In the home projects for everyone

Everyday ELECTRONICS

APRIL 81

60p

Australia $1·00 New Zealand $1·10 Malaysia $4·50

AND THERE'S MORE WHERE THIS CAME FROM

It's a long time since one of our adverts was presented in 'list' form - but simply because we do not try to squeeze this lot in every time doesn't mean that it's not available. Our new style price list (now some 40 pages long) includes all this and more, including quantity prices and a brief description. The kits, modules and specialized RF components - such as TOKO coils, filters etc. are covered in the general price list - so send now for a free copy (with an SAE please). Part 4 of the catalogue is due out now (incorporating a revised version of pt.1).

LINEAR ICs - NUMERIC LISTINGS

TBA120S	1.00	KB4413	1.95
L200	1.95	KB4417	1.80
U237B	1.28	TDA4420	2.25
U247B	1.28	KB4420B	1.09
U257B	1.28	KB4423	2.30
U267B	1.28	KB4424	1.65
LM301H	0.67	KB4431	1.95
LM301N	0.30	KB4432	1.95
LM308H	0.96	KB4433	1.52
LM308N	0.65	KB4436	2.53
LM339N	0.66	KB4437	1.75
LM348N	1.86	KB4438	2.22
LF351N	0.38	KB4441	1.35
LF353N	0.76	KB4445	1.29
LM374N	3.75	KB4446	2.75
LM380N-14	1.00	KB4448	1.65
LM380N-8	1.00	NE5044N	2.26
LM381N	1.81	NE5532N	1.85
ZN419CE	1.95	SD6000	3.75
NE544N	1.80	SL6270	2.03
NE555N	0.30	SL6310	2.03
NE556N	0.50	SL6600	3.75
NE560N	3.50	SL6640	2.75
NE562N	4.05	SL6690	3.20
NE564N	4.29	SL6700	2.35
NE565N	1.00	ICL8038CC	4.50
NE566N	1.60	MSL9362	1.75
NE570N	3.85	MSL9363	1.75
SL624	3.28	HA11211	1.95
TBA651	1.81	HA11223	2.15
uA709HC	0.64	HA11225	1.45
uA709PC	0.36	HA12002	1.45
uA710HC	0.65	HA12017	0.80
uA710PC	0.59	HA12402	1.95
uA741CH	0.66	HA12411	1.20
uA741CN	0.27	HA12412	1.55
uA747CN	0.70	LF13741	0.33
uA748CN	0.36	SN76660N	0.80
uA753	2.44		
uA758	2.35		
TBA810AS	1.09		
TBA820M	0.75		
TCA940E	1.80		
TDA1028	2.11		
TDA1029	2.11		
TDA1054	1.45		
TDA1062	1.95		
TDA1072	2.69		
TDA1074A	5.04		
TDA1083	1.95		
TDA1090	3.05		
HA1137	1.20		
HA1196	2.00		
HA1197	1.00		
TDA1220	1.40		
LM1303	0.99		
LM1307	1.55		
MC1310P	1.90		
MC1330	1.20		
MC1350	1.20		
HA1370	1.90		
HA1388	2.75		
TDA1490	1.86		
MC1496P	1.25		
SL1610P	1.60		
SL1611P	1.60		
SL1612P	1.60		
SL1613P	1.89		
SL1620P	2.17		
SL1621P	2.17		
SL1623P	2.24		
SL624C	3.28		
SL1625P	2.17		
SL1626P	2.44		
SL1630P	1.62		
SL1640P	1.89		
SL1641P	1.89		
TDA2002	1.25		
TDA2020	3.00		
ULN2242A	3.05		
ULN2283B	1.00		
CA3080E	0.70		
CA3089E	1.84		
CA3090AQ	3.35		
CA3123E	1.40		
CA3130E	0.80		
CA3130T	0.90		
CA3140E	0.46		
CA3189E	2.20		
MC3357P	2.35		
LM3900N	0.60		
LM3909N	0.68		
LM3914N	2.80		
LM3915N	2.80		
KB4400	0.80		
KB4406	0.60		
KB4412	1.95		

FREQUENCY DISPLAY & SYNTHESISER ICs

SAA1056	3.75
SAA1058	3.35
SAA1059	3.35
11C90DC	14.00
LM1232	19.00
LM1242	19.00
MSL2318	3.84
MSM5523	11.30
MSM5524	11.30
MSM5525	7.85
MSM5526	7.85
MSM5527	9.75
MSM55271	9.75
ICM7106CP	9.55
ICM7107CP	9.55
ICM7216B	19.25
ICM7217A	9.50
SP8629	3.85
SP8647	6.00
95H90PC	6.00
HD10551	2.45
HD44015	4.45
HD12009	6.00
HD44752	8.00

CMOS 4000 SERIES

4001	0.17	4043	0.85
4000	0.17	4044	0.80
4002	0.23	4046	1.30
4008	0.80	4047	0.99
4009	0.58	4049	0.52
4010B	0.58	4050	0.55
4011AE	0.20	4051	0.65
4011B	0.20	4052	0.65
4012	0.55	4053	0.65
4013	0.55	4063	1.09
4015	0.95	4066	0.56
4016	0.52	4068	0.25
4017	0.80	4069	0.20
4019	0.60	4070	0.20
4020B	0.93	4071	0.20
4021	0.82	4072	0.20
4022	0.90	4073	0.20
4023	0.17	4075	0.20
4024	0.76	4076	0.90
4025	0.17	4077	0.20
4026	1.80	4078	0.20
4028	0.72	4082	0.20
4029	1.00	4093	0.78
4030	0.58	4175	0.95
4035	1.20	4503	0.69
4040	0.83	4506	0.51
4042	0.85	4510	0.99
		4511	1.49
		4512	0.98
		4514	2.55
		4518	1.03
		4520	1.09
		4521	2.36
		4522	1.49
		4529	1.41
		4539	1.10
		4549	3.50
		4554	1.53
		4560	2.18
		4566	1.59
		4568	2.18
		4569	3.03
		4572	0.30
		4585	1.10

TTL N and LSN

		7443N	1.15	74LS112	0.38	74LS169	2.00
		7444N	1.12	74LS113	0.38	74170N	2.30
7400N	0.13	7445N	0.94	74LS114	0.38	74LS170	2.00
74LS00	0.20	7446N	0.94	74118N	0.83	74LS174	1.20
7401N	0.13	74LS47	0.89	74120N	1.15	74175N	0.87
74LS01	0.20	7448N	0.56	74121N	0.42	74LS175	1.10
7402N	0.14	74LS48	0.99	74122N	0.46	74176N	0.75
74LS02	0.20	74LS49	0.99	74123N	0.73	74177N	0.78
7403N	0.14	7451N	0.17	74LS124	1.75	74181N	1.65
74LS03	0.20	74LS51	0.24	74125N	0.38	74LS181	3.50
7404N	0.14	7453N	0.17	74LS125	0.44	74LS183	2.10
74LS04	0.24	7454N	0.17	74126N	0.57	74184N	1.35
7405N	0.18	74LS54	0.24	74LS126	0.44	74185N	1.34
74LS05	0.26	74LS55	0.24	74128N	0.74	74LS190	0.92
7406N	0.28	7460N	0.17	74132N	0.73	74192N	1.05
7407N	0.38	74LS63	1.24	74LS132	0.78	74LS192	1.80
7408N	0.17	7470N	0.28	74LS136	0.40	74193N	1.05
74LS08	0.24	7472N	0.28	74LS138	0.60	74LS193	1.80
7409N	0.17	7473N	0.32	74141N	0.56	74194N	1.05
74LS09	0.24	74LS73	0.38	74142N	2.65	74196N	0.99
7410N	0.15	7474N	0.27	74143N	3.12	74LS196	1.10
74LS10	0.24	74LS74	0.28	74144N	3.12	74LS197	1.10
7411N	0.20	7475N	0.38	74LS145	0.97	74198N	1.50
74LS11	0.24	7476N	0.37	74147N	1.75	74199N	1.60
7412N	0.17	74LS76	0.38	74148N	1.09	74LS247	0.93
7413N	0.30	74LS78	0.38	74LS148	1.19	74LS257	1.08
7414N	0.51	7480N	0.48	74150N	0.99	74LS260	1.53
74LS15	0.24	7481N	0.86	74151N	0.55	74LS279	0.52
7416N	0.30	7482N	0.69	74LS151	0.84	74LS283	1.20
7417N	0.30	7485N	1.04	74153N	0.64	74LS293	0.95
7420N	0.16	74LS85	0.99	74LS153	0.54	74LS365	0.49
74LS20	0.24	74LS86	0.40	74154N	0.96	74LS366	0.49
7421N	0.29	7489N	2.05	74155N	0.54	74LS367	0.43
74LS21	0.24	7490N	0.33	74LS155	1.10	74LS368	0.49
7423N	0.27	74LS90	0.90	74156N	0.80	74LS374	1.80
7425N	0.27	7491N	0.76	74157N	0.67	74LS377	1.95
7427N	0.27	74LS91	1.10	74LS157	0.55	74LS379	1.30
74LS27	0.44	7492N	0.38	74LS158	0.60	74LS393	1.40
7428N	0.35	74LS92	0.78	74159N	2.10		
74LS28	0.32	7493N	0.32	74160N	0.82		
7430N	0.17	74LS93	0.99	74LS160	1.30		
74LS30	0.24	7494N	0.78	74161N	0.92		
7432N	0.25	7495N	0.65	74LS161	0.78		
74LS32	0.24	74LS95	1.14	74LS162	1.30		
7437N	0.40	7496N	0.58	74163N	0.92		
7438N	0.33	74LS96	1.20	74LS163	0.78		
74LS38	0.24	7497N	1.85	74164N	1.04		
7440N	0.17	74LS107	0.38	74LS164	1.30		
74LS40	0.24	74109N	0.63	74165N	1.05		
7441N	0.74	74LS109	0.70	74LS165	1.04		
7442N	0.70	74110N	0.54	74167N	2.50		
74LS42	0.99	74111N	0.68				

VOLTAGE REGULATORS

78series	0.95
79series	1.00
78Mseries	0.65
78Lseries	0.35
79L05	0.85
78MGT2C	1.75
79MGT2C	1.75
723CN	0.65
L200	1.95
TDA1412	0.75
NE5553N	1.25
LM317MP	1.48
LM337MP	1.48

MICROMARKET

8080A/2	7.50
8212	2.30
8214	3.50
8216	1.95
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	7.50
2114	6.50
4027	5.78
2102	1.70
2112	3.40
2513	7.54
HM4716	4.50
81LS97	1.25

CRYSTAL FILTER PRODUCTS

10.7MHZ 2 POLE TYPES:	
10M15A 15KHZ BW	2.49
10.7MHZ 8 POLE TYPES:	
10M4B1 15kHz BW	14.50
H4402 7.5KHZ BW	15.50
10M22D 2.4KHZ SSB	17.20
HF FIRST FILTER:	
B34F8A 34.5MHz HF	32.00

RADIO CONTROL CRYSTALS

(No splits available)

AM TX:-	
3rd OT 30pF HC25U	1.65
AM/FM RX:-	
3rd OT 30pF HC25U	1.65
FM TX :-	
Fund 20pF HC25U	1.85
Pairs FM	3.25
Pairs AM	3.10

CRYSTALS

32.768 kHz	2.70
100kHZ	3.85
455kHZ	5.00
1.0MHz	3.00
3.2768MHz	2.70
4.000MHz	2.00
4.19439MHz	2.30
6.5536MHz	2.10
10.0MHz	2.50
10.6985MHz	2.50
10.7015MHz	2.50
10.245MHz	2.50
10.7MHz	3.00
11.52MHz	2.50
100MHz	3.00

TOKO COILS AND FILTERS
SEE THE EXTENSIVE SECTION IN OUR NEW PRICE LISTS AND CATALOGUE

LF/HF FIXED INDUCTORS –FULL E12 RANGE

7BA series 1uH-1mH	0.16
8RB series	
100uH-33mH	0.19
10RB series	
33mH-120mH	0.33
10RBH series	
120mH-1.5H	0.55
PIEZO SOUNDER	
PB2720	0.44

LEDs

5MM RED	0.12
3MM RED CLEAR	0.15
3MM RED	0.15
2.5 X 5MM RED	0.17
5MM GREEN	0.15
3MM GN CLEAR	0.16
3MM GREEN	0.16
2.5 X 5MM GN	0.20
5MM YELLOW	0.15
3MM YELLOW CL	0.16
3MM YELLOW	0.18
2.5 X 5MM YE	0.20
5MM ORANGERED	0.20
5MM ORA CL	0.29
3MM ORANGERED	0.19
2.5 X 5MM ORA	0.24
5MM INFRA RED	0.56
BPW41 IR DET	1.51
IR OPT CPLR	1.44
5MM CLIP	0.04

LCDs

3.5 digit	9.45
4 digit	8.95
5 digit	8.95

SCHOTTKY DIODE BAL MIXERS (SBL1=MD108)

SBL1 1-500MHz	4.25
SBL1-8 .1-200MHz	4.55
SBL1-X 10-1000MHZ	5.75
SRA1 .5-500MHz	8.45
SRA1-1 .1-500MHz	9.25
SRA1H .5-500MHz	13.35
SRA3 .025-200MHz	10.25

VARICAP TUNING DIODES

BA102	0.30
BA121	0.30
ITT210	0.30
BB204B	0.36
BB105B	0.36
BB109	0.27
MVM125	1.05
BB212	1.95
KV1210	2.45
KV1211	1.75
KV1226	1.95
KV1225	2.75
KV1215	2.55
KV1225	2.75

SWITCHING AND PIN DIODES SHOTTKY DIODES

1N6263	0.62
BA182	0.19
BA244	0.17
BA379	0.35
TDA1061	0.95

SIGNAL DIODES & RECTIFIERS

1N4148	0.06
1N4001	0.06
1N4002	0.07
1N5402	0.15
OA91	0.07
AA112	0.25
BRIDGES:	
1A/50V	0.35
6A/200V	0.75

TRANSISTORS AUDIO DEVICES

BC237	0.08
BC238	0.08
BC239	0.08
BC307	0.08
BC308	0.08
BC309	0.08
BC413	0.10
BC414	0.11
BC415	0.07
BC416	0.08
BC546	0.12
BC556	0.12
BC550	0.12
BC560	0.12
BC639	0.22
BC640	0.23
2SC1775	0.18
2SA872A	0.14
2SD666A	0.30
2SB646A	0.30
2SD668A	0.40
2SB648A	0.40
2SD760	0.45
2SB720	0.45
2SC2546	0.19
2SA1084	0.20
2SC2547	0.19
2SA1085	0.20

AUDIO POWER DEVICES

2SB753	2.34
2SB723	2.34
2SK133	3.00
2SJ 48	3.00
2SK134	3.10
2SK135	3.75
2SJ 50	3.75
BD535	0.52
BD536	0.52
BD377	0.33
BD378	0.33
BD165	0.30
BD166	0.31

SMALL SIGNAL RF DEVICES

BF194	0.18
BF195	0.18
BF224	0.22
BF241	0.18
BF274	0.18
BF440	0.21
BF441	0.21
BF362	0.49
BF395	0.18
BF479	0.66
BF679S	0.55
BFR91	1.33
BFW92	0.60
BFT95	0.99
BFY90	0.90
40238	0.85

RF POWER DEVICES

VN66AF	0.95
2N3866	0.85

SMALL SIGNAL RF FET/MOSFET

BF256	0.38
2SK55	0.28
2SK168	0.35
J310	0.69
J176	0.65
40823	0.65
40673	3SK51
3SK45	0.49
3SK51	0.54
3SK60	0.58
MEM680	0.75
BF961	0.70
BF960	1.24
3SK48	1.64

LCD Module

CM161.
Miniature clock, 12/24 hr., alarm, day, date, backlight.
All for.....9.95

CAPACITORS
All 5mm or less spacing

CERAMIC 50v
2P2,3P3,4P7,6P8
8P2,10P,15P,18P..0.04
22P,27P,33P,47P
56P,68P,82P,100P.0.05
150P,220P,270P
330P,390P,470P...0.055
1N0,2N2,3N3,4N7..0.06
10N (0.01uF)....0.05
22N,47N..........0.06
100N,220N........0.09
MONOLITHIC CERAMIC
10N,100N.........0.16

FEEDTHRU
1N0 SOLDER IN....0.09

POLYESTER (SIEMENS)
10mm LEAD SPACING
10N,22N,33N......0.17
47N,68N,100N.....0.19
220N,470N........0.22
1uF..............0.29

POLYESTER (GENERAL)
10mm LEAD SPACING
10N,15N,22N,33N..0.06
47N,68N,100N.....0.08
220N.............0.11
20mm LEAD SPACING
220N,330N,470N...0.18

MYLAR
5mm LEAD SPACING
1N0,10N,22N,33N..0.08
100N.............0.09
20mm LEAD SPACING
220N,470N....... 0.17

POLYSTYRENE
10P,15P,18P,22P,
27P,47P,56P,68P..0.08
100P,180P,220P,
270P,330P,390P...0.09
470P,680P,820P...0.10
1N0,1N2,1N5,1N8..0.11
2N2,2N7,3N3,3N9..0.12
4N7,5N6,6N8,10N..0.13

TANTALUM BEAD CAPS
16v: 0.22,0.33,
0.68,1.0.........0.18
16v: 2.2,4.7,10..0.19
6v3: 22,47.......0.30
10v: 22,100......0.35

ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT)

(uF/voltage)
1/63,2.2/50,4.7/35
10/16,15/16,22/10
33/6.3...........0.08
22/16,33/10,
47/10............0.09
10/63,22/50,33/50,
47/16,100/16.....0.10
47/63,100/25,220/16
470/6.3..........0.12
100/63,470/16,
1000/10..........0.18
1000/16,470/63...0.23
1000/63,2200/16..0.30
3300/25..........0.69
1000/100.........0.88
10000/70.........3.00

AXIAL (HORIZ. MOUNT)
1/25,4.7/16,6.4/25
10/16............0.08
4.7/63,22/10,22/16
33/16............0.09
47/25,100/16.....0.10
100/25...........0.11
1000/16..........0.25
2200/16,1000/25..0.36
1000/35,4700/16..0.45
1000/50..........0.58

RESISTORS

0.25W, 5% E12 CARBON
1ohm-10M.........0.02
0.25W 1% E12 METAL FILM
1.1ohm-1M........0.05

HORIZ CARBON PRESETS
10mm TYPE
100ohms-2M5......0.12
HORIZ CERMET PRESETS
1k, 10k..........0.27

PRICES EXCLUDE VAT - PLEASE ADD 15%*
Postage 35p per order. CWO please. (*UK only)

CWO PLEASE : Commercial MA terms on application. Goods are offered subject to availability, prices subject to change - so please phone and check if in doubt.

Please send an SAE with all enquiries.
Access/Barclaycd (min £5 please)
Callers welcome

ambit INTERNATIONAL

200 North Service Road, Brentwood, Essex

TELEPHONE (STD 0277) 230909 TELEX 995194 AMBIT G POSTCODE CM14 4SG

CATALOGUES
2 & 3....60p ea
4...........75p
(4 inc. rev. of part 1)
ALL PARTS :
.......£1.75......

BI-PAK NEW EXTENDED 1981 RANGE

TRANSISTORS

AC107	25
AC125	30
AC126	22
AC127	22
AC128	20
AC12BK	37
AC132	26
AC141	26
AC141K	40
AC142	26
AC142K	40
AC176	24
AC176K	40
AC187	25
AC187K	40
AC188	25
AC188K	40
ACY17	50
ACY18	50
ACY19	50
ACY20	50
ACY21	50
ACY22	50
AD130	75
AD140	70
AD142	85
AD143	85
AD149	70
AD161	40
AD162	40
AD161/162 M/P	80
AF114	50
AF115	50
AF116	50
AF117	50
AF118	65
AF124	50
AF125	50
AF126	50
AF127	50
AF139	38
AF239	42
AL102	1.90
AL103	1.80
ASY26	50
ASY27	50
ASY28	50
ASY29	50
AU104	1.90
AU110	1.90
AU113	1.90
BC107	10
BC107A	11
BC107B	11
BC107C	12
BC108	10
BC108A	11
BC108B	11
BC108C	12
BC109	10
BC109A	11
BC109B	11
BC109C	12
BC113	16
BC114	17
8C115	18
BC116	19
BC116A	20
BC117	20
BC118	17
BC119	29
BC120	35
BC125	25
BC126	30
BC132	18
BC134	18
BC135	18
BC136	20
BC137	20
BC138	28
BC139	32
BC140	25
BC141	28
BC142	25
BC143	25
BC144	40
BC145	46
BC147	09
BC148	09
BC149	09
BC150	20
8C151	22
BC152	20
8C153	25
BC154	19
BC157	10
BC158	10
BC159	10
BC160	26
BC161	38
BC167	11
BC168	10
8C169	10
BC169C	11
BC170	09
8C171	09
BC172	09
BC173	09
BC174	15
BC175	35
BC177	14
BC178	14
BC179	14
BC180	12
BC181	10
BC182	10
BC182L	10
BC183	10
BC183L	10
BC184	10
BC184L	10
BC186	15
BC187	18
BC207	11
BC208	11
BC209	12
BC212	10
BC212L	10
BC213	10
BC213L	10
BC214	10
BC214L	10
BC225	26
BC226	36
BC237	13
BC238	14
BC239	15
BC251	15
BC251A	16
BC261	18
BC300	30
BC301	28
BC302	29
8C303	28
BC304	28
BC307	13
BC327	12
BC328	13
BC337	13
BC338	13
BC384	14
BC440	30
BC441	30
BC460	32
BC461	32
BC477	20
BC478	20
BC479	20
BC546	10
BC547	10
8C548	10
BC549	11
BC550	14
BC556	14
BC557	13
BC558	13
BC559	14
BCY30	80
BCY31	80
BCY32	85
BCY33	80
BCY34	80
BCY70	14
BCY71	15
BCY72	15
BCZ10	70
BCZ11	70
BCZ12	70
BD106	50
BD115	50
BD116	50
BD121	65
BD123	65
BD124	75
BD131	35
BD132	35
BD131/132 M/P	80
BD133	40
BD135	35
BD136	35
BD137	35
BD138	36
BD139	38
BD140	38
BD139/140 M/P	80
BD155	50
8D175	60
BD176	60
BD177	68
BD178	68
BD179	75
BD180	75
BD185	68
BD186	68
BD187	75
BD188	75
BD189	78
BD190	78
BD195	90
BD196	90
BD197	95
BD198	95
BD199	99
BD200	99
BD201	80
BD202	80
BD201/202 M/P	1.70
BD203	80
BD204	80
BD203/204 M/P	1.70
BD205	80
BD206	80
BD207	80
BD208	80
BD222	47
BD225	47
BD232	85
BD233	65
BD234	55
BD235	55
BD236	58
BD237	65
BD238	65
BD239A	50
BD240A	50
BD239A/240A	1.00
BD240	45
BD241	45
BD506	38
BD508	38
BDX32	2.20
BDY11	1.30
BDY17	1.80
BDY20	80
BDY55	1.40
BDY56	1.60
8F115	25
BF117	50
BF118	75
BF119	75
BF121	50
BF123	60
BF125	50
BF127	60
BF152	25
BF153	25
BF154	22
BF155	35
BF156	28
BF157	28
BF158	28
BF159	28
BF160	28
BF162	24
BF163	30
BF164	50
BF165	50
BF167	24
BF173	24
BF176	36
BF177	24
BF178	25
BF179	30
BF180	30
BF181	30
BF182	30
BF183	30
BF184	22
BF185	22
BF186	26
BF187	26
BF188	32
BF194	10
BF195	10
BF196	12
BF197	12
BF198	15
BF199	16
BF200	30
BF222	90
8F224	20
BF240	17
BF241	18
BF244	28
BF257	30
BF258	30
BF259	35
BF262	60
BF263	60
BF270	36
BF271	31
BF273	36
BF274	38
BF324	35
BF336	34
BF337	34
8F338	38
BF371	26
BF457	37
BF458	37
BF459	38
BF594	30
8F595	28
8F596	28
BFR39	24
BFR40	25
BFR42	25
BFR50	25
BFR52	25
BFR62	24
BFR79	28
BFR80	28
BFW10	55
BFX29	25
BFX30	30
BFX84	24
BFX85	26
BFX86	26
BFX87	26
BFX88	26
BFX90	55
BFY50	20
BFY51	20
BFY52	20
BFY53	20
BFY90	80
BIP19	38
8IP20	38
BIP19/20 M/P	80
BRY39	39
BSX19	20
BSX20	20
BSX21	21
BSY95	13
BSY95A	13
BU105	1.60
BU105/02	1.95
BU204	1.40
BU205	1.40
BU208	1.90
BU208/02	2.25
GP300	40
MJ480	95
MJ481	1.05
MJ490	95
MJ491	1.15
MJ2955	90
MJE340	50
MJE370	55
MJE371	60
MJE520	45
MJE521	65
MJE2955	90
MJE3055	65
MJE3440	52
MP8113	52
MPF102	60
MPF104	35
MPF105	35
MPSA05	20
MPSA06	20
MPSA55	20
MPSA56	20
ND120	18
OC19	85
OC20	1.85
OC22	1.50
OC23	1.50
OC24	1.35
OC25	1.00
OC26	1.00
OC28	90
OC29	95
OC35	90
OC36	90
OC41	20
OC42	22
OC44	24
OC45	20
OC70	24
OC71	15
OC72	24
OC74	26
OC75	30
OC76	35
OC77	50
OC79	40
OC81	22
OC81D	24
OC82	24
OC82D	30
OC83	26
OC84	38
OC139	80
OC140	80
OC169	80
OC170	80
OC171	80
OC200	46
OC201	95
OC202	1.20
OC203	85
OC204	90
OC205	1.15
R2008B	2.50
R2010B	2.60
TIC44	29
TIC45	35
TIP29	30
TIP29A	55
TIP29B	42
TIP29C	44
TIP30	38
TIP30A	40
TIP30B	42
TIP30C	44
TIP31	38
TIP31A	40
TIP31B	42
TIP31C	44
TIP32	38
TIP32A	40
TIP32B	42
TIP32C	44
TIP41A	44
TIP418	46
TIP41C	48
TIP42A	44
TIP42B	46
TIP42C	48
TIP2955	60
TIP3055	50
TIS43	22
TIS90	20
TIS91	22
TIS92	22
UT46	20
ZTX107	10
ZTX108	10
ZTX109	10
ZTX300	12
ZTX301	12
ZTX302	16
ZTX303	16
ZTX304	20
ZTX330	15
ZTX500	13
ZTX501	12
ZTX502	16
ZTX503	12
ZTX504	25
ZTX531	25
ZTX550	25
2N388	36
2N388A	56
2N404	20
2N404A	24
2N524	40
2N527	50
2N598	40
2N599	46
2N696	24
2N697	24
2N698	30
2N699	32
2N706	10
2N706A	12
2N707	48
2N708	14
2N711	30
2N717	30
2N718	25
2N718A	50
2N726	29
2N727	29
2N743	20
2N744	20
2N914	20
2N918	30
2N929	20
2N930	18
2N946	40
2N1131	24
2N1132	24
2N1302	25
2N1303	28
2N1304	28
2N1305	28
2N1306	35
2N1307	35
2N1308	40
2N1309	40
2N1599	35
2N1613	28
2N1711	30
2N1889	45
2N1890	45
2N1893	40
2N2147	75
2N2148	70
2N2192	38
2N2193	38
2N2194	38
2N2217	25
2N2218	25
2N2218A	28
2N2219	28
2N2219A	30
2N2220	20
2N2221	20
2N221A	22
2N2222	20
2N2222A	20
2N2368	18
2N2369	14
2N2369A	14
2N2411	25
2N2412	25
2N2646	47
2N2711	22
2N2712	22
2N2714	22
2N2904	24
2N2904A	26
2N2905	24
2N2905A	26
2N2906	18
2N2906A	20
2N2907	20
2N2907A	22
2N2923	15
2N2924	15
2N2925	15
2N2926G	10
2N2926Y	09
2N29260	09
2N2926R	09
2N2926B	09
2N3010	20
2N3011	20
2N3053	22
2N3054	45
2N3055	42
2N3402	21
2N3403	21
2N3404	29
2N3405	42
2N3414	16
2N3415	16
2N3416	29
2N3417	29
2N3614	1.00
2N3615	1.05
2N3616	1.05
2N3646	09
2N3702	09
2N3703	09
2N3704	09
2N3705	09
2N3706	10
2N3707	10
2N3708	09
2N3708A	09
2N3709	09
2N3710	10
2N3711	10
2N3771	1.40
2N3772	1.60
2N3773	2.20
2N3819 (FET)	18
2N3820 (FET)	35
2N3821 (FET)	60
2N3823 (FET)	60
2N3903	12
2N3904	12
2N3905	12
2N3906	12
2N4058	12
2N4059	14
2N4060	14
2N4061	12
2N4062	12
2N4220 (FET)	35
2N4284	28
2N4285	28
2N4286	28
2N4287	28
2N4288	28
2N4289	28
2N4290	28
2N4291	28
2N4292	28
2N4293	28
2N4860 (FET)	60
2N4923	65
2N5135	10
2N5138	10
2N5172	14
2N5194	56
2N5245	40
2N5294	50
2N5296	50
2N5448	12
2N5457 (FET)	32
2N5458 (FET)	32
2N5459 (FET)	35
2N5551	36
2N6027 (P.U.T.)	34
2N6121	70
2N6122	70
2N6289	70
2S301	50
2S302	43
2S302A	43
2S303	56
2S304	71
2S305	80
2S306	80
2S307	80

