaving and the fixed contact it is moving to. As a result, both fixed contacts are momentarily short-circuited together.

If we used a switch of this nature in the circuit of Fig. 1 its contact life would be very limited. When, for instance, the switch is moved from the 10 volt secondary tap to the 12 volt tap there will be an instant when the 2 volt winding between the taps is short-circuited. A very heavy current will flow in that instant. If the switch was inadvertantly allowed to rest for any time with the adjacent fixed contacts short-circuited by the moving contact it is quite possible that either the switch contacts would be excessively heated or the section of transformer secondary between the corresponding taps would burn out.

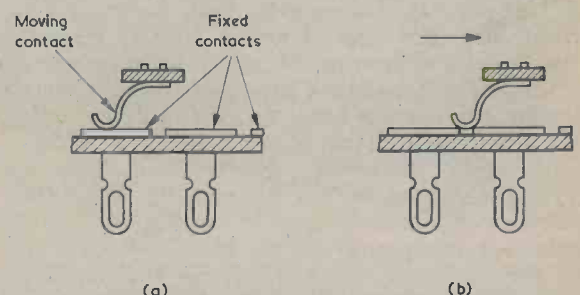


Fig. 2(a). Side view showing two fixed contacts in a typical make-before-break rotary switch.

(b). When the moving contact is moved from one position to the next it momentarily short-circuits the two adjacent fixed contacts.

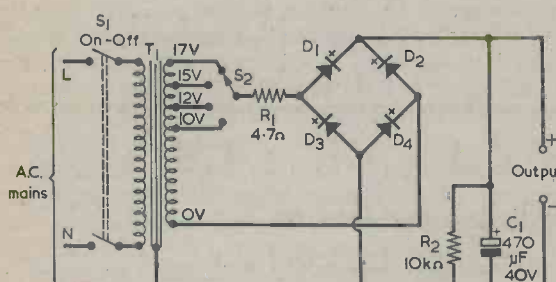


Fig. 1. A very simple variable voltage unregulated mains power supply. Could anything go wrong in such a basic circuit?

SWITCH TYPE

A rotary switch having the action shown in Fig. 2 is described as a "make-before-break" switch. This is because the new contact is made before the old contact is broken. Fortunately, it is possible these days to get miniature "break-before-make" rotary switches, and with these the switch moving contact leaves the old fixed contact before it makes to the new fixed contact.

A break-before-make switch is essential for a circuit such as that shown in Fig. 1, or for any other circuit in which different voltages with high current capabilities are selected. If the action of a rotary switch is not specified by a supplier, be wary of it as the odds are that it is a make-before-break type. Most of the older rotary switches are of this type.

Make-before-break switches have their uses, of course, and are normally the better choice in wavechange applications or when the switch selects, say, different audio sources in a hi-fi system. Because the switch makes to the new fixed contact before leaving the old contact there are less circuit disturbances and, usually, less crackles in the radio or hi-fi audio output when the switch is adjusted. ■

RADIO & ELECTRONICS CONSTRUCTOR

JUNE 1981

IN NEXT MONTH'S ISSUE

PROXIMITY LAMP SWITCH

***No Fumbling in the Dark for Manual Switches**

This project is a proximity switch which can be used to turn on a bedside lamp by placing a hand on the insulated case of the unit. Switches of this type are often incorporated in clock-radios intended for bedside use, and it was the convenience of using one of these which led to the present design.

TELEPHONE CHARGE REMINDER

Reduce Your Phone Bills

When making telephone calls it is very easy to lose track of the passage of time, with consequent high phone bills arriving on the doormat in due course. One way of overcoming this problem is to have a device which gives an indication of the number of time units which are being accumulated while the call is in progress.

The unit described provides a brief audible tone each time a unit elapses. The units are for inland calls, as detailed in the British Telecom leaflet "Telephone Charges", and a Table is given showing time units for local, up to 56km and over 56km for Peak, Standard and Cheap periods.

SLEEPY TIME RADIO SWITCH

Suggested Circuit

TELEVISION A.G.C. FAULT

In Your Workshop

• CB • CB • CB • CB • CB • CB • CB •

The UK Spec: Will the details be available by our next issue? If they are, you can be certain R & EC will have a full analysis ready . . .

PLUS MANY OTHER ARTICLES

Voltmeter Sensitivity Booster

By A. F. Olivera

Gives analogue multimeter electronic performance.

Input impedance typically 40 megohms.

In certain circumstances voltage readings taken with a low sensitivity meter can be misleading. Consider, for example, the circuit diagram shown in Fig. 1.

In accordance with Ohm's Law the current through R1 and R2 is 0.05mA, and the voltage across R2 must therefore be 1 volt. If, however, this voltage were to be measured with a voltmeter of 2,000Ω per volt sensitivity set to its 1 volt range, the reading obtained would be 0.1 volt! Voltmeters of 20,000 and 50,000Ω per volt sensitivity would give readings of about 0.5 volt and 0.7 volt respectively. Obviously, the greater the meter sensitivity the more accurate the reading.

ELECTRONIC BOOSTER

The sensitivity booster described in this article will convert an analogue voltmeter into an electronic voltmeter. The booster has been designed for ease of use, yet is inexpensive and simple to build. One of its attractive features is that, in contrast to other similar projects which have been published in the past, no zero adjustment is required.

Of course it has its limitations, one of these being that voltages in excess of some 23 volts cannot be measured using the booster. But this is not a serious handicap since the majority of voltage tests on solid state equipment generally lie within this range. In any case, voltages in excess of 23 volts can still be measured by the basic meter although, of course, without the benefit of the booster.

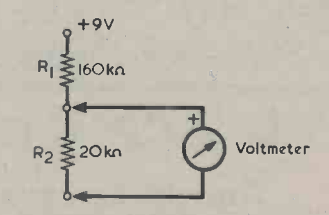


Fig. 1. A simple test circuit. The voltage across R2 is 1 volt, but an analogue voltmeter will indicate a voltage lower than this.

French Post Office offers CB Users an 'Amnesty'

Following the formal recognition of 27MHz CB by the French authorities last year, (2W FM, 22 channels) — the French Post Office has set an interesting precedent by offering the present band of illegal users a transitional period of two years to 'get in line'.

Users of unapproved sets (ie AM and SSB sets according to the USA standards) have got until January 1983 to get their sets modified to conform to the legal specification. A provisional licence will be issued covering this period until January 1983 — whereupon unmodified equipment will become unlicencable. Presumably any CB user registering under this scheme — but failing to provide evidence of getting his set modified and approved will then by easily identified by the French Post Office.

This seems like an interesting an imaginative solution to the problem, but nevertheless present a formidable task of administration — unless a simple and 'type approved' conversion kit is available. An obvious parallel can be drawn with the UK situation, and it remains to be seen if the Home Office are prepared to show a similarly innovative approach to an otherwise insurmountable problem.

Dashboard-top speaker - with built-in filter

With most 'rigs' - be they legal amateur transceivers, or otherwise - the internal loudspeaker ends up pointing the sound exactly where you don't really want it - ie up you left trouserleg, or into the parcel shelf. This is an ideal solution - being a highly efficient 70mm dia unit in a matt black accoustically designed enclosure. Not only does the sound point at the operator's ears, the internal 300Hz-3kHz audio filter keeps it clean and crisp. Available from Ambit *as the AMB4/8 for £9.95. (4/8 ohms impedance, 4W handling. Inc mountings)*

Meanwhile, back at Waterloo Bridge House....

For those of you who don't know, Waterloo Bridge House in London SE1 is the home of the Home Office radio regulatory division. It is the task of those therein to try and administer the proposed UK CB frequencies— and after fighting for over twenty years to keep CB out, it seems reasonable to assume that there will be a little antagonism on the part of the HO when it comes to dealing with the CB fraternity. Partly because people at the HO feel that CB (however erroneously) really is a waste of time, and partly because the HO has been the subject of fairly childish and badly informed tirades from various quarters claiming to represent CB attitudes and opinions.

The Home Office is staffed by Civil Servants — whose task is to administer the laws of the land, and the policies of the government (in between stirring tea and working out the values of their index-linked pensions — and all those other aspects of their 'lot' which attracts the cynical derision of many observers). They also advise the politicians when the subject is outside the comprehension of the politicial spectrum (like how many beans make five, allowing for inflation and the imbalance of Sterling M3).

It has been virtually impossible to locate anyone in the Home Office prepared to admit to have anything to do with CB administration — since the government has yet (at the time of writing) to make a definitive statement regarding the administration of the Home Secretary's statement in terms of licences and specifications.

As before the actual announcement of the intention to licence 27MHz and 928MHz FM, rumours are rife. Rumours that the decision is being held up whilst being privately fed to potential UK manufacturers seem fairly daft, since any realist cannot imagine a UK manufacturer being able to match the US $40-70 prices being quoted ex-factory in the far east.

Nude Vicar bites mad CB enthusiast — Shock Horror Scandal......

The sadly ill-informed comment in the national media following the CB announcement on February 26th included CB pundits claiming that the cost of the conversion would be £80 — and that an FM set would cost £400. It's really rather frightening to think what other rubbish the media pump out when they can report such ignorance in 'good faith'. Naturally enough, the AM users immediately decided to ignore the prospect of FM and continue their campaign of civil disobedience to try to force the government to capitulate all the way and permit AM and SSB. And after that, no doubt 100W linears etc. etc.

Land of the Free etc.

If you read last month's supplement to the bitter end, you may recall a parallel being drawn between the UK's public behaviour towards CB, and the US's behaviour towards the ownership of firearms. It was a moderately prophetic statement in view of the attempted assassination of the President, and whilst we cannot draw any satisfaction from this state of affairs — it would seem worthwhile reiterating that if we are to import CB, then please let's try and avoid importing too many other unnecessary facets of the USA and its liberalism gone wild.

The use of CB code and language may be a dimension of the 'fraternal' aspects of CB — but it is also basically a means of avoiding direct and straightforward communication in 'normal' conversation. After all, how many people would walk up to someone in the street and strike up a random conversation unless there was some obvious mutual concern/interest?

In times of adversity, such barriers are more easily overcome. Any group standing on the pavement watching a house burning down can usually be expected to exchange opinions before long. In fact, unless something fairly dramatic is going on to provide common interest, you might easily get labelled as some sort of nut case. And possibly even be arrested for some version of the assault law — particularly if you open the conversation with:

"Hi there, good buddy. You got your ears on, c'mon?"

So, if we are to allow that some form of jargon is necessary to enable the normal communication barriers to be overcome between 'ordinary' people where CB is concerned, why don't we devise some of our own. The best suggestions will be published each month.

AM to FM conversions: How feasible?

The popular support for the idea and basic concept of CB has tended to give some of the self-appointed spokespersons of CB the idea that their attitudes and considerations are quite irrefutable in all matters. The startling technical naivity of too many CB users has concerned many better informed people — and the aggressive stance adopted on the subject of AM could well backfire and cause the introduction of the 27MHz FM facility to be delayed whilst penalties for AM illegal use are greatly increased, and the AM black market gradually stamped out as illegal operators are rounded up.

FM is technically desirable. Once again, the only consideration fuelling AM is one of financial interest — and the only halfway point would seem to be the acceptance by both sides that an approvable FM conversion be available for a reasonable sum.

Well, thanks to the French decision reported herein, someone out there obviously thinks it can be done. A brief check through the circuits of popular AM rigs shows that indeed it is a relatively straightforward process, since several basic AM designs have been simply adapted by the manufacturer to cope with the demands of FM.

The Midland series 150M set is a good example — since the FM adapter is an entirely separate module (*FIGURE ONE*). However, the question of spectral purity of the transmission raises serious questions — since frequency modulating a phase locked-loop synthesiser system can be strewn with pitfalls for the unwary. The maximum deviation that can be expected from such an arrangement is likely to be only 1-2kHz. Purpose designed FM systems can naturally cope with any value required.

At the basic level, the FM adaption is simply achieved by tapping off some of the undetected IF (usually at 455kHz) and switching the microphone to an FM modulator that is connected across the varicap in the PLL's VCO. Such a modification is within the scope of many electronics enthusiasts — although the actual determination of the frequency deviation level is probably not, unless you have access to a deviation meter. (Note: R & EC will be presenting a circuit for a low cost deviation meter in an early issue.)

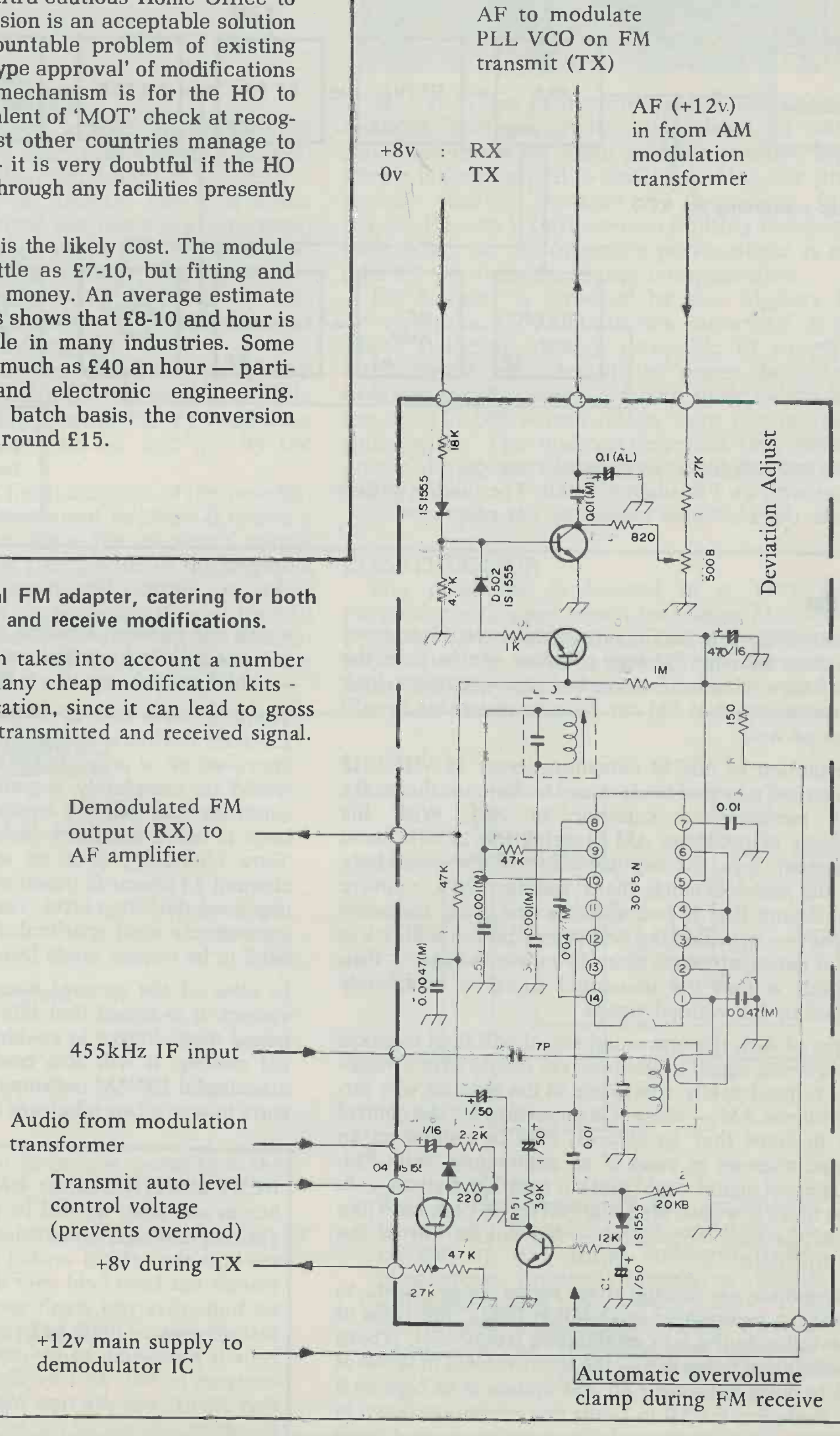
In other words, for the ultra-cautious Home Office to accept that an FM conversion is an acceptable solution to the otherwise insurmountable problem of existing AM users, some form of 'type approval' of modifications will be necessary. One mechanism is for the HO to authorize the radio equivalent of 'MOT' check at recognized establishments (most other countries manage to operate such a system) — it is very doubtful if the HO could handle the scheme through any facilities presently at their disposal.