DIODES

AA119	08
AA120	08
AA129	09
AAY30	09
AAZ13	15
AAZ17	15
BA100	10
BA102	20
BA144	09
8A148	15
BA154	12
BA155	14
BA156	14
BA173	15
BA248	16
B8104	30
BAX13	07
BAX16	08
BY100	22
BY101	22
BY105	22
BY114	22
BY124	22
BY126	11
BY127	12
BY128	16
BY130	17
BY133	21
BY156	08
BY164	51
BY176	75
BY206	30
BY210/600	09
BYZ10	45
BYZ11	45
BYZ12	40
BYZ13	40
BYZ16	41
BYZ17	36
BYZ18	36
BYZ19	36
OA5	60
OA10	35
DA47	08
OA70	08
OA79	10
OA81	10
OA85	10
OA90	07
OA91	07
OA95	07
OA182	13
OA200	08
OA202	08
IN34A	07
IN60	06
IN914	04
IN916	05
IN4148	04
IS44	05

74 SERIES TTL

7400	14
7401	12
7402	12
7403	12
7404	13
7405	13
7406	28
7407	28
7408	20
7409	20
7410	13
7411	20
7412	22
7413	30
7414	50
7416	28
7417	28
7420	14
7421	32
7422	24
7423	28
7425	28
7426	30
7427	28
7428	34
7430	14
7432	28
7433	36
7437	30
7438	30
7440	15
7441	60
7442	60
7443	1.00
7444	1.00
7445	90
7446	90
7447	65
7448	65
7450	15
7451	15
7452	15
7453	15
7454	15
7460	15
7470	32
7472	28
7473	32
7474	30
7475	44
7476	35
7480	48
7481	95
7482	70
7483	68
7484	95
7485	95
7486	28
7489	1.95
7490	36
7491	75
7492	50
7493	36
7494	75
7495	65
7496	65
74100	1.10
74104	50
74105	50
74107	32
74110	46
74111	60
74118	95
74119	1.20
74121	36
74122	46
74123	60
74124	60
74136	65
74141	60
74144	2.50
74145	80
74150	1.00
74151	65
74153	65
74154	1.00
74155	70
74156	70
74157	70
74160	90
74161	90
74162	90
74163	90
74164	1.00
74165	1.00
74166	1.00
74167	2.30
74174	90
74175	80
74176	85
74177	85
74180	90
74181	2.30
74182	85
74184	1.35
74190	1.00
74191	1.00
74192	95
74193	1.00
74194	90
74195	90
74196	95

CMOS

CD4000	18
CD4001	19
CD4002	20
CD4006	92
CD4007	22
CD400B	80
CD4009	40
CD4010	48
CD4011	22
CD4012	22
CD4013	45
CD4014	84
CD4015	84
CD4016	42
CD4017	80
CD4018	85
CD4019	45
CD4020	99
CD4021	1.05
CD4022	95
CD4023	23
CD4024	70
CD4025	20
CD4026	1.50
CD4027	48
CD4028	80
CD4D29	1.00
CD4030	55
CD4031	2.00
CD4034	1.95
CD4035	1.20
CD4036	3.30
CD4037	95
CD4038	1.15
CD4040	95
CD4041	78
CD4042	78
CD4043	88
CD4044	88
CD4045	1.50
CD4046	1.10
CD4047	95
CD4048	65
CD4049	45
CD4050	45
CD4052	80
CD4054	1.25
CD4055	1.25
CD4056	1.35
CD4068	25
CD4069	25
CD4070	29
CD4071	25
CD4072	25
CD4081	26
CD4082	26
CD4085	90
CD4093	70
CD4501	28
CD4502	1.20
CD4503	70
CD4506	70
CD4507	60
CD4508	2.95
CD4510	99
CD4511	1.15
CD4516	1.10
CD4518	1.00
CD4520	1.00
CD4528	1.10
CD4531	1.50
CD4561	1.00

VOLTAGE REGULATORS

MVR7805-NVR7824	all 58p Ea.
MVR7905-NVR7924	all 63p Ea.
78L05-78L24	all 28p Ea.
79L05-79L24	all 55p Ea.
LM309K	1.25
UA79MGHC	2.50
LM320 15v. 12v. 15v. 24v	95p Ea.

74 LS SERIES TTL

74LS00	13
74LS01	13
74LS02	15
74LS03	15
74LS04	15
74LS05	22
74LS08	21
74LS09	21
74LS10	20
74LS11	22
74LS12	26
74LS13	34
74LS14	50
74LS15	34
74LS20	18
74LS21	26
74LS22	32
74LS26	38
74LS27	35
74LS28	35
74LS30	18
74LS32	22
74LS33	34
74LS37	28
74LS38	28
74LS40	25
74LS42	55
74LS47	72
74LS48	80
74LS49	90
74LS51	24
74LS54	28
74LS55	28
74LS63	1.40
74LS73	30
74LS74	30
74LS75	38
74LS76	42
74LS78	46
74LS83	68
74LS85	75
74LS86	38
74LS90	38
74LS91	1.10
74LS92	68
74LS93	58
74LS95	95
74LS96	1.10
74LS107	40
74LS109	70
74LS112	38
74LS113	68
74LS114	38
74LS122	68
74LS123	60
74LS124	1.60
74LS125	45
74LS126	45
74LS132	60
74LS136	50
74LS138	60
74LS139	68
74LS145	1.15
74LS147	2.00
74LS148	1.60
74LS151	70
74LS153	68
74LS155	65
74LS156	80
74LS157	60
74LS158	60
74LS160	85
74LS161	75
74LS162	1.00
74LS163	90
74LS164	90
74LS165	1.20
74LS166	1.70
74LS168	1.80
74LS169	1.80
74LS170	2.50
74LS173	95
74LS174	95
74LS175	95
74LS181	2.70
74LS183	2.80
74LS190	95
74LS191	95
74LS192	95
74LS193	95
74LS194	95
74LS195	85
74LS196	1.00
74LS197	85
74LS221	1.00
74LS240	1.60
74LS241	1.60
74LS242	1.60
74LS243	1.60
74LS244	1.50
74LS245	2.20
74LS247	1.20
74LS248	1.20
74LS249	1.20
74LS251	1.20
74LS253	90
74LS257	90
74LS258	1.10
74LS260	85
74LS259	1.50
74LS261	4.00
74LS266	72
74LS273	1.65
74LS275	3.50
74LS279	85
74LS280	2.40
74LS283	85
74LS290	90
74LS293	1.00
74LS295	1.90
74LS298	1.50
74LS299	3.50
74LS323	3.50
74LS324	1.90
74LS325	3.00
74LS326	3.20
74LS327	3.10
74LS348	1.80
74LS352	1.50
74LS353	1.50
74LS365	45
74LS366	55
74LS367	62
74LS368	80
74LS373	1.45
74LS374	1.45
74LS375	1.10
74LS378	1.20
74LS386	75
74LS393	1.10
74LS395	2.00
74LS398	2.70
74LS399	2.00
74LS490	1.40
74LS670	2.50

COMPUTER I.C.'s

2114 L-3	2.40
2708	3.50
2516/2716-5v	4.90
4116	2.25

LINEAR I.C.'s

CA270BE	95
CA280Q	95
CA3011	98
CA3014	1.75
CA3018	65
CA3020	1.75
CA3028	80
CA3035	2.30
CA3036	1.00
CA3042	1.60
CA3043	1.85
CA3046	70
CA3052	1.60
CA3054	1.10
CA3075	1.50
CA3080	65
CA3081	1.50
CA3085	95
CA3089	2.00
CA3090	3.60
CA3123E	1.50
CA3130E	90
CA3140E	48
LF351N	55
LF353N	88
LF356N	90
LH0042CH	2.25
LM301A	25
LM334	1.60
LM308	75
LM309K	1.25
LM317H	2.50
LM318H	1.95
LM320/5v	95
LM320/12v	95
LM320/15v	95
LM320/24v	95
LM324N	48
LM337T	1.35
LM339N	65
LM348N	90
LM380	85
LM381	1.45
LM382N	1.20
LM384	1.45
LM1458	42
LM3900	58
LM3909N	70
LM3911N	1.20
LM3914N	2.20
LM3915N	2.20
MC1304	1.90
MC1310P	1.45
MC1312	1.70
MC1350	1.20
MC1352	1.40
MC1469	2.70
MC1496	90
NE555	20
NE556	55
NE561	3.80
NE562	4.00
NE565	1.20
NE566	1.50
NE567	1.70
72702	46
UA703C	25
UA709C	25
72709	46
709P	35
UA710C	40
72710	30
UA711C	32
72711	32
UA723C	45
72723	45
UA741C	24
72741	24
741P	17
UA747C	60
72747	60
UA748	35
748P	35
SN76013N	1.60
SN76023N	1.65
SN76110	1.50
SN76115AN	1.90
SN76660N	90
TAA550B	35
TAA621	2.00
TAA661B	1.50
TAD100	1.30
TBA120B	70
TBA540	1.40
TBA641A	2.20
TBA800	85
TBA810S	95
TBA820	70
TBA920Q	2.50
TCA270S	1.40
ZN414	90
ZTK33B	15

SILICON RECTIFIERS

200mA	
IS920 50v	06
IS921 100v	07
IS922 150v	08
IS923 200v	09
IS924 300v	10
1 Amp	
IN4001 50v	04½
IN4002 100v	05
IN4003 200v	06
IN4004 400v	06
IN4005 600v	07
IN4006 800v	07
IN4007 1000v	08
1.5 Amp	
IS015 50v	09
IS020 100v	10
IS021 200v	11
IS023 400v	13
IS025 600v	14
IS027 800v	16
IS029 1000v	20
IS031 1200v	25
3 Amp	
IN5400 50v	11
IN5401 100v	12
IN5402 200v	14
IN5403 300v	15
IN5404 400v	16
IN5405 500v	17
IN5406 600v	18
IN5407 800v	22
IN5408 1000v	25
6 Amp	
BYX38-300	45
BYX38-600	60
8YX38-300R	45
BYX38-600R	60
10 Amp	
IS10/50 50v	30
IS10/100 100v	35
IS10/200 200v	40
IS10/400 400v	50
IS10/600 600v	60
IS10/800 800v	70
IS10/1000 1000v	85
IS10/1200 1200v	95

BRIDGE RECTIFIERS

1 Amp RMS	
BR1/50v	20
BR1/100v	22
BR1/200v	25
BR1/400v	29
2 Amp RMS	
BR2/50v	35
BR2/100v	40
BR2/200v	44
BR2/400v	50
BR2/1000v	65
6 Amp RMS	
BR6/50v	75
BR6/100v	80
BR6/200v	88
BR6/400v	95

THYRISTORS

1 Amp – TO39 CASE	
THY1A/50v	34
THY1A/100v	38
THY1A/200v	42
THY1A/400v	50
THY1A/600v	65
THY1A/800v	78
BT101/500R	80
BT102/500R	80
BT106	1.25
BT107	93
BT108	98
2N3228	70
3 Amp – TO66	
THY3A/50v	35
THY3A/100v	37
THY3A/200v	40
THY3A/400v	50
THY3A/600v	60
THY3A/800v	75
5 Amp – TO64	
THY5A/50v	36
THY5A/100v	45
THY5A/200v	50
THY5A/400v	57
THY5A/600v	60
THY5A/800v	75
5 Amp – TO66	
THY5A/50v	36
THY5A/100v	45
THY5A/200v	50
THY5A/400v	57
THY5A/600v	60
THY5A/800v	75
2N3525	77
BTX30/50L	40
BTX30/400L	70
BT116	1.50
C106D	38
BTY79/400R	95
5 Amp – TO220 PLASTIC	
THY5A/50vP	35
THY5A/100vP	45
THY5A/200vP	47
THY5A/400vP	50
THY5A/600vP	60
THY5A/800vP	70
10 Amp – TO48	
THY10A/50v	45
THY10A/100v	50
THY10A/200v	55
THY10A/400v	60
THY10A/600v	80
THY10A/800v	1.10
16 Amp – TO48	
THY16A/50v	65
THY16A/100v	80
THY16A/200v	90
THY16A/400v	1.20
THY16A/600v	1.50
THY16A/800v	2.00
30 Amp – TO49	
THY30A/50v	1.30
THY30A/100v	1.50
THY30A/200v	2.95
THY30A/400v	4.00
THY30A/600v	4.20

TRIACS & DIACS

2 Amp – TO39	
TRI2A/100v	30
TRI2A/200v	42
TRI2A/400v	50
10 Amp – TO48	
TRI110A/100v	55
TRI10A/200v	80
TRI10A/400v	90
4 Amp – TO202	
TRI4A/400v	55
8 Amp – TO220	
TRIBA/400v	64
10 Amp – TO220 – PLASTIC	
TRI10A/400P	68
6 Amp – TO220	
TRI6A/100v	45
TRI6A/200v	52
TRI6A/400v	60
12 Amp – TO220	
TRI12A/400v	70
DIACS	
BR100	20
D32	20

ZENER DIODES

400W 1.3V-39V	all at 8p
1.3W 1.3V-100V	all at 15p
10W 1.3V-100V	all at 35p

LARGEST SELECTION – LOWEST PRICES

AERIALS

105	Adjustable Aerial Gutter Mount	3.00
106	C.B. Mobile Antenna	9.50
107	FM Indoor Ribbon Aerial	0.50
108	4 Section Car Aerial (Stainless)	2.16
109	4 Section Car Aerial (Chrome)	1.80
110	8 Section 1200mm Telescopic Aerial	2.00
111	8 Section 750mm Telescopic Aerial	2.60
112	5 Section 570mm Telescopic Aerial	2.64
113	Roof Mounting Aerial (Car)	3.80

AUDIO LEADS

114	5 pin – 3.5mm 3 & 5 connected	0.65
115	5 pin – 3.5mm 1 & 4 connected	0.65
116	Car Aerial Ext Lead	1.00
117	Mains Cassette Lead	0.48
119	2×2 pin Plug in In Line Stereo Jack Socket	0.74
120	Universal Car Adaptor Plug	0.52
123	20ft. Coiled Guitar Lead	1.50
125	5 pin to 5 pin DIN	0.65
126	5 pin to DIN to open ends	0.65
127	5 pin to DIN to 4 Phono Plugs	1.00
128	5 pin Plug to 5 pin socket	0.75
129	5 pin to 5 pin Plug (Mirror image)	0.72
130	2 pin Plug to 2 pin Line Socket 5 mtrs	0.55
132	2 pin Plug to 2 pin Line Socket 10 mtrs	0.85
133	5 pin Plug to 2 Phono Plug	0.65
136	Headphone ext lead 7 mtrs	1.50

A.B.S. PLASTIC BOXES

141	4"×1"×2"	1.08
142	4.4"×1.22"×2.44"	1.24
143	4.75"×1.56"×2.56"	1.30
144	6.00"×2.00"×3.15"	1.50
145	7.5"×2.38"×4.33"	2.64
146	2.8"×4.37"×1.63"	1.40
147	3.78"×6.33"×2.06"	1.92
148	5.63"×4.14"×2.19"	2.14
149	5.63"×6.7"×2.19"	2.62
150	6.65"×4.98"×2.76"	3.84
151	9.57"×7.36"×4.06"	5.82

VERO CASES

152	23/16"×2"×1" Black	0.47
153	23/16"×2"×1" White	0.47
154	Vero plastic case box	4.82

INSTRUMENT CASES

155	8"×5¼"×2"	1.70
156	11"×6"×3"	2.63
157	6"×4¾"×1¾"	1.64
158	9"×5¼"×2½"	2.20

ALUM BOXES

159	5¼"×2¼"×1½"	0.83
160	4"×4"×1½"	0.83
161	4"×2¼"×1½"	0.83
162	5¼"×4"×1½"	0.93
163	4"×2¼"×2"	0.83
164	3"×2"×1"	0.57
165	7"×5"×2½"	1.30
166	8"×6"×3"	1.68
167	6"×4"×2"	1.12
168	Sloping Box – Large	6.97
169	Sloping Box – Small	4.63

CASSETTES

301	Low Cost C60	0.36
302	Low Cost C90	0.45
303	Low Cost C120	0.65
304	30 Min Letter Tape	0.38
305	Empty Library Case	0.12

CAPS, CHOKES, TRIMMERS

327	Jackson Coupling	0.74
328	Jackson Slow Motion Drive	1.38
329	Jackson 300PF Dilecon	2.64
330	Jackson 500PF Dilecon	3.10
331	Jackson 01-365PF	2.86
332	Jackson 02-365PF Dual	4.34
333	Jackson 804 10PF	2.62
334	Jackson 804 25PF	2.88
335	Jackson 804 50PF	2.88
336	Jackson 804 100PF	3.42
337	Trimmer Cap 40PF	0.20
338	Trimmer Cap 250PF	0.25
339	Trimmer Cap 450PF	0.30
340	Trimmer Cap 750PF	0.34
357	Repanco CH1 2.5MH	0.44
358	Repanco CH2 5.0MH	0.50
359	Repanco CH3 7.5MH	0.50
360	Repanco CH4 10.0MH	0.56
361	Repanco CH5 1.5MH	0.44
362	Repanco CH6 5UH	0.38
363	Repanco DRX1 Coil	0.60
364	Repanco DRR2 Coil	1.00

CABLE per metre

390	Light Mic Cable	0.10
391	Twin Mic Cable	0.15
392	Fig. 8 Stereo Cable	0.12
393	4 Way SCR Cable	0.35
394	4 Way Ind. Screened Cable	0.18
395	Heavy Mic Cable	0.25
396	3 Amp 3 Core Mains Cable	0.16
397	Twin Oval Mains	0.10
398	Fig. 8 Speaker Cable	0.07
399	Low Loss Coax. 750ohms	0.20
400	Uniradio 76-50ohms coax.	0.30

ELECTROLYTIC CAPACITORS

430	470uF 50v	0.30
431	1000uF 25v	0.40
432	1000uF 63v	1.00
433	1000uF 100v	1.25
435	2200uF 25v	0.70
436	2200uF 40v	1.20
437	2200uF 100v	2.00
438	3300uF 100v	2.40
439	4700uF 25v	0.90
440	4700uF 63v	2.30

ENAM. COPPER WIRE 2oz

365	40 swg	1.00
366	38 swg	0.88
367	36 swg	0.90
368	34 swg	0.82
369	32 swg	0.80
370	30 swg	0.80
371	28 swg	0.76
372	26 swg	0.74
373	24 swg	0.66
374	22 swg	0.62
375	20 swg	0.60
376	18 swg	0.60
377	16 swg	0.52
378	14 swg	0.52

TINNED COP. WIRE 4oz

379	24 swg	0.94
380	22 swg	0.83
381	20 swg	0.86
382	18 swg	0.90
383	16 swg	0.78

HARDWARE IN PACKS OF 25

839	OBA 1" Bolt	0.70
840	OBA ½" Bolt	0.40
842	2BA 1" Bolt	0.35
843	2BA ½" Bolt	0.30
844	2BA ¼" Bolt	0.32
845	4BA 1" Bolt	0.28
846	4BA ½" Bolt	0.20
847	4BA ¼" Bolt	0.18
848	6BA 1" Bolt	0.24
849	6BA ½" Bolt	0.18
850	6BA ¼" Bolt	0.20
851	OBA Solder Tags	0.20
852	2BA Solder Tags	0.16
853	4BA Solder Tags	0.14
854	6BA Solder Tags	0.12
855	OBA Full Nut	0.42
856	2BA Full Nut	0.26
857	4BA Full Nut	0.18
858	6BA Full Nut	0.18
859	OBA Washer	0.12
860	2BA Washer	0.09
861	4BA Washer	0.09
862	6BA Washer	0.09

FUSE HOLDERS

506	20mm Chassis Fuse Holder	0.14
507	1¼" Chassis Fuse Holder	0.14
508	1¼" Car in line Fuse Holder	0.12
509	20mm Panel Fuse Holder	0.26
510	1¼" Panel Fuse Holder	0.32

FUSES:

Quick Blow 20mm:

611	150mA	0.06
612	250MA	0.06
613	500MA	0.06
614	800MA	0.07
615	1 Amp	0.06
616	1.5 Amp	0.07
617	2.0 Amp	0.06
618	2.5 Amp	0.06
619	3.0 Amp	0.06
620	3.15 Amp	0.07
621	5.0 Amp	0.06

Semi Delay: 20mm

622	100MA	0.07
623	250MA	0.07
624	500MA	0.07
625	1 Amp	0.07
626	1.6 Amp	0.07
627	2 Amp	0.07
628	2.5 Amp	0.07
629	3.15 Amp	0.07
630	5.0 Amp	0.07

Quick Blow: 1¼":

631	250MA	0.06
632	500MA	0.06
634	800MA	0.06
635	1 Amp	0.06
636	1.5 Amp	0.06
637	2.0 Amp	0.06
638	2.5 Amp	0.06
369	3 Amp	0.06
641	4 Amp	0.06
642	5 Amp	0.06

KNOBS

1101	Black/Silver Knob	0.28
1102	Large Calibrated Knob	0.30
1103	Alli PA100 Knob	0.46
1104	Heavy Brushed Alli Knob 15mm	0.32
1105	Heavy Brushed Alli Knob 22mm	0.40
1106	Heavy Brushed Alli Knob 28mm	0.52
1107	Matt Black Knob 17mm	0.40
1108	Matt Black Knob 24mm	0.46
1109	Matt Black Knob 28mm	0.56
1110	All Metal Serated Edge Knob 15mm	0.34
1111	All Metal Serated Edge Knob 24mm	0.48
1112	All Metal Serated Edge Knob 30mm	0.60
1113	Black Plastic Metal Skirt	0.24
1114	Black Pointer Knob	0.22
1115	Black/Chrome Instrument Knob 22mm	0.32
1116	Alli Push Button Knob 11mm	0.14
1117	Black Plastic Slider Knob	0.12
1118	Chrome Slider Knob	0.14
1119	Chrome/Black Slider Knob	0.22

MICROPHONES etc.

1325	Crystal Desk Mike	3.30
1326	Cassette Mike 2.4mm + 3.5mm Plugs	1.46
1327	Dynamic Cassette Mike	1.86
1328	Dual Imp Dynamic Mike	10.50
1329	Dual Imp Condenser Mike	13.20
1330	Plastic Mike Holder	0.66
1331	Windshield Medium (Pair)	1.38
1332	Windshield Large (Pair)	1.92
1333	Gooseneck 320mm (Chrome)	2.60
1334	Gooseneck 515mm (Chrome)	3.50
1335	Mike Floor Stand	10.70
1336	Cassette Deck Mike 5K ohm	5.30
1337	Mike Boom Arm	8.80
1338	Crystal Mike Insert	0.52
1339	Two-Station Intercom	6.60
1340	Mobile or CB Mike 600 ohms	5.98
1341	Mobile or CB Mike 250 ohms	6.00

SEMICONDUCTOR HARDWARE

867	T0220	0.20
868	T03	0.20
869	S055 — Insulating kits in packs of 5	0.20
870	T066	0.20
871	T064	0.20
872	T048	0.20
873	T03 Single Heat Sink	0.26
874	T03 Double Heat Sink	1.35
875	Double Sided Heat Sink	2.65
876	T05/39 Heat Sink	0.15
877	T018 Heat Sink	0.15
878	T01 Heat Sink	0.10
879	T0220 Heat Sink	0.15
880	T066 Transistor Cover	0.14
881	T03 Transistor Cover	0.14

METERS

1305	2" Meter 2 Amps	2.88
1307	2" Meter 50UA	2.88
1308	2" Meter 100UA	2.88
1309	2" Meter 500UA	2.88
1310	2" Meter 1MA	2.88
1311	2" Meter 50 volts	2.88
1312	SWR and FS Meter	9.50
1313	SWR and Power Meter	11.90
1315	Test Meter 20,000 OPV	24.75
1316	Multi Tester RE185M	40.00
1317	Double VU Meter	3.25
1319	100-0-100 UA Meter 45mm	1.90
1320	Min Level Meter 23mm	0.95
1321	VU Meter 40mm	1.96
1322	Test Meter 1000PV	6.50
1323	Test Meter 20,000 OPV	11.40
1324	Test Meter 50,000 OPV	19.75

SWITCHES

1958	Min SPST Toggle Switch	0.70
1959	Min SPDT Toggle Switch	0.75
1960	Min DPDT Toggle Switch	0.80
1961	Min DPDT Centre Off Switch	0.95
1962	Push Button SPST	0.90
1963	Push Button SPDT	0.95
1964	Push Button DPDT	0.98
1965	1P 12W Rotary Switch	0.60
1966	2P 6W Rotary Switch	0.60
1967	3P 4W Rotary Switch	0.60
1968	4P 3W Rotary Switch	0.60
1973	Min DPDT Slide Switch	0.15
1974	Std Slide Switch	0.16
1975	SPST Toggle Switch	0.33
1976	DPDT Toggle Switch	0.46
1977	Rotary On-Off Switch	0.56
1978	Push to Make Switch	0.15
1979	Push to Break Switch	0.19
1981	SPST Rocker Switch (Black)	0.32
1982	SPST Rocker Switch (White)	0.32
1983	SPST Rocker Switch (Blue)	0.32
1984	SPST Rocker Switch (Yellow)	0.32
1985	SPST Rocker Switch (Luminous)	0.32
1986	Sub min SPST Toggle Switch	0.54
1987	Sub min SPDT Toggle Switch	0.58
1988	Sub min DPDT Toggle Switch	0.62
1989	Keyboard 24 way	1.50
1990	Keyboard 40 way	1.60
1991	Keyboard Switch	0.20
1992	Push to Make Switch (metal body)	0.32

BATTERY HOLDERS

200	Batt Holder 2×HP7 short	0.18
201	Batt Holder 4×HP7 short	0.19
202	Batt Holder 6×HP7 short	0.20
203	Batt Holder 4×HP7 long	0.19
204	PP3 Battery Clips	0.07
205	PP9 Battery Clips	0.12
206	Batt Holder 4×HP11 long	0.25
207	Batt Holder 4×HP11 short	0.25
208	Batt Holder 4×HP2 long	0.30

ETCHANT AND PENS

1610	Dalo Etch Resist Pen	0.90
1611	Ferric Chloride ½lb pack	0.95
1612	Pentel Etch Resist Pen	0.65

SOLDERING EQUIPMENT

1925	12 volt soldering iron MLX	5.46
1927	Multicore solder 22 swg tube	1.00
1928	Multicore solder 22 swg reel	3.50
1929	Multicore solder 18 swg reel	3.50
1930	Desolder braid	0.75
1931	X25 Soldering Iron	4.20
1932	X25 ⅛" replacement Bit	0.50
1933	X25 3/16" replacement Bit	0.50
1934	X25 3/32" replacement Bit	0.50
1935	X25 Replacement Element	1.80
1936	Desolder Pump	5.56
1937	Desolder Pump Nozzles	0.64
1938	SK1 Soldering Kit	7.00
1939	ST3 Iron Stand	1.60
1940	Horizontal IC Desoldering Bit	1.95
1941	Vertical IC Desoldering Bit	1.95
1942	Antex Heat Shunt	0.15
1943	CCN240 Soldering Iron	4.20
1944	CCN240 3/32" Replacement Bit	0.50
1945	CCN240 ⅛" Replacement Bit	0.50
1946	CCN240 3/16" Replacement Bit	0.50
1947	CCN240 Replacement Element	1.90
1948	C240 Soldering Iron	4.20
1949	C240 3/32" Replacement Bit	0.50
1950	C240 ⅛" Replacement Bit	0.50
1951	C240 3/16" Replacement Bit	0.50
1952	C240 Replacement Element	1.70
1953	G Soldering Iron	4.20
1954	Model G 3/32" Replacement Bit	0.50
1955	Model G ⅛" Replacement Bit	0.50
1956	Model G 3/16" Replacement Bit	0.50
1957	Model G Replacement Element	1.90

MAINS PLUGS AND SOCKETS

1618	13 Amp Rubber Plug	0.52
1619	13 Amp Plastic Plug	0.46
1620	13 Amp Free Socket	0.50
1621	13 Amp 2 way Free Socket	1.50
1622	13 Amp 4 way Free Socket	4.20
2019	2 Amp Terminal Block } 12 way	0.24
2020	5 Amp Terminal Block } 12 way	0.24

PDTS

1831	1K	Lin Single Pots	29
1832	2K2	Lin Single Pots	29
1833	4K7	Lin Single Pots	29
1834	10K	Lin Single Pots	29
1835	22K	Lin Single Pots	29
1836	47K	Lin Single Pots	29
1837	100K	Lin Single Pots	29
1838	220K	Lin Single Pots	29
1839	470K	Lin Single Pots	29
1840	1M	Lin Single Pots	29
1841	2M2	Lin Single Pots	29
1842	4K7	Log Single Pots	29
1843	10K	Log Single Pots	29
1844	22K	Log Single Pots	29
1845	47K	Log Single Pots	29
1846	100K	Log Single Pots	29
1847	220K	Log Single Pots	29
1848	470K	Log Single Pots	29
1849	1M	Log Single Pots	29
1850	2M2	Log Single Pots	29
1851	4K7	Lin Dual Pots	88
1852	10K	Lin Dual Pots	88
1853	22K	Lin Dual Pots	88
1854	47K	Lin Dual Pots	88
1855	100K	Lin Dual Pots	88
1856	220K	Lin Dual Pots	88
1857	470K	Lin Dual Pots	88
1858	1M	Lin Dual Pots	88
1859	2M2	Lin Dual Pots	88
1860	4K7	Log Dual Pots	88
1861	10K	Log Dual Pots	88
1862	22K	Log Dual Pots	88
1863	47K	Log Dual Pots	88
1864	100K	Log Dual Pots	88
1865	220K	Log Dual Pots	88
1866	470K	Log Dual Pots	88
1867	1M	Log Dual Pots	88
1868	2M2	Log Dual Pots	88
1869			
1870	4K7	Lin switched pots	68
1871	10K	Lin switched pots	68
1872	22K	Lin switched pots	68
1873	47K	Lin switched pots	68
1874	100K	Lin switched pots	68
1875	220K	Lin switched pots	68
1876	470K	Lin switched pots	68
1877	1M	Lin switched pots	68
1878	2M2	Lin switched pots	68
1879	4K7	Log switched pots	68
1880	10K	Log switched pots	68
1881	22K	Log switched pots	68
1882	47K	Log switched pots	68
1883	100K	Log switched pots	68
1884	220K	Log switched pots	68
1885	470K	Log switched pots	68
1886	1M	Log switched pots	68
1887	2M2	Log switched pots	68
1888	100K	Log-Anti Log Dual Pot	88
1889	5K	Log pot 16mm switched	36
1890	5K	Log pot 17mm switched	48
1891	10 ohm wire wound pots		85
1892	22 ohm wire wound pots		85
1893	47 ohm wire wound pots		85
1894	100 ohm wire wound pots		85
1895	220 ohm wire wound pots		85
1896	470 ohm wire wound pots		85
1897	1K ohm wire wound pots		85
1898	2K ohm wire wound pots		85
1899	4K7 ohm wire wound pots		85

TOOLS CROC CLIPS ETC

2001	Insulated croc clips (Red)	0.06
2002	Insulated croc clips (Black)	0.06
2003	1½ insulated croc clips (Red)	0.07
2004	1½ insulated croc clips (Black)	0.07
2005	30 Amp croc clips 100mm per pair	0.74
2006	Test Leads	0.55
2007	Test Lead Kit	1.70
2008	4mm Test Lead Set	1.36
2009	4mm Test Prods Set	0.52
2010	Pincer Action Prod Set	1.40
2011	Cutters	5.50
2012	Pliers	5.20
2013	Croc clip test set	1.00
2014	Resistance sub box	4.30
2015	IC Extraction Tool	0.64
2016	Neon Mains Tester/Screwdriver	0.52

MIN PRESETS 9p EACH

1801	100 ohm	Horizontal
1802	220 ohm	Horizontal
1803	470 ohm	Horizontal
1804	1K	Horizontal
1805	2K2	Horizontal
1806	4K7	Horizontal
1807	10K	Horizontal
1808	22K	Horizontal
1809	47K	Horizontal
1810	100K	Horizontal
1811	220K	Horizontal
1812	470K	Horizontal
1813	1M	Horizontal
1814	2M2	Horizontal
1815	4M7	Horizontal
1816	100 ohm	vertical
1817	220 ohm	vertical
1818	470 ohm	vertical
1819	1K	vertical
1820	2K2	vertical
1821	4K7	vertical
1822	10K	vertical
1823	22K	vertical
1824	47K	vertical
1825	100K	vertical
1826	220K	vertical
1827	470K	vertical
1828	1M	vertical
1829	2M2	vertical
1830	4M7	vertical

TRANSFORMERS

2021	6-0-6v 100mA	0.90
2022	9-0-9v 75mA	0.90
2023	12-0-12v 100mA	1.15
2024	0-6v 0-6v 280mA	1.60
2025	0-12v 0-12v 150mA	1.60
2026	6-0-6v 1 Amp	2.40
2027	9-0-9v 1 Amp	2.00
2028	12-0-12v 1 Amp	2.50
2029	15-0-15v 1 Amp	2.75
2031	Multi tap ½ Amp	3.40
2032	Multi tap 1 Amp	4.80
2033	Multi tap 2 Amp	6.40
2034	0-35v 1.7 Amp	4.90
2035	0-55v 2 Amp	6.65
2036	0-17v 750mA	2.85
2037	Min audio output	0.25
2038	min audio driver	0.36
2039	0-20v 1 Amp	3.50
2040	0-45-55v 1.5 Amps	6.45
2041	0-55-65v 1 Amps	8.46
2042	0-25v 2 Amps	4.50
2043	15-0-15 150mA	2.40

2017
PICK UP FOR
ACOUSTIC GUITAR
£5.50

2018
TELEPHONE
PICK UP COIL
£0.66

170
QUICK TEST BLOCK 'KEYNECTOR'
£6.50

1617
T03 TRANSISTOR
SOCKET

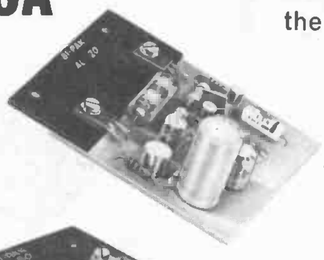
MAINS FUSES
13A PLUG TYPE

643	1A	£0.12 each
644	2A	£0.12 each
645	3A	£0.12 each
646	5A	£0.12 each
647	13A	£0.12 each

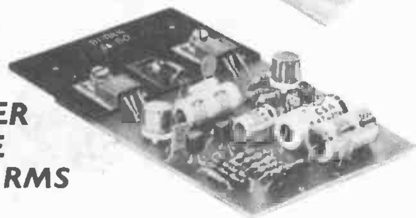
CHOOSE FROM OVER 20 TOP QUALITY MODULES

BI-PAK Audio Modules are famous for their variety, quality of design and ruggedness. For over 10 years BI-PAK have been suppliers to manufacturers of high quality audio equipment throughout the world—to date, well over 100,000 modules have been sold—this is why discerning amateur enthusiasts insist on using BI-PAK modules in their equipment. They know that every item is designed and tested to do the job for which it is entended before it leaves the factory. Whatever you are building, there is a kit or module in the BI-PAK range to suit your every need from 5 watts to 125 watts, from amplifiers to equalisers. AND if you cannot see what you require in this advertisement, just write or phone us—we are waiting to help you!

AL20A-30A
AUDIO AMPLIFIER MODULES

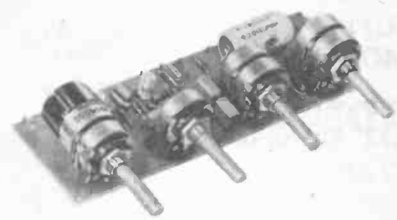


AL80
AUDIO AMPLIFIER MODULE
35 Watts RMS

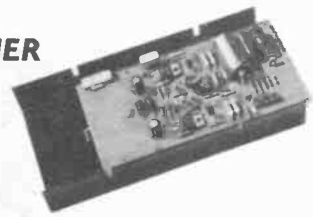


AL60
AUDIO AMPLIFIER MODULE
25 Watts RMS

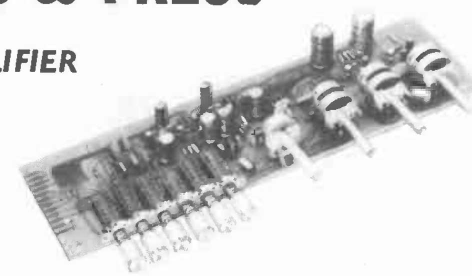
PA12
STEREO PRE-AMPLIFIER



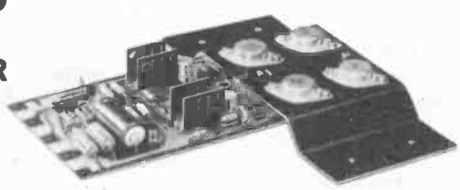
AL120
AUDIO AMPLIFIER
50W R.M.S.
With integral heat sink and short-circuit protection



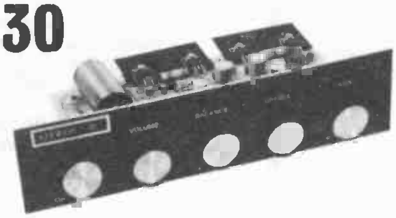
PA100 & PA200
STEREO PRE-AMPLIFIER



AL250
POWER AMPLIFIER



Stereo 30
COMPLETE AUDIO CHASSIS



GE100
10 CHANNEL MONOGRAPHIC

latest addition

MM100 Suitable for disco mixer
MM100G Suitable for guitar pre-amp-mixer

£12.43 each

BI-PAK

COMPLETELY GUARANTEED

AMPLIFIERS

AL10. 3 watt Audio Amplifier Module 22-32v supply	£3·08
AL20. 5 watt Audio Amplifier Module 22-32v supply	£3·57
AL30A. 7-10 watt Audio Amplifier Module 22-32v supply	£4·16
AL60. 15-25 watt Audio Amplifier Module 30-50v supply	£5·15
AL80. 35 watt Audio Amplifier Module 40-60v supply	£8·07
AL120. 50 watt Audio Amplifier Module 50-70v supply	£13·14
AL250. 125 watt Audio Amplifier Module 50-80v supply	£19·60

STEREO PRE-AMPLIFIERS

PA12. Supply voltage 22-32v input sensitivity 300mv. Suit: AL10/AL20/AL30	£8·55
PA100. Supply voltage 24-36v inputs: Tape Tuner. Mag P.U. Suit: AL60/AL80	£17·55
PA200. Supply voltage 35-50v inputs: Tape Tuner, Mag P.U. Suit: AL80/AL120/AL250	£18·24

BI-KITS

STA5. 5 watts per channel Stereo Amplifier Kit consisting of: 2 × AL20 amplifiers, 1 × PA12 pre-amplifier, 1 × PS12 power supply, 1·2036 transformer and necessary wiring diagram. **£19·52**

STA10. 10 watts per channel Stereo Amplifier Kit consisting of 2 × AL30 amplifiers, 1 × PA12 pre-amplifier, 1 × PS12 power supply, 1 × 2036 transformer and necessary wiring diagrams. **£20·63**

STA15. 15 watts per channel Stereo Amplifier Kit consisting of: 2 × AL60 amplifiers, 1 × PA100 pre-amplifier, 1 × SPM80 power supply, 1 × 2034 transformer, 2 × coupling capacitors for 8 ohms 470mfd 30v and necessary wiring diagram. **£36·76**

BI-KITS

STA25. 25 watts per channel Stereo Amplifier Kit consisting of: 2 × AL60 amplifiers, 1 × PA100 pre-amplifier, 1 × SPM120/45 power supply, 1 × 2040 transformer, coupling capacitors for 8 ohms 470mfd 45v, 1 × reservoir capacitor 2200mfd 100v and necessary wiring diagram. **£40·50**

STA35. 35 watts per channel Stereo Amplifier Kit consisting of: 2 × AL80 amplifiers, 1 × PA200 pre-amplifier, 1 × 2035 transformer, 2 × coupling capacitors 470mfd at 50v for 8 ohms, 1 × reservoir capacitor 2200mfd 100v and necessary wiring diagram. **£45·76**

BI-KITS

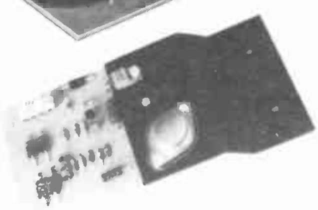
STA50. 50 watts per channel Stereo Amplifier Kit consisting of: 2 × AL120 amplifiers, 1 × PA200 pre-amplifier, 1 × 2041 transformer, 2 × coupling capacitors 1000mfd 63v, 1 × SPM 120/65 1 × reservoir capacitor 3300mfd 100v and necessary wiring diagram. **£59·89**

STA100. 100 watts per channel Stereo Amplifier Kit consisting of: 2 × AL250 amplifiers, 1 × PA200 pre-amplifier, 2 × SPM120/65 power supplies, 2 × 2041 transformers, 2 × coupling capacitors 1000mfd 100v and necessary wiring diagram. **£84·68**

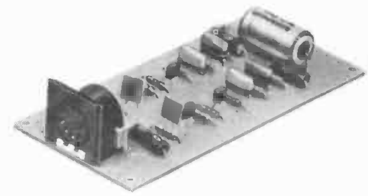
PS12
POWER SUPPLY MODULE

SPM80
STABILISED POWER SUPPLY

SPM120
STABILISED POWER SUPPLY

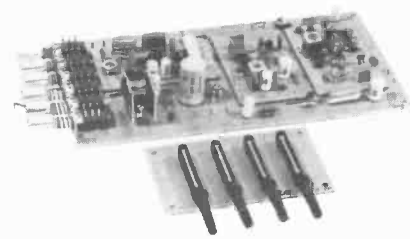


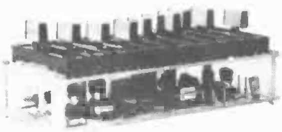
MPA30
MAGNETIC CARTRIDGE PRE-AMPLIFIER



BP124
SIREN ALARM MODULE

S450
STEREO FM TUNER Fitted with phase lock-loop



MkII


EQUALISER

MONO PRE-AMPLIFIERS

MM100. Supply voltage 40-65v inputs: Tape, Mag P.U. Microphone Max output 500mv. **£12·43**

MM100G. Supply voltage 40-65v inputs: 2 Guitars, Microphones Max output 500mv. **£12·43**

POWER SUPPLIES

PS12. 24v Supply. Suit: 2 × AL10, 2 × AL20, 2 × AL30 & PA12/S.450. **£1·65**

SPM80. 33v Stabilised supply. Suit: 2 × AL60, PA100 to 15 watts. **£4·84**

SPM120/45. 45v Stabilised supply. Suit: 2 × AL60, PA100 to 25 watts. **£6·38**

SPM120/55. 55v Stabilised supply. Suit: 2 × AL80, PA200. **£6·38**

SPM120/65. 65v Stabilised supply. Suit: 2 × AL120, PA200, 1 × AL250. **£6·38**

SG30. 15-0-15 Stabilised power supply for 2 × GE100MK11. **£3·80**

MISCELLANEOUS

MPA30. Stereo Magnetic Cartridge Pre-Amplifier—Input 3·5mv, Output 100mv **£3·27**

S.450. Stereo FM Tuner Supply Voltage 20-30v—Varicap tuned. **£25·66**

STEREO 30. Complete 7 watt per cannel Stereo Amplifier Board—includes amps, pre-amp, power supply, front panel, knobs, etc—requires 2039 Transformer. **£21·09**

Transformers are not included with power supplies
SPM120 Range also require reservoir and output capacitors

BP124. 5 watt 12v max.—Siren Alarm Module. **£3·85**

GE100MK11. 10 channel mono-graphic equaliser, complete with sliders and knobs. **£23·00**

VPS30. Variable regulated stabilised power supply 2-30v 0-2 amps. **£7·60**

PS250. Consists—1 capacitor & 4 diodes for constructing unstabilised power supply for AL250 to 125 watts. **£2·90**

TRANSFORMERS

2034. 1·7 amp 35v. Suit SPM80. **£4·90**
2035. 2 Amp 55v. **£6·65**
2036. 750mA 17v. Suit PS12. **£2·85**
2040. 1·5 Amp 0-45v-55v. Suit: SPM120/45, SPM120/55v. **£6·45**
2041. 2 Amp 0-55v-65v. Suit: SPM120/55, SPM120/65v. **£8·46**
2039. 1 Amp 0-20v. Suit: Stereo 30 **£3·50**
2043. 150mA 15-0-15v. Suit: SG30. **£2·40**

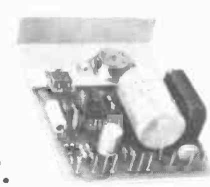
ACCESSORIES

139. Teak Cabinet. Suit: Stereo 30, 320 × 235 × 81mm. **£7·00**
140. Teak Cabinet. Suit: STA15, 425 × 290 × 95mm. **£9·50**
FP100. Front Panel for PA100 & PA200. **£1·80**
BP100. Back Panel for PA100 & PA200. **£1·60**
GE100FP. Front Panel for one GE100MK11. **£1·75**
2240. Kit of Parts including Teak Cabinet, Chassis, Sockets and Knobs, etc. (To House STA15 Amplifier.) **£19·95**

Full data sheets are available FREE on request, please enclose a S.A.E.

VPS30
REGULATED VARIABLE STABILISED POWER SUPPLY

KIT £20 + V.A.T.



Stabilised Power Supply Kit
Variable from 2-30 volts and 0-2 Amps
Kit includes:
1 VPS30 Module
1 25 volt 2 Amp Transformer
1 0-50v 2" Panel Meter
1 0-2 Amp 2" Panel Meter
1 470 ohm Wirewound Potentiometer
1 4K7 ohm Wirewound Potentiometer
Wiring diagram included

Access and Barclaycards accepted—just telephone our Orderline—Ware (STD 0920) 3182. All prices exclude V.A.T., add 50p postage per order. Terms: C.W.O., cheques, Postal Orders payable to Bi-Pak.

THE BI-PAK OPTO SHOW

LEDs

1501	£0·10	TIL209 Red LED ·125"
1502	£0·16	TIL211 Green LED ·125"
1503	£0·16	TIL213 Yellow LED ·125"
1504	£0·10	FLV117 Red LED ·2"
1505	£0·16	FLV310 Green LED ·2"
1506	£0·16	FLV410 Yellow LED ·2"
1507	£0·80	2nd Grade LED pack, 10 assorted
1522	£0·12	MIL32 Clear Illuminating Red LED ·125"
1532	£0·12	FLV111 Clear Illuminating Red LED ·2"
1524	£0·65	CQX21 Red Flashing LED
1525	£0·75	CQX95 Two Colour LED

OPTO-ISOLATORS

1515	£0·55	Opto-isolator IL74 Single
1516	£1·16	Opto-isolator ILD74 Dual
1517	£2·10	Opto-isolator ILQ74 Quad

7 SEGMENT LED DISPLAYS

1508	£0·80	BDL307 7 segment LED display ·3"
1509	£1·80	BDL527 Dual 7 segment LED display ·5"
1510	£0·98	BDL707 7 segment LED display ·3"
1511	£1·75	BLD747 7 segment LED display ·6"
1512	£1·90	BDL727 Dual 7 segment LED display ·5"

MISCELLANEOUS

1514	£0·60	ORP12 Light Dependent Resistor
1518	£0·60	Photo Transistor P20 NPN
1519	£0·26	Photo Darlington MEL11 NPN
1520	£0·40	Photo Transistor OCP71 PNP
1526	£0·38	FPE100 Infra Red Emitter
1527	£0·38	CQY89 Infra Red LED

BEGINNERS PAK

No. 1—100 TRANSISTORS

A pack of well known transistors, as used in many popular projects. A must for beginners (and very useful to experienced constructors too).

10	BC107/8	TO18 Metal	NPN
10	BC237	TO92 Plastic	NPN
5	BC177/8	TO18 Metal	PNP
5	BC251	TO92 Plastic	PNP
10	BFY51-BC141	TO39 Metal	NPN
5	BC160	TO39 Metal	PNP
5	AC176	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	AC176	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 BAX13-13	General Purpose Diode, Silicon
5	C106D	Thyristor 400v, TO202 Case
2	10 Amp Triacs 400v	TO220 Case, Isolated Tab
2	4 Amp Triacs 400v	TO220 Case, Non-Isolated Tab
10	Assorted 3 Amp	Thyristors 50-600 volts, TO64-TO66 Case
5	Assorted 1 Amp	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 5 Amp, 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 Volts 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

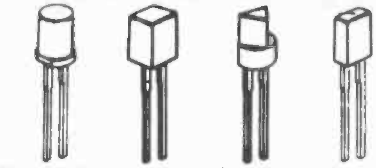
Code No.'s mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

ELECTROLYTIC PAKS

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

EC1	Values from ·47mFD-10mFD	£1·00
EC2	Values from 10mFD-100mFD	£1·00
EC3	Values from 100mFD-1000mFD	£1·00

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	£0·28	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

CERAMIC PAKS

Containing a range of first quality miniature ceramic capacitors.

MC1	40 miniature ceramic capacitors: 5 of each value: 22pf, 27pf, 33pf, 39pf, 47pf, 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 or each value: 4700pf, 6800pf, ·01µf, ·015µf, ·022µf, ·033µf, ·047µf	£1·00

SPEAKERS AND CROSSOVERS

1901	Dome Tweeter 3½", 8 ohms, 50w	£3·20
1902	Dome Tweeter 3", 8 ohms, 20w	£2·60
1903	Flared Horn Tweeter, 8 ohms, 30w	£3·80
1904	2-way Crossover, 15w, 8 ohms	£1·24
1905	2-way Crossover, 40w, 8 ohms	£2·70
1906	3-way Crossover, 60w, 8 ohms	£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, 4 ohms, 10w	£3·90
1920	5¼" Whoofer, 8 ohms, 10w	£3·90
1921	5¼" Dual Cone, wide range, 8 ohms	£5·80
1922	8" Dual Cone, long throw, 8 ohms, 15w	£4·84
1923	8" Whoofer, dual 4 + 8 ohms rubber edge, 20w	£7·80

DIL SOCKETS

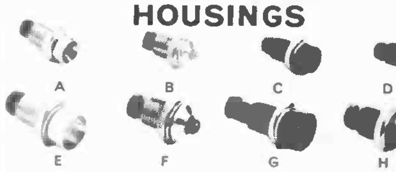
1601	8 Pin	£0·09	1605	20 Pin	£0·20
1602	14 Pin	£0·11	1606	22 Pin	£0·24
1603	16 Pin	£0·12	1607	24 Pin	£0·28
1604	18 Pin	£0·18	1608	28 Pin	£0·32
			1609	40 Pin	£0·36

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
RPY76A	Infra Red Detector			£0·65

LED CLIPS AND HOUSINGS



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 Rec, 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	100 ohms-820 ohms	£1·00
R2	80 Mixed ¼w	1K ohms-8·2K ohms	£1·00
R3	80 Mixed ¼w	10K ohms-82K ohms	£1·00
R4	80 Mixed ¼w	100K ohms-1M	£1·00
R5	60 Mixed ½w	100 ohms-820 ohms	£1·00
R6	60 Mixed ½w	1K ohms-8·2K ohms	£1·00
R7	60 Mixed ½w	10K ohms-82K ohms	£1·00
R8	60 Mixed ½w	100K ohms-1M	£1·00

TANTALUM BEAD CAPACITORS

401	0·1µF	16v	£0·11	414	47·0µF	16v	£0·55
402	0·22µF	16v	£0·11	415	100µF	10v	£0·82
403	0·33µF	16v	£0·11	416	·1µF	35v	£0·12
404	0·47µF	16v	£0·11	417	·22µF	35v	£0·12
405	0·68µF	16v	£0·11	418	·33µF	35v	£0·12
406	1·0µF	16v	£0·11	419	·47µF	35v	£0·12
407	2·2µF	16v	£0·12	420	·68µF	35v	£0·12
408	3·3µF	16v	£0·13	421	1·0µF	35v	£0·12
409	4·7µF	16v	£0·14	422	2·2µF	35v	£0·13
410	6·8µF	16v	£0·15	423	3·3µF	35v	£0·15
411	10·0µF	16v	£0·16	424	4·7µF	35v	£0·18
412	22·0µF	16v	£0·28	425	6·8µF	35v	£0·30
413	33·0µF	16v	£0·50	426	10·0µF	35v	£0·38

FAIRCHILD/ DARLINGTONS

TYPE	Pol	VCEO	VCBO	I.C.	HFE	CASE	£ p
2N6052	PNP	—100v	—100v	12A	750-18K	TO3	1·50
2N6282	NPN	60v	60v	20A	750-18K	TO3	1·25
MJ3000	NPN	60v	60v	10A	1KMN	TO3	1·00
SE9300	NPN	60v	60v	10A	1000	TO220	0·90
SE9031	NPN	80v	80v	10A	1000	TO220	0·95
SE9304	NPN	80v	80v	10A	1000	TO3	0·95
SE9305	NPN	100v	100v	10A	1000	TO3	1·00
SE9401	PNP	—80v	—80v	10A	1000	TO220	1·10
TIP115	PNP	—60v	—60v	2A	1K	TO220	0·40
TIP117	PNP	—100v	—100v	2A	1K	TO220	0·50
TIP120	NPN	60v	60v	5A	1K	TO220	0·60
TIP121	NPN	80v	80v	5A	1K	TO220	0·65
TIP122	NPN	100v	100v	5A	1K	TO220	0·68
TIP126	PNP	—80v	—80v	5A	1K	TO220	0·70
TIP127	PNP	—100v	—100v	5A	1K	TO220	0·72

POWER SUPPLIES

137	AC-DC Adaptor 6, 7½, 9 & 12 volts	£3·75
138	DC-DC Adaptor 6, 75, 9 volts	£2·70

CABINETS

139	Teak 30 Case	£7·00
140	Teak 60 Case	£9·50

Access and Barclaycards accepted—just telephone our Orderline—Ware (STD 0920) 3182. All prices exclude V.A.T., add 50p postage per order. Terms: C.W.O., cheques, Postal Orders payable to Bi-Pak at address below.

BI-PAK
SEMICONDUCTORS

BARCLAYCARD VISA

Access

Dept. EE4, P.O. BOX 6, WARE, HERTS.
Tel: Ware (STD 0920) 3442. Telex: 817861.
Giro No. 3887006.
Visit our shop at: 3, Baldock St, Ware, Herts.

EDITOR
F. E. BENNETT

ASSISTANT EDITOR
B. W. TERRELL B.Sc.

PRODUCTION EDITOR
D. G. BARRINGTON

TECHNICAL SUB-EDITOR
S. E. DOLLIN B.Sc.

ART EDITOR
R. F. PALMER

ASSISTANT ART EDITOR
P. A. LOATES

TECHNICAL ILLUSTRATOR
D. J. GOODING

EDITORIAL OFFICES
Kings Reach Tower,
Stamford Street,
London SE1 9LS
Phone: 01-261 6873

ADVERTISEMENT MANAGER
R. SMITH
Phone: 01-261 6671

REPRESENTATIVE
R. WILLETT
Phone: 01-261 6865

CLASSIFIED MANAGER
C. R. BROWN
Phone: 01-261 5762

MAKE-UP AND COPY DEPARTMENT
Phone 01-261 6615

ADVERTISEMENT OFFICES
Kings Reach Tower
Stamford Street,
London SE1 9LS

Projects... Theory...

and Popular Features...

DO CATALOGUES LIE?

A letter published this month draws attention, once again, to a Mail Order problem which will have been encountered at some time by most constructors: the "out of stock" item.

In an attempt to dispel suspicion that catalogues tell lies we must first recognise that, with the best will in the world, it is not possbile for a retailer to guarantee that his stock level will be held as intended at all times. Certain items can quickly (and unexpectedly) become exhausted; because of a sudden rise in demand generated by an especially popular magazine project, for example.

Some components cannot be speedily replaced. Cash flow problems and high interest rates have a serious effect upon the component market, at all levels in the distribution chain, from manufacturer to retailer. The situation is further aggravated now that many components come from countries outside the UK.

What about the case where a retailer marks "cancelled" against an item although it was listed in that supplier's current catalogue?