The next stumbling block is the likely cost. The module itself could sell for as little as £7-10, but fitting and checking the set will cost money. An average estimate of labour costs these days shows that £8-10 and hour is considered to be equitable in many industries. Some specialist services cost as much as £40 an hour — particularly for computer and electronic engineering. However, if tackled on a batch basis, the conversion should be completed for around £15.

Remember ! This circuit is intended to indicate the relative simplicity of an FM conversion unit. Until UK specs are available, it would be unwise to attempt to anticipate the exact requirements.

Figure one: **A typical FM adapter, catering for both transmit and receive modifications.**

This thorough approach takes into account a number of factors ignored in many cheap modification kits - beware of oversimplification, since it can lead to gross distortion of both the transmitted and received signal.



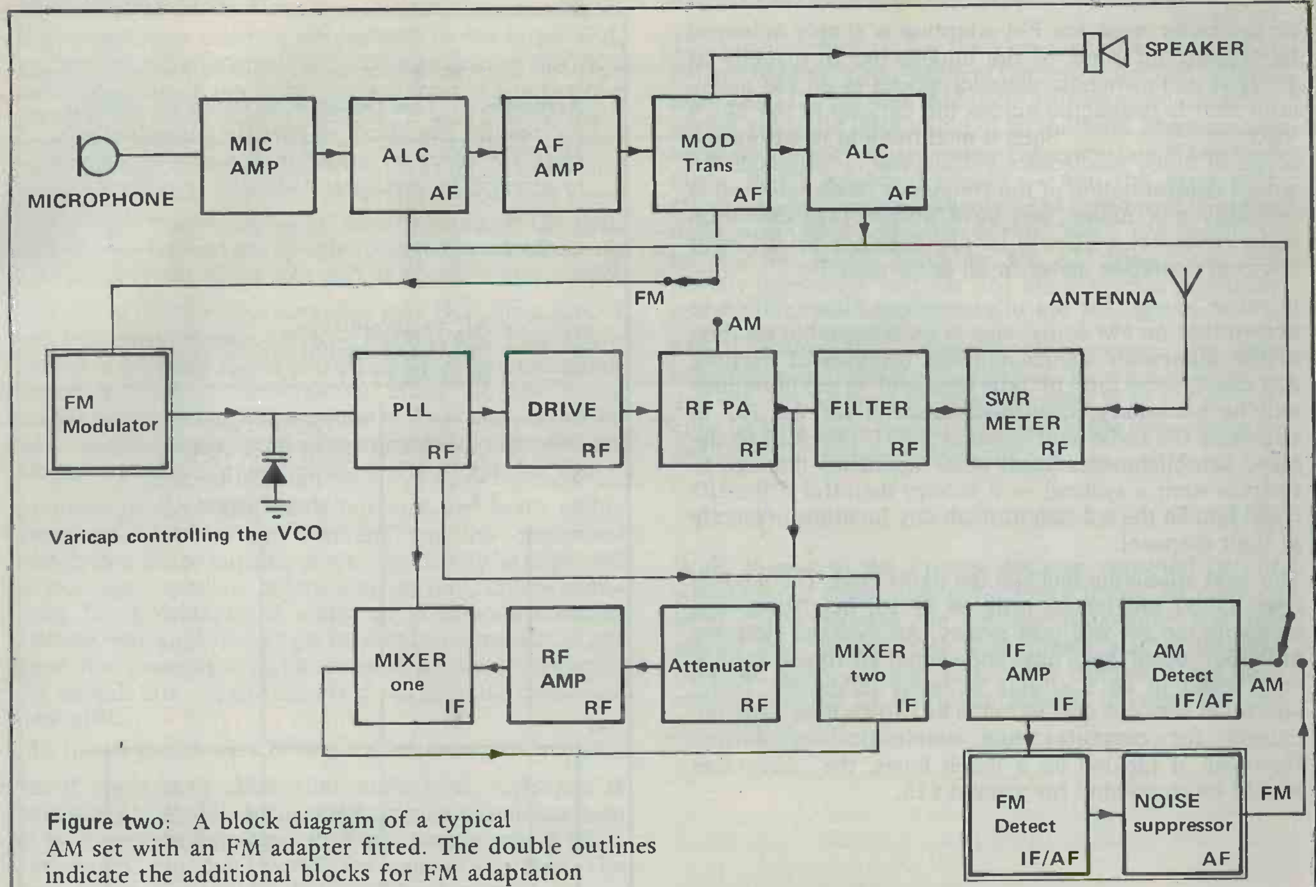


Figure two: A block diagram of a typical AM set with an FM adapter fitted. The double outlines indicate the additional blocks for FM adaptation

Why FM

The first of the R & EC CB supplements went into some of the reasons why FM was a better choice from the point of view of interference, but perhaps users don't fully appreciate that FM can be a considerable benefit to them as well.

The evolution of NBFM communications at VHF/UHF has spawned a host of devices and techniques that make circuit performance superior to AM. With the cacophony of overseas AM clogging the 27MHz band during most days, the capture effect of FM could help make the service much more usable. FM's 'capture effect' means that if two stations are using the same frequency — provided the wanted signal is 3-4dB (2:1 in terms of ratios) stronger than the unwanted one — then the result is that the unwanted signal is completely flattened by the wanted signal.

In terms of AM, the unwanted signal will tend to cause an interfering signal in the receiver output over a range of 100:1. Incidentally, this is one of the reasons why aircraft still use AM — since it is important for the control tower to know that an aircraft may be calling on an occupied channel in case of an emergency. With FM, the strongest signal could mask a possible distress call. Maybe there is a case for using AM on CB channel 9 (the nominal distress frequency) — but not on any of the other channels.

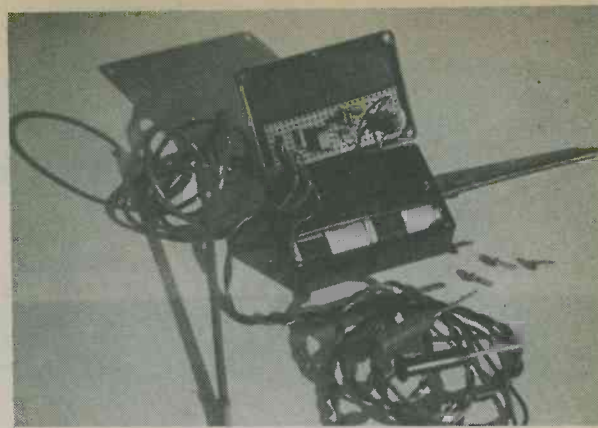
The question of comparative range boils down to achieving a reasonable modulation index (the ratio of the deviation to the max modulating frequency). Where the modulation index is 5 — the improvement in terms of signal to noise ratio over an AM system is as high as 8 times. Reducing the MI to 1 cuts this advantage down to just over 2 times. In view of the considerations of band width and channel spacing, most 10kHz channelled CB sets use 1.5kHz deviation, resulting in an MI of about 0.5 — which roughly equates to the S/N performance of AM.

There is some talk of 12.5kHz channel spacing with 2.5-3kHz deviation being permitted — and whilst the improved MI is very useful, the use of 12.5kHz spacing would be completely non-standard in terms of other countries and existing equipment. One suggestion has been to use a standard deviation of 1.5kHz for the 23 'Euro channels', plus an additional allocation from channel 23 upwards based on the 12.5kHz spacing and improved deviation level. The only drawback being the components used (particularly the synthesiser) would need to be custom made from scratch.

In view of the general desirability of a sensible FM system, it is hoped that this decision will not be postponed much longer to enable the equipment designs to get moving. It will also enable R & EC to produce a meaningful FM/AM conversion project, so that FM can start to win a few admirers as quickly as possible!

NEXT MONTH.........the UK spec is expected soon - but in any case, we will be publishing the results of a survey amongst knowledgeable 'realists' so we can see how the official verdict compares. The 928MHz feature has been held over due to pressure of space- we hope that you aren't too disappointed, but this feature goes to press only a few days before the issue is published, so we cannot always predict the contents in full. And by the way, did you notice that *R&EC* was the first magazine to carry a thorough analysis of the legalization announcement ?

The voltmeter sensitivity booster with the lid opened up. The Veroboard panel is positioned so that it does not foul the two batteries when the lid is screwed in place. The negative test prod is fitted to one end of the case.



OPERATIONAL AMPLIFIER

The booster is designed around an operational amplifier connected as a unity gain voltage follower. This means that the voltage presented at the input is exactly reproduced at the output, but at a much lower impedance. In actual fact there is a very small voltage difference between input and output due to the differential input offset voltage, but this difference is so small (typically 2mV) that it easily falls within the normal tolerance of most multimeters and is therefore not worth nulling out.

Due to the high input impedance of the op-amp used, which is typically 40MΩ, there is very little loading of the circuit being tested. Power to operate the meter is provided by the i.c. and not by the circuit under test.

Fig. 2 shows the full circuit diagram of the booster. An LM308 op-amp was chosen because it draws a very low supply current. Since the op-amp's output can only range to within 1 or 2 volts of the negative rail voltage, both the input and output are referenced to the junction of the potential divider formed by R3 and R4; this junction is at a voltage level of about 3 volts positive, well within range of the op-amp's output.

ZD1 provides protection against excessive input voltages. Voltages greater than about 24 volts will cause the diode to zener, and the positive input to the i.c. is thus limited to this level. ZD1 also protects against reverse voltages by becoming forward biased. R1 and R2 are current limiting resistors, and their effect on the op-amp's performance is negligible. C1 provides frequency compensation.

The booster is powered by two Mallory M154 "Photoflash" 15 volt batteries connected in series. These batteries, though incapable of supplying a large current, are adequate to power the circuit. In order to avoid power wastage a push switch is used for the On-Off switch rather than the more usual slide switch. The booster therefore only consumes power during the short time a reading is actually being taken.

CONSTRUCTION

The prototype is housed in a Vero general purpose plastic case which measures 71.5 by 49 by 24.5mm. It is the exact size to accommodate end-to-end the two batteries, and the case itself forms the body of the booster's negative probe. The

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 10kΩ
R2 10kΩ
R3 47kΩ
R4 5.6kΩ

Capacitor
C1 33pF ceramic plate

Semiconductors
IC1 LM308
ZD1 BZY88C24V

Switch
PB1 miniature push button, press to make

Batteries
BY1, BY2 15V "Photoflash" type M154 (Mallory)

Miscellaneous
Verobox type 75-1413-E
Veroboard, 0.1in. matrix
Red test prod
Wire, solder, etc.

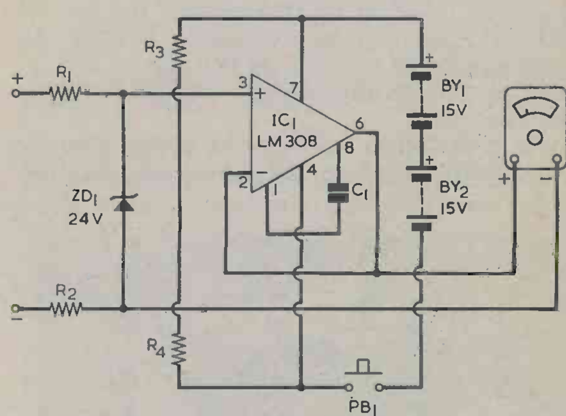


Fig. 2. The circuit of the voltmeter sensitivity booster. This employs an LM308 as a voltage follower, with protection against excessive input voltages being provided by ZD1. The multimeter should, preferably, have a sensitivity of 10,000Ω per volt, or better.

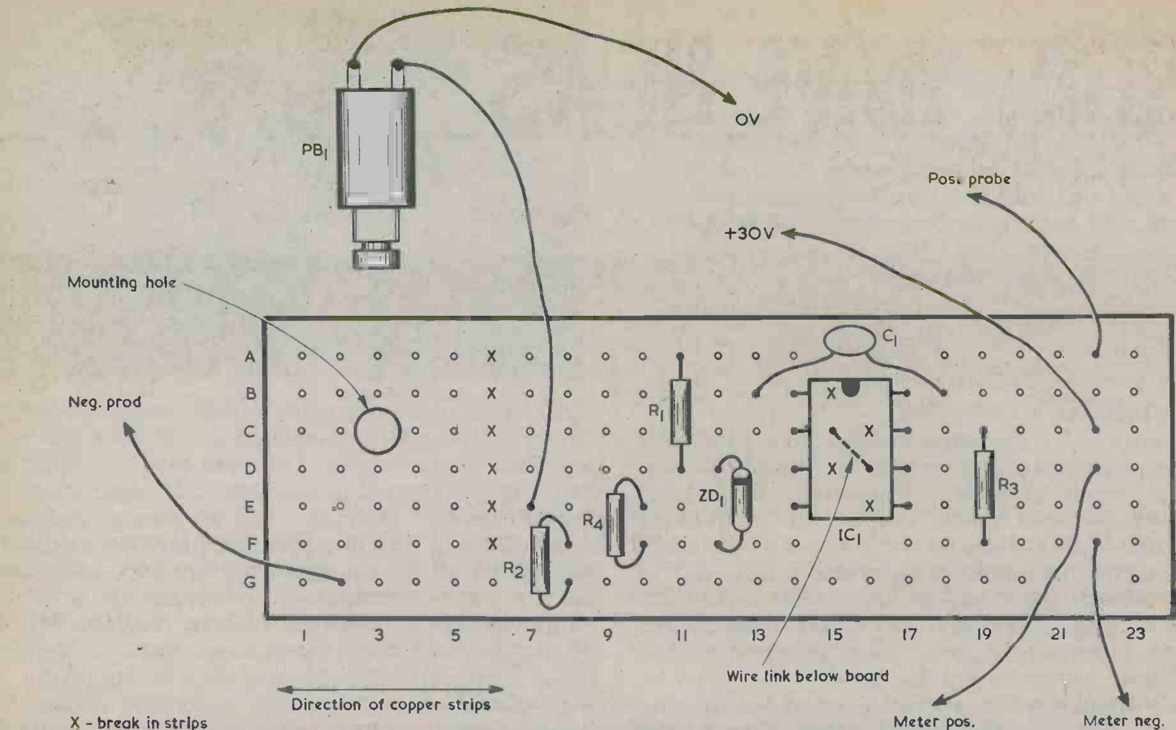


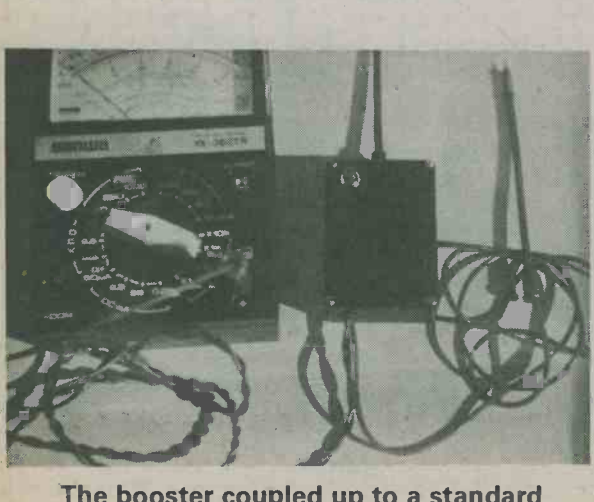
Fig. 3. The booster Veroboard layout. The bush of PB1 passes through the mounting hole and secures the board to the lid of the plastic case in which the booster is housed.

prod part is made from a piece of threaded brass rod about 10cm. long, passing through a hole drilled in one end of the box. It is held in place with two suitable nuts and washers, a solder tag being placed on the inside for the electrical connection to the prod. The free end of the rod is filed to a point, and a piece of sleeving is fitted over it leaving only the pointed tip exposed.

A plastic strip is glued lengthwise across the inside of the case to form a battery compartment, and a small nut and bolt is fixed to each end of this compartment to serve as contacts for the battery terminals. It is useful to have access to the terminals from the outside of the case as the battery voltage can then be periodically checked without having to unscrew the lid.