This is less easy to explain, or to justify, in our opinion. The difficulties referred to above may cause a temporary out-of-stock situation. But having placed an item in a catalogue, we feel the retailer is honour bound to make every effort to maintain continuity of stock for a reasonable period following the issue of a catalogue.

Where one or more items on a customer's order happen to be out of stock there are three choices for the supplier:

1. Despatch promptly all those items available at the time and send the balance as soon as they become available.
2. Hold the entire order until all items can be supplied.
3. Supply those items available and close the order—making an appropriate refund, including a fair proportion of post and packing charges.

The nature of the order, variety of parts included and the supplier's knowledge of the likely date of arrival for replacement stock, all play a part in determining how the order will be handled.

The one vital requirement is that the customer be advised without delay just what the situation is and how the supplier proposes to deal with the matter. For a customer to be left in the dark about the fate of his order is quite inexcusable, but we believe such discourtesy is rarely, if ever, experienced by our readers from our advertisers.

Fred Bennett.

Our May issue will be published on Thursday, April 16. See page 251 for details.

Everyday ELECTRONICS

VOL. 10 NO. 4 APRIL 1981

CONSTRUCTIONAL PROJECTS

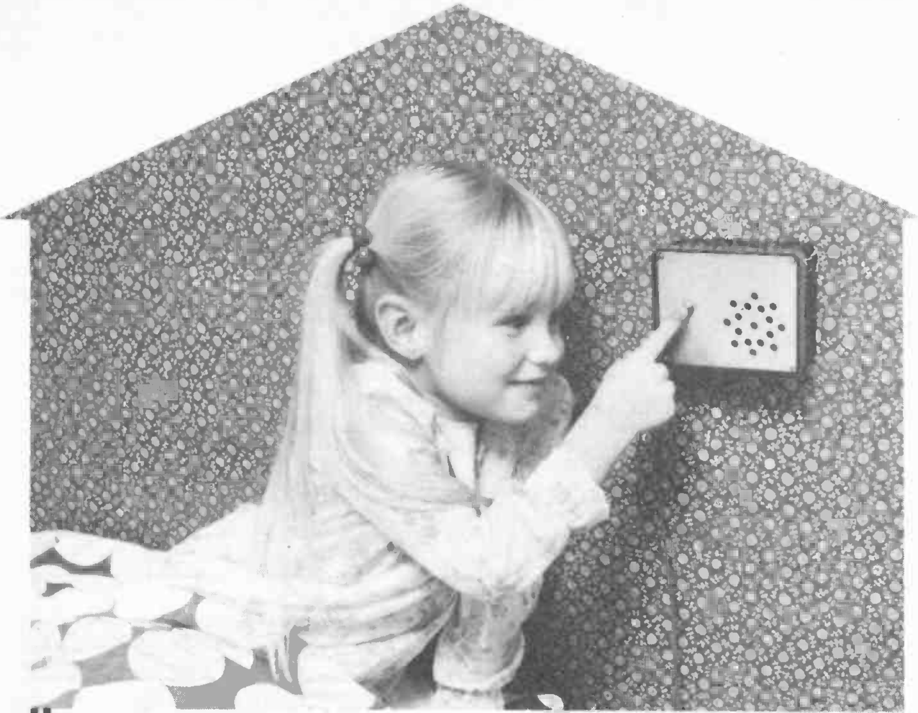
GENERAL FEATURES

Back Issues
Certain back issues* of EVERYDAY ELECTRONICS are available worldwide price 80p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.
* *Not available:* October 1978 to May 1979.

Binders
Binders to hold one volume (12 issues) are available from the above address for £4·40 (home and overseas) inclusive of postage and packing. Please state which Volume.

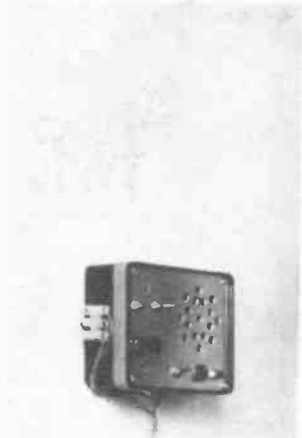
Subscriptions
Annual subscription for delivery direct to any address in the UK: £10·00, overseas: £11·00. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613 Kings Reach Tower, Stamford Street, London SE1 9LS.

See page 251 for details



INTERCOM

BY F. C. JUDD



AN INTERCOM system is always useful in the home, and this particular design can be used to communicate between two rooms and also as a doorbell with two-way speech capability—a useful asset when it comes to screening unwanted visitors.

The system described here operates on the basis that everything is controlled from the Master unit. One switch sets the system either on standby, where either station can call the other but no speech is possible, or on talk, in which case speech is possible.

A second switch controls the direction of speech, that is determines whether Master talks to Slave, or vice versa. The Slave unit consists of no more than a loudspeaker/microphone and a call button, whilst all the circuitry and power supply are housed in the Master unit.

CIRCUIT

The complete circuit diagram of the Intercom system is shown in Fig. 1. This consists of four sections: power supply, mic pre-amp, main amplifier and buzzer.

In common with many intercom systems, a loudspeaker is used both as microphone and loudspeaker; LS2 is used in the Master unit and LS1 in the Slave.

Because of this, a grounded base transistor pre-amplifier is necessary to provide a low impedance input to match the eight-ohm loudspeakers. This is built around TR1.

MAIN AMPLIFIER

The transistor pre-amp provides enough output power to fully drive the main amplifier built around a standard power amplifier i.c. (IC2), the LM380. This has the requisite low impedance output to drive either of the speakers in the normal way.

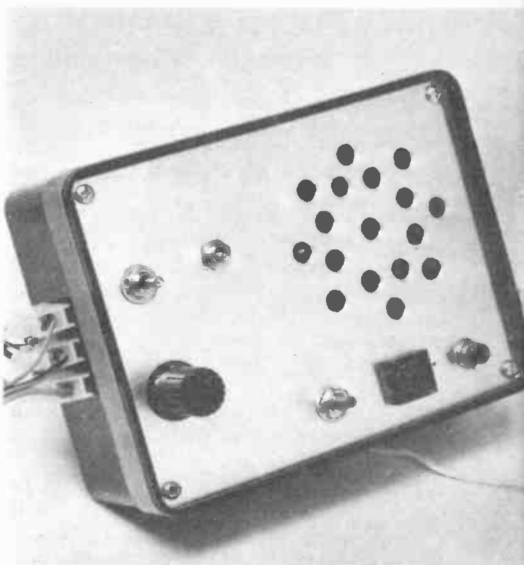
There is little to say about this part of the circuit as all the work is done inside the chip and the only extra components are a few support items necessary for stability and frequency compensation.

The input level into the main amplifier is controlled by VR1 and this acts as a volume control. Sensitivity and gain throughout the system are such that a person speaking at an average level about two or three feet from either unit will provide full output at the listening end with VR1 at maximum.

BUZZER

The buzzer sound is in fact derived from a simple timing circuit built around the ubiquitous NE555 timer i.c. This device, IC1, is connected as a square wave oscillator and its output is connected to an output coupling capacitor, C5, which differentiates the output signal producing a succession of short duration pulses. These provide a very loud buzzing sound without running the i.c. at full power all the time.

A mains transformer T1 provides a low a.c. voltage which is rectified by the bridge rectifier D1-D4 and then smoothed by C1 and C2, to provide a 12 volt rail for the rest of the system. A neon is connected across the primary of T1 and indicates when the equipment is switched on.



The Master unit showing front panel controls and the terminal block to the left of the unit.

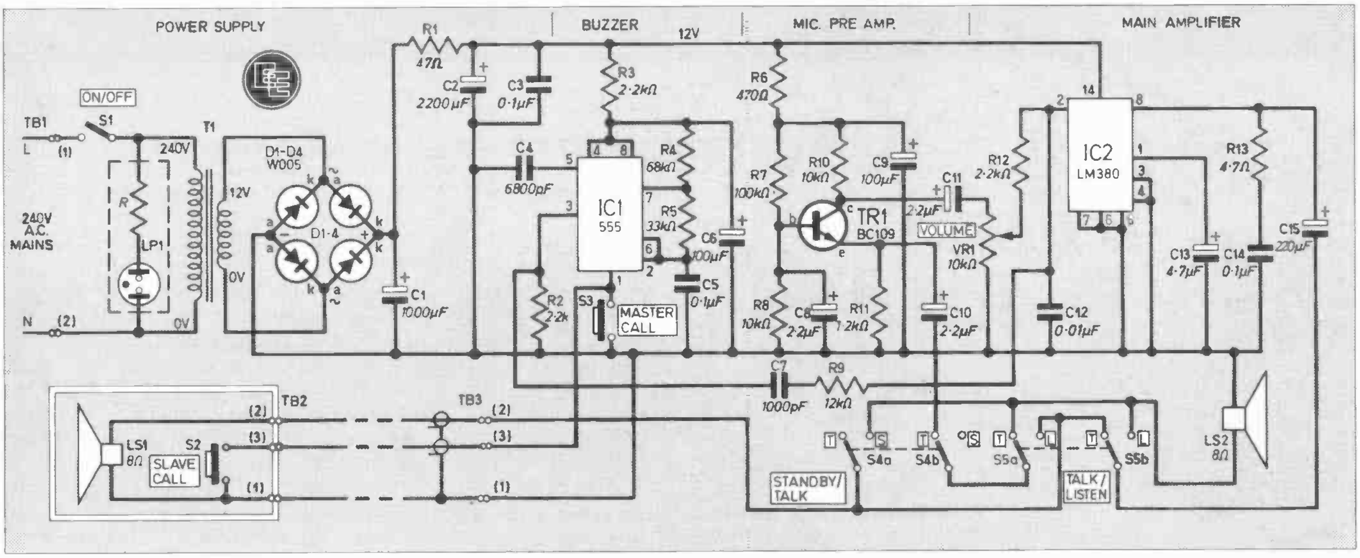


Fig. 1. Full circuit diagram of the Intercom. The circuit of the Slave unit is shown in the inset bottom left.

CONSTRUCTION starts here

CIRCUIT BOARDS

The construction of the Intercom system is based on three circuit boards. These are all mounted in the Master unit as are all the controls. The Slave unit is constructed in an identical box, but contains only the call push button S2 and a loudspeaker, LS1.

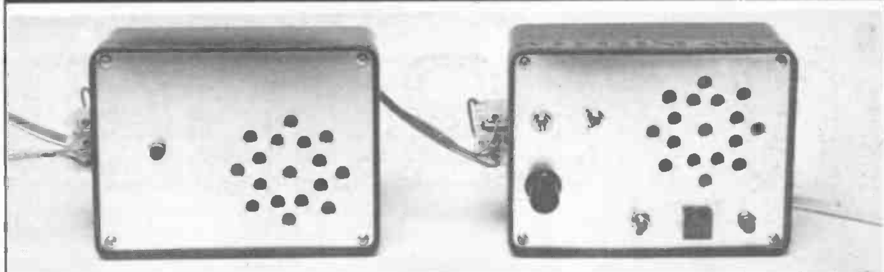
It is important that the board layout given in Fig. 2, 3, 4 are followed exactly including breaks in the copper strips, as adjacent strips can cause a certain amount of instability especially with i.c. amplifiers.

The first circuit board houses the pre-amp and main amplifier components. There is no particular order of construction for this board or indeed any other. It would be a good idea to use an i.c. socket for IC2. The transistor TR1 should be soldered in position whilst using a heat shunt on its leads.

The power supply is similarly constructed on its own board, and the transformer T1 is bolted directly to the board.

The buzzer is finally assembled on the third circuit board. It can be seen that this board is somewhat thinner than the other two and is only six strips wide. This is to enable the lid to be fitted onto the box without the panel mounted components fouling the circuit board mounted inside.

COMPONENTS



See Shop Talk page 247

Resistors

R1 47Ω
R2 2·2kΩ
R3 2·2kΩ
R4 68kΩ
R5 33kΩ
R6 470Ω
R7 100kΩ
R8 10kΩ
R9 12kΩ
R10 10kΩ
R11 1·2kΩ
R12 2·2kΩ
R13 4·7Ω
All ¼W carbon ± 5%

Capacitors

C1 1,000μF 25V elect.
C2 2,200μF 25V elect.
C3 0·1μF polyester
C4 6,800pF polystyrene
C5 0·1μF polyester
C6 100μF 25V elect.
C7 1,000pF polystyrene
C8 2·2μF 25V elect.
C9 100μF 25V elect.
C10 2·2μF 25V elect.
C11 2·2μF 25V elect.
C12 0·01μF polyester
C13 4·7μF 25V elect.
C14 0·1μF polyester
C15 220μF 25V elect.

Semiconductors

IC1 NE555 timer i.c.
IC2 LM380 audio amplifier i.c.
TR1 BC109 *npn* silicon
D1-D4 W005 50V, 1A bridge rectifier

COMPONENTS approximate cost £22 complete

Miscellaneous

VR1 10kΩ carbon linear potentiometer
S1 single-pole mains rated miniature toggle
S2, 3 push-to-make, release-to-break single-pole (2 off)
S4, 5 d.p.d.t. miniature toggle (2 off) (see text)
T1 mains primary/12V 100mA secondary
LS1, 2 70mm miniature, 8 ohm impedance (2 off)
TB1 two-way screw terminal block
TB2, 3 three-way screw terminal block (2 off)
LP1 mains neon indicator with integral series resistor
Cases, plastic with plastics front panel 130 × 100 × 50mm, West Hyde type MIN030 or similar (2 off); 0·1 inch matrix stripboard, 37 holes by 14 strips (2 off), 37 holes by 6 strips (1 off); Veropins; interconnecting wire; knob; two-core screened cable for interconnecting units; 3A mains cable.

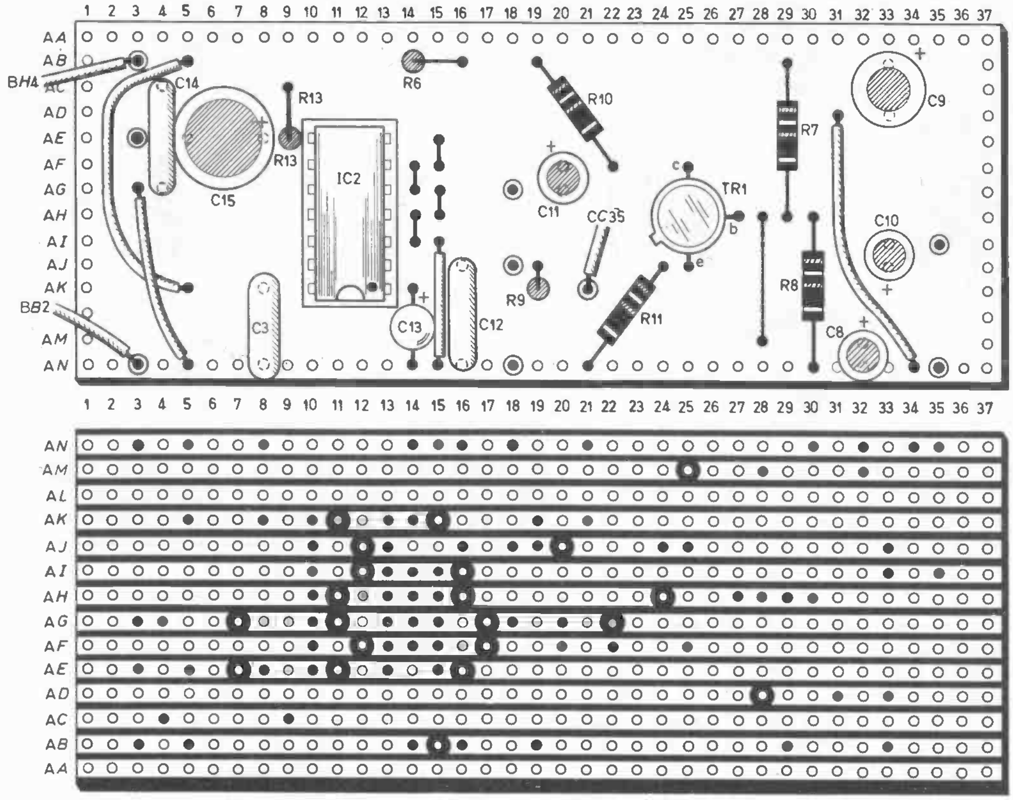


Fig. 2 Component layout on the main amplifier board. This is Board A.

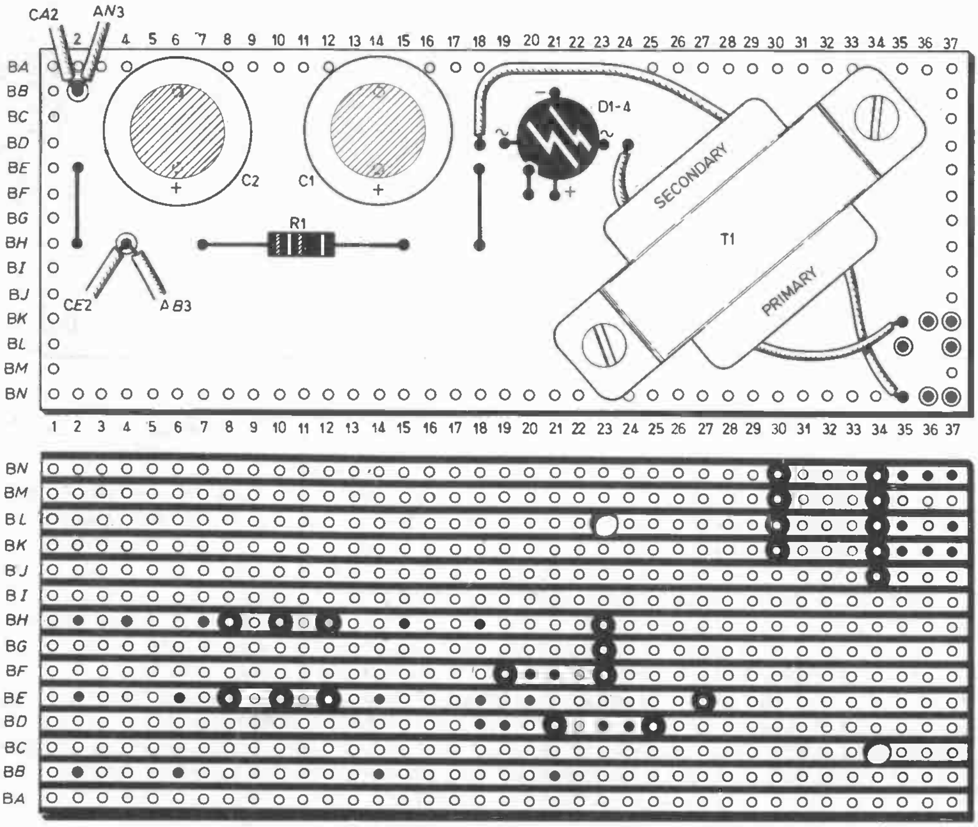
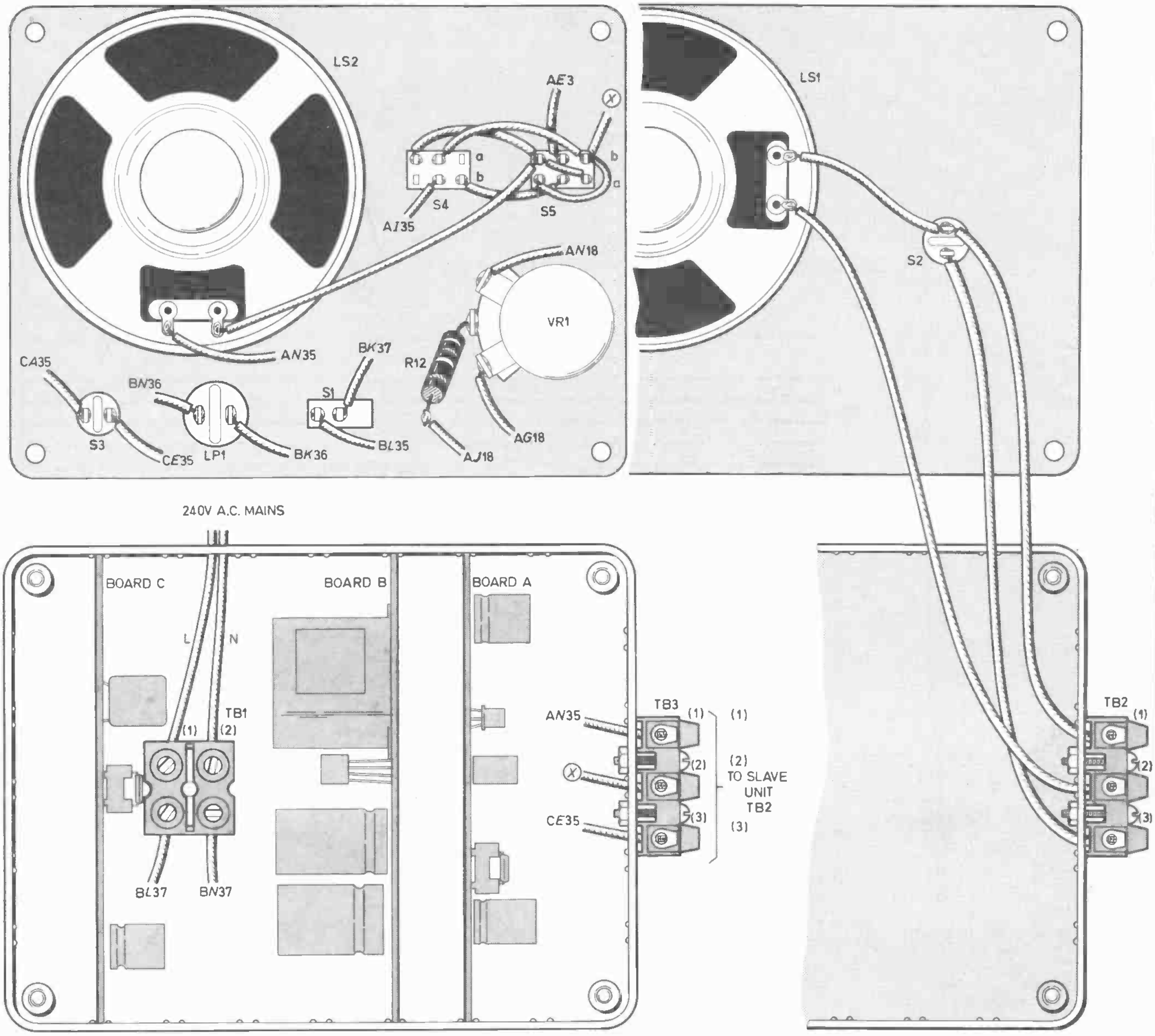


Fig. 3. Component layout and positioning of the mains transformer on the power supply board. This is Board B.



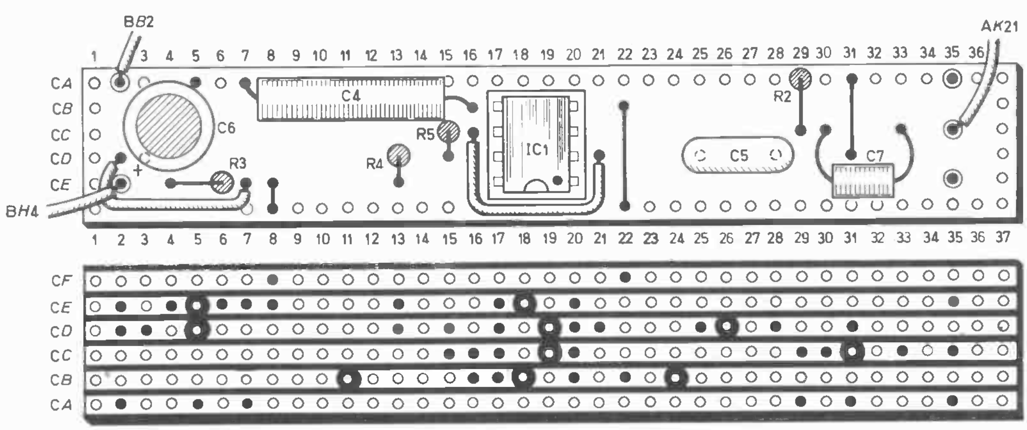
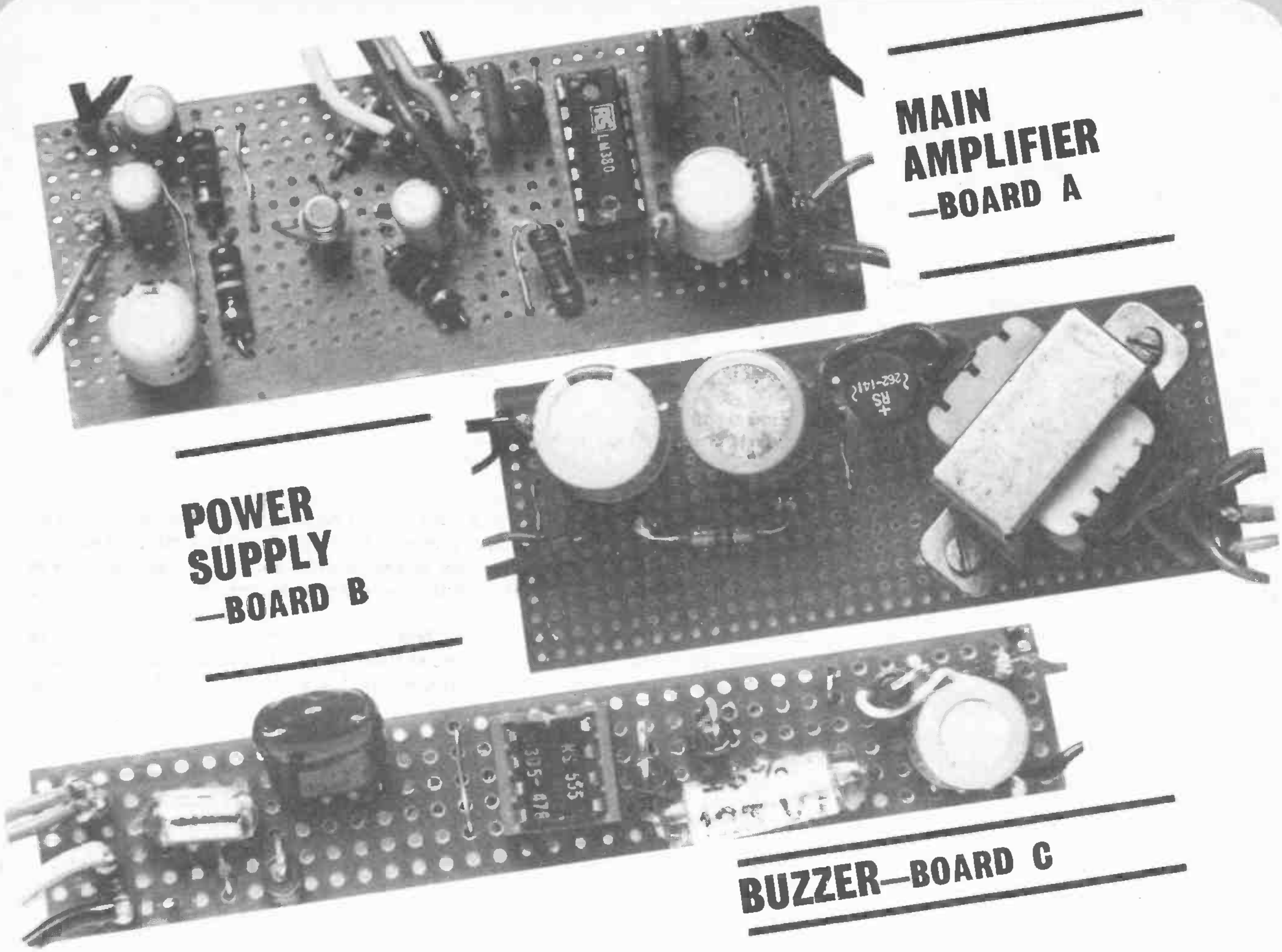


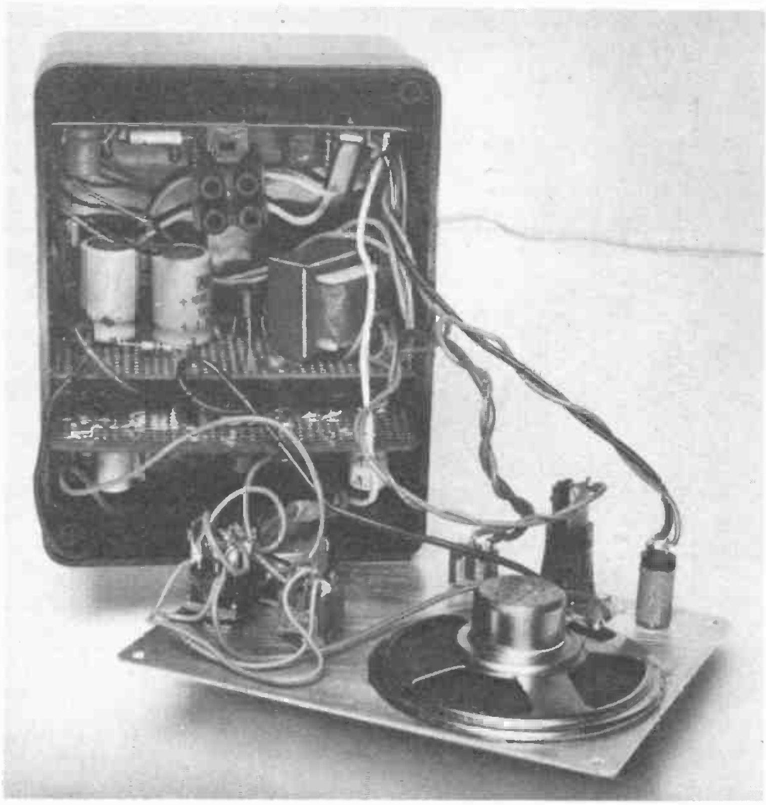
Fig. 4. (left) Buzzer board. This is Board C.