A hole is drilled in the box end opposite to the prod to provide an exit for the cable leads, a rubber grommet being fitted in this hole to improve appearance and hold the cables in place. Three wires pass through the hole, these being the two connections to the multimeter and the positive probe lead.

The components are mounted on a piece of Veroboard as detailed in Fig. 3. It should be noted that there are ten breaks in the strips (including six to isolate the mounting hole) and one wire link under IC1. The push switch is mounted on the box lid, and it holds the stripboard in place. A couple of washers placed between the board and the inside of the box lid will provide sufficient clearance for the solder joints on the underside of the stripboard.



The booster coupled up to a standard analogue multimeter.

USING THE BOOSTER

It should be fairly obvious how the booster is used. The output leads are connected to a multimeter switched to a suitable volts range, and the reading is taken while the booster's switch is pressed. The unit is quite well protected and no harm has occurred to the prototype when subjected to deliberate overloads, even with the booster switched off.

It will be noticed that if the switch is pressed while the prods are open-circuit, so that the inputs to the i.c. are floating, unstable nonsense readings are obtained. This is due to stray hand capacitance effects acting on the op-amp's high input impedance, and the readings may be safely ignored. The readings stabilize as soon as the prods are referenced one to the other (either by short-circuiting them or by applying them to a test circuit to take a reading) and the booster's performance is in no way affected by this phenomenon.

It is worthwhile, as a matter of interest, breadboarding a circuit similar to that shown in Fig. 1 and comparing voltage measurements taken with and without the booster. The effectiveness of the booster will immediately become apparent! ■

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

Regular readers of these columns will know that it is at this time of the year we review the results achieved in the – by now – annual Quest for Laos.

Information on broadcasting matters from this remote area is sparse to say the least, Dxers cannot rely on the published schedules and supposedly current frequencies – even though these are printed in good faith. Nothing daunted however the writer, in company no doubt with other Dxers, observed the various channels on several occasions throughout the 'season' – roughly from late October through to mid-February.

Houa Phan reportedly operates on **4658** and **6168** with the Domestic Service in Laotian from 2300 to 0100 and from 1330 to 1430, the best chance of reception here in the U.K. being from 2300 onward but tune to the channel a few minutes earlier for the National Anthem etc.

A signal suspected to be from Houa Phan was heard on a carefully measured **4652.8** during late January at 2337, YL with a talk in Laotian (presumably) – very similar to the wellknown Radio Peking sound. A tentative logging of course but what else if not Houa Phan – particularly as it was also reported elsewhere as being on **4653.**

Vientiane is currently on **6130** and has been reported by several Dxers this season. The writer finally caught up with this one at the very end of January when, at 2304, there was the unmistakable YL in Lao until 2312, there following a short burst of military music, male announcer then back to the YL with her endless talking – at least until fade-out under co-channel QRM at 2320.

Perhaps the meagre results achieved – other U.K. Dxers fared much better – will spur on others to 'have a go' from next October onward in the Quest for Laos.

AROUND THE DIAL

For the general guidance of readers, the following items are presented as those thought to interest the majority. Some are for the Dxer and some for the short wave listener – I trust the mix is acceptable to most.

● YUGOSLAVIA

Radio Belgrade on **9620** at 2027, a programme in English all about tourism in Yugoslavia. Belgrade very often has interesting programmes about life in the country and towns of Yugoslavia and is not prone to the usual propaganda one expects from Eastern-bloc countries. The evening English programme is scheduled from 2000 to 2030, beamed to Europe, the Middle East and Africa.

● LEBANON

Beirut on **11980** at 1830, the National Anthem, station identification, programme and frequency details when opening the English programme intended for Africa, scheduled from 1830 to 1900. A newscast commences, the programmes.

● ROMANIA

Radio Bucharest on **7195** at 2110, station identification in the English programme for European consumption, scheduled from 2100 to 2130. This one also features some interesting programmes but is inclined to include some of the usual propaganda such as industrial and agricultural feats expressed in percentage terms – which of course are meaningless unless some actual amounts are stated.

● POLAND

Warsaw on **7285** at 1845, all about recent events in Poland in the English programme for Europe, scheduled from 1830 to 1900.

● SPAIN

Madrid on **7275** at 1900, station identification, frequency details and programme review at the start of the English programme for Europe, scheduled from 1900 to 1930. This is another station which carries very interesting programmes – especially to those who holiday regularly at one of the many Spanish resorts.

● U.S.S.R.

Radio Kiev on **7260** at 2005, with a commentary on world events according to the Soviet point of view in the English programme for Europe, scheduled on this channel from 2000 to 2030.

● VATICAN CITY

Vatican on **7250** at 0645, Mass in Latin in the English programme for Europe, scheduled from 0630 to 0700 (to 0615 on Sundays).

● NORTH KOREA

Pyongyang on a measured **7203** at 0855, announcements in Korean, followed by the National Anthem and sign-off. According to my information this would be the Korean service to the Near and Middle East and Africa, scheduled from 0800 to 0850 on this channel.

● CLANDESTINE – 2

"Voice of the Broad Masses of Eritrea" on a measured **7230.5** at 1537, OM with a harangue in a local vernacular (in Tigre according to the BBC

Monitoring Service), interspersed with military music and rousing marching choruses. Sign-off at 1600. Announces as "Voice of the Eritrean Masses" (arabic = "Huna Sawt al-Jamahir al-Iritriyah").

●NEW CALEDONIA
Radio Noumea on **7170** at 0830, OM with announcements in French and identification followed by music on a mandolin-type instrument. A good clear signal on a clear channel until Vienna opened with tuning signal at 0858 – effectively blocking out Radio Noumea – grrrr!

●VANUATU
Port Vila on **7260** at 0801, OM with a newscast in vernacular (schedule states the local language Bislama) heard through to 0812, the signal gradually fading until lost beneath interference and also splatter from **7265.** Logged, albeit tentatively, on LSB (lower side band) to escape much of the QRM. Vanuatu was formerly the New Hebrides.

●BRAZIL
Radio Nacional Brasil on **11780** at 2000, station identification and various announcements complete with echo-effect then into a programme of Latin American-style music and songs in Portuguese in the English programme to Europe, scheduled from 2000 to 2100.

●INDIA
AIR Delhi on **3365** at 0022, OM in vernacular in the A programme, scheduled here from 0025 to 0230 and from 1330 to 1830. The power is 10kW. An early opening or preliminary announcements?
AIR Delhi on **7280** at 1547, a current affairs commentary in English.

●KENYA
Nairobi on **7210** at 0705, local-style orchestral music, chants, announcements in Swahili. The schedule of this one is from 0630 to 1330 on this frequency – all programmes in Swahili.

●TOGO
Lama-Kara on a measured **3222** at 1755, with a discussion in vernacular, the schedule being from 0530 to 0830 and from 1630 to 2230. The power is 10kW and the channel is a 'muddy' one, often covered by commercial interference.

●LIBERIA
ELWA Monrovia on a measured **3227** at 1752, European-style guitar music, local pops, OM announcements in vernacular in the Home Service, scheduled on this channel from 0600 to 0800 and from 1805 to 2220. The power is 10kW.

●AUSTRALIA
Melbourne on **7260** at 0859, 'Waltzing Matilda' and station identification in English, time-check at 0900 then into the Indonesian programme.
VLH9 Lyndhurst on **9680** at 1248, announcements in English, light music programme in the Domestic Service, scheduled from 0830 to 1502 on this channel.

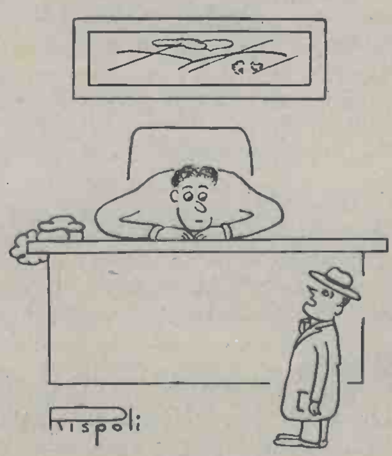
●SRI LANKA
Colombo on **11800** at 1950, when radiating a plaintive song in, presumably, Sinhalese, followed by some sad-sounding local-style music. Sign-off on this channel is reportedly around 2030.

●SOUTH KOREA
Seoul on **11725** at 1000, station identification and a newscast in the English programme for Latin America, South East Asia, Africa, the Middle East and North Africa, scheduled from 1000 to 1100.

●CLANDESTINE
The Voice of Democratic Kampuchea on **11685** at 1205, talk in Cambodian (presumably news comment) until 1215 when some local-style music was broadcast. The duration of this particular programme is from 1200 to 1255, all in Cambodian. Also in parallel on **11990** (not heard) this station is pro-Pol Pot and thought to be located in China.

●VIETNAM
Hanoi on a measured **6426** at 2135, local-type music with announcements in the Chinese programme for the Far East, scheduled from 2100 to 2200 on this frequency.

●CHINA
CPBS Xining, Quinghai on **4940** at 1513, male and female announcers alternate in Chinese, just audible under Kiev. The schedule of Xining is from 2150 to 0100 and from 0930 to 1325 relaying the Home Service 1 interspersed with some locally originated programmes.
Radio Peking on **7010** at 2005, a programme of that lovely-sounding Chinese classical music in the Polish programme for Europe, scheduled from 2000 to 2100 on this channel.
CPBS Guizhou on **7275** at 1435, a long discussion in Chinese, a poor signal just audible under co-channel QRM. Schedule unknown.
CPBS Neimenggu, Hohhot on **7300** at 1120, OM in Chinese – presumably with exhortations of some kind.
CPBS Hangzhou, Zhejiang on **4785** at 2304, female announcer in Chinese. This is Zhejiang 1 which has local programmes and also some relays from Peking 1. The schedule is from 2100 to 0500 and from 0850 to 1415. The frequency can vary up to **4786.** This one is not often logged simply for the reason that the channel is normally occupied by a commercial service but on this occasion the noise generator was absent!



"Hello, I'm a micro-chap"

3-STAGE M.W. SUPERHET

By R. A. Penfold

Two high gain transistors and an integrated a.f. amplifier.

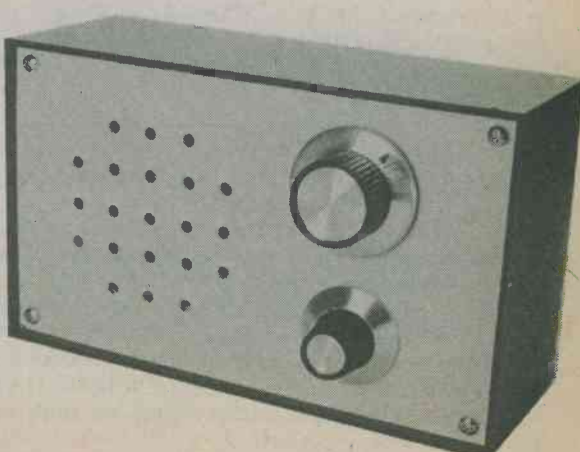
Low component count.

Full speaker output.

Although it employs only three active devices (including a MOSFET and an audio power i.c.) this set provides a good performance over the medium wave band, giving a level of sensitivity and selectivity which is equal to that of most small commercially produced superhets. It is completely self-contained with an internal ferrite aerial and 9 volt battery, and it gives an output power of about 100 to 200mW r.m.s. to its miniature loudspeaker. The set is reasonably compact, having outside dimensions of approximately 158 by 95 by 60mm., and the only controls are a tuning capacitor and a combined volume control and on-off switch. When it is completed the set requires alignment before it is ready for use, but the procedure is quite simple and no test equipment is needed.

SUPERHET CIRCUIT

The set works with a standard superhet design, having an aerial input stage covering the normal medium wave band of about 530 kHz to 1.6MHz. The local oscillator tunes from 1MHz to 2.07MHz, and its frequency is 470kHz above signal frequency. The aerial and oscillator signals are mixed to produce an intermediate frequency of 470kHz which is then amplified by the i.f. stages before being applied to the detector and following a.f. amplifier.



The 3-stage medium wave superhet is assembled in a neat plastic case.

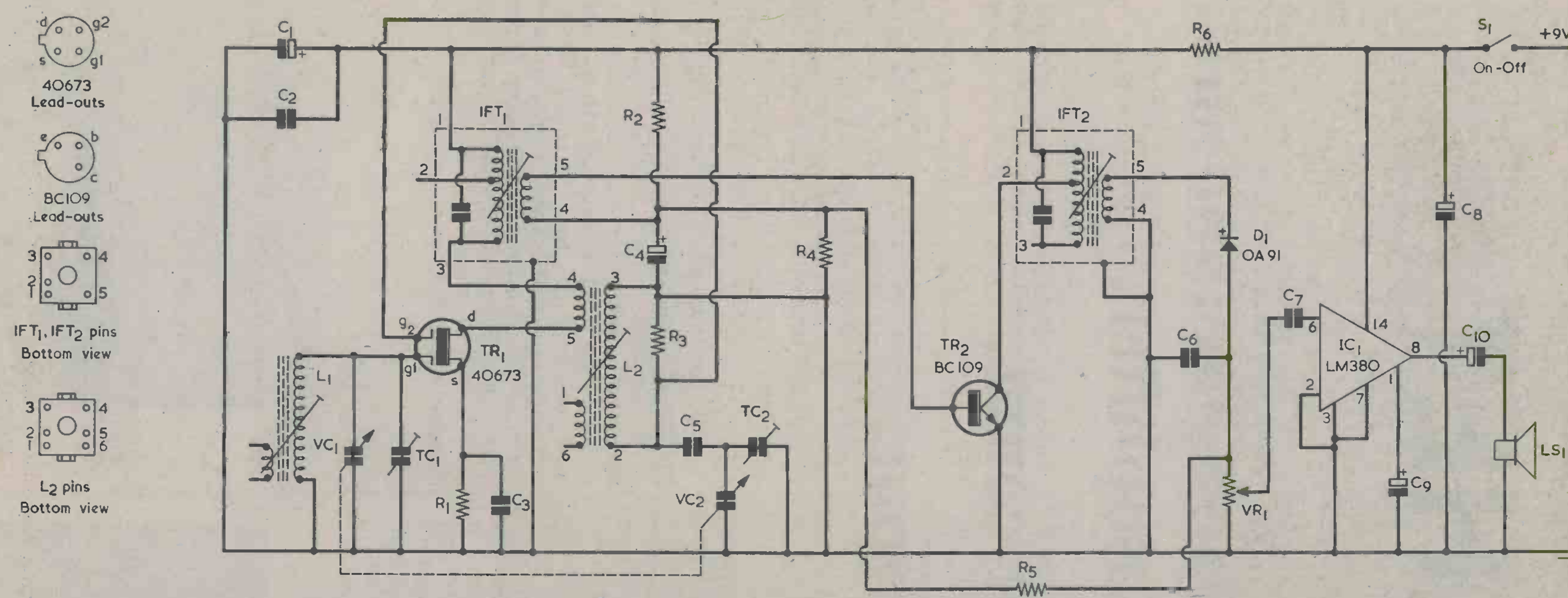
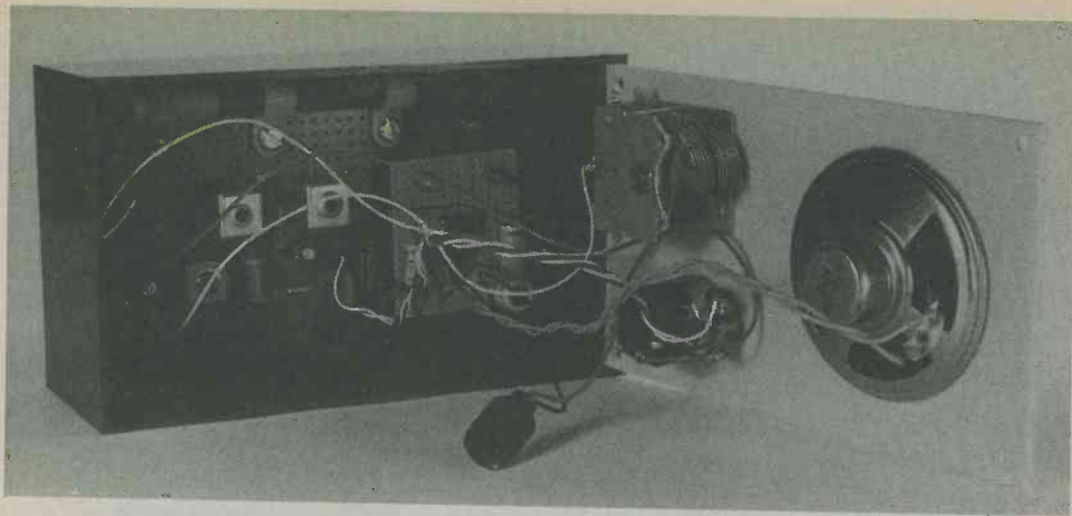


Fig.1. The circuit of the medium wave superhet receiver. By using a high gain mixer-oscillator and a high gain i.f. amplifier, together with an integrated circuit a.f. amplifier, adequate sensitivity is given with only three active devices.