Fig. 5. (above left) Front panel interwiring and interior layout of the Master unit.

Fig. 6. (above right) Interior layout and wiring of the Slave unit.

INTERCOM





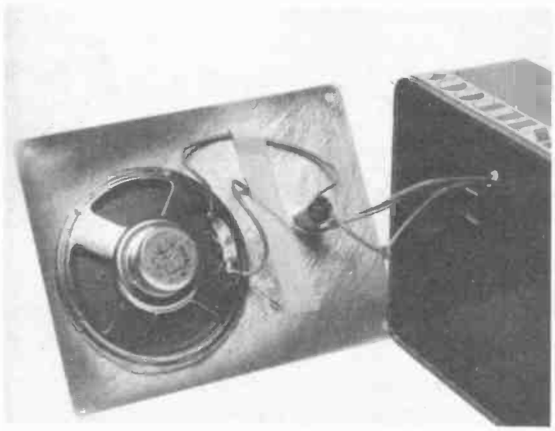


Photo left shows inside of the Master unit. The arrangement of the three circuit boards and the front panel wiring can be clearly seen. Photo above shows a similar view of the Slave unit. If can be seen that the interior of the box is empty apart from the call switch.

MASTER UNIT

When the circuit boards are all complete the Master unit can be tackled next. This is housed in a plastics box 130×100×50mm with a plastics lid (West Hyde type MIN 030). The lid should be drilled to take all the components as seen in Fig. 5 and when these have all been mounted in place, then the final inter-wiring can be completed.

If the recommended case is used then the circuit boards will slide into the moulded slots on the inside of the case. If another case is used then some other method of securing the circuit boards will have to be devised.

The loudspeaker is mounted in place behind a matrix of holes drilled through the panel and secured with Araldite or similar adhesive. Care must be taken not to get the glue on the loudspeaker cone.

Finally the Slave unit is constructed. This is built into the same type of box as the Master and should present no difficulties (see Fig. 6). Loud-speaker mounting is also the same as that for the Master unit.

The two parts of the system are joined together using twin-core screened lead. The braiding or screen forms the common earth lead, one core the signal lead and the other core the buzzer lead. This cable is joined to each unit with a three-way screw terminal block (TB2 and TB3). The accompanying photographs should make this clear.

TALK/LISTEN

The specification of S5, the TALK/LISTEN switch deserves some comment. In the prototype this is a two-pole change over switch and means that the person using the Master unit can decide which way the speech is directed, set S5 accordingly, and leave it set.

Some constructors may wish to have a biased switch here whereby the speech direction is permanently from Slave to Master unless the biased switch was held in the opposite direction. Such biased switches are readily available and connection details are identical to those given in Fig. 5.

INSTALLATION AND USE

The two units, Master and Slave, should be installed in their final positions according to how the constructor wishes to use the system. Although it is unlikely that both units will be situated in the same room, care should be taken that they are not so close as to cause feedback problems.

The operation of this intercom system is governed by the two switches S4 and S5. The TALK/LISTEN switch, S5, determines the way in which the conversation can take place. In one position Slave can talk to Master (this is the LISTEN position), in the other position Master can talk to Slave (this is the TALK position).

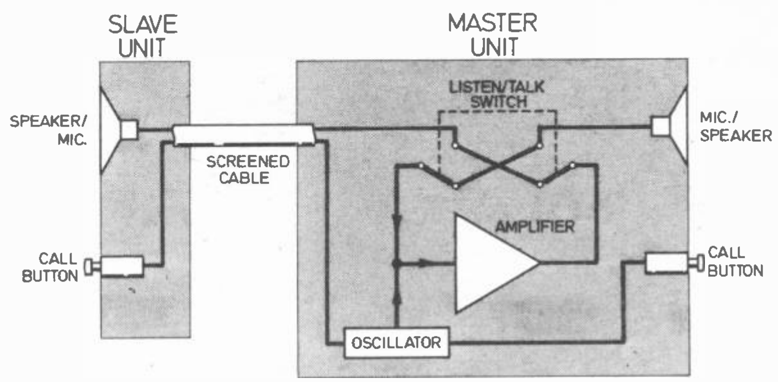
The STANDBY/TALK switch, S4, controls the buzzer. In one position the buzzer will operate and conversation cannot take place (this is the STANDBY position); in the other conversation can take place (this is the TALK position).

BUZZER

To use the system it must first be switched on with S1; S4 is set to the STANDBY position and S5 to LISTEN.

Suppose Slave wishes to talk to Master. He presses his call button S2. The buzzer sounds and to answer the call Master switches S4 to the TALK position. The call then goes ahead and at the end, the system is returned to its original state, that is all switches in their original positions.

Suppose now that Master wishes to talk to Slave. He presses his call button S3; S4 should be switched over to the TALK position and S5 switched over to TALK position after Slave answers. The call can then go ahead. Once again the system is restored to its original state afterwards. ☐

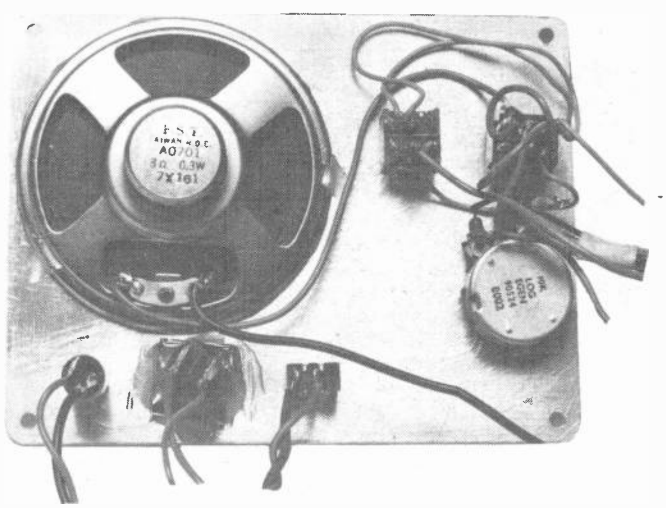


HOW IT WORKS

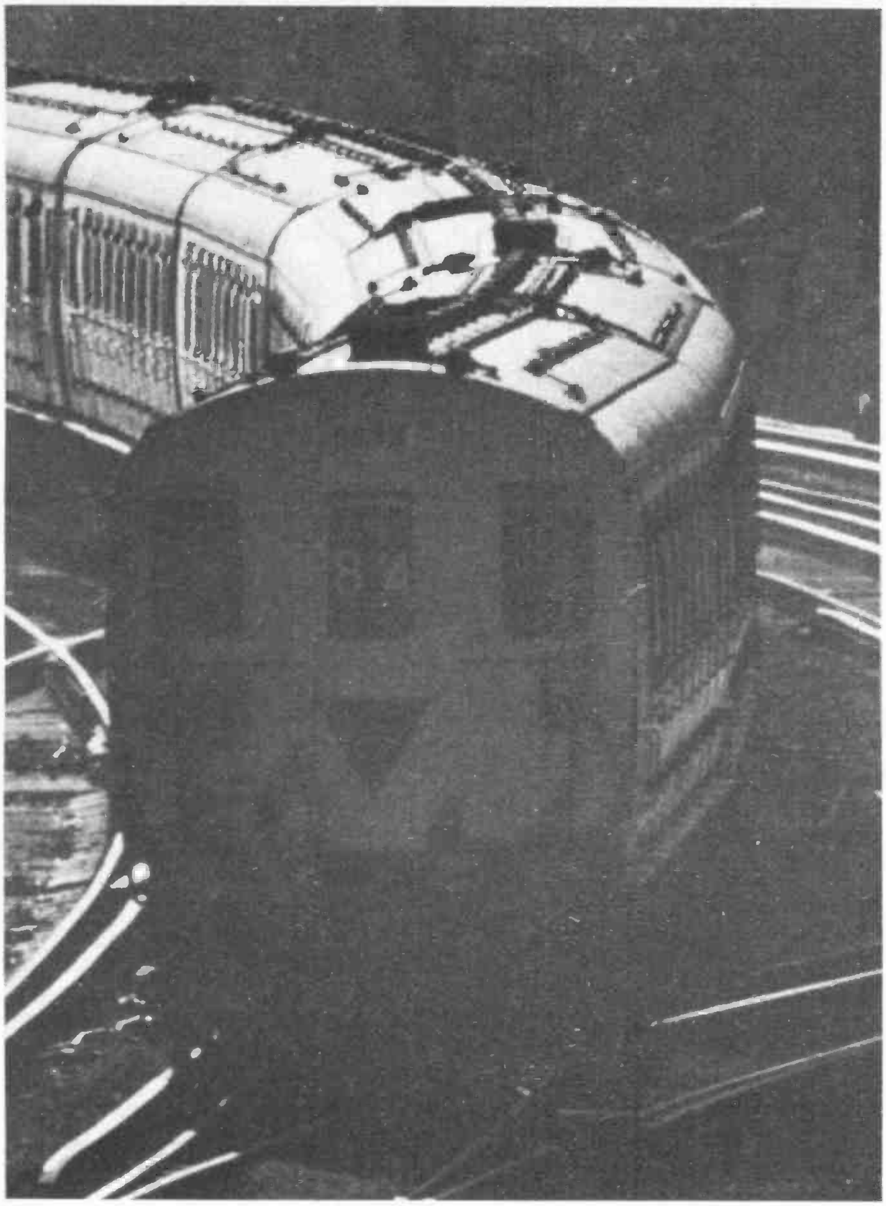
This two-station system can be broken down into several sections—buzzer, amplifier and listen/talk switch—all built into the Master unit. The Slave unit contains nothing more than a loudspeaker and call button.

The loudspeakers double up as microphones so a listen/talk switch is necessary to make sure that when one station is speaking, the other is listening.

To use the system, the call button is first pressed. This sounds the buzzer. The listen/talk switch should then be set to the appropriate position and the conversation can begin. All switch controls are situated on the Master unit.



Close up view of the rear of the Master unit front panel.



MODEL RAILWAY DEADMAN'S HANDLE

By D. LINDLEY

One of the problems associated with model electric trains, especially when using one of the more old fashioned "resistive" controllers, is that the speed control may be left just on but set too low to drive the train. This has been known to burn out the electric motor in the locomotive.

When a small child is operating the layout, he or she cannot be expected to appreciate this danger and is more likely to experience the above result.

To help avoid this happening, this Deadman's Handle has been designed. It is suitable for use with most resistive controllers and consists of a push-to-make switch controlling a relay wired between the controller and the track.

Releasing the switch will open-circuit the track supply and stop the train at any setting of the power controller. Since it could be inconvenient to keep this switch depressed all the time that the train is running, a time delay has been built in, so that provided the button is pressed every few seconds, the train will keep on running.

REALISTIC STARTING

Once the train has been stopped in this way, to ensure more realistic starting (that is to bring the controller up from minimum again rather than switch the power straight back on at say maximum voltage) an interlock has been built in. This ensures that the controller must be off before the Deadman's Handle can be re-energised to complete the controller output circuit.

An inexpensive resistive type controller is available from almost any model shop. The diagram in Fig. 1 shows how its circuit is modified so that the Deadman's Handle may be connected to it. It would be left to the constructors' discretion as to whether the Deadman's Handle is hard-wired into the controller or whether sockets are provided so that the connections can be removed.

CIRCUIT

The full circuit of the Deadman's Handle is shown in Fig. 2. With the controller rheostat set at maximum resistance (minimum speed), the junction of R1 and R2, and hence the base of TR1 will be negative with respect to its emitter. The transistor will turn on thus lighting D1. At the same time virtually maximum negative voltage appears at the emitter of TR1 which reaches S1.

Depressing S1 connects this negative voltage via R6 to the base of TR2. This transistor conducts activating the relay, RLA. When the contacts close, the controller to track circuit is completed via contacts RLA1. A second set of contacts, RLA2, completes the circuit via D2 and this bypasses TR1 and illuminates D2. Thus both D1 and D2 are now lit.

As the resistance of the controller rheostat is decreased the train will set off, the junction of R1 and R2 goes positive thus turning off TR1 and extinguishing D1, and control supplies are maintained via contacts RLA2 and D2.

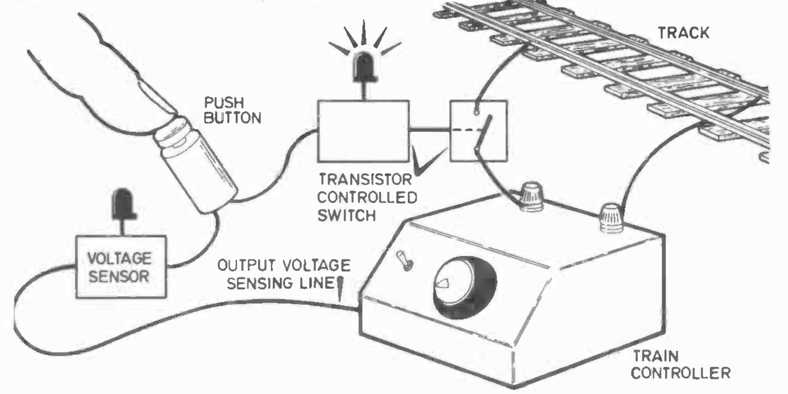
CAPACITOR

At the same time capacitor C1 will be charged. If S1 is now released while the train is running then, the charge on this capacitor is sufficient to keep TR2 switched on for a few seconds, but as the capacitor discharge current falls TR2 will turn off and the relay will de-energise stopping the train and extinguishing D2.

To restart, it will be necessary to turn off the controller.

Should S1 be depressed again before the relay has had time to de-energise then C1 will revert to its maximum charge and the train will not be stopped.

HOW IT WORKS



A transistor controlled switch is connected in series in the controller track output.

A voltage sensing line comes from the controller and goes to a sensing circuit. If the control knob is set at zero, the voltage sensor detects this, lights up its l.e.d. and produces a voltage at its output, which is connected to a push-button.

To start the train, the push-button is depressed. This activates the transistor controlled switch lighting up its l.e.d. The control knob is advanced extinguishing the l.e.d. on the voltage sensor and the train moves off.

If the button is released whilst the train is moving then, after a certain time delay, the switch will open cutting off the power to the track. The train cannot be restarted without returning the control knob to zero.

TIME DELAY

The length of this time delay is governed by components C1, R4 and R5 and the values of these were found largely by trial and error.

A low value of R5 will give a high charging current which makes the charging curve of C1 rather steep. In practice this means that different values of R5 will not make a significant difference to the time delay period provided that the value of this resistor does not become too large.

However, if the value of R5 is too large, then the current flowing into C1 will be so low as to flatten the charging curve so that C1 will not only take a long time to charge up but also the maximum base current flowing through TR2 as C1 discharges would be insufficient to saturate TR2.

In addition, R5 prevents the transistors and l.e.d.s being damaged by the maximum charging current of C1.

The function of R4 is to control the maximum charge which the capacitor can retain. With R4 open circuit the time delay is in excess of two minutes. With the value shown for R4 in circuit it is about four seconds. If the reader prefers he can replace R4 with a 50 kilohm preset and set up the time delay to suit his own taste.

A secondary function of R4 is to ensure that TR2 is turned hard off once C1 is discharged by making the base of TR2 positive via R5 and R6.

CIRCUIT BOARD

Most of the components are mounted on a small piece of 0·15 inch matrix stripboard 7 strips by 16 holes (see Fig. 3). It can be seen that the two l.e.d.s are also mounted on this board but on the "wrong" side and the method of securing the lead connections is shown clearly in the diagram, see Fig. 4.

The circuit board together with the relay and switch are all secured in a die cast box, size 115×90×55mm and the basic layout can be seen in Fig. 3 and the accompanying photographs.

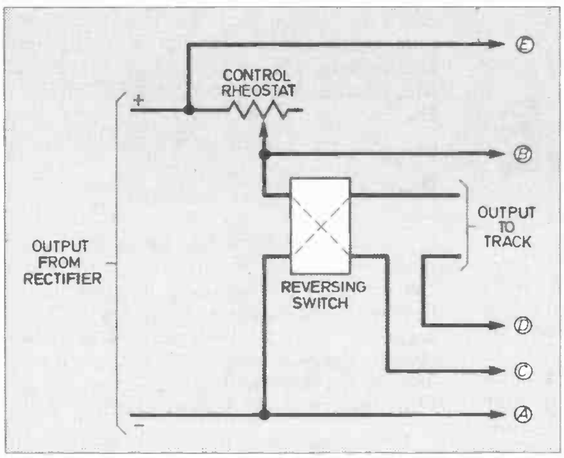


Fig. 1. Interior schematic of part of the train controller showing connection points. Some models may not have a reversing switch so follow back connections from output terminals for points *C* and *D*. Some control rheostats may have only two terminals. Point *B* is the connection that leads to the output terminals and point *E* the other terminal.

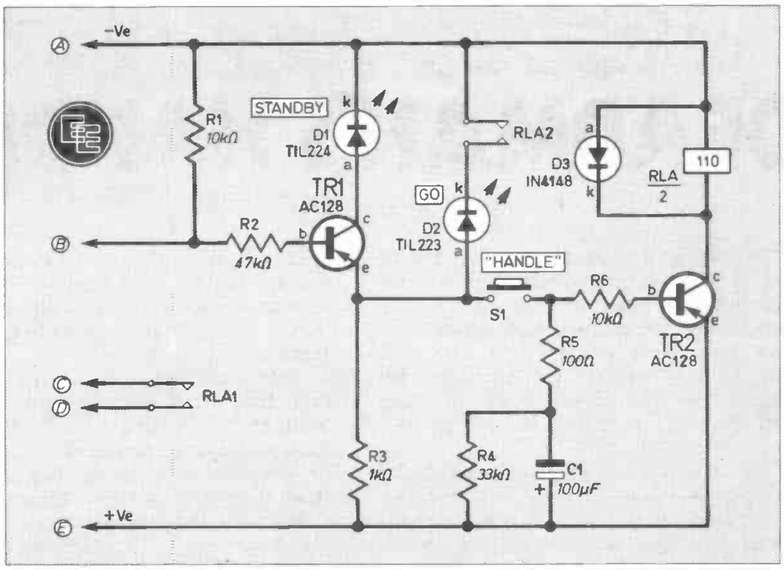
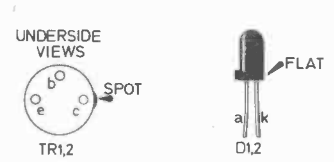


Fig. 2. Full circuit diagram of the Model Railway Deadman's Handle. Points *A, B, C, D, E* correspond with similar points marked on Fig. 1.

MODEL RAILWAY - DEADMAN'S HANDLE



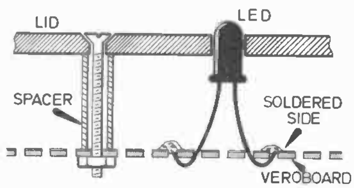
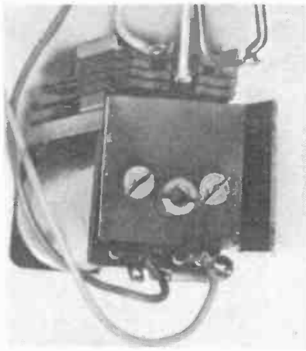


Fig. 4. Detailed view showing how the l.e.d.s D1 and D2 are mounted and also how the circuit board is secured to the box lid.



End-on view of relay contacts showing mounting bracket.

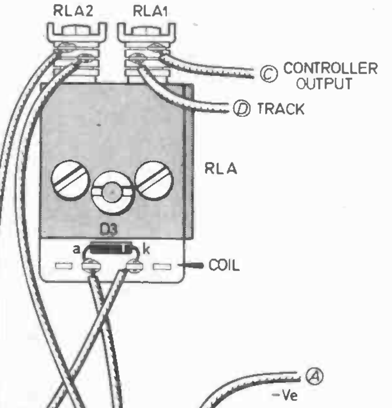
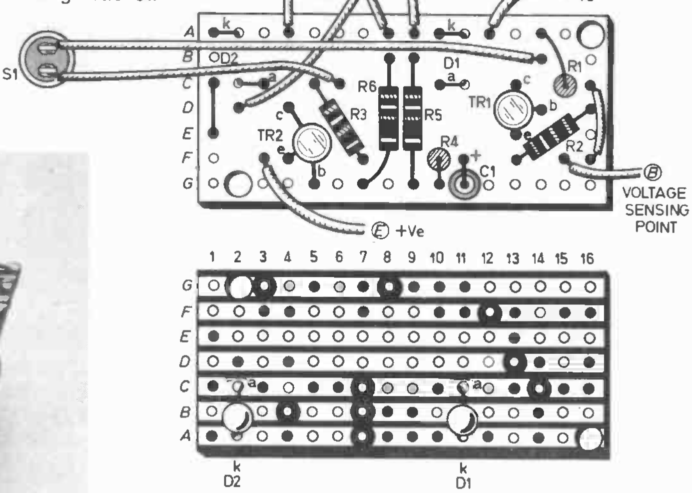
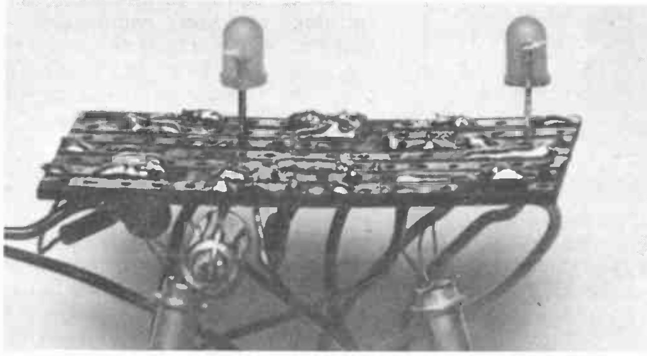



Fig. 3. Circuit board layout and component interwiring.



Close-up view of circuit board showing l.e.d. mounting. Note how the diode leads pass through the board and then returns via adjacent holes to be soldered.

COMPONENTS

Resistors
- R1 10kΩ
- R2 47kΩ
- R3 1kΩ
- R4 33kΩ (see text)
- R5 100Ω
- R6 10kΩ
- All ¼W carbon ± 5%

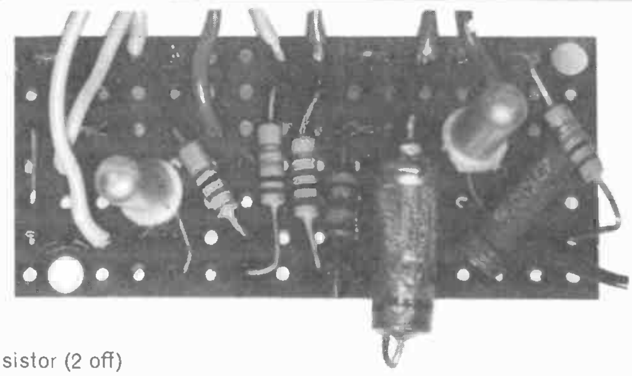
See **Shop Talk** page 247

Capacitor
- C1 100μF 16V elect.

Semiconductors
- TR1, 2 AC128 *pnp* germanium or any other similar transistor (2 off)
- D1 TIL224 yellow l.e.d.
- D2 TIL223 green l.e.d.
- D3 1N4148 small signal silicon

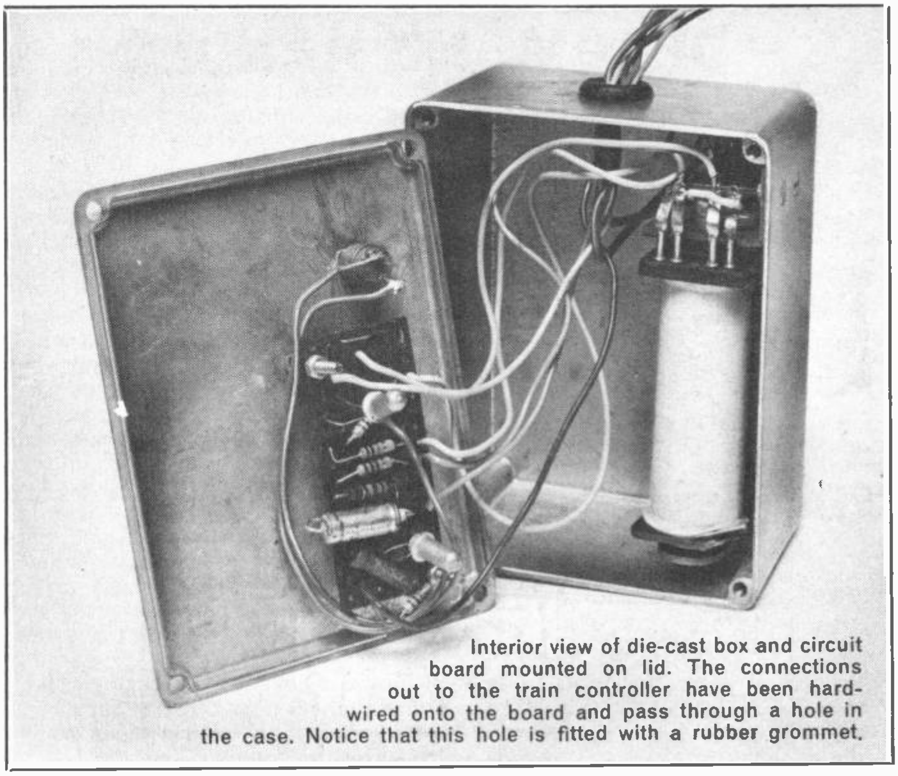
Miscellaneous
- S1 single-pole push-to-make, release-to-break
- RLA relay with 12V, 110 ohm coil, and two sets of normally open contacts rated at least 12V 5A.

Die-cast aluminium case 115 × 90 × 55mm; stripboard, 0·15 inch matrix, size 7 strips by 16 holes; five-amp connecting wire; mounting bracket and 6BA nuts and bolts for relay; 6BA nuts, bolts and spacers to mount circuit board (2 off each); rubber grommet; hook up wire; five-way screw terminal block or other connector if required (see text).



The completed circuit board.

COMPONENTS approximate cost £8·00 excluding case and controller



Interior view of die-cast box and circuit board mounted on lid. The connections out to the train controller have been hard-wired onto the board and pass through a hole in the case. Notice that this hole is fitted with a rubber grommet.

The lid should be drilled to take the switch S1 and two holes should also be drilled for the l.e.d.s. These should be drilled in such a position that when the circuit board is also mounted on the lid, the l.e.d.s will protrude through these holes.

RELAY

The relay is fixed to one side of the box with an L-shaped bracket and 6BA nuts and bolts. It would certainly be a good idea to wire up the relay before finally fixing it in place as it may be impossible to do the job any other way because of lack of space.

Finally the connections to the train controller can be installed (see Fig. 1). If you elect to hard-wire into the controller then the wires should be colour coded and cut to a reasonable length. The hole that they will pass through on the case side should be fitted with a rubber grommet to protect the insulation.

Of course the wiring that is going to carry current to the tracks should be sufficiently rated. In practice this means using 5A mains wire for connections *C* and *D*. The other three connections are simply for power supply and voltage sensing purposes.

CONNECTORS

On the other hand if you want to terminate the connections to the controller on the die cast box then a suitable connection method will have to be decided on.

Plastic screw terminal blocks are suitable or you could use 4mm sockets. Whatever method is chosen, the case will have to be drilled to take the connectors and space or rather lack of space will have to be considered.

It should also be remembered that the comments regarding wire rating made earlier still apply and any subsequent interconnecting cables will have to be sufficiently highly rated. ⌑

FLAT SCREEN TELEVISION

A PIECE OF CAKE FOR DUNDEE

A UNIQUE TV tube developed by Sinclair Research will go into production in a new plant at the Timex factory in Dundee, Scotland. One million tubes are expected to be produced per year.