The tuning capacitor, volume control/on-off switch and speaker are mounted on the front panel. The main component board is bolted to the rear panel of the case.

The complete circuit is given in Fig.1. TR1 is the mixer-oscillator. This is a dual gate MOSFET instead of the more usual bipolar transistor and it gives increased gain as well as requiring a simpler circuit.

L1 is the ferrite aerial coil and this is tuned over the medium wave band by VC1 and trimmer TC1. A MOSFET has an extremely high input impedance and the tuned circuit can be connected directly to its gate 1. The ferrite aerial specified has a coupling winding which would be required with a bipolar transistor, and no connections are made to this winding. The aerial coil also biases the gate 1 to the negative supply rail potential.

The input signal at the gate 1 appears in amplified form at the drain of TR1, and the degree of amplification can be varied by the voltage on the gate 2. This gate is in the oscillator circuit, with the result that the voltage on it varies at oscillator frequency and the requisite mixing action is given.

L2 is the oscillator coil and the winding between pins 2 and 3 is tuned by VC2 (ganged with VC1) and trimmer TC2. C5, in series with the winding, is a padding capacitor and ensures that the oscillator frequency is always 470kHz above signal frequency at all settings of the 2-gang capacitor. R3 is connected across the tuned winding to provide a small measure of damping which results in stable operation at the higher oscillator frequencies. The drain of TR1 couples through the winding of L2 between its pins 5 and 4 to the primary of the first i.f. transformer. Positive feed-

COMPONENTS

Resistors
(All fixed values ¼ watt 5%).
- R1 3.9kΩ
- R2 120kΩ
- R3 100kΩ
- R4 18kΩ
- R5 18kΩ
- R6 680Ω
- VR1 10kΩ potentiometer, log, with switch S1.

Capacitors
- C1 100μF electrolytic, 10V. Wkg.
- C2 0.22μF polyester type C280.
- C3 0.015μF ceramic plate.
- C4 10μF electrolytic, 10V. Wkg.
- C5 180pF ceramic plate.
- C6 0.01μF polyester type C280.
- C7 0.0047μF ceramic plate.
- C8 100μF electrolytic. 10V. Wkg.
- C9 10μF electrolytic, 10V. Wkg.
- C10 220μF electrolytic, 10V. Wkg.
- VC1, VC2 208 + 176pF 2-gang capacitor, type "00" (Jackson)
- TC1, TC2 part of VC1, VC2.

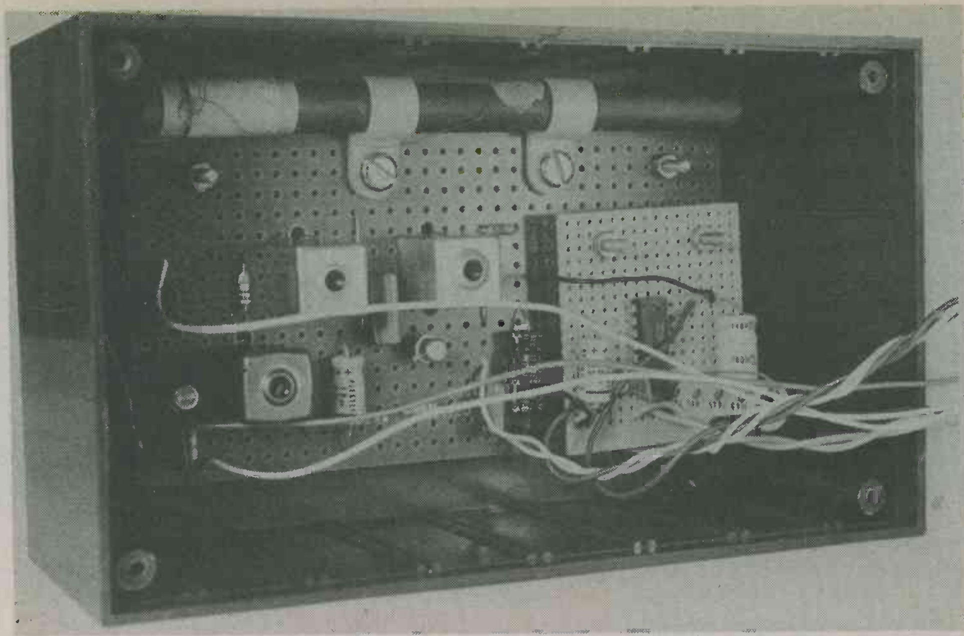
Inductors
- L1 medium wave ferrite aerial type MW. 5FR (Denco).
- L2 oscillator coil type TOC1 (Denco).
- IFT1 470kHz i.f. transformer type IFT13 (Denco).
- IFT2 470kHz i.f. transformer type IFT14 (Denco).

Semiconductors
- TR1 40673
- TR2 BC109
- IC1 LM380
- D1 OA91

Speaker
- LS1 miniature speaker, 40Ω – 80Ω

Switch
- S1 s.p.s.t., part of VR1.

Miscellaneous
- Plastic case (see text).
- Plain perforated board, 0.15in. matrix.
- Veroboard, 0.1in. matrix.
- 2 control knobs.
- 9 volt battery type PP3.
- Battery connector.
- 2 nylon clips for ferrite aerial (see text).
- Nuts, bolts, wire, etc.



The main component board is of 0.15in. matrix, which is reasonably compatible with the pins and mounting lugs of the i.f. transformer's and oscillator coil. A small sub-assembly board, of 0.1in. matrix, carries the a.f. amplifier i.c. and its immediate components.

back from the oscillator tuned winding is given by direct connection to the gate 2. The coupling winding of L2 between its pins 1 and 6 is normally employed in the emitter circuit of a bipolar transistor and is not required here. It will be observed that the oscillator circuit is extremely simple and requires very few components.

The intermediate frequency signal at TR1 drain is applied across the whole primary of IFT1, instead of to pins 2 and 3 as would occur with a bipolar transistor. This method of connection can be employed because of the higher output impedance of TR1. The secondary of IFT1 couples to the base of TR2, which is a high gain common emitter amplifier. Most superhets have two stages of i.f. amplification, but this set obtains sufficient gain due to the high gain i.f. stage and the increased gain conferred by the MOSFET mixer-oscillator.

The collector of TR2 couples to pin 2 of IFT2, with pin 1 connecting to the positive rail. Again, this method of connection differs from the more usual form, which is to use pins 2 and 3 of the primary. The secondary of IFT2 couples to the detector, D1, and the detected a.f. signal is developed across volume control VR1. C6 bypasses the i.f. content in the detected signal. Also developed across VR1 is a direct voltage which is proportional to the strength of the i.f. signal applied to D1, and this voltage is fed back, via R5, to the secondary of IFT1 and thence to the base of TR2. R5 and C4 filter out the a.f. signal across the volume control. A strong i.f. signal from IFT2 causes the upper end of VR1 track to go negative, and this negative voltage then reduces the base bias current for TR2, lowering its gain and thereby producing automatic gain control. There is in consequence a reasonably constant audio output level for received signals of different strengths. The a.g.c. also combats fading in signals from the more distant stations.

The audio amplifier employs the popular LM380 integrated circuit. The non-inverting input at pin 2 connects direct to the negative rail whilst the inverting input at pin 6 couples to the slider of VR1 via C7. Normally, pin 6 would connect direct to the potentiometer slider, but a d.c. blocking capacitor is needed here because of the direct voltage produced across VR1 track by the diode detector. An internal feedback path in the i.c. gives the LM380 a voltage gain of 34dB, or 50 times, and this is sufficient to give an output power of 100 to 200mW from the set when using a high impedance loudspeaker. The set will work with any miniature speaker having an impedance in the range of 40Ω to 80Ω speaker giving the highest output power. C9 decouples the supply to the pre-amplifier stage inside the LM380.

R6, C1 and C2 provide decoupling for the mixer-oscillator and i.f. amplifier stages, whilst C8 is the main supply bypass capacitor. The quiescent current consumption of the set is 9mA, and this can rise to about 20mA at high volume levels.

COMPONENTS

Some comments need to be made concerning components. The 40673 required for TR1 is available from Ambit International. VC1, VC2 is a 208 + 176pF 2-gang variable capacitor, Jackson type 00, with VC1 being the 208pF section. Trimmers TC1 and TC2 are integral with the variable capacitor and are not separate components. The two i.f. transformers and the oscillator coil are supplied pre-aligned, and the transformer cores will require only a slight re-adjustment after the receiver has been completed. The cores should, in consequence, be left alone until it is time for them to be adjusted. The cores of the i.f. transformers and the oscillator coil should be adjusted with a correct trimming tool, such as the Denco TT5. The ferrite aerial is held in place by two 9.5mm. nylon cable "P" clips, these being available from Maplin Electronic Supplies. If difficulty is experienced in purchasing the Denco components they may be obtained direct from the manufacturer at Denco (Clacton) Ltd., 357 Old Road, Clacton-on-Sea, Essex, CO15 3RH.

The prototype was assembled in a plastic case measuring about 155 by 90 by 50mm. This is a Teko case type TEKP3P, available from West Hyde Developments Ltd., Unit 9, Park Street Industrial Estate, Aylesbury, Bucks. The 0.015μF ceramic plate capacitor required for C3 can be obtained from a number of suppliers.

CONSTRUCTION

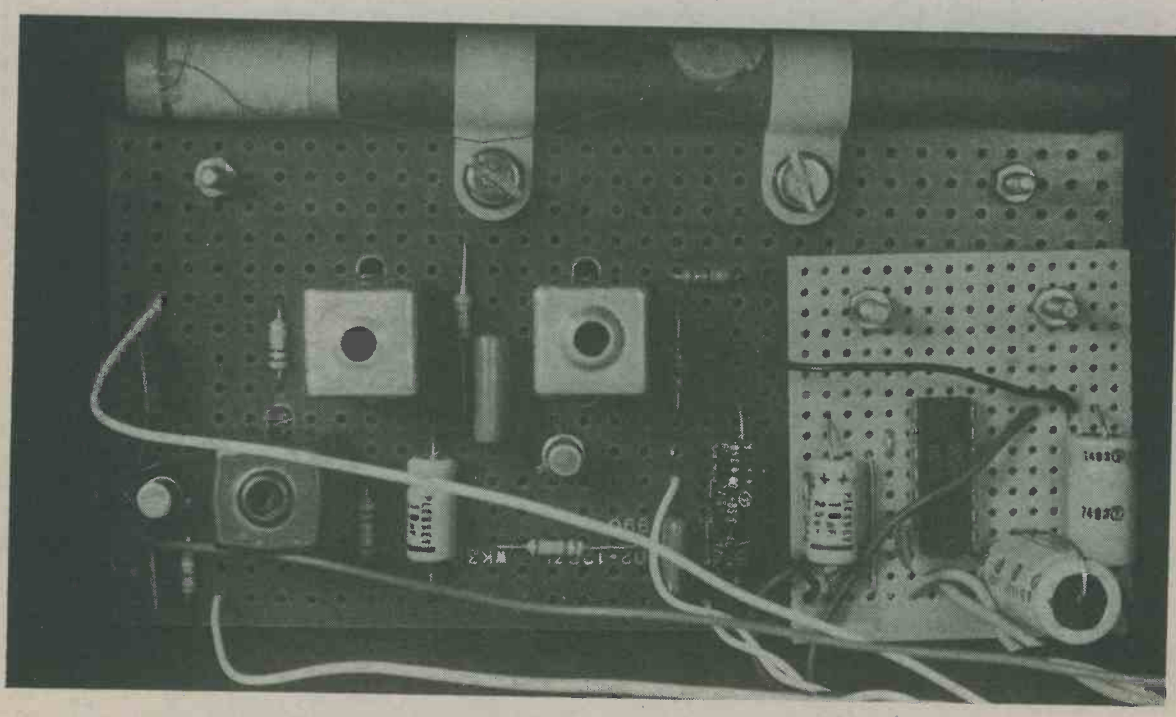
As can be seen from the photographs, VC1 VC2 and VR1, S1 are mounted on the right hand side of the front panel, with the 2-gang capacitor in the upper position. The capacitor has three holes in its front plate which are tapped 4BA, and three 4BA clear holes should be drilled in the front panel for the mounting bolts. Pass a piece of paper with a ¼in. hole in the centre over the capacitor spindle and mark the hole positions on this with a pencil. The paper can then be used as a template for marking out the three holes in the front panel. A central hole of about 15mm. diameter is also required. The three 4BA bolts securing the capacitor to the front panel must be very short, as their ends must not pass more than fractionally beyond the inside surface of the capacitor front plate. If the mounting bolts pass too far into the capacitor they would damage the fixed or moving vanes.

Some sort of speaker grille is required and this can be provided by drilling a matrix of holes, about 4 to 6mm. in diameter, in the front panel. The pattern of holes required can be seen in the photographs of the front panel. Miniature loudspeakers do not normally have any provision for panel mounting, and the loudspeaker will need to be glued in place behind the matrix of holes. The glue should be applied only to the outer rim of the speaker, taking great care to ensure that no glue gets on to the diaphragm, where it would detrimentally affect the speaker performance. A strong adhesive is required.

MAIN PANEL

There are two component panels, a large one consisting of plain perforated board of 0.15in. matrix with which the pins of the oscillator coil and i.f. transformers are reasonably compatible, and a small Veroboard of 0.1in. matrix which takes the LM380 and its associated components. After it has been wired up, the small panel is mounted on the large panel.

The large panel measures 2.5 by 5in., and this is a standard size in which the board is sold. Fig.2 shows the component layout and underside wiring of this panel. Construction starts with the drilling of the six holes having the diameters shown. The four smaller holes take M3 bolts, whilst the two larger holes take M4 bolts which secure the ferrite aerial clips to the board. It will also be necessary to enlarge some of the holes in the board with a 3.3mm. diameter drill to allow the pins and mounting lugs of the oscillator coil and the two i.f. transformers to pass through. The components can then be fitted one at a time. Their lead-outs are bent flat along the board underside and are soldered together in the manner shown in Fig.2. Tinned copper wire of around 22 s.w.g. can be used for long wires and for bridging gaps where component leads are too short. Note that connections are made to both mounting lugs of the oscillator coil and to one mounting lug of each i.f. transformer. The upper view shows two wires at holes I22 and A22. These wires carry the positive and negative supplies from the small panel to the large panel, and they are not fitted at this stage. The leads



Looking down directly on the main component board and the smaller a.f. board. The ferrite aerial is secured to the main board.

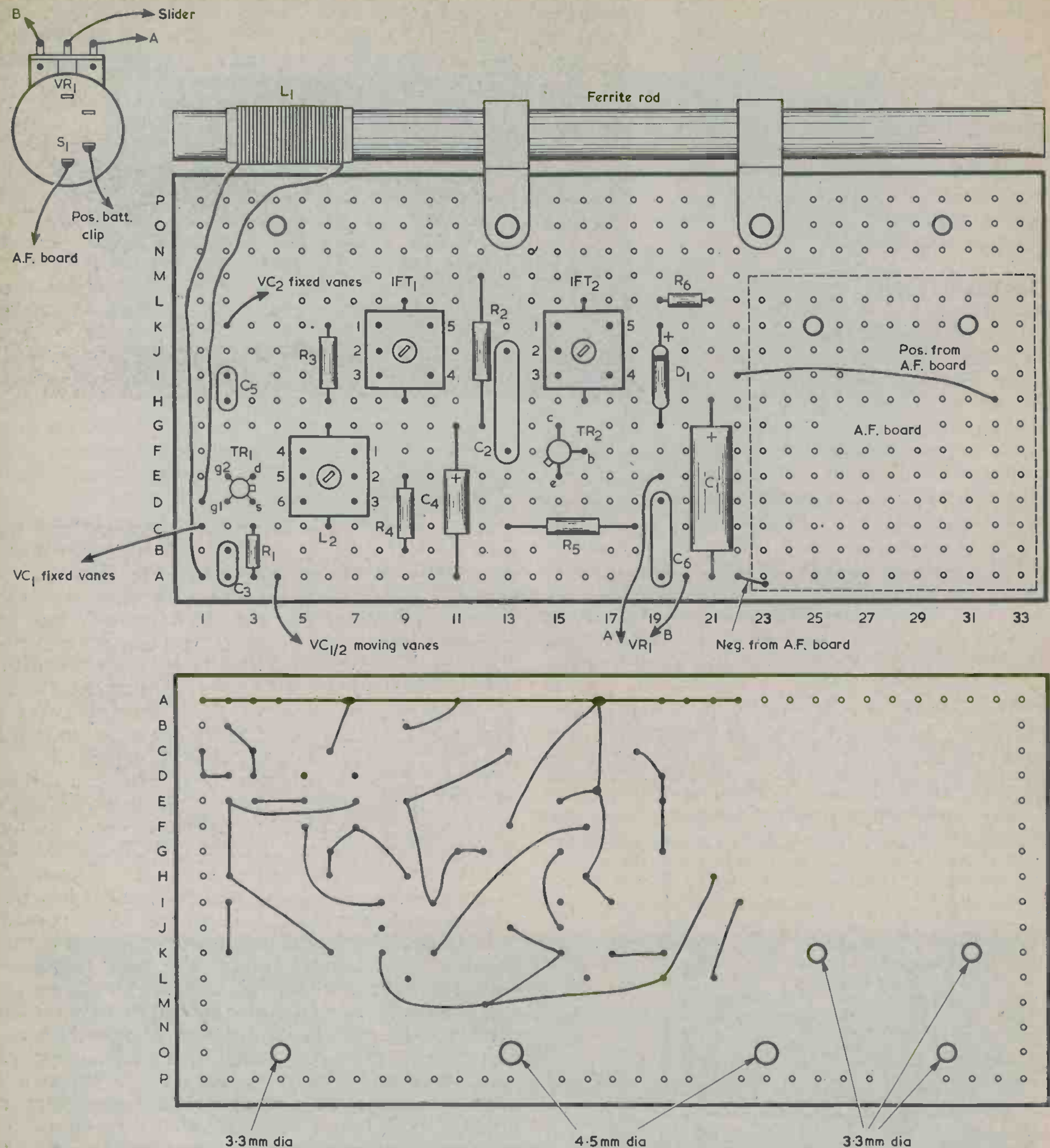


Fig. 2. The main component board. Check with the inset diagram of Fig.1. to obtain correct orientation of L2.

which connect to the front panel components can, however, be fitted. These are flexible wires which are cut to their final length when their ends are connected later.

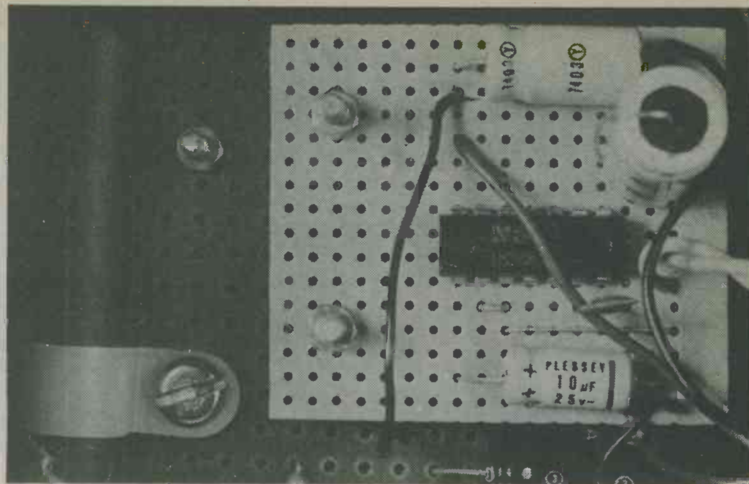
A.F. PANEL

The small 0.1in. Veroboard for the LM380 has 17 copper strips by 16 holes, and has to be cut from a larger size by means of a hacksaw. Details are given in Fig.3.

First drill out the two 3.3mm. diameter holes and then make the four breaks in the copper strips at the points indicated. The components and three link wires are then soldered in place, as also are the leads which carry the positive and negative supplies to the large panel and the leads which connect to the front panel components. As with the leads from the large panel, these are flexible wires which are cut to their final length when their remote ends are connected. Also connected at this stage is the negative battery clip lead.

The small a.f. board is then mounted on the large board using two M3 bolts and nuts with spacing washers, after which the two wires carrying the positive and negative supplies are connected to the large board.

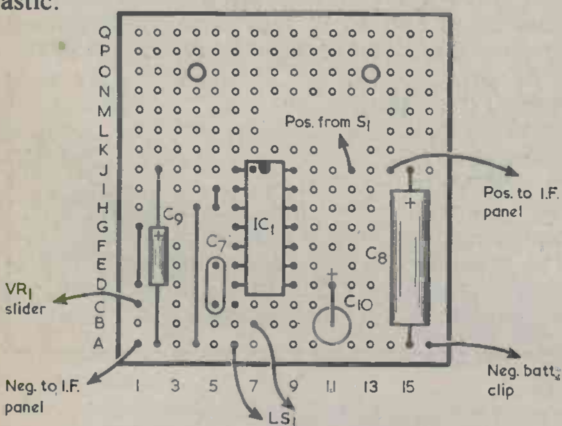
The large board is secured to the back panel of the case, using M3 bolts and nuts with spacing washers again. The connections to the front panel components can then be made. The two wires to the speaker can be lightly twisted together for neatness and they should



A closer view of the a.f. amplifier board.

be long enough to allow the front panel to be swung out as illustrated in the photograph showing the inside of the case and the rear of the front panel. The three wires to VR1 may also be twisted together and given a length which allows the front panel to swing out. The three leads to VC1, VC2 must **not** be twisted together. They should be kept separate and should be as short as is reasonably possible. VC1 is the front section of the 2-gang capacitor. The positive battery clip lead is soldered to the appropriate tag of S1 at this stage.

There is plenty of space for the PP3 battery beneath the loudspeaker. It can be held in position, when the front panel is screwed to the case, by a piece of foam plastic.



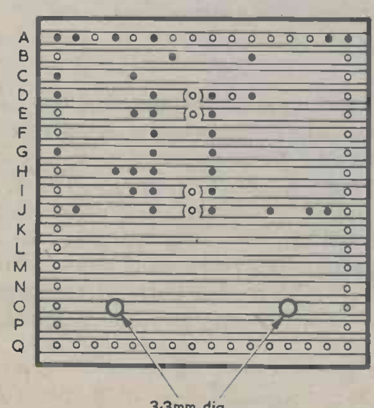


Fig.3. The a.f. amplifier board. This is bolted to the main component board.

ALIGNMENT

After construction has been completed and the wiring carefully checked, the set is ready for alignment. Since the i.f. transformers are pre-aligned it will probably be possible to tune in a few stations as soon as the set is switched on, and their strength may be increased by moving the aerial coil along the ferrite rod. Tune accurately to a **weak** signal and then adjust the cores of IFT2 and IFT1 to peak the signal. The i.f. alignment is now complete. It is necessary to use a weak signal for alignment as the a.g.c. action in the receiver will mask the peak with strong signals.

The frequency coverage of the receiver can next be checked. If the receiver does not tune to a sufficiently high frequency with the capacitor vanes in the minimum capacitance position, TC2 should be unscrewed until the correct coverage is given. If coverage does not extend to a sufficiently low frequency with the tuning capacitor at maximum capacitance TC2 should be screwed in, provided that this does not unduly reduce the high frequency coverage at the other end of the band. Strictly speaking, it is the core of L2 which should be adjusted for correct coverage at the low frequency end of the band. However, like the i.f. transformers L2 is supplied pre-aligned and its core should only be adjusted if correct coverage is not available within the adjustment range of TC2. In practice, it is unlikely that it will be necessary to make any adjustment to the oscillator coil core.

After the oscillator tuned circuit has been found to give adequate frequency range the signal frequency tuned circuit has next to be aligned. Tune to a station at the low frequency end of the band and adjust the position of the aerial coil on the ferrite rod for maximum signal strength. Next, tune to a signal at the high frequency end and peak this with TC1. Then return to the low frequency end and readjust the position of the aerial coil on the ferrite rod for maximum signal strength, and tune back to the high frequency end and readjust TC1. Keep repeating this procedure until no further improvement can be made. Final adjustments should always be made with weak signals. After the alignment has been completed the set will track correctly, giving good sensitivity over the whole of the band. The aerial coil should then be secured in its position on the ferrite rod by means of adhesive tape. ■

Relay Switching

By P. F. Bowles

Relays use logic, too.

In all but the simplest circuit diagrams, electromagnetic relays are depicted with what is described as the "detached" presentation. The relay coil is shown as a rectangle and the relay contacts can appear anywhere in the diagram. Unless otherwise stated, the contacts are always shown in the de-energised, or released, position.

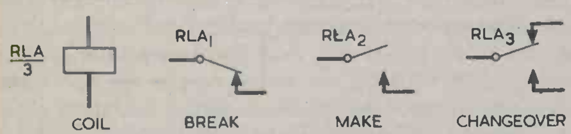


Fig. 1. Relays are usually depicted in circuit diagrams with "detached" presentation. Here we have Relay "A" with three contact sets, numbered RLA1, RLA2 and RLA3.

The relay may be designated by a letter or number. In Fig. 1 the relay is RLA. Its coil is identified as RLA/3, the figure 3 indicating that the relay has three contact sets. Sometimes the figure is omitted. The three contact sets are also shown in Fig. 1, and consist of a "break" set, a "make" set and a changeover set. The break contact set breaks when the relay energises and the make contact set makes when the relay energises. The break set may also be referred to as "normally closed" and the make set as "normally open".

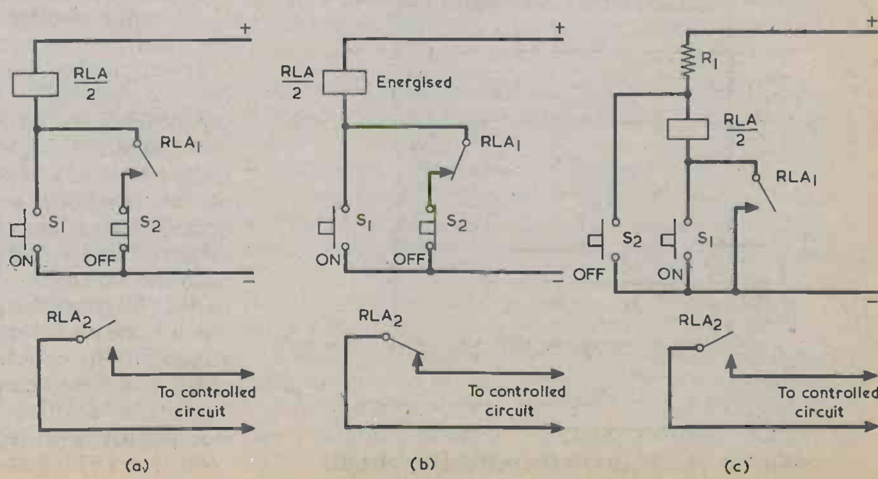
LATCH CIRCUITS

Relays are particularly useful for switching circuits on and off when it is necessary for the controlling circuit to be completely isolated from the switched circuit. Fig. 2(a) shows a latching relay circuit. Push-button S1, in this diagram, closes when it is pressed and push-button S2 opens when it is pressed. In Fig. 2(a) the relay is de-energised and both its contact sets are open.

When S1 is pressed the relay energises and contact set RLA2 closes to turn on the controlled circuit. Contact set RLA1 also closes and, when S1 is released, ensures that current still flows in the relay coil via this contact set and switch S2. The situation is shown in Fig. 2(b). The relay now remains energised and, in the jargon, is "held on by its own contact". If push-button S2 is next pressed the circuit to the relay coil is broken and the relay releases, turning off the controlled equipment. The circuit then reverts to the condition shown in Fig. 2(a).

An alternative method of energising and de-energising the relay is shown in Fig. 2(c). When S1 is pressed the relay energises and latches in the energised state due to the circuit completed by contacts RLA1. In this case the relay coil is

Fig. 2(a). Relay switching circuit with On and Off buttons. S1 is push-to-make, and S2 is push-to-break.
(b). If S1 is pressed the relay energises. It stays energised when S1 is released because of the circuit completed through S2 and contacts RLA1.
(c). An alternative circuit. Pressing S1 causes the relay to latch on through contacts RLA1. Pressing S2 short-circuits the relay coil and releases the relay.



supplied via the resistor R1. When push-button S2 is pressed it short-circuits the relay coil, whereupon the relay releases again and stays released. The resistor will normally have a value of the same order as the relay coil resistance and it requires a wattage rating suitable for the period, with S2 pressed, when it has the whole supply voltage applied across it.

SEQUENTIAL SWITCH

A sequential switching circuit which aptly demonstrates "relay logic" is given in Fig. 3. In this diagram the controlled circuit is turned on and off by contacts RLB2. When push-button S1 is pressed these contacts close. Pressing S2 a second time causes the contacts to open again.

Circuit operation is broken down into steps in Fig. 4. In Fig. 4(a) S1 is pressed for the first time. Current flow (which is assumed to be from positive to negative) is indicated by the arrows. The current flows from the positive rail through contact set RLA1, S1 and contact set RLA2 to the upper end of coil RLB/2. Relay RLB energises and its contacts RLB1 and RLB2 close. Relay RLA cannot energise because the lower side of its coil is coupled to the positive rail through the circuit path from that rail to RLB/2 and thence via contacts RLB1. Whilst S1 remains closed, coil RLA/2 is short circuited.

S1 is released in Fig. 4(b), taking the short-circuit off coil RLA/2. Current now flows from the positive rail through coil RLA/2, contacts RLB1 and coil RLB/2. Both relays are energised and contacts RLA1 and RLA2 have moved to the energised position.

SWITCHING OFF

S1 is pressed again in Fig. 4(c). At the instant of switch closure, contacts RLB1 are made, so that the switch completes a short-circuit across coil RLB/2 through contacts RLB1, RLA1, the switch itself and RLA2 to the negative rail. Relay RLB releases and no further energising voltage is available for it. Whilst the switch is pressed, an energising circuit for coil RLA/2 is given through contact set RLA1, the switch and contact set RLA2. This circuit is broken when S1 is released, whereupon relay RLA de-energises and the circuit returns to the state it had in Fig. 3, with both relays released.

The two relays should be of the same type and should have the same coil resistance. The supply

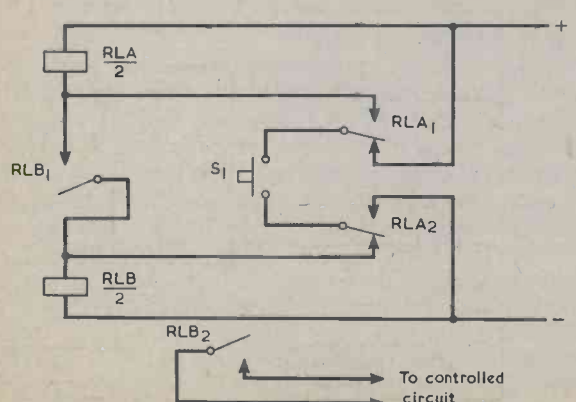


Fig. 3. A sequential switching circuit.