These flat screen monochrome tubes will be incorporated into a multistandard Sinclair Microvision pocket TV with f.m. radio, measuring about 6 x 4 x 1in. Retailing at £50 this set will receive transmissions almost anywhere in the world, and will be powered by a small 9V battery.

The revolutionary tube, measuring 4 x 2 x $\frac{3}{4}$in, comprises two sheets of glass, the phosphor screen being coated on the rear one and is viewed through the front face from the same side that the electrons strike. The electron gun is set to one side of the screen with its axis parallel to the screen and the beam is bent towards the screen by electrostatic deflection plates.

Further applications of this unique kind of c.r.t. are likely. Sinclair foresees a three-tube projection TV with a 50in diagonal full-colour display. The optics and electronics could fit into a shoe-box-sized unit projecting onto a wall-mounted screen.

New Jobs For Scotland

The Secretary of State for Scotland welcomed these plans which are expected to create at least 1,000 new jobs. The Scottish Office has offered financial assistance towards the investment costs involved by The Sinclair Company.

The sub-contractor, Timex, has the world's largest watch plant at Dundee. This company will be installing advanced automated plant and machinery for the special processes involved in producing the new tube.

Clive Sinclair, founder of Sinclair Research, with a mock-up new multistandard flat screen television.

FREEZER ALARM

BY R. A. PENFOLD

THIS device sounds an audible alarm signal in the event of loss of mains to a freezer. Instant warning would be given of either a supply failure or the power being accidentally switched off, or if the fuse in the plug "blows," possibly saving a great deal of expensive food from being spoiled.

There are other possible uses for a device of this type and it could, for example, be used to monitor the mains supply to any other piece of mains operated equipment, in particular an item which would give erroneous results in the event of a brief mains failure passing unnoticed. This would include certain types of automatic, timing, and computer equipment. No doubt there are other situations where a unit of this type would prove useful.

THE CIRCUIT

The full circuit diagram of the Freezer Alarm appears in Fig. 1. This really breaks down into two sections; the mains circuitry and a simple battery operated tone generator circuit.

The mains cable from the freezer to its plug is interrupted at a screw terminal socket to enable a mains relay to be permanently wired across the mains supply (L and N). A normally closed contact of the relay controls the alarm generator circuit.

With the mains supply present, the relay contacts open and cut off the power to the alarm generator. If the supply fails for some reason, the relay contacts close and switch on the alarm.

It would be possible to devise a purely electronic circuit which did not need an electro-mechanical relay, but using a relay has the advantage of extreme simplicity, and of complete isolation between the mains and the battery powered part of the circuit. This last point is very important, since there would otherwise be a risk of sustaining an electric shock when changing the battery.

AUDIBLE ALARM

A simple two-transistor circuit is used to generate the alarm signal. TR1 and TR2 are both connected as straight forward common emitter amplifiers with LS1 acting as the collector load for TR2, and interstage coupling being provided by C2. Positive feedback from TR2 collector to TR1 base is provided by C3, and this gives an operating frequency of very roughly 1 kHz. Resistor R4 is included in series with C3 to limit the feedback current to a safe level.

S1 is included in series with the relay contact so that once the unit has been set off and discovered, the alarm can be turned off. C1 is merely a supply decoupling capacitor.

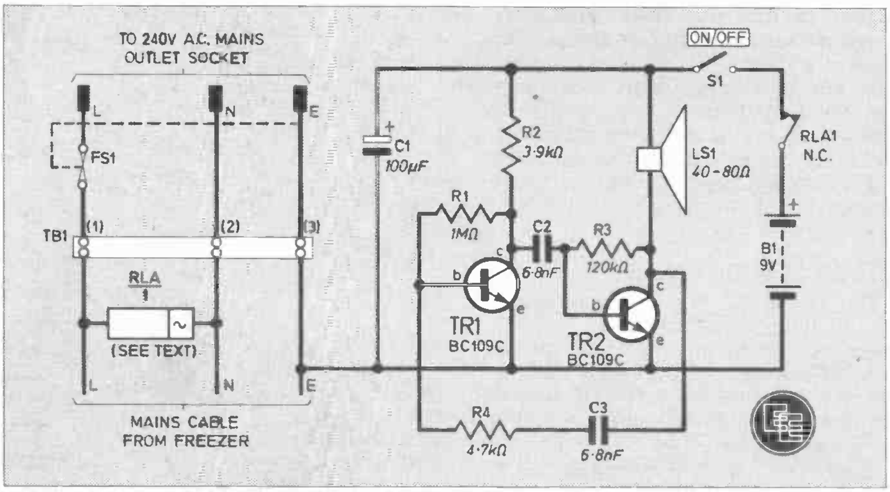


Fig. 1. The complete circuit diagram of the Freezer Alarm.

The current consumption of the unit is about 40mA from the battery supply when the alarm is activated. The PP3 size battery is capable of supplying this for very many hours, particularly the Duracell version.

Of course, under normal circumstances the mains supply is present and the alarm is switched off, giving no battery consumption whatever. Thus the battery should have its shelf life of many months, and the unit is very economical to run.

The amount of power consumed by a normal mains relay is also very small and insignificant.

CONSTRUCTION starts here

CIRCUIT BOARD

The circuit, with the exceptions of S1, LS1, and the relay, is constructed on a 0·1 inch pitch stripboard measuring 21 holes by 10 strips. As can be seen from Fig. 2, there are no breaks in any of the copper strips, and construction of the board is quite straightforward.

The two mounting holes are 3·3mm in diameter and will accept either M3 or 6BA mounting bolts.

A plastic Verobox having approximate dimensions of about 180 x 110 x 55mm is used as the case for the unit, or any plastic box of about this size should be suitable.

A speaker grille is made on the front panel of the case. This merely consists of a matrix of holes about 3 or 4mm in diameter. The speaker will almost certainly have to be glued in place as few miniature types have provision for screw fixing. Use a good quality adhesive such as an epoxy type, and be careful not to smear any onto the diaphragm.

Probably the best way of mounting the relay is to glue it in position. Again, a good quality adhesive must be used.

ASSEMBLY DETAILS

The layout of the components on the stripboard is shown in Fig. 2. There are no breaks required on the underside strips. Assemble the components in any order and attach suitable lengths of flying leads to reach the remote components.

The board in the prototype was mounted on the lid of the case by means of 6BA fixings, and 5mm long spacers were used to hold the board clear of the lid.

The exact positioning of the components and mains cable inlet holes is not critical and may be altered to suit the position of the freezer relative to its power socket. The arrangement to suit the author's requirements is seen in Fig. 2, and its wiring is mainly straightforward.

However, be very careful to connect the relay correctly, especially if it is of a different type to that employed on the prototype unit. A mistake here could cause either a short circuit on the mains supply, or the mains supply to be connected to the battery operated part of the circuit!

A small metal bracket to hold the battery in place can be fabricated from aluminium, or alternatively a piece of double sided tape can be used to fix it in place as was used in the prototype.

With all the components secured in place interconnect them, and wire up to the board according to Fig. 2. Note that if a relay type other than that specified is employed, then the base connections are almost certain to be different to that shown here, and must therefore be ascertained.

TESTING

In order to test that the unit is working, after a final check of all the wiring has been made, it is merely necessary to ascertain that the alarm sounds when the unit is

COMPONENTS

See Shop Talk page 247

Resistors
R1 1MΩ
R2 3·9kΩ
R3 120kΩ
R4 4·7kΩ
All ¼ watt carbon ± 5%

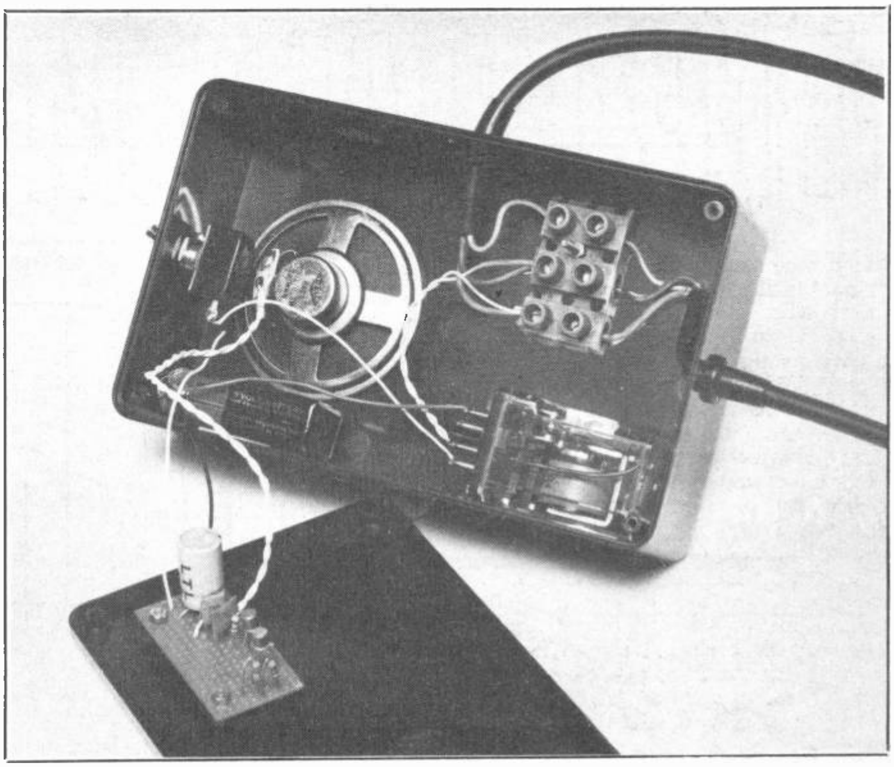
Capacitors
C1 100µF 10V elect.
C2 6·8nF ceramic plate
C3 6·8nF ceramic plate

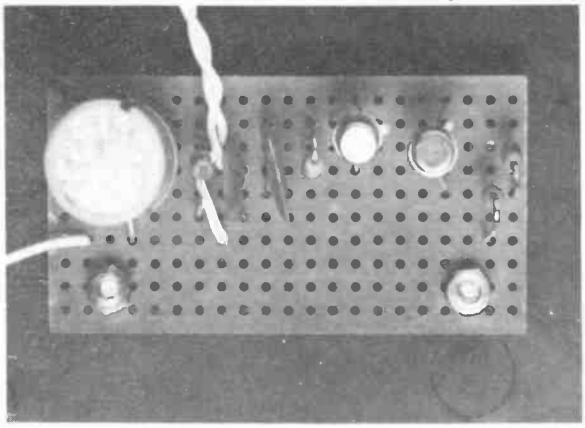
Semiconductors
TR1, 2 BC109C *npn* silicon (2 off)

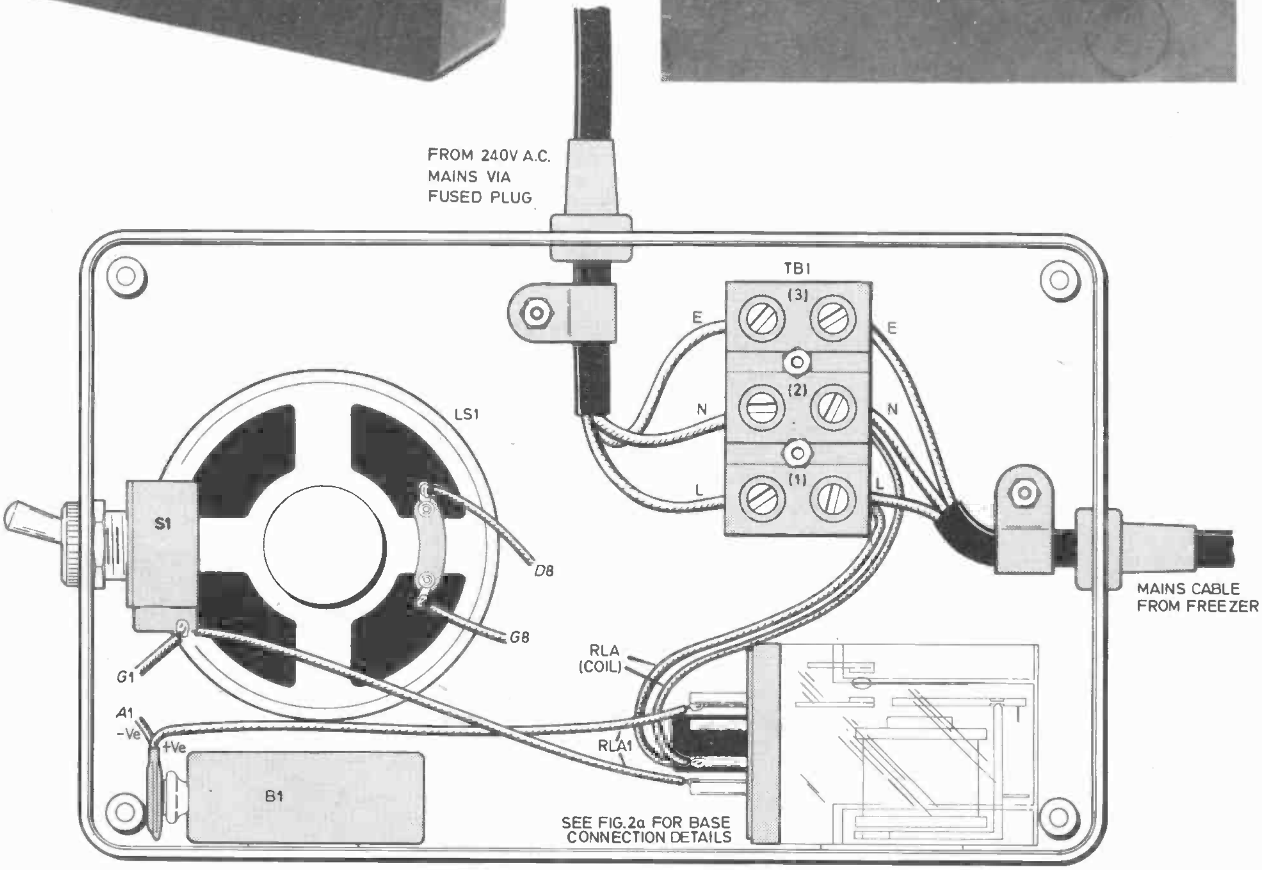
Miscellaneous
S1 single pole on/off toggle
RLA mains relay, plug-in octal type with at least one set of normally open contacts (RS 348-762 used in prototype, has 2 sets of changeover contacts)
LS1 miniature moving coil loudspeaker, 40 to 80 ohms
B1 9V type PP3
TB1 3-way screw terminal block
Stripboard: 0·1 inch matrix size 10 strips × 21 holes; battery connector to suit B1; suitable lengths and rating of 3-core mains cable; 6BA fixings and 5mm long spacers; case, Vero type 202-21391 A.

Guidance only Approx cost **£9·50** complete

The completed prototype. This does not have the latching facility incorporated.







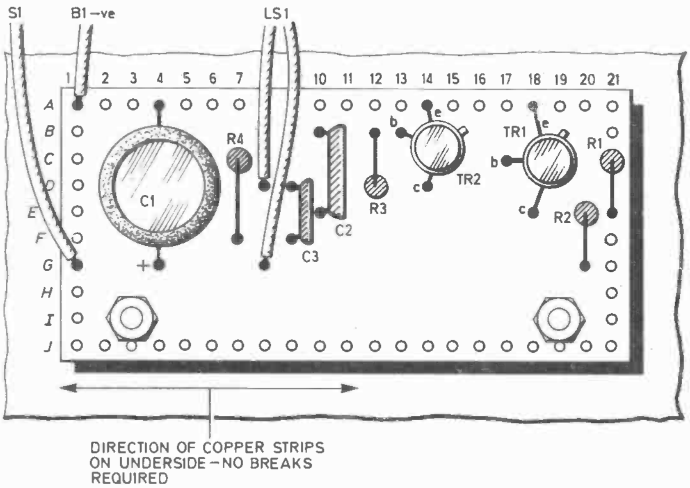


Fig. 2. The layout of the components on the circuit board and interwiring of the remainder of the components mounted in the case.

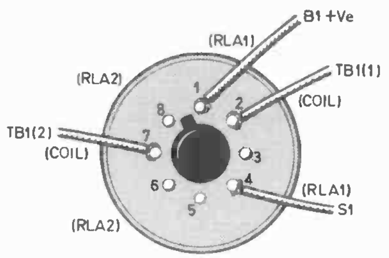


Fig. 2a. Shows the connections to the base of the specified relay.

not connected to the mains, and ceases when it is plugged in.

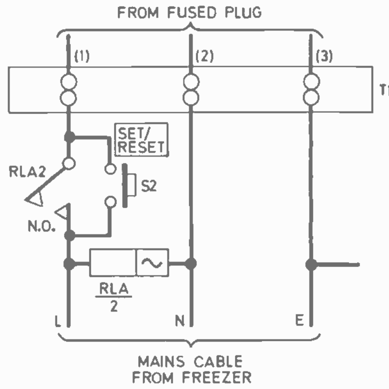
Always unplug the unit from the mains when renewing the battery. Alternatively, a battery compartment that would permit the battery to be changed without removing the rear panel of the case can be obtained and might be a worthwhile proposition.

In some situations, such as where a freezer is mounted in an outbuilding, it would probably be beneficial to have the loudspeaker remotely located from the rest of the unit, and fitted in its own case. It is quite acceptable to do this, and no problems should arise even if a connecting cable many metres long is used.

LATCHING OPERATION

In some applications it may be necessary for the unit to activate the alarm continuously even if there is only a brief pause in the mains supply. Otherwise the unit would only give a very short alarm signal in this occurrence, which might well be missed.

Where necessary, this latching action can be provided by modifying the circuit as shown in Fig. 3a. Here a second relay contact (RLA2), of the normally open type, is used to disconnect the mains supply in the event that the supply fails and the relay de-energises. Thus, when the mains supply is restored the relay is not activated again. S2 is needed to SET the unit when it is initially turned on. It simply connects the mains supply to the relay so that contacts RLA2 close, maintaining the supply to the relay once S2 is released.



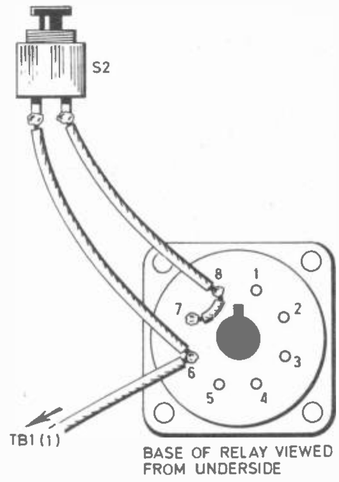


Fig. 3a. Modifications to the circuit diagram to incorporate a latching action; 3(b) right, additional wiring to be carried out to realise the latching action.

Switch S2 can also be used to RESET the unit when it has been triggered and the mains supply has been restored. If pressing S2 fails to reset the unit this simply means that the mains supply is still absent.

The *additional wiring* to be made to the wiring in order to obtain the latching action is detailed in Fig. 3b.

Just a Hiccup

By now my readers know my weakness for knocking computers, so I will preface what I am about to say with this, that it is obvious to everyone that no modern country or large organisation could be run without their aid. At the same time one must never forget that they are only as good as their programmers and that in addition they do suffer from the usual faults inherent in any electronic apparatus.

This was brought home to me forcibly about three days ago, when I had a letter from the VAT people, threatening to dismember me and use my skin for lampshades. The cause of their displeasure was the assumption that I had not paid their September quarter. Having checked and found that my cheque was sent on December 15 and had already been cleared by my bank, I telephoned to remonstrate with them. The official said "Ah! Yes the computer must have hiccupped!"

This left me with the dreadful thought, that a bad joint somewhere on a computer could start a global nuclear war! I would like to think that the wizards who invented these machines are concentrating on a way to make sure that when they fail, they fail "safe" and announce to the world loud and clear (particularly the operators) that they are malfunctioning. Mind you I cannot deny they are fascinating little beasts.

In Russia they are taking over a large amount of diagnostic medicine, and to think that they can actually play chess! They are not yet capable of beating the champions, as they can only think five moves ahead and a top player thinks at least ten.

Components to Computers

I now move on to the more worrying aspect, from the home constructors angle. In the last year, at least three of my colleagues have decided to drop components and go into computer hardware and software.

I know it is very tempting for any components retailer like myself, especially when I think of them selling items at three figures, while I am struggling to sell a few sixpenny resistors. You will also hear a deep sigh when see them going off on their Caribbean cruises while I am wondering whether I can afford a week with British Waterways. However I know I shall not change direction, because my heart would not be in it, but I just hope that not too many of my friends will follow their example!

Bio-electrics

I am always very intrigued by the medical effect of electricity on the human body. For example, now we know that the muscles, heart and brain are all electrically operated. What effect do huge discharges of current, such as a thunderstorm have on them? I know my wife usually feels queer whenever a storm is around. I offered to fit her with a lightning conductor, but although I was joking I know her case is by no means unique.

I think this is a huge field that could be seriously studied, in other words, what deleterious effect does it have on the human body and could it be used to make us feel better instead of worse? I wonder if I have any doctors among my readers. I only know of one, my youngest son, who would regard it as a filial duty to read my articles, but unfortunately he happens to be a Doctor of Philosophy which doesn't help at all.

After sales service

We sell a small kit of parts to make a radio receiver and have been selling it for over ten years. Quite recently I had two returned by cutomers. I have never refused to help a customer when they are really stuck and in each case I found incorrect wiring and a faulty transistor. My query is this. Am I obligated other than morally to help them and am I entitled to charge for the time spent? My own feelings are that the answer is "Yes" in both cases.

ELECTRONIC SWITCH FOR STARTING INDUCTION MOTORS

K. LANGFORD

SINGLE phase mains voltage a.c. motors of fractional horse power rating appear in many and varied designs but, apart from a few serving specialised applications, fall into two basic types: brush motors, some of which are called "Universal" when designed to run on either a.c. or d.c., and induction motors which run only on a.c.

BRUSH MOTORS

Brush motors have windings on both field (stator) and armature (rotor), contact to the moving member being made by copper/carbon brushes rubbing against a segmented copper commutator. Such motors have a very high power to size ratio and an excellent starting torque, finding many applications in the household for driving vacuum cleaners, food mixers, lawn mowers, portable power tools and so on.

The rotor winding may be either in series with those on the stator (series wound) which is usual with mains voltage machines or in parallel where they are encountered in low voltage applications for driving models.

This type of motor is self-starting and may be reversed by changing the polarity of the rotor with respect to that of the stator; their speed may be controlled using a triac.

INDUCTION MOTORS

Induction motors have a field winding and a solid (actually laminated) rotor without any wiring. Rotation is induced by the fluctuating field in the rotor caused by the repeated changes in direction of the a.c. in the stator.

Such motors are heavy and robust in construction, have a poor starting torque but in the absence of brush gear need little maintenance apart from periodic lubrication.

They are frequently used to drive stationary power tools such as lathes, millers and drilling machines and for refrigeration pumps together with other light engineering applications where a three phase supply may not be available.

In general such motors can be designed to be reversible but with one exception are not self-starting, the odd man out being the shaded-pole type which has very poor starting torque and low electrical efficiency and is suitable only for light duties like driving tape decks, record players, and small ventilating fans.

The shade rings, which distort a portion of the field in the stator, induce rotation and are fixed at the time of assembly. These motors are not reversible.

STARTER WINDING

The other types of induction motor are all very similar to each other in requiring some artificial method of starting but once started will run in either direction, speed of rotation being a function of the mains frequency.

To start such a motor electrically as opposed to mechanical priming, it is necessary to convert it briefly into a two phase machine. This is achieved by including on the stator a second set of windings (starter or subsidiary windings) which are fed by a current out-of-phase with that in the main (running) windings. Reversal may be easily arranged by changing the polarity of the starter windings with respect to those on the stator using a heavy duty d.p.d.t. switch. Such motors are generally referred to as split-phase types.

The out-of-phase current is normally provided in one of two ways; by means of a capacitor in series with the starter windings which causes a leading current to flow in them or, by altering their inductance by using wire of different gauge and arranging the number of turns so that a phase shift is created.

Since many of these motors are used in power applications they may need a high starting torque for example when driving compressors. This requirement is satisfied by designing the starter windings to draw a heavy current, perhaps up to four times the running current for a brief period until the motor reaches top speed.

CENTRIFUGAL SWITCH

To cut out the subsidiary windings a centrifugal switch is fitted inside the motor. This consists of movable weights attached to a fixing on the shaft and these fly outwards as the speed builds up.

A suitable linkage mechanism allows the action of the weights to open the normally closed contacts of a switch so isolating the starter windings. When the motor is switched off, spring pressure restores the weights and the switch contacts to their original positions ready for the next start.

Readers will appreciate that the switch contacts have to break a heavy inductive or capacitive current (perhaps 10 amp) depending on the type of motor. Destructive arcing and consequent contact burn is quite common.

Many such switches fail long before the motor reaches the end of its useful life, usually because the linkage mechanism wears or the contacts burn out. The author experienced such a failure on a one-third h.p. motor driving a 3½ inch lathe.

Returning such a motor to the makers is precluded by transport costs while spare parts are frequently unobtainable due to obsolescence. An alternative was sought and after some experimenting the circuit below was evolved to function in place of the switch, the latter being removed from the motor.

CIRCUIT DESCRIPTION

The unit described here works equally well for motors with a capacitor in series with the starter windings (capacitor start) or for those relying on different inductances to give the phase shift and is applicable to either reversing or non-reversing motors.

The circuit diagram is shown in Fig. 1. To avoid mechanically breaking the heavy currents involved a triac is used, the gate current (less than 20mA) being controlled by a reed switch.

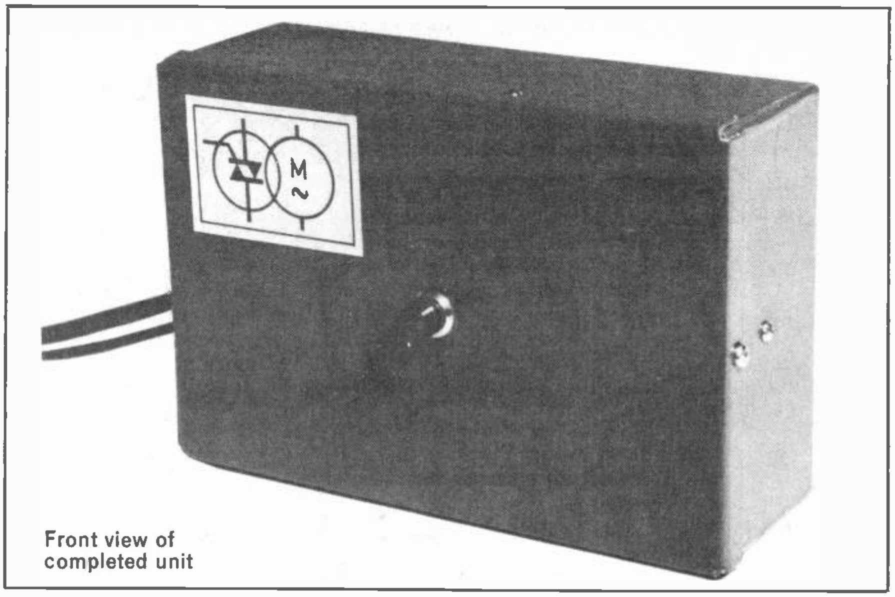
The motor should reach full running speed after about 1 to 2 seconds after which time the starter winding is no longer required. This on-time is set by the time constant of the timing circuit, R1 and C2.

Any transistor with a gain of at least 100 is suitable. The higher gain of TR1 the smaller the timing capacitor needed.

Resistor R1 cannot be greatly altered since sufficient base current must flow to provide the minimum collector current to operate the reed coil.

A reed switch is preferred to a relay as the former is small, totally enclosed and capable of several million operations.

Any transformer capable of delivering about 12V after rectification and smoothing is suitable. Battery operation is uneconomic since the drain is about 20mA while the motor is running and separate switching for the a.c. and d.c. would be needed.