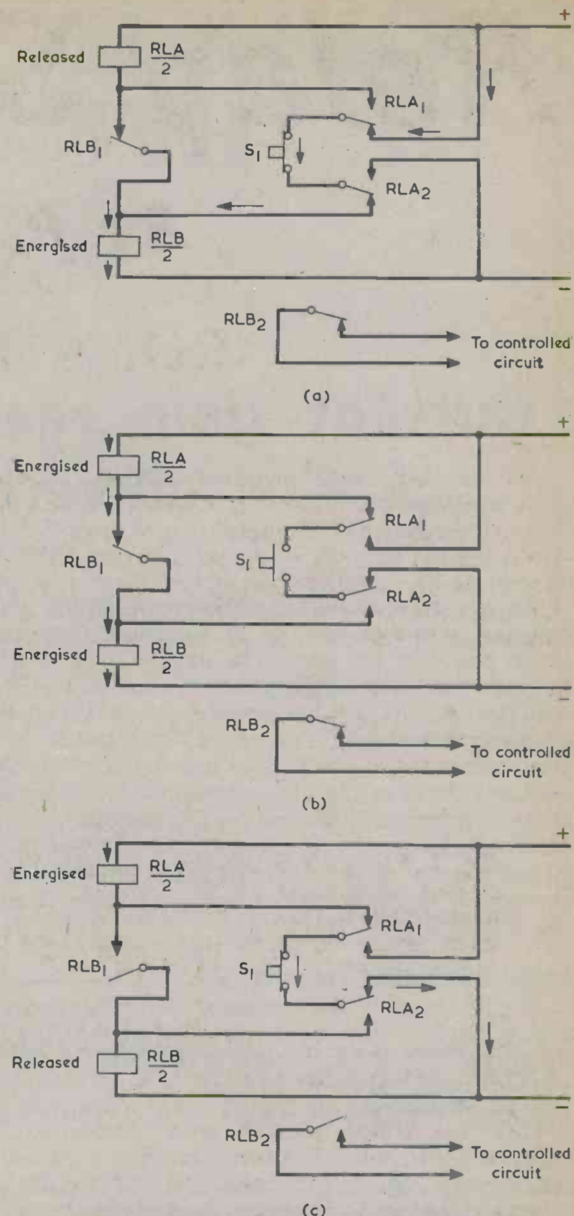


Fig. 4(a). When S1 of Fig. 3 is first pressed, relay RLB energises.
(b). Releasing S1 causes both RLA and RLB to energise.
(c). Closing S1 a second time maintains RLA energised with RLB releasing. Relay RLA releases when S1 is opened.

voltage is twice the value needed for energising a single relay. When S1 is pressed the full supply voltage is applied across one or other of the relay coils, according to the position of the contacts RLA1 and RLA2. It is quite in order, with a standard relay, for the higher voltage to be applied across its coil.

For purposes of explanation we have assumed in all the diagrams that the upper supply rail is positive. In practice, supply polarity is unimportant and the upper rail can be negative, if desired.

(Editor's note. The circuit of Fig. 3 is due to M. G. Ashby and appeared originally in the September 1971 issue). ■

CONSTANT CURRENT HFE METER

By D. Snaith

Current gain readings with constant current sources.

Bipolar transistor hFE measuring instruments are not new, and a number of designs have appeared in these pages in the past. The author returns to the subject because the appearance of small constant current devices on the home-constructor market make it possible to make up a meter in which test transistor base currents are completely independent of supply voltages and of voltage drops across base-emitter junctions. The constant current devices also allow current limiting to be given so that there are no risks of damage to test transistors or indicating meters in the event of accidental short-circuits or incorrect connections at the test terminals.

FULL CIRCUIT

The full circuit of the transistor hFE meter is given in Fig. 1. Three constant current i.c.'s type LM334Z are employed, the constant current they pass being controlled by the value of external resistance which is connected between their pins 1 and 3. The constant current, in amps, is equal to 0.0677 divided by the value of the external resistor. R1 has a value of 680Ω so that, when range switch S1(a) is set to position 1, the constant current is 0.1mA. The value of R2 is 6.8kΩ, whereupon setting S1(a) to position 2 results in a constant current of 0.01mA. The values of R5 and R6 are the same, respectively, as those of R1 and R2, with the result that IC3 similarly produces a constant current of 0.1mA when S1(b) is in position 1 and a current of 0.01mA with S1(b) set to position 2.

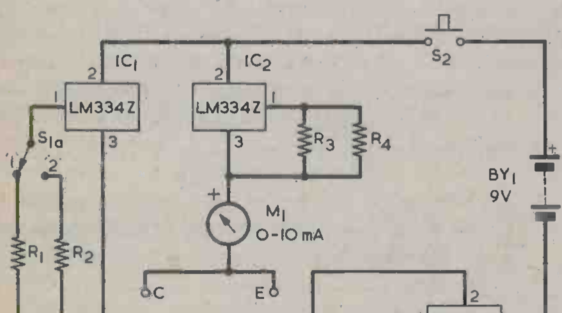


Fig. 1. The complete circuit of the transistor hFe meter. IC1 and IC3 are constant current devices which provide pre-selected base currents. IC3 limits the current in the meter circuit.

The collector-emitter current passed by the test transistor flows through meter M1, which has an f.s.d. rating of 10mA. IC2 is set up, by means of R3 and R4, to pass a constant current which is just slightly more than 10mA. The i.c. thereby functions as a current limiter and ensures that the maximum current which can flow in the circuit cannot exceed its constant current.

Two sets of terminals are provided, one for n.p.n. and one for p.n.p. transistors. The transistors are connected to the test terminals as indicated. After a test transistor has been connected, push-button S2 is pressed to obtain a gain reading. Since current is only drawn from the 9 volt battery when S1 is pressed, and since the maximum current cannot exceed slightly more than 10mA, a small battery can be used for BY1. A PP6 or PP7 would be suitable.

The LM334Z i.c. is available from Maplin Electronic Supplies. S1(a)(b) can be a 2-pole 6-way rotary switch with adjustable end stop set for 2-way operation.

N.P.N. TRANSISTORS

When an n.p.n. transistor is connected to the test terminals the circuit set up is as shown in Fig. 2(a). The transistor functions as a common emitter amplifier with the meter in its collector circuit. If S1(a) is in position 1 the base current is 0.1mA so that, should the transistor have a current gain of exactly 100 times, the meter will indicate 10mA. If the transistor has a gain of 50 times the meter indication will be 5mA. Should the meter read more than f.s.d. the transistor gain will be greater than 100 times, whereupon S1 (a) is moved to position 2, giving a base current of 0.01mA . In the event of the transistor having a gain of 1,000 times the meter will once again indicate 10mA. It is very much more likely that the gain will be lower than this figure. A gain of 300 times will result in a meter indication of

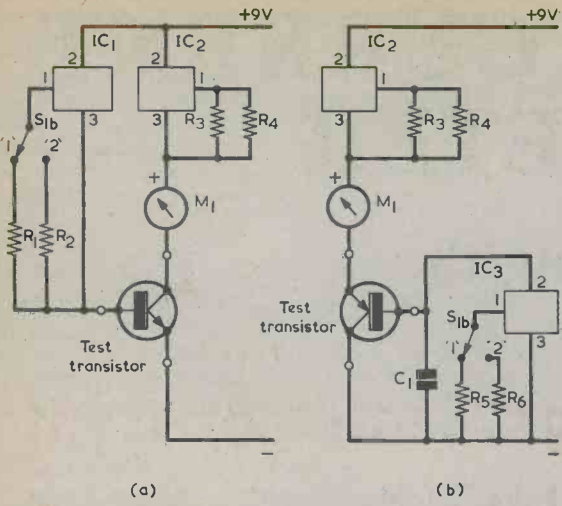


Fig. 2(a). The test circuit which is set up when an n.p.n. transistor is connected to the meter.

(b). Connecting a p.n.p. transistor produces the test circuit shown here.

3mA, and a gain of 400 times will produce a meter reading of 4mA.

As will be seen, the current gain of the transistor is read directly from the scale calibration of the meter, with the 10 on the meter scale corresponding to 100 or 1,000 according to the setting of S1(a).

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 680Ω
R2 6.8kΩ
R3 8.2Ω
R4 see text
R5 680Ω
R6 6.8kΩ

Capacitor
C1 0.01μF polyester

Semiconductors
IC1 LM334Z
IC2 LM334Z
IC3 LM334Z

Switches
S1(a)(b) 2-pole 2-way rotary
S2 push-button, press to make

Meter
M1 0-10mA panel mounting moving-coil meter

Battery
BY1 9 volt battery

Miscellaneous
Plastic case
6 insulated terminals
Pointer knob
Battery connector

P.N.P. TRANSISTORS

Connecting up a p.n.p. transistor gives the test circuit shown in Fig. 2(b). In this instance the transistor functions as an emitter follower, with the result that the meter reads emitter current. The emitter current is equal to the collector current plus the base current but, since the base current will normally be very much less than the collector current, the error introduced is negligibly small.

Gain indications are the same as with the n.p.n. test circuit, an f.s.d. reading in the meter corresponding to a gain of 100 times when S1(b) is in position 1 and to 1,000 times when S1(b) is in position 2. C1 is included in the p.n.p. circuit to overcome the risk of instability. The base and collector of the test transistor are in phase and the input impedance at the base is fairly high. Without C1 the circuit could oscillate if there were long test leads to the base and collector and these ran close to each other. There is no risk of instability with the n.p.n. test connection because the base is held at a low impedance and the base and collector are, in any case, out of phase.

With both p.n.p. and n.p.n. test transistors there should be a reasonable but very probably not precise correlation between readings obtained with a particular transistor on the two ranges. The lack of exact correlation will be due to the different collector currents involved. There is no real need to use close tolerance resistors for R1, R2 and R5, R6, and 5% components will give adequate accuracy for all practical purposes.

LIMITING CURRENT

The value of R4 is found experimentally, and it is assumed that the constructor has a reasonable stock of fixed resistors between 22Ω and 68Ω.

The circuit is initially assembled, as illustrated in Fig. 3, without R4. The collector and emitter terminals of either set of test terminals are connected together, causing the meter to be connected across the 9 volt supply in series with IC2. With only R3 in circuit the meter will give a reading of about 8.3mA when S2 is pressed. Starting with 68Ω and using a slightly lower value after each check, find the resistance required in R4 which causes the meter needle to pass beyond the

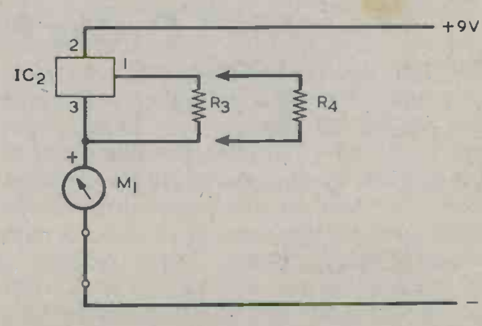


Fig. 3. The meter is initially assembled without R4. Various values are then checked experimentally until the required value is found.

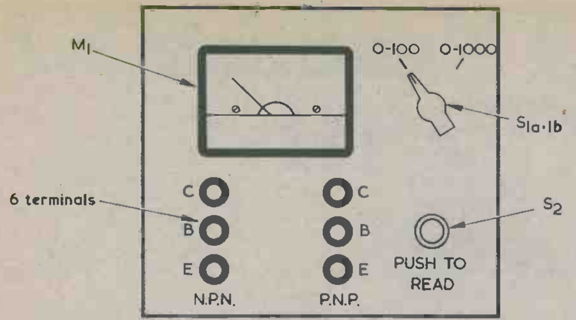


Fig. 4. A recommended front panel layout for the hFE meter. Connections to test transistors are made by way of short flexible leads terminated in small crocodile clips.

10mA calibration point and just rest gently against the end-stop at the f.s.d. end of the scale. When a suitable resistance value has been found, the resistor is permanently soldered into circuit and becomes R4. In the prototype circuit the value required in R4 was 33Ω. Take great care not to accidentally try a resistor lower than 22Ω, as there would then be excessive current in the meter.

The current range specified for the LM334Z is 1μA to 10mA, but no harm will be caused to IC2 if it is operated fractionally above 10mA, particularly with a supply voltage of 9 volts only.

CASE

The transistor gain meter can be assembled in a small plastic case, and a recommended front panel layout is shown in Fig. 4. S1(a)(b) and S2 are positioned to the right of the meter, and can be operated by the right hand without obscuring meter readings. Large insulated terminals are preferred for the test transistor connections.

Note that, unlike the circuit presentation in Fig. 1, the p.n.p. collector terminal is above the base terminal, with the emitter terminal below. Wiring to the terminals follows Fig. 1, of course. However, positioning the p.n.p. terminals in the same order as the n.p.n. terminals reduces possible confusion in the use of the hFE meter.

BOOK REVIEW

TOWERS' INTERNATIONAL MICROPROCESSOR SELECTOR. By T. D. Towers, M.B.E., M.A., B.Sc., C.Eng., M.I.E.R.E. 259 pages, 245 x 165mm. Published by W. Foulsham & Co. ISBN 0-572-01037-0. Price £14.95.

(The letters ISBN in the description of this book stand for International Standard Book Number. We shall be quoting the ISBN in future reviews as a service to librarians).

T.D. Towers' Selector series already consist of a book covering transistors, another for operational amplifiers and a third for field-effect transistors. To these very useful reference works is now added the present Microprocessor Selector.

The book starts with a 5 page introduction to microprocessors which deals with history, operation, terminology, coding and availability. The introduction is followed by tables listing single-chip microprocessors, multi-chip microprocessors and bit-slice microprocessors. The Tabulations, which make up the main body of the book then begin. The column headings are: Device Type Number, Function, Data Word Length, Device Description, Micro Family, Maker, Package, LSI Type, Operating Temperature Range, DC Supply Voltages, Quiescent Power, Input Logic Levels, Output Logic Levels and Substitute. More than 7,000 i.c.'s are listed.

There are ten appendices, and these include a glossary of microprocessor terms together with details of microprocessor families, manufacturers and codings, microprocessor trainer and development systems, bibliography and notes on the entries in the Tabulations.

Radio Topics

By Recorder

Moving into a new house can have its amusing as well as its traumatic moments. I myself have just made such a move, complete with all the books, papers, files and technical bits and pieces which are part of the background for a jobbing journalist whose field is electronics.

My new house is actually quite an old one, but it is of solid construction and warm temperament. My neighbours tell me that it has had a succession of owners, each averaging an occupancy of about seven years. And it must be to an unknown occupier of several removes in the past that I owe a small debt of gratitude.

DOOR BELL

My new house did not have a front door bell. Now, when I get engrossed in some really interesting work it takes more than a few knocks at a front door to catch my attention, and visions arose in my mind of me soldering away in my workroom at a particularly tricky design, blissfully unaware of an unsatisfied stream of postmen, charity collectors and Jehovah's Witnesses, all pounding away fruitlessly at my front door.

The obvious solution was an old fashioned, good and noisy, electric bell, whereupon all that was required was a bit of wiring around the house. My heart sank a little when I inspected the front door jamb on which the bell push would have to be mounted. This presented about five inches of solid wood, in which a hole would have to be drilled to allow the bell push wires to pass through. The handymen amongst you will raise an eyebrow at my baulking at such a simple task, but with the tools available to me I would have to drill through from both sides, with the two holes meeting at the middle. I have to confess here that if I had the commission to dig the Channel Tunnel, starting from both the English side and the French side, the outcome would be two tunnels.

Then I spied an irregularity on the surface of the door jamb at bell push height. After a little work with a pen knife I found two short stubs of wire of around 12 s.w.g. with about quarter of an inch of PVC insulation still present on them. These had been painted over and over until the door jamb surface was virtually flush. The wires disappeared completely into the interior of the wood and so I next searched for their reappearance elsewhere. And there, sprouting out of the woodwork near the electricity meter, were another two thin PVC covered wires of around 12 s.w.g.

A swift check with a continuity tester soon revealed that these were the other end of the two stubs at the door jamb. All that I had to do was to solder on two short extensions to the stubs of wire, pass sleeving over them, connect up the bell push and screw it in place.

Guessing the time of that original installation is rather like carbon dating a find in an excavation. I make it at least five layers of paint over the wire stubs and, since the insulation is PVC. The wire must have been fitted in place after the early 1950's. At any event, a very neat and unobtrusive wiring job now has the electrons flowing along it every time soneone leans on my front door bell, just as it had some twenty to thirty years ago.

CONDUCTIVE SPRAY

Plastic housings for electronic equipment are popular with manufacturers because they are cheap to produce, are light, and have more than adequate strength for most applications. But plastic is an insulator and it provides no screening against electromagnetic interference (EMI) or radio frequency interference (RFI). Attempts have been made to produce plastics with conductive fillers, but these have been unsuccessful because the high density of fillers required to provide effective shielding modifies the plastic to a state which is unacceptable for strength and rigidity.

This is where two conductive coatings, Xecote and Xeprime, come on to the scene. Xecote can be sprayed on to a plastic surface just like any ordinary paint and it dries in about 15 minutes. Full cure time is 24 hours. It contains highly conductive nickel particles which are inert and do not oxydise. A single pass provides a uniform coating of 0.0005 to 0.002 inch, and a coating of 0.002 to 0.003 inch is sufficient for effective shielding. The shielding is effective up to 10GHz, at which the coating gives a measured attenuation of 70dB. The surface resistivity is less than 1Ω per square.

Xecote adheres to most plastics, including acrylics, polycarbonates, ABS, polyphenelene oxides and fibreglass. The alternative fromulation is Xeprime. Xeprime can be employed as a conductive primer, and it is also available as a non-conductive primer for subsequent coatings of Xecote. Xeprime is intended for use with polyesters and composite substrates and, like Xecote, can be applied in the same way as ordinary paints.

A 6 page bulletin giving details of these two products is available from MCP Electronics Ltd., 38 Rosemont Road, Alperton, Wembley, Middlesex, HA0 4PE.

DOWN TO EARTH

The young lady in the photograph is a technician handling sensitive electronic equipment which can be readily damaged by high static voltages. The bench is covered with a conductive table top mat, the technician's feet rest on a mat of the same material and she wears a wrist strap which provides positive earthing.

All the earthing items are produced by Modulux Industrial Equipment Ltd., a leading supplier of high quality robust factory and laboratory furniture, who have entered into an agreement with 3M United Kingdom Ltd. to provide complete protection against static electricity for the safe handling of micro-electronic components.

The latest generation of electronic devices can be inadvertently weakened or damaged during vital assembly and handling by operators with insufficient earthing. The ready availability from Modulux Industrial Equipment of the 3M Static Control Work Station Grounding Kit to effectively drain off electrostatic discharge comes as a vital step to improving standards and quality for the 80's. The 3M kit includes a 4 by 2 ft. Static Control coloured bench top mat, a 4 by 6 ft. matching floor mat of the same conductive material, and a wrist strap which connects to the table top and provides body contact with earth for the worker. The Static Control mats are available in brown or gold colours to match or contrast with other Modulux industrial furniture. The 3M kit comes in a compact, convenient pack to complement an existing furniture installation, or it can be delivered additionally with a furniture order.

Research has shown that thousands of volts of electrostatic charge can be generated in a technician's body by simply walking across floors, sliding elbows across working bench tops or rubbing against stool seats. The use of the Modulux earthed furniture certainly eradicates all the risks of high electrostatic voltages. Further details can be obtained from Public Relations, 3M United Kingdom Ltd., 3M House, P.O. Box 1, Bracknell, Berkshire, RG12 1JU.

THERMAL STRIPPER

The second photograph shows the new temperature control unit type TC–1 which has been made available by Eraser International Ltd., Unit M, Portway Industrial Estate, Andover, Hants, SP10 3LU, for use with their recently introduced TWC–1 Thermal Hand Wire Stripper.

The combination of the TC–1 temperature control unit and the hand wire stripper enables the tool to successfully strip problematic insulations such as PTFE and Teflon. In addition to stripping these types of insulation the tool, with the control unit, will strip all normal type wire insulations such as PVC and nylon.

The TC–1 operates from a 240 volt 50Hz supply and no external transformers or power supplies are required. Low voltage high current electricity is fed from the heat control unit through the alloy stripping blades of the tool to give instant heat, adjustable in temperature from ambient to 700 deg F at the touch of a button. This instant heat will strip even the toughest high temperature insulations with ease, leaving the wire free from oxides, nicks or deformations.

Further, the use of the temperature control unit enables the temperature of the stripping blades to be varied to eliminate such problems as smoking, excessive fumes, etc., which are often associated with thermal wire stripping.

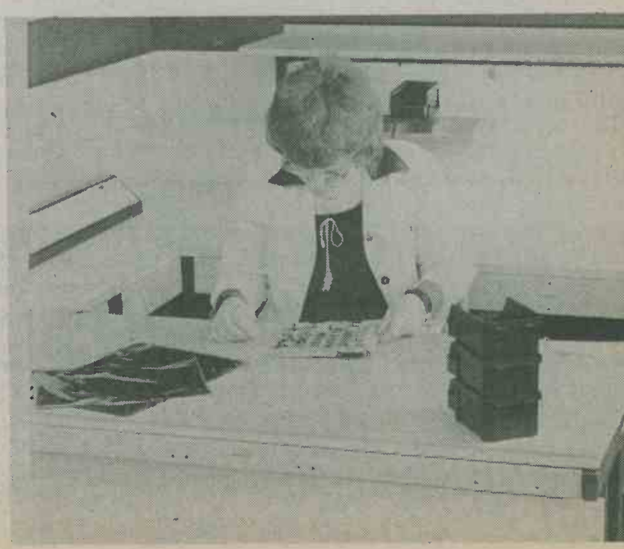
The TC–1 heat controller is available separately or alternatively as a complete unit with the wire stripper.

MARCONI AND THE POLICE

North Yorkshire police are to use some of the latest computer technology in the fight against crime.

The core of their new control system is a central processor at police headquarters in North-

The technician here wears a wrist strap to provide positive body earthing. To further guard against high static voltages, the bench is covered with an earthed conductive top mat, and her feet rest on another earthed mat of the same material. All these items are produced by Modulux Industrial Equipment Ltd.



allerton which stores information and is also linked to every police station in the area. The new Resource Availability System has been developed and supplied by Marconi Space and Defence Systems, Kidsgrove, Staffs, and will enable the North Yorkshire force to be more effectively co-ordinated and controlled.

There will be 13 operator positions in the headquarters control room complex, each equipped with a visual display unit and keyboard to update and request information, and a further 16 VDU's at division and sub-division stations. The system also provides a means of passing telex-type messages over the same network.

All units will have direct access both to the central processor and the Police National Computer at Hendon, reducing reaction time and increasing the economic and efficient use of police resources.

Another Marconi company, Marconi Avionics Limited, at Basildon, is helping the Metropolitan Police. The London Metropolitan force, the largest in the United Kingdom, is to put into service the Marconi Avionics "HELI-TELE" helicopter-mounted television viewing system in its new Bell 222 helicopter.

HELI-TELE enables a steady view of the ground to be obtained from a helicopter. There is very precise stabilization of the TV camera mounting, and this allows pictures to be taken at long range, with a powerful zoom lens to show important detail, unaffected by the vibration and other movements experienced in helicopters.

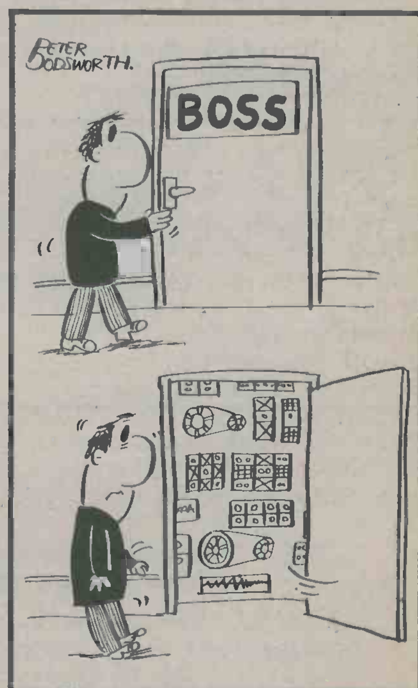
The system comprises a stabilized steerable television camera, with a cockpit-mounted monitor for control purposes, and a data link to a remote control post. Data is transmitted "live" in real time and can be recorded remotely. This facility has proved useful for many tasks, ranging from traffic supervision to crowd control.

The TV camera system, many of the functions of which are automatic, is controlled by an operator in the helicopter who is free to concentrate on aiming the camera and operating the zoom lens.

HELI-TELE, developed in the United Kingdom and now in operation in several countries in a variety of helicopters, has earned nearly £1½ million in exports alone. The system for the Metropolitan Police, which has been operating since last Summer, is now being fitted to the new Bell 222 helicopter.

So useful has the system proved that a second system has now been ordered, for service in mid-1981, on the second Bell 222 ordered by the Metropolitan Police. ■

The Eraser International thermal wire stripper type TWC–1 and the TC–1 temperature control unit. Stripping temperatures up to 700 deg F are available for high temperature insulations. Lower temperatures, for PVC, nylon and similar insulations can also be selected.



PULSE POWER SUPPLY

By Stephen P. Narey

Pulse width control of motor speed.

This article describes a circuit for controlling the speed of a small d.c. motor of the type used in small hand drills. It could doubtless be used for other similar purposes.

ESSENCE OF OPERATION

A variable voltage regulator type LM317T is connected in the conventional manner, as shown in Fig. 1. RX is chosen to give the desired output voltage from the simple formula

$$Vout = 1.25(1 + RX/240).$$

For the 8 volts required by the author RX was made 1.5kΩ, the other resistor being 270Ω because 240Ω was not available at the time of making up the circuit. The regulated voltage is then

$$1.25(1 + 1{,}500/270)$$

or slightly more than 8 volts.

If we now make RX equal to zero, the output of the regulator will drop to 1.25 volts:

$$Vout = 1.25(1 + 0/270) = 1.25.$$

Here lies the clue for the operation of the power supply. If we pull point "X" down to zero volts by, say, the application of a square wave, we will get the same waveform appearing at the output of the regulator, but it will be referenced to 1.25 volts and not to zero volts. This is illustrated in Fig. 2. The amplitude of the output waveform will be determined by the voltage to which we have set the regulator by the two resistors, RX and 270Ω. Maximum voltage will be the regulated voltage, and minimum voltage will be 1.25 volts.

By varying the duty cycle of the waveform at point "X" we can effectively alter the rate at which the regulator will deliver power to its load. This gives the method by which we alter the speed of the motor, but because the amplitude of the d.c. applied to the motor does not fall we do not lose power at low revs.

Fig. 1. The basic circuit for the LM317T variable voltage regulator.

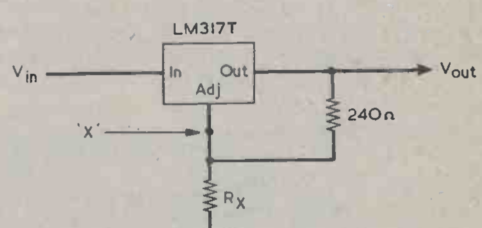
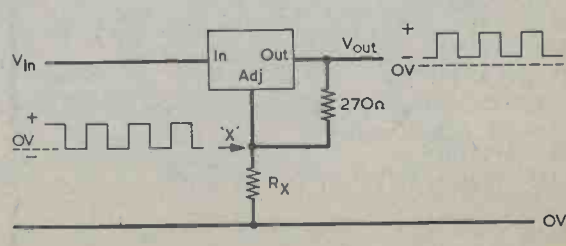


Fig. 2. If RX is short-circuited by the negative pulses of a square wave, another square wave appears at the regulator output.



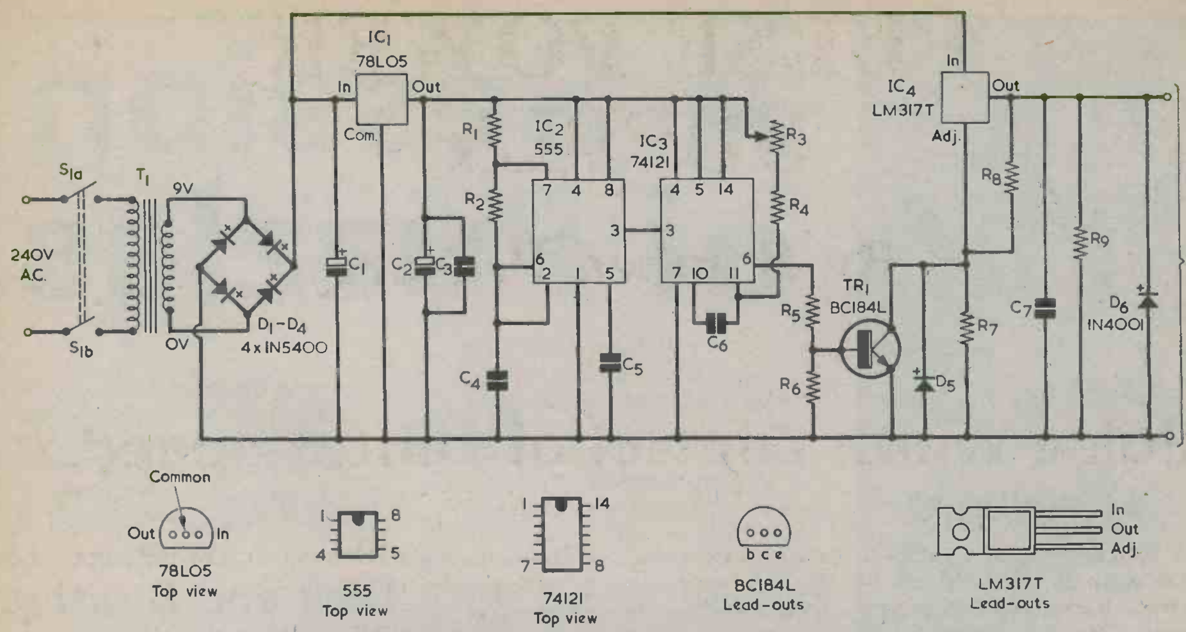


Fig. 3. The full circuit of the pulse power supply. IC2 triggers IC3 into producing a series of positive pulses whose width is controlled by R3.

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
- R1 82kΩ
- R2 18kΩ
- R3 20kΩ potentiometer, linear
- R4 1.5kΩ
- R5 4.7kΩ
- R6 1.5kΩ
- R7 1.5kΩ
- R8 270Ω
- R9 180Ω

Capacitors
- C1 4,700μF electrolytic, 16 V. Wkg.
- C2 47μF electrolytic, 16 V. Wkg.
- C3 0.1μF disc ceramic
- C4 0.22μF polyester
- C5 0.1μF polyester
- C6 1μF polyester
- C7 0.1μF disc ceramic
- C8 220μF electrolytic, 16 V. Wkg. (see text)

Transformer
- T1 mains transformer, secondary 9V at 2A

Semiconductors
- IC1 78L05
- IC2 555
- IC3 74121
- IC4 LM317T
- TR1 BC184L
- D1-D4 1N5400
- D5 1N4001
- D6 1N4001

Switch
- S1 (a)(b) d.p.s.t. toggle

THE CIRCUIT

In the circuit of Fig. 3, a 555 is connected in the normal way for a free-running pulse generator, and it produces a chain of negative-going pulses at around 55Hz. These pulses are fed to the 74121, which is arranged to produce a stable output pulse of duration determined by R3, R4 and C6. R3 is variable, so the length of the output pulse may be adjusted. This is fed to the base of TR1, which performs the required function of regularly pulling point "X" down to zero volts. The waveforms throughout the circuit are as shown in Fig. 4.