Front view of completed unit

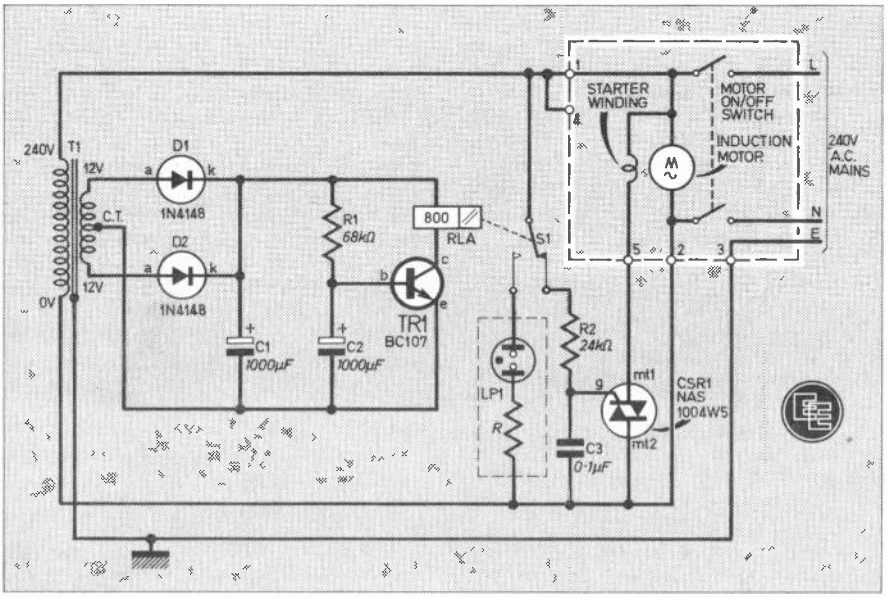
A 10A triac will cover most requirements but if in doubt measure the a.c. load on the starter windings with the motor stalled.

D.C. VOLTAGE

The required d.c. voltage is derived from a step-down mains transformer with centre-tapped secondary to provide full-wave rectification with D1 and D2. C1 smooths the resulting pulsed d.c. to provide a smooth d.c. level of about 16 volts. A highly smoothed supply is not required.

When the motor master on-off is turned on, power is applied to the starter winding through CSR1 which is triggered into conduction via the normally closed contact in S1.

Fig. 1. Circuit diagram of the Electronic Switch.



The d.c. applied to the timer circuit, causes C2 to charge up through R1. Initially C2 is discharged and so the voltage at TR1 base is at 0V, consequently TR1 is turned off, and no current flows through the relay coil. After about 1 to 2 seconds the voltage at TR1 base reaches 0·6V and base current flows.

As soon as base current flows TR1 is fully turned on and collector current passes through the operating coil of the reed switch and the latter changes over.

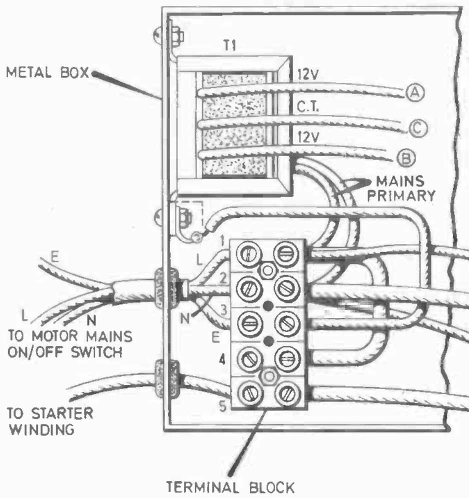
REED CONTACTS

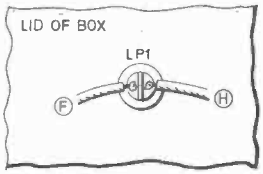
As soon as the reed contacts open, the triac is deprived of gate current and the starter windings are cut out of circuit. Thus the short time delay of the R1/C2 combination has an identical function to that of a centrifugal switch.

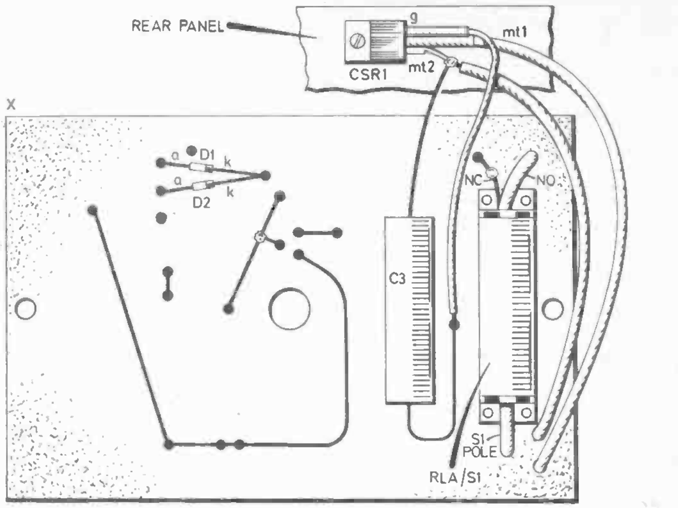
The normally open contact closes and switches on a mains voltage neon indicator lamp which acts as a fail safe indicator. Should the motor start and the neon not light then it has either burnt out (rare) or the reed has stuck leaving the windings in circuit. The motor should immediately be switched off and the fault investigated otherwise the subsidiary windings will overheat and ultimately fail.

For most motors a time delay of about 1 to $1^1{}_2$ seconds is ample for speed to build up. For a machine started on full load, two seconds may be desirable. Longer time can be arranged by increasing the value of C2 keeping R1 as given.

If R1 is increased, a point will be reached at which, for any particular transistor, insufficient collector current will be passed to operate the reed. Thus the higher the gain of TR1, the greater the permissable value of R1 and the smaller the timing capacitor C2 which may be used.







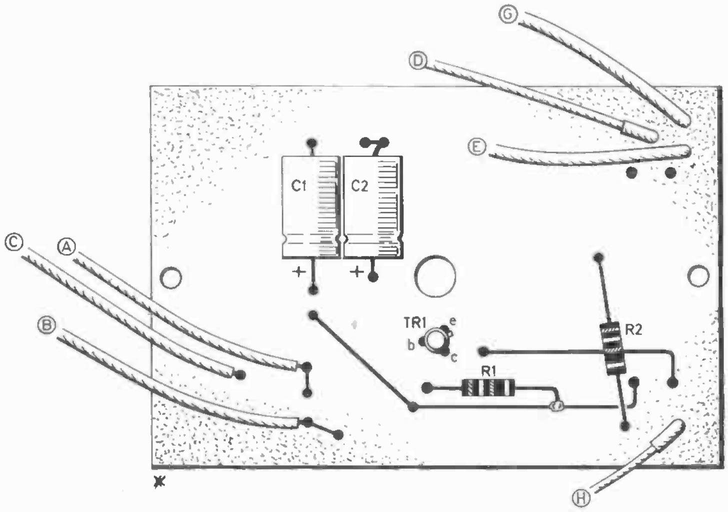


Fig. 2. Interwiring details. Topside of the board is seen at the top of the page with underside below.

COMPONENTS

See Shop Talk page 247

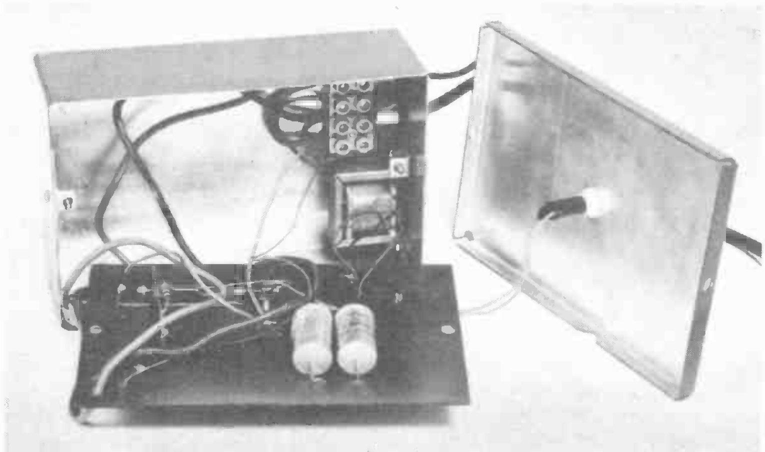
Resistors
R1 68kΩ ½W
R2 24kΩ 3W
Both carbon ±5%

Capacitors
C1 1000μF 25V elect.
C2 1000μF 25V elect.
C3 0·1μF polyester

Semiconductors
TR1 BC107 *npn* silicon
CSR1 NAS1004W5 400V 10A triac
D1, 2 1N4148 small signal silicon diodes (2 off)

Miscellaneous
LP1 Panel mounting mains neon indicator with integral resistor
RLA 800Ω reed operating coil
S1 single-pole changeover dry reed switch
T1 miniature mains transformer with 12-0-12V 250mA secondary
Metal case, 150 × 105 × 55mm; piece of s.r.b.p. board, 105 × 150mm; five-way 10A screw terminal block; four-way 10A cable or equivalent; 10A single core cable; stranded interconnecting wire; 6BA nuts and bolts (6 off); fixing brackets.

Approx. cost Guidance only £12·50



Interior view showing board displaced. The transformer and underside of the component board can be clearly seen.

CONSTRUCTION starts here

HYBRID

From Fig. 2 it can be seen that the circuit is something of a hybrid, a.c. mains and 12V d.c. being intermingled, and although many layouts are possible, the one chosen aims to keep apart the 240V and 12V circuits as far apart as practicable. Readily available components are employed throughout.

The circuitry is housed in an AB13 aluminium box 152 × 102 × 51mm with the centre portion kept free of components and wiring so that if desired the neon indicator may be mounted in the centre of the lid, space being available for the body of the lamp.

Those wishing to mount the neon separately will need an extra grommet hole to take out the lead wires. The box lid will not then be drilled.

First drill the two grommet holes for the three mains leads live, neutral and earth and the single lead from the starter windings of the motor. Next mount the transformer as near to one bottom corner of the box as is practicable leaving 2 or 3mm clearance. Use 6BA bolts for attachment.

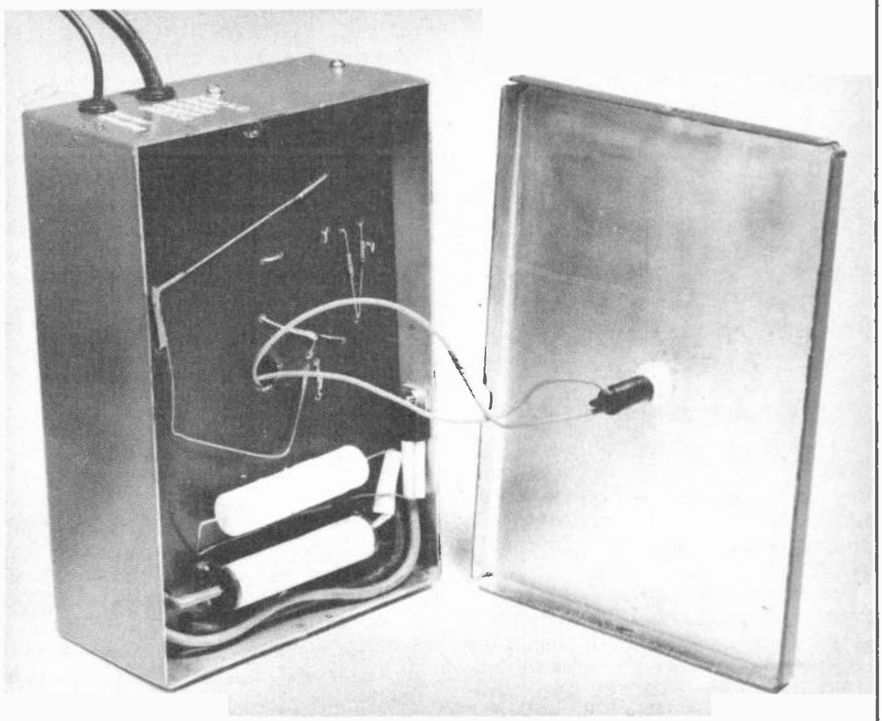
The diagram shows the transformer mounted horizontally from one end of the box leaving space above for the other components. Again 6BA clearance holes are used in the brackets.

Now drill two more holes in the bottom of the box for fixing the five-way 10A terminal block. If placed in a position near to that illustrated then space is left for the two capacitors beneath the circuit board. If countersunk headed 6BA screws are at hand this will give a neater job leaving no protrusions on the base.

A final hole is needed for the triac which is mounted 50 to 60mm from the end of the box remote from the transformer and just under the top edge. A 4BA or 6BA bolt and nut will be required.

CIRCUIT BOARD

Now cut a piece of plain s.r.b.p. board approx 150 × 100mm and drill two holes to coincide with those in the angle bracket. Since the brackets are inaccessible with the board in position attach a 6BA bolt to each using Araldite under the head so that the thread is upwards allowing the circuit board to slip on and be finally fixed with two nuts.



Interior view of the unit showing mounting position of CSR1, circuit board, and reed operating coil.

Now drill the board for all the components in the approximate positions indicated. A No 55 drill is a useful size but is not critical. If the neon is to be mounted in the box lid make a generous clearance hole in the centre of the board to accommodate the body section.

Finally make two holes to take the mains leads from the two anode leads on the triac, close to each corner of the board. The triac specified needs no separate heat sink or mounting set and is insulated internally so that the box itself will conduct away any heat generated during the brief period it is switched on.

Mounting points for components or flying leads may be provided where needed by drilling two holes about 5mm apart and threading through a piece of copper wire and soldering the free ends to make a closed loop.

This may be easier for the novice than attempting the drill to the exact size for mounting pins. Perforated s.r.b.p. could be used in place of the panel used by the author if desired.

The reed coil needs special attention and is best attached by drilling suitable clearance holes, passing the connecting lugs through and twisting a loop of tinned copper wire round each.

If a generous blob of solder is now applied the coil is held rigidly in position. Attach and wire up all the components except the triac using their own leads where possible and stiff tinned copper or insulated wire for longer connections.

FINISHING OFF

All components should be rigidly fixed and there should be no loose wires. To make wiring easier do not solder the flying leads from the transformer secondary until everything else is in position.

Use sleeving for any crossing connections or for those in close proximity. Next tackle the triac. For the mt1 and mt2 connections which may carry up to 10A use stranded wire such as 10A household cable.

Tin the leads well and fix a length of this cable to the anode tags of the triac then run on a length of sleeving to give complete insulation from each other and from the side of the box.

Next solder on the gate connection (20mA load only) using thin flexible insulated wire, again adding sleeving for insulation at the solder joint. Connect the loose ends of the triac leads to the terminal block. Finally solder the three transformer secondary leads into their correct positions, mount the triac on the box and the unit is ready for test.

TESTING

Firstly check all connections very carefully, then connect a low wattage mains lamp to terminals 4 and 5 on the terminal block and a three core mains cable to terminals 1, 2 and 3 according to Fig. 2. Be sure that the earth link between terminal 3 and the transformer is in place.

Now switch on the mains. If the wiring is correct the lamp will light for between one and three seconds, extinguish and then the neon will light.

Switch off, wait for about ten seconds and try again. This time the time will be shorter due to the fact that C2 will be still holding some of its charge.

Only if everything is satisfactory can the device be wired to the motor. In the event of the reed relay not working either the position of the reed within the coil is incorrect, or the gain of the transistor is too low to allow sufficient current to flow into the coil.

INSTALLATION

There are two types of motor with which this device can be used, non-reversing and reversing. In either case before any work commences, the motor *must* be isolated from the mains.

For a non-reversing motor the first step is to remove the terminal cover on the motor itself and disconnect the mains supply noting carefully to which terminal each of the three mains leads is attached.

Loosen the terminal block by removing the retaining screws and identify the wires attached to the other side. There should be two to the starter windings via a capacitor, if fitted, and two to the main running windings.

One of the two starter winding leads will go via a centrifugal switch to the starter winding itself, the other will usually be connected in common with one of the running windings.

Disconnect all the wires that were connected to the back of the terminal block apart from any earth terminals and connect the common lead to the terminal that carried the mains "live" lead.

Locate the other running lead, using a bulb and battery to establish continuity if necessary, to the terminal that carried the "neutral" mains lead.

CENTRIFUGAL SWITCH

When this is completed, remove the motor end casing to expose the old centrifugal starter switch. Remove as much as possible of this switch, particularly any loose moving parts attached to the shaft but ignoring rigidly fixed rotating parts. Interfering with these could upset the balance of the shaft.

At this stage the second wire from the starter winding will have been located. If the motor uses a capacitor to provide phase shift then this will be attached to this lead, and any connections should be made via this capacitor.

A piece of 10A stranded wire should be attached to the second starter winding lead. The other end of this is attached to terminal 5 on the terminal block in the starter unit.

TERMINAL BLOCK

The final step is to refix the terminal block on the motor in position and reconnect the mains cables in the same positions. Mains leads should also be taken to the terminal block in the new starter unit and connected to the appropriate terminals; terminal 1 for live, 2 for neutral, and 3 for earth. These can be taken from the mains connections on the terminal block on the motor.

It now only remains to find a suitable mounting position for the starter unit not too far from the motor it is operating. The interwiring consists of mains rated 10A cable. Four-core cable would be ideal but as it is somewhat difficult to get hold of, ordinary three core plus an additional wire will suffice.

Whichever wiring is used it should be neat and not excessively long or untidy.

REVERSING MOTOR

In the case of reversing motors the principle is the same but the presence of a reversing switch complicates matters. You will find that there are four leads plus earth running into the motor terminal block from the reversing switch. Two are direct mains, and the others have their polarity changed by the reversing switch.

As described above, identify all four leads from the windings and their locations underneath the block, remove the centrifugal switch and lengthen the lead from the starter winding.

Connect one lead from the running winding to the "live" position on the motor terminal block and the second to the "neutral" position. Note that there will be no common lead.

Since "live" and "neutral" have no real meaning in a.c. work, call one of the reversing wires *A* and the other *B* for identification.

Connect the unlengthened starter winding lead to position *A* under the block. No connection is made to *B*.

The lengthened lead is then either taken directly to position 5 on the terminal block in the starter unit or via the capacitor on the motor, if fitted, to the same place.

Reconnect the two reversing leads on the outside of the motor terminal block to positions *A* and *B* and reconnect the power leads and mains lead to the new starter unit as described above. The switch is now ready for use.

If, during testing, the motor is found to run backwards then reverse the leads to the reversing switch in the motor. This will ensure that the markings on the reversing switch are correct.

LIMITATIONS

Although this electronic device is an excellent substitute for a centrifugal switch one snag should be appreciated. Since the timer capacitor only loses its charge slowly about ten seconds must be allowed after switching off the motor before another start is possible.

This is no hardship since this type of motor is never recommended for frequent start/stop duty and machines where this is required normally incorporate a clutch mechanism so that the on/off sequence is not on the motor.

For readers who may have purchased a secondhand motor and had difficulty in identifying the two sets of windings: if they are accidentally interposed the motor will usually start but run roughly with vibration, lack power and heat up rapidly.

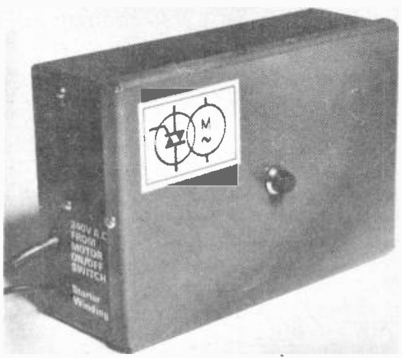
WARNING

Some types of motor have what is called a resiliant mount, the body being supported in a metal cradle on two rubber discs and retained in place with split clamps. The rubber insulates the motor from the mounting cradle and from any machine to which the motor is attached so that although the motor is correctly earthed, the machine may not be.

Normally the makers run a flexible earth lead from motor to cradle and anyone buying a secondhand machine should ascertain that the link is in place.

The starter unit is best mounted on as rigid a foundation as possible and not on the motor itself as vibration might limit the life of both the neon and reed switch.

Finally capacitors associated with these motors charge to mains peak during operation that is to something in the region of 350V. This can administer a very nasty electric shock, so before handling, discharge via an insulated conductor across the leads.



By Dave Barrington

Amateur and CB Radio

Not wanting to enter into the pros and cons regarding amateur and citizens band radio and its frequency allocation and use, we can appreciate the main arguments centred around foreign imported goods "stealing" a march on UK manufacturers.

To show that we are keeping a careful eye on the situation and not neglecting this important new area, we would like to mention two items that are suitable for both amateur and CB radio enthusiasts. And they are all British designs and manufacture.

To aid better reception ZL Communications have marketed two new versions of the Slim Jim aerial, claimed to be used by over 80 per cent of British 2 metre amateurs, for both 27MHz and 2 metre use.

Aimed at citizen band reception, the Big Jim—Omni-directional Base Station Attenna—BJ27, to give it its full title, aerial is also available for mobile mounting. Measuring 9ft long, the aerial has a claimed gain of 3dB (EIA) and an impedance of 50 ohms.

It is claimed to have low angle radiation for local or DX working. Two-way CB contacts between the UK and US have produced S9 plus signals and 10-4 copy both ways.

For the radio amateur, the 2 metre Slim Jim Super aerial is only 42 inches long and is claimed to be 50 per cent more efficient than other similar aerials. The smaller dimensions and high efficiency have been made possible by a unique high "Q" helical stub matching system.

On the base station model the helical stub and main element is completely enclosed in a ¾in diameter housing giving full protection against all weather conditions. The mobile version is constructed with a stainless steel flexible main element and the stub section is completely sealed against the weather.

Brief technical spec. for the 2 metre aerial is as follows. Type: Omni-directional vertical, 144-146MHz. Gain: 3dBi or approximately 6dB over a typical quarter-wave ground-plane. Angle of Maximum Radiation with Respect to Ground: approximately 5 degrees. Impedance: 50 ohms. VSWR: Average 1·2 to 1 or less across the band 144-146MHz.

For more information contact ZL Communications, Dept EE, Cantley, Norwich, Norfolk NR13 3RT.

Speech Processor

A new bandwidth filter or speech processor for communications systems has recently been introduced by T & T Electronics.

For many years different methods of putting information onto a transmitted carrier wave have been tried in the search for greater efficiency and single sideband transmissions have long been regarded as one of the best, especially among radio "hams", when compared with the older a.m. or f.m. systems. Nevertheless, it is possible to improve these systems by "processing" the speech waveform before applying it to the transmitter.

Exhaustive testing and field trials have resulted in the Persuader speech processor from T & T Electronics. It is simple to install and connects between the existing microphone and the transmitter.

A switch is provided so that it may be switched in or out of circuit as required. When switched into circuit the Persuader will remove unwanted speech frequencies below 300Hz and above 3kHz and is claimed to increase the average level of speech relative to the peaks.

The Persuader from T. & T. Electronics

An average gain of 15dB can be achieved which is equal to an increase in "Talk Power" of 32 times. The input will accept signals over the range of 0·5 millivolts to 100 millivolts and is suitable for most standard microphones. Once the "Set Level" control has been adjusted to show the correct level on two light emitting diodes (l.e.d.s) the output will automatically be correct for the rig and microphone in use.

Full details of the Persuader speech processor can be obtained from T & T Electronics, Dept EE, Green Hayes, Surlingham Lane, Rockland St Mary, Norwich, NR14 7HH.

Newsletter

It was only recently that Maplin announced the discontinuance of their *Newsletter/Price List.* We have just been informed that they have had a change of heart and that they will again be issuing regular editions throughout the year.

For more details write to Maplin Electronic Supplies at Dept. E.E, 284 London Road, Westcliff-on-Sea, Essex. A stamped addressed envelope would be appreciated.

CONSTRUCTIONAL PROJECTS

Intercom

As the circuit boards and components for the Master unit in the *Intercom* are a very tight fit it would be a good idea to use a larger case, allowing for different board fixings. The ones used in our prototype units were the MIN030 (black) with metal front panels from the West Hyde Developments, (Dept EE, Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET), Minos range.

If a metal plate is used for the front panel of the *Intercom*, the first action to take when building would be to incorporate an "Earthing" lead to the metal front panel for added safety.

This can best be achieved by using a three-way terminal block (in place to the two-way type), solder tag and earthing lead. The three-core mains lead is connect to one side of the block and the earthing lead, with the solder tag fixed at the opposite end, run from the other side to the metal panel. The solder tag can be fastened under the switch.

Looking at the details for the mains transformer this seems to be a fairly standard type and should not cause purchasing problems. However, the one used in our unit is the Bi-Pak 2021 type.

Model Railway Deadman's Handle

The only item that may present problems in the *Model Railway Deadman's Handle* is likely to be the relay. Depending on the type finally selected it may necessitate a different layout within the case.

The one shown in the prototype is one of the old ex-GPO types which only seems to be available from surplus shops and not as a new item. However, the type called-up in our components list is an RS "Open" two-pole changeover type, order as No. 348 835. Also, Maplin, Electrovalue, Watford and Home Radio are able to supply power relays which are suitable for this project.

Certain relays have their metal frame connected to the moving contacts and this type should NOT be used if mounted in a metal case.

Freezer Alarm

Although an octal-base mains relay was used in the author's *Freezer Alarm,* practically any mains relay may be used. This will, of course, mean different pinning arrangements.

As we are dealing with mains voltages be extra careful when wiring to the relay pins and double check all wiring before switching on.

Digital Rule

The ultrasonic transducers for the *Digital Rule* are available from Arrow Electronics, Dept EE, Leader House, Coptfold Road, Brentwood, Essex. Suitable transducers can also be purchased from Electrovalue, Maplin and Watford.

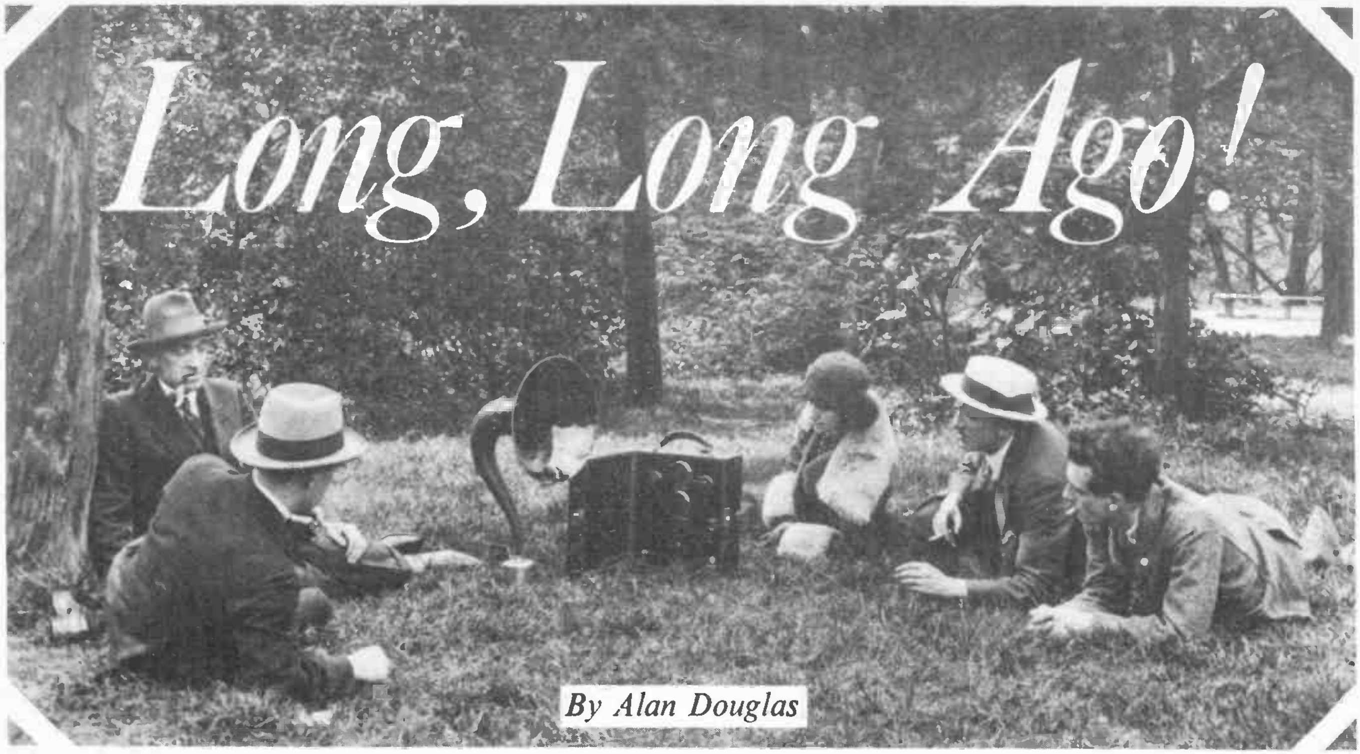
The semiconductor and display devices are fairly common items and should be stocked by people like Marshalls, Magenta, Electrovalue, and Watford Electronics.

Electronic Switch for Motors

The triac, reed relay coil and contacts for the *Electronic Switch for Starting Induction Motors* are available from Electrovalue. An equivalent triac, with internal diac connected to gate, is the Q4010LT listed by Electrovalue.

Long, Long Ago!