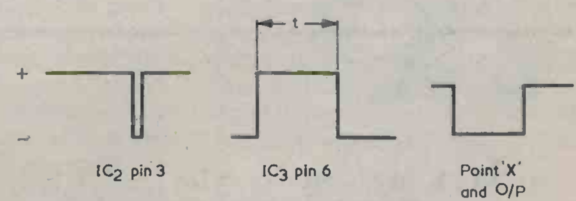
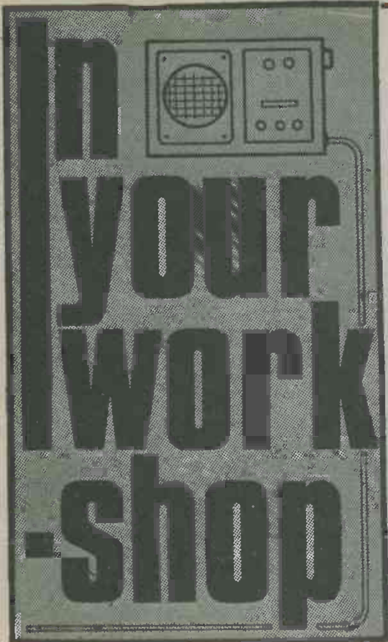


Fig. 4. The waveforms which appear in the power supply circuit. The length of t is set by R3.

The circuit can be easily modified for different output voltages by suitable adjustment of the value of RX. The maximum rated output voltage for the LM317T is 37 volts and its maximum rated output current is 1.5 amps. C8 (not shown in Fig. 3) may be added across the output terminals if required, and it reduces jerkiness at low speed with certain types of motor. Resistor R9 ensures that there is always an output load for the LM317T.

Construction can be in any form, the author using a standard diecast box. The box also provides the heat sink for the LM317T although, due to the nature of operation, little heat is dissipated. The circuit works very well with a motor of 0.5 amp rating. ■



A Session of Puzzles. No. 2.

Puzzle along with Dick and Smithy.

DICK'S BLACK BOX

Dick meditated for some moments, then purposefully picked up Smithy's pen and pulled the note-pad towards him. Quickly he sketched out a new circuit. (Fig. 7).

"This," he said confidently, "is a real stinker. I've got a completely enclosed black box with two terminals on it. One terminal connects via a 470kΩ resistor to a zero voltage d.c. supply line. Also connected to this terminal is a 0.01μF capacitor. If you connect the other terminal of the box to a d.c. supply, which can have any voltage between 150 and 300 volts, a steady oscillation at around 100Hz is given at the two points I've marked as the output."

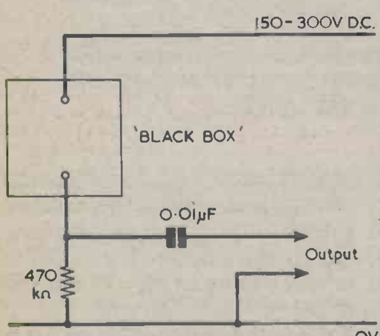


Fig. 7. Dick's black box. What are the two components inside the box which produce the mysterious 100Hz oscillation at the circuit output?

"Is the high voltage supply point positive or negative?"

"It doesn't matter," said Dick. "You get the oscillation regardless of the polarity of the d.c. supply."

"How many components are there in the box?"

"Two," replied Dick gleefully "and you've got to tell me what they are. Neither of the components is a capacitor."

"Humph," grunted Smithy. "Is a strong oscillation given at the output points?"

"Fairly strong. It has a peak-to-peak amplitude of around 4 to 6 volts and it's at high impedance."

"Blimey," said Smithy, "this really is a stinker. Is the oscillation sinusoidal?"

"Nope."

"You say that neither of the components in the box is a capacitor. Is there an inductor in the box?"

"Nope."

"Not even a relay?"

"Nope."

"Any mechanical device?"

"Nope."

"Any silicon semiconductor?"

"Nope."

"All right then," grated Smithy, "any germanium semiconductor?"

"Nope."

(Dick was right, this **is** a stinker. Can **you** guess what is in his black box?)

Dick grinned happily.

"Give up?" he asked.

"Not yet," replied Smithy slowly. "Let me think a bit. There are only two components in the box, and they aren't capacitive or inductive, and there are no mechanical devices. Also, the oscillation is given with a d.c. supply of either polarity. Now, that gives me the glimmering of an idea."

"Does it?"

"Yes it does," said Smithy. "Does this black box of yours have to be light-proof?"

"It does," confirmed Dick. "As I said at the beginning, the box is completely enclosed."

"Then," said Smithy, "I'll make a guess that one of the components in the box is a neon bulb."

"Good thinking. One of the components **is** a neon bulb. What's the other one?"

"Since one of the components is a neon bulb," stated Smithy thoughtfully, "the other component must be a photocell of some sort. I think I've got it. Would the remaining component be a light dependent resistor?"

"You've got it," said Dick. "The second component is an ORP12 photoconductive cell, or light dependent resistor. The neon bulb is one of those little wire-ended types and it's mounted so that its body is on top of the sensitive surface of

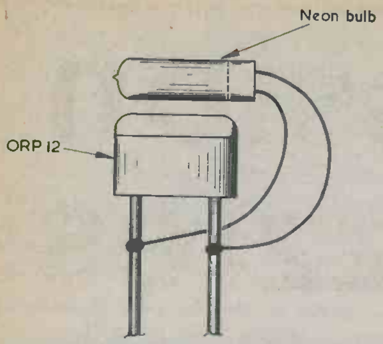


Fig. 8. A wire-ended neon bulb soldered to the leads of a photoconductive cell. (This arrangement was originally described by G. A. French in the May 1970 issue.)

the ORP12. The two components are wired in parallel and they connect to the terminals of the black box." (Fig. 8).

"That black box circuit," said Smithy thoughtfully, "will oscillate because of two effects. The first of these is that the resistance of an ORP12 alters rather slowly when the light intensity on it changes, this being particularly the case with a decrease in light intensity. The second effect is that the striking voltage for a neon is a little higher than its maintaining voltage. The resistance offered by an ORP12 in complete darkness is very high, being around 10MΩ or more, so that when the power is first applied the neon bulb strikes immediately and lights up. This causes the resistance of the ORP12 to fall to a level which takes the voltage across the neon below maintaining level, and the neon goes out. The ORP12 resistance then starts to increase relatively slowly until sufficient voltage is given across the neon for it to strike once more and illuminate the ORP12. Whereupon the ORP12 resistance decreases and another cycle starts. The frequency is controlled by the sluggishness of the ORP12 in changing its resistance value and the oscillator output voltage will be the difference between the neon striking and maintaining voltages.

"That was very good, Dick!"

"You liked it, eh?"

"I did," commended Smithy. "Where did you get the idea?"

"I was looking through some old 'Suggested Circuit' articles by that G. A. French geyser."

"Geyser?" repeated a horrified Smithy. "You really must show more respect for your elders and betters. Anyway, I've got another puzzle for you."

MURDER MYSTERY

"Okeydoke," said Dick equably, "I'm all ready for it."

Smithy drew the note-pad in front of him and tore off the top sheet. Busily he wrote on the clean surface of the sheet below. (Fig. 9).

"This has to do with a murder mystery," he said. "The police chief is investigating a murder for which there are five suspects, and he eventually interviews his favourite Supergrass. Now, that Supergrass knows very well who the murderer is but he's not going to stick his neck out and pass on the murderer's name directly. So he presents the police chief with a note on which he's written the names of the five suspects in exactly the same way as I've shown them here."

Dick looked baffled.

"If all seems very confusing to me," he said. "How can you find the murderer from that note?"

"Very easily," replied

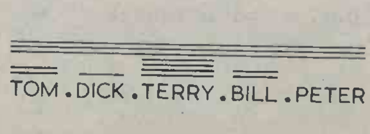


Fig. 9. Out of the five suspects listed here, one is the murderer.

Smithy. "In fact the note says precisely who the murderer is."

(Can you, dear reader, find out who of the five suspects is the murderer? This is quite a simple little puzzle to finish off with).

"Well, it doesn't tell me anything," said Dick. "What do all those lines over the names mean?"

"Do you," asked Smithy, "remember the way in which logic expressions are presented?"

"Why yes, of course I do," said Dick, "a bar over a letter in Boolean algebra means 'not', doesn't it?"

"That's right," agreed Smithy. "Also, if we infer multiplication between two letters then this means AND. On the other hand, if we put a plus sign between two letters, it represents OR. Now, do you remember the De Morgan equations?"

"I think so," said Dick uncertainly. "It's something about changing AND signs to OR signs."

"I'll write the two equations down," said Smithy. "Here they are for two letters, A and B." (Fig. 10).

"Ah yes," stated Dick. "I remember them now. On the left hand side of the equation there's one long bar over all the letters, and on the right side there are individual bars over each letter. If the letters are linked with AND's on the left they're linked with OR's on the right, and vice versa."

"You've got it," said Smithy. "One final point is that the two equations can be extended to any number of terms, as required."

"Are you saying we can use one of the De Morgan equations to sort out this note about the murderer?"

"I am."

$$\overline{A + B} = \bar{A} . \bar{B}$$

$$\overline{A . B} = \bar{A} + \bar{B}$$

Fig. 10. The two De Morgan equations. These can be expanded to any number of terms.

"But there isn't one bar over all the names, there's three!"

"I know. What you have to remember next is that if you have one bar over another bar the two cancel out, because there's a double inversion. So we can start off by taking away two of the three long bars, and leave only one bar over all the names."

Smithy wrote out the new expression. (Fig. 11(a).).

"That looks," said Dick, "as though we can do a De Morgan on it."

"We can," agreed Smithy. "What we have to do is add another bar over each name, and we put plus signs between them to represent OR. Here's what we get."

Smithy's pen moved busily again. (Fig. 11(b).).

$$\overline{\overline{\overline{TOM}} . \overline{DICK} . \overline{\overline{\overline{\overline{TERRY}}}} . \overline{\overline{BILL}} . PETER}$$

(a)

$$\overline{\overline{\overline{TOM}}} + \overline{\overline{DICK}} + \overline{\overline{\overline{\overline{\overline{TERRY}}}}} + \overline{\overline{\overline{BILL}}} + \overline{PETER}$$

(b)

$$\overline{TOM} + DICK + \overline{TERRY} + \overline{BILL} + \overline{PETER}$$

(c)

Fig. 11(a). First step in simplifying the murder suspect note.
(b). De Morgan intervenes.
(c). The final form of the suspect note.

"Now we're getting closer to the final answer," he went on. "Two of the names have three bars over them, so two of those three cancel out to leave one bar. One name has no less than five bars over it so four bars, or two pairs of bars, cancel out. And another name has only two bars above it, and these similarly cancel out. Which brings us to the final result."

Carefully, Smithy wrote the final expression. (Fig. 11(c).).

"Let's read that out," said Dick excitedly. "The murderer is not-Tom OR Dick OR not-Terry OR not-Bill OR not-Peter."

"Which means," said Smithy, "that the murderer must be Dick. The overall statement says that there are five alternatives as to who the murderer is. The first of these alternatives is that the murderer is not-Tom. The third alternative is not-Terry, the fourth is not-Bill and the fifth is not-Peter. The second alternative is Dick, and so Dick has to be the murderer."

PUZZLING OVER

"I don't know whether I should be annoyed or flattered over you choosing my name for the murderer," grinned Dick. "At any event this has been quite an interesting little session."

"A bit of a change from servicing?"

"Definitely."

"What I always say is that there's nothing like the odd puzzle to pass away the time and sharpen up the wits. What do you always say?"

"I always say," said Dick, "the same thing that you always say." ■

TRADE NEWS

PROFESSIONAL-GRADE HF DFC BREAKS COST BARRIER

High-quality 8-digit frequency counters for sine or square wave inputs from B. Davis Electronics, of Brett Drive, Bexhill-on-Sea, Sussex, start at only £116 for a 60MHz instrument with a resolution down to 10Hz.

An integral x10 prescaler/amplifier widens the range to 600 MHz and a crystal oven increases initial accuracy from ±1 ppm to ±0.2 as well as making readings practically independent of ambient temperature. Both options can be factory retrofitted. The 8-digit display is by seven-segment ½ in. LEDs using the latest reflector technology for utmost clarity.

Power requirements are ac mains or 9-16V dc. For bench use, tilt legs are provided and a carrying case is also available.

Davis 600 MHz digital frequency counter in carrying case.

ADVANCED VIDEO TECHNOLOGY AT LOW PRICE

In launching their new video recorder, model VT 8000, Hitachi have combined to offer the consumer, an entirely newly designed VHS unit embodying a wealth of advanced video technology but at a price to appeal to the first time buyer, this model retailing with VAT at only £549.

The VT 8000 has a timer which can be set to record any programme up to 10 days in advance and has an AM/PM 12 hour digital clock on the front of the recorder. The motor drive system of the VT 8000 which would normally occupy a large part of the VTR mechanism has been much reduced by incorporating a direct drive capstan with a built in motor to reduce space requirements. The motor has a special IC incorporated in the drive circuit which precisely controls motor speed accurately to the signal from the motor's built in frequency generator. The flywheel has been eliminated and its function is now performed by the rotor. The cylinder of the VT 8000 employs a built in direct drive motor system to effect compactness and lightness and to obtain rotational accuracy.

The VT 8000 comes complete with an aerial RF cable, remote control unit, 180 video tape and a protective dust cover.

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SMALL ADVERTISEMENTS

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(Continued from page 573)

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DIGITAL AUDIO

A typical audio signal voltage waveform is shown in (a), and in (b) its amplitude is sampled at a fixed frequency by an analogue-to-digital converter (a.d.c.), which assesses the height of the waveform at the sampling points against a scale calibrated from zero to 8,192. The a.d.c. generates a series of pulses in binary form (pulse present for 1, pulse absent for 0) which corresponds to the height of the audio signal at each instant of sampling. 8,192 is 2 to the power of 13, so each sampling word comprises 13 bits.

The sampling and assessing process is known as quantising and the conversion of the analogue signal to its digital equivalent as pulse code modulation (p.c.m.). The p.c.m. signal can be broadcast, or recorded on disc or tape. At the reproducing end it is fed to a digital-to-analogue converter (d.a.c.) and thence to the loudspeaker, as in (c).

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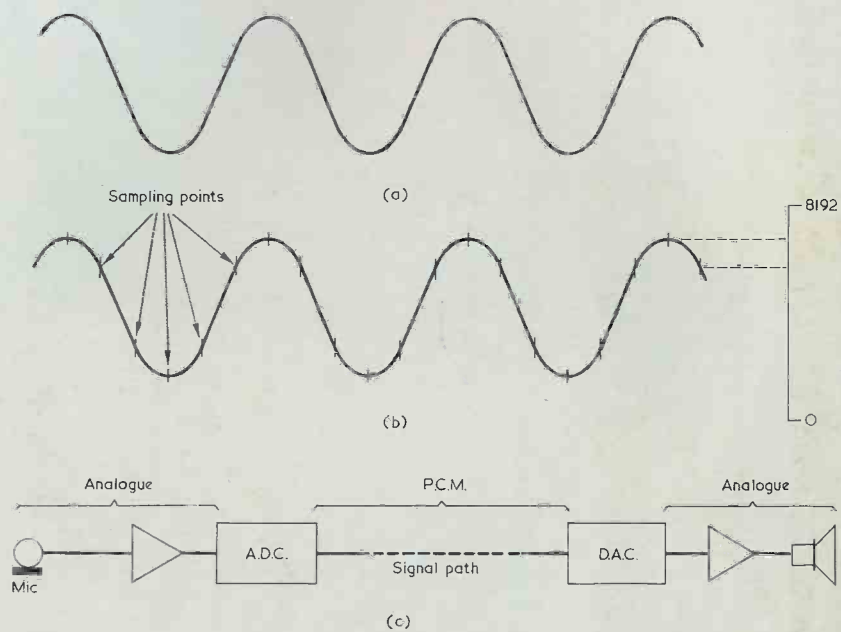

(a) (b) (c)

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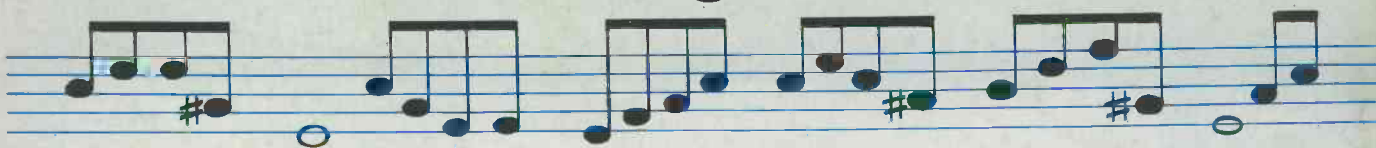

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