By Alan Douglas



When all the woods were green. Time: *Summer* 1924. Location: *Near Esher, Surrey. The attentive listeners in this verdant setting include (far left) W. James, of Wireless World, and J. Dainty, Editor of Wireless Trader. Far right is Alan Douglas, designer of the portable radio (the centre piece of this picture) and author of these reminiscences.*—Wireless World photo.

ELECTRONIC hobbies differ from other hobbies; the elusive nature of electricity means that the experimenter is always working by proxy, as it were. The steam enthusiast can see the motive power; woodworkers, photographers and motorists all have easy access to the fundamentals of their hobbies.

Not so the electronics man. He can never see, never even visualise, his prime mover—the electron. So he is much more influenced by the design of the moment, he can't argue, and must take the "black box" as it is.

Does this affect his outlook, patience and skill? I think it can. The hobbyist who has only to "put together" can never know the satisfaction of constructing from the raw materials, starting from the bare bones and so involving himself from the fundamentals up.

Yet at one time, the enthusiast had to do just this with radio—the beginning of electronics. No results from a sophisticated circuit of today can ever equal the excitement of hearing a voice in space, a voice where previously there had been nothing except occasional Morse.

Really Home Made

Did you know that at one time experimenters had to build their own variable capacitors, wind their own a.f. transformers, and certainly could not get any signals at all without an external aerial perhaps 80ft long and 40ft high?

Can one place oneself in the position where there were no amplifiers of any kind, no mains units, and if any signal was lost, no means of recovering it?

This was the position when I built my first receiver in 1913. How well I recall getting the cardboard tube, 10 inches long and 4 inches wide, carefully shellacing it with many coats, and laboriously winding some 200 turns of 18 gauge cotton covered wire to form the tuning inductance. How I sat with this and the crystal detector for hours on end, waiting for messages that never came—only the time signals from the Eiffel Tower!

Crystals

The rectifying properties of "crystals" were discovered in 1874, but for radio, the first use appears to have been by General Dunwoody in the USA in 1906.

Now let me quote from a paragraph in a book which I wrote in 1923. *Certain crystalline materials function best as rectifiers when used in conjunction with a metallic contact; for the most sensitive rectifiers the metal contact should take the form of a wire point, hermetically sealed and preferably of gold or platinum; e.g., a gold whisker bearing upon silicon or lead sulphide.* Does this ring a bell today, 58 years later?

Then again, *one of the contacts should have a large area where it meets the crystal; this is to a great extent to prevent the other contact from forming an opposing and undesirable second rectifier.* Not so undesirable today! For when the carborundum detector was first used with an applied d.c. potential, as by Col. Fessenden in 1910, it was within an inch of becoming a transistor as we know it.

It is interesting to note how the wind blows in circuit element design. First, we had the condition above when no signal could be lost. This meant thick stranded aerial wire with excellent end insulation; low-loss coils properly wound with Litz (fine multi-strand insulated wire) and pure ebonite panels. Of course, high sensitivity headphones were essential.

If a receiving set incorporating these features, such as the 1918 Mk III Trench Receiver, is used today, the range and selectivity are incredible.

Valves and Note Magnifiers

It was during the First World War that valve amplifiers were introduced to the Army. A common type had three transformer-coupled stages consuming 3 amp at 6V and having a tapped input transformer for gain control.

At this time, frequency response was unheard of and these units were called note magnifiers because they were meant for Morse reception. The 120 ohm headphones were fed from a step-down transformer but, though I cannot now recall the gain, it must have been quite low.

It will be realised that in trench warfare aerials would be very inefficient, usually being attached to bayonets stuck in the ground. Therefore the valve amplifiers were very welcome. Equally, however, it was very easy to interfere with or jam this kind of signal, and one of the most fearsome devices to do this was called the power buzzer.

Just a very large and powerful buzzer, weighing I think about 20lb, and producing hundreds of volts at the contact breaker; this back e.m.f. was fed to a simple V-shaped aerial about 6 inches above the ground, and when turned on, blotted out every kind of signal for hundreds of feet. I was always sorry for the unfortunate 6 volt accumulators driving the buzzer—it was certainly a short life and a gay one per charge!

Valve amplifiers did not have it all their own way; the heavy heater current made them weighty and the brilliant light emitted by the straight tungsten wire filaments could be seen a long way off; this made them unsuitable for light aircraft.

Carbon Amplifier

The indefatigable S. G. Brown invented a carbon amplifier which consisted of two carbon granule capsules face to face, driven at the common centre point by a vibrating reed which formed part of his famous A type headphones—slightly enlarged for this purpose.

The two carbon capsules were connected to a centre-tapped transformer and powered by a small dry battery; a magnified and distorted replica of the input signal was delivered to a pair of headphones and certainly it was possible to receive Morse on this device; incredible though it may seem, these amplifiers were used on some scout aircraft.

As with all Brown products, they were exquisitely made and remarkably stable. The push-pull drive was to increase the signal and reduce the noise. Years later, a double button carbon microphone with a similar push-pull drive was used by the BBC for a very long time; it was made by the Western Electric Co.

R.F. Amplification

It is interesting to note that a.f. amplification was thought to be much more important than r.f. at this time; but soon, attention was being turned

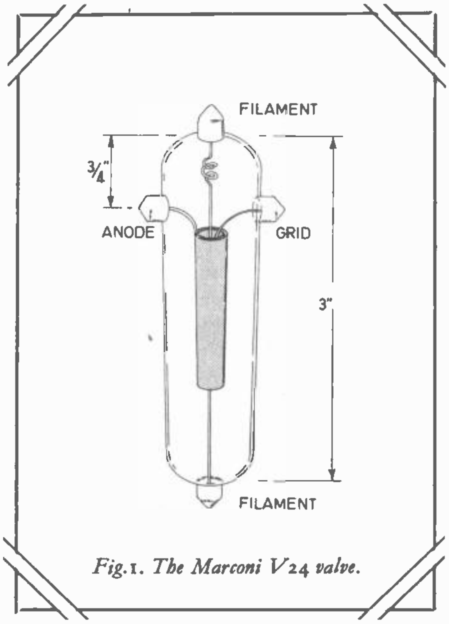


Fig. 1. The Marconi V24 valve.

to the input signal. Losses in the aerial or tuning circuits were not now so important, so the mass of the coils could be greatly reduced.

Just at the end of the 1914-18 war, a 5 valve receiver of great sensitivity was introduced by the RAF, the Mk 10. It had two r.f., one detector, and 2 a.f. stages; it was highly efficient and in this I saw the Marconi V24 valve for the first time. See Fig. 1.

The simple but ingenious design of the V24 reduced the inter-electrode and base capacitances since the electrode paths were so far removed from each other. Compact, strong and reliable, this valve was used for many years in Marconi marine equipment.

Not all valves behaved so well, one Marconi valve had a small "pip" at the top which had to be heated with a match for some time before the vacuum was good enough to apply the h.t.!

Telephony and Broadcasting

All the foregoing was related to Morse transmissions, speech had not yet really arrived. A delightful little book which was published in 1913 says (of Wireless telephony) *The method is not making much headway at present, as considerable power is necessary, much more than is wanted for telegraphy, and the results seem somewhat capricious.*

But of course it had to come. Experimental speech and music transmissions had been made as long ago as 1910, but transmissions for public entertainment did not arrive until 1921—PCGG of the Hague. Soon Writtle appeared (2MT), then 2LO and included here is a photo of one of the early Savoy Hill studios.

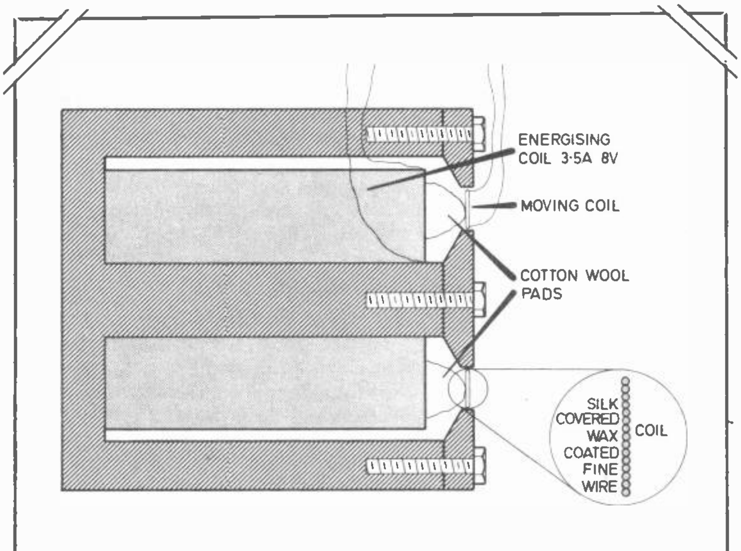
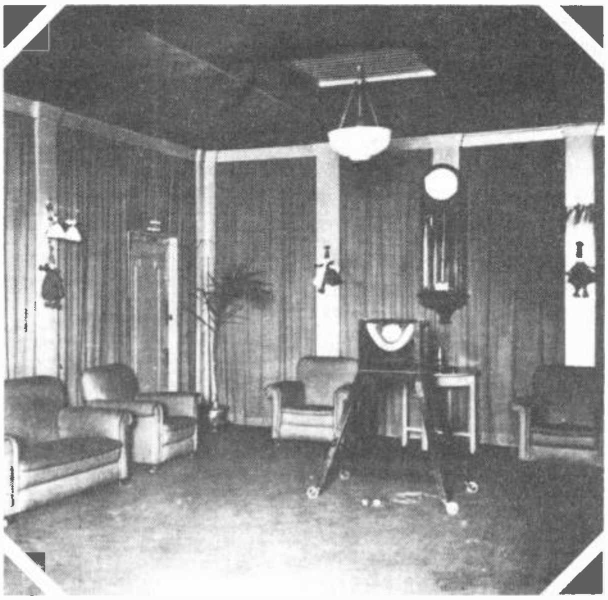
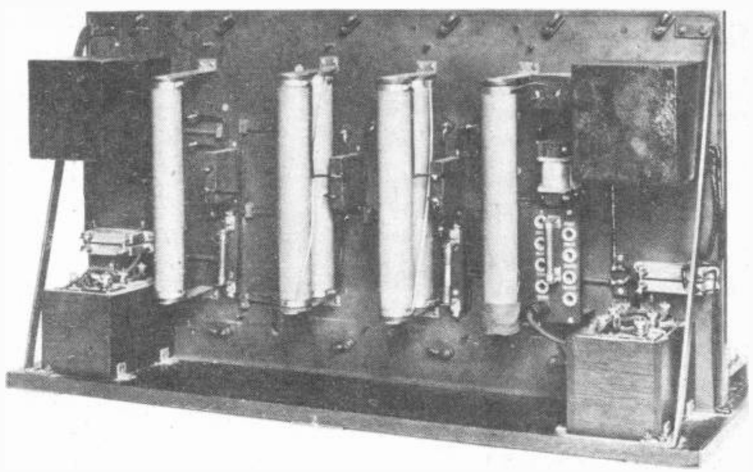


Fig. 2. The Sykes-Round moving coil microphone. The diaphragm was in fact the silk covered wire used to wind the edgewise coil, and it was made rigid by the wax with which it was impregnated while winding it between polished brass discs.

BBC studio of 1923 showing Sykes-Round magnetic ("moving coil") microphone on rubber cradle—BBC photo.



Marconi A amplifier, back view with the screening covers removed. Designed by Capt. H. J. Round this amplifier was introduced in 1923 to work with the Sykes-Round microphone. It had five resistance-capacity coupled stages with transformers at the input and output. Marconi DEV valves were used throughout. The valve-holders were suspended by elastic bands to minimise microphony. Note the enormous wire-wound coupling resistors for the valves! Two were used together in such a way that the windings opposed each other; this made them non-inductive. Note also the large Siemens 1·5V dry cells in the grid bias boxes and the metal-cased mica capacitors coupling between the stages. The front of the box, the base panel and the whole of the inside were thick sheet copper for effective screening; and after all this, you could only just hear on good microphones!—BBC photo.



Incidentally, people often ask why the heavy drapes. In those days everything was resonant; microphones, amplifiers, speakers all had peaks and troughs. It was to prevent these peaks from arising, as far as possible, that the drapes were used to cut down any possibility of echo or reverberant sound. As the resonances in the equipment were gradually eliminated, so were the damping curtains.

Moving Coil Microphone

Much has been written about the early days of British broadcasting, but I don't think details of the first co-ordinated studio system are so readily available. After many trials with various microphones, the search for quality with low background noise and no resonances stimulated Dr. Sykes and H. J. Round to devise the moving coil microphone. See Fig. 2.

The idea of designing a moving coil to act also as a diaphragm resulted in a precarious piece of apparatus. The coil was made from silk covered aluminium wire of 44s.w.g. wound *edgewise,* that is one turn on top of the next, until the final diameter was reached. This was only possible by winding in hot wax between two rigid discs.

When cold, the 40 ohm coil could easily be removed and, in spite of the wax, was extremely light. It was held in the polepiece gap by a touch of rubber solution on three tufts of cotton wool. Precarious indeed, especially when the studio got warm! The whole thing was slung in very heavy rubber to reduce mechanical shocks.

Naturally the signal output was very small, so the "A" amplifier (see photo) was designed; a very low noise triode stage, fed four further stages, raising the signal to headphone level. Further amplifiers, the "B" and "C", increased the signal for line transmission or monitoring loudspeakers. Of course, all were battery driven.

Receivers

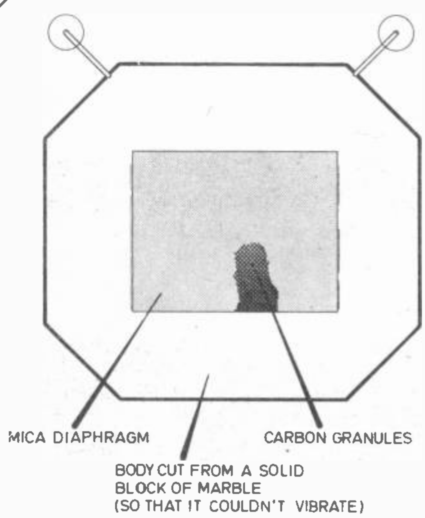
Receivers at this time were very simple; as the power of the transmitters was limited to 1·5kW, an outside aerial was a necessity if more than a few miles from the station.

It was not long before the idea of a portable receiver was attacked by a number of investigators, and the author designed the first portable to include a self-contained aerial. *(This receiver is shown in the heading photograph.)*

Alas, there were no compact loudspeakers at that time, but none the less, interest was very great when this portable receiver was shown at the Wembley Exhibition of 1924 and the first set was bought by Dame Clara Butt, the second by Ivor Novello. I was lucky enough to obtain French valves with the then incredibly low filament consumption of 60mA, which made the design possible, and enabled reception at Dame Clara's home at Goring-on-Thames.

End of an Era

The Reisz carbon microphone (Fig. 3) which succeeded the first moving coil microphone marked the end of an era of experimenting and improvising; so much was now known about acoustics that subsequent progress was rapid and all the foregoing was soon forgotten; but *we* must never forget that were it not for the pioneers we would not be able to sit back and enjoy our TV, tapes or discs covering a range of 20 to 20,000Hz—which in those days would have been thought madness to even contemplate! ⌑



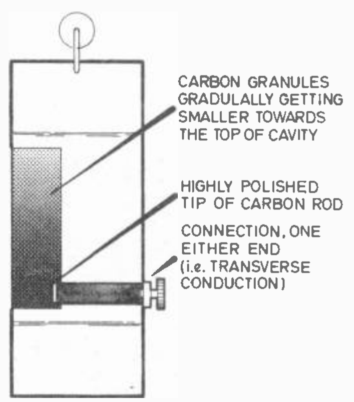
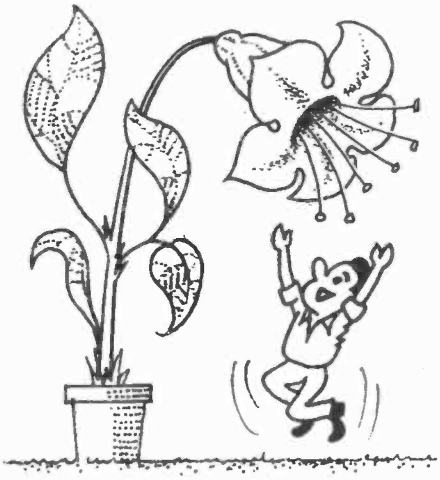


Fig.3. The Reisz carbon microphone. The carbon granule sizes varied from one-thousandth inch to 15-thousandth and the current was about 5mA at 6V

FREE 24 page GLOSSARY of I.C. TERMS NEXT MONTH



GUITAR HEADPHONE AMPLIFIER

Pocket-size battery operated amplifier. Provides adequate drive to a pair of ordinary stereo headphones for practice purposes.

AUDIO TEST SET

A more advanced project for the hi-fi addict in *two parts*. Provides facilities for extensive performance checks on amplifiers, such as t.h.d., power output, frequency response, sensitivity and gain measurement, when used in conjunction with an a.f. generator and c.r.o.

PHONE BELL REPEATER or BABY ALARM

Handy device for the home. Gives audio warning at a remote location if phone rings or baby cries.

SOIL MOISTURE INDICATOR

Grow better plants with this simple unit. Three degrees of moisture content at root level indicated by l.e.d.

LIGHTS REMINDER & IGNITION LOCATOR

Useful dual-purpose aid for the motorist. Gives audible warning when side lights are left on with the door open and illuminates ignition switch for a sufficient period to insert key.

NEW SERIES
Beginners Introduction to Logic

Everyday ELECTRONICS

MAY 1981
ISSUE ON SALE THURSDAY, APRIL 16

For your ENTERTAINMENT

By BARRY FOX

Perpetual Motion

If you are passing through Oxford do try and call in at the Clarendon Laboratories (just opposite Keble Road) and ask to see their "dry pile" battery. It's on display in a large glass case alongside some other interesting scientific relics, such as the first British laser of 1962 and the equipment used to liquify helium for the first time in 1933.

There are also the first klystron valves made in 1941 and 1942. These helped us win the war with radar.

The dry pile appears at first sight to be a working perpetual motion machine! But it isn't and the Clarendon Laboratories are by their own admission rather touchy about anyone describing it as such. Nevertheless, people still come from all round the world to look at what they have often been told is the only real perpetual motion machine in the world.

The dry pile is in fact a dry battery. To be strictly accurate it's not even a *dry* battery, it's a battery which contains just enough water to serve as electrolyte but not sufficient to cause internal short circuits.

Two yellow pillars stand upright under a glass bell jar. Each yellow pillar is a stack of 2,000 pairs of zinc foil and paper discs impregnated with manganese dioxide. The yellow colour comes from a coating of molten sulphur which keeps the internal moisture content stable.

Each pillar generates around 2,000 volts at a current of just one nano-ampere and has a small bell cup fixed to the bottom. A tiny metal ball striker hangs on a thread between the two bells.

The two batteries are oppositely poled, so one bell is at 2 kilovolts positive and the other at 2 kilovolts negative. As the striker touches the positive bell it charges positive and is attracted to the negative bell. It there takes up a negative charge and is attracted to the positive bell and so on. So day in, day out, like a perpetual motion machine, the bell jingles away.

It's been going on like this since at least 1840 when the dry pile bell was bought from a London shop by an Oxford scientist. No one knows how long it will go on ringing but it could be for several hundred years more. It seems more likely that the little metal striker will be physically worn away before the battery finally runs down.

Dry Image

The dry pile idea proved very useful during the war when the Admiralty needed a very high voltage, very low current source for the image converter tube of an infrared telescope. An Oxford physicist, working in the Admiralty, suddenly remembered that he had once seen the dry pile in the Clarendon. He searched and found a recipe for making dry pile batteries which had been published in the old magazine, *The English Mechanic*, way back in 1915.

During the war years a large number of dry pile replica batteries were built and they successfully supplied the 3kV necessary for the lead sulphide cathode of the telescope image tube.

Most Secret

While on the subject of electronic technology in the last war I can't recommend too highly Professor R. V. Jones's excellent book on the subject *Most Secret War*, now available in Coronet paperback for £1·95.

Although nearly 700 pages long it's a gripping account of how the two sides jockeyed for electronic superiority. On the light side there was the myth of the radioactive death ray which never existed; on the serious side there was the dilemma of whether planes should transmit radar to reap the benefits of electronic navigation but at the same time risk detection by the enemy's electronic homing devices.

It seems that scientific intelligence has much in common with science journalism. Professor Jones soon learned what most journalists discover early in their careers. The most effective way of getting a dull document read from cover to cover is to ask urgently for its immediate return.

Occasionally consumer electronic companies send out a panicky letter to the press asking that a previous press release be returned or destroyed. On several occasions I've burrowed through my waste paper basket desperately looking for a release which seemed innocuous but in fact contained some gold-plated error which I would never have noticed if the company hadn't panicked and told me to tear it up.

Professor Jones also used a routine working technique with which many journalists will have much sympathy. Essentially it relies on a room full of box files, each with a general title. Every incoming document is read and filed in what seems the most appropriate box file.

As few people as possible are involved, not because of security, but because the larger the field any one person is covering the better their chance of making a correlation between one fact buried in one box file and another apparently unrelated fact buried in another box file. This kind of happy-chance cross correlation can't work with a computerised system because you are always at the mercy of whoever has originally stored and indexed the information in the computer memory. You just can't prophesy in advance what correlations may in the future prove vital.

It's highly unlikely for example, that any computer could, even today, have told the Admiralty that the answer to their problem of power for an infrared telescope was to be found in pseudo perpetual motion machine contained under a glass bell jar in the Clarendon Laboratories.

Information Overload

The snag, of course, is that we are now suffering from information overload. No one human being has the time, energy or brain capacity to read and digest every document that may one day prove relevant.

Small wonder then that the Japanese are believed to be working hard, mainly in secret on so-called "cognitive" electronic equipment to interface the human brain with electronic circuitry. Already speech sensitive circuits will respond to human command and reply in a synthesised voice.

The next stage will be a machine to type a letter from an input of spoken words. Electronic "readers" will soon be used to convert written or printed words into electronic data. Witness the trend towards postal codes on mail; this is the basis of electronic sorting.

But none of this equipment has any true *intelligence*. So for the foreseeable future those fortuitous cross correlations which enabled wartime scientists to piece together intelligence information from a wide range of sources, will rely on that most remarkable of all memory banks, the human brain.

Near Criminal

Professor Jones, for many years a pillar of Aberdeen University, was recently counting his box files because, as he puts it, they're "going to be something of a problem when I move from my present office on my retirement next year". He finished the war with around 400 files and now has 1500.

Much of the original wartime scientific material, for instance secret decoded messages that came from the now famous cipher team at Bletchley, remained with the Ministry of Defence. But in 1970 some faceless person inside the Ministry decided that the space they were occupying was too valuable and destroyed nearly all of that original material.

Professor Jones describes the decision as "near-criminal". What it means is that future historians and scientists will never have the opportunity of discovering first hand from original documents how science, and especially electronics, helped us win a war we could so easily have lost.

Semiconductor News

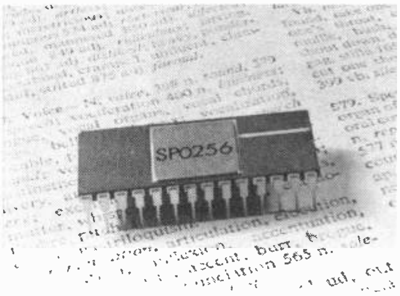
SPEECH SYNTHESIS CHIP

A new speech synthesis microchip has just been unveiled by the American company **General Instrument Microelectronics.** Designated the **SP0256**, the makers claim that the new chip is a "considerable advance in low cost solid state speech synthesis and will lead rapidly to many product applications".

The SP0256 has a complex LSI structure resembling a single-chip microcomputer and incorporates four major function blocks. The first a software programmable digital filter, is made to model the vocal tract.

The second, a 16K ROM, stores both the basic elements of human speech, as data, and instructions on how to handle that data.

The third section is a central processor which controls the flow of data from the ROM to the filter and the necessary instructions to make sense of that data.



Finally there is a digital to analogue converter to convert digitally synthesised speech into an audio signal voltage.

The combination of the software controlled filter and micro-controller allows the SP0256 to emulate almost any human sound and even allows for difference in accent and pitch. Unlike other devices this also offers the designer a trade-off between voice quality and size of vocabulary.

The 28-lead LSI device is intended for use in many professional and consumer applications and it will be up to the user to specify the vocabulary and speech quality he requires. GIM will then programme that part of the ROM with the requisite instructions.

In addition to this the company intends to release the chip with several standard vocabularies to enable the home constructor to take advantage of this technology.

Facilities are also available to extend the ROM by attaching external memory. This gives the user scope for extremely complex word repertoires or very high quality speech synthesis which would be beyond the capacity of the chip memory alone.

In practical terms this means that the SP0256 is capable of reproducing up to 256 discrete sequences (usually words or phrases) without the extra ROM and up to 3,825 sequences when fully expanded. In fact it is capable of addressing up to 491K bits of extra memory.

GIM say that the SP0256 chip will be available in this country complete with preprogrammed memory within the next few months. No price has been fixed but £15 to £20 seems quite likely.

NEW RECTIFIERS

New diode developments from **Mullard** include a range of fast recovery rectifier diodes. The **BYV30** and **BYV92** have average forward currents of 12A and 35A and a fast recovery time of less than 100ns.

Further new types are fast soft recovery diodes **1N3899** and **1N3909.** These are designed for use in high frequency power supplies and inverters.

Mullard is also phasing out its range of plastic rectifier diodes and replacing them with glass bead types. Glass types, it is claimed, are more reliable and have avalanche capacity.

Still on diodes, **TRW** are introducing a range of snubberless Schottky devices (a snubber network being a sort of interference suppression network). These are designed for rectification in high current 5V logic supplies in strategic and industrial applications.

ASEA MAFO has developed a new high radiance infra-red emitting diode. This gallium aluminium arsenide device designated as **1AX124** is specifically designed for optical fibre applications and is hermetically sealed into a modified TO-18 case so there is no risk of damaging the chip.

FIBRE OPTIC KIT

Fibre optics technology is rapidly becoming the "in-thing" for data transmission but suffers from one major draw-back, namely connections.

However, a new low cost fibre optic link kit has just been developed by **Hewlett Packard** and is claimed to represent a new era in this technology because of the ease with which the connectors are attached to the fibre optic cables. Coupling, it is claimed, can be achieved within three minutes.

Much more extensive use of fibre optics should be possible with this kit and such applications as factory floor data communications and short distance telecommunications becomes a distinct possibility.

Priced at £32·67 it may even appeal to the more adventurous constructor. The kit comprises a transmitter, receiver, 5m of fibre optic cable with connectors attached, additional connectors and polishing kit. *Further details may be obtained from the UK agents, Celdis Ltd, in Reading.*

TDC 1023J SIGNAL CORRELATOR

Signal pattern comparisons are an important part of many data processing systems and a new single chip correlator from **TRW LSI Products** may well find a big market.

Designated the **TDC1023J**, this 28-pin d.i.l. device has the ability to compare a stored 64-bit reference word against incoming data at a sampling rate of 20MHz.

Furthermore, it can be clocking in the next word whilst comparison is taking place and shorter word lengths can be accommodated if necessary. Incoming data words are continuously compared bit for bit with the reference word and an output is generated for each word showing the number of correct bits. This is in the form of a 7-bit binary weighted output.

There are even facilities for loading a minimum number of correct correlations per word into a flag register on the chip. If the 7-bit output equals or exceeds this number then a separate output signal is generated—very useful for statistical analysis.

—IN BRIEF—

Memory Chip

"A new stage in the evolution of its non-volatile memory product family" is how **GIM** describes their new **EAROM,** the **ER4201.** The device is the first in a proposed line of *n*-channel N-MOS products. This new chip has been designed with the microcomputer in mind and has a 128×8 bit memory. It offers 5V operation in Read mode and a 350ns maximum access time.

In common with other EAROMS the ER4201 will have in-circuit electrical word alterability with on-board address, mode and data latching.

Floppy Disc Controller

The **TMS9909** floppy disc controller (F.D.C.) is a new member of the **Texas Instruments** 9960 microprocessor family. It features enhanced data transfer rates and a wide range of new control facilities as well as generating up to 64 error status returns.

Hence in a 9909 based system, it will be able to specify *what* has gone wrong should a floppy disc system fail instead of just indicating that *something* is wrong.

Function Converter

Converting a logarithmic function into a linear one is often a problem in some processes. The **DIV100KP** precision log-antilog divider from **Burr-Brown** is designed to get round this and comprises four op-amps and four logging transistors integrated into a single monolithic circuit.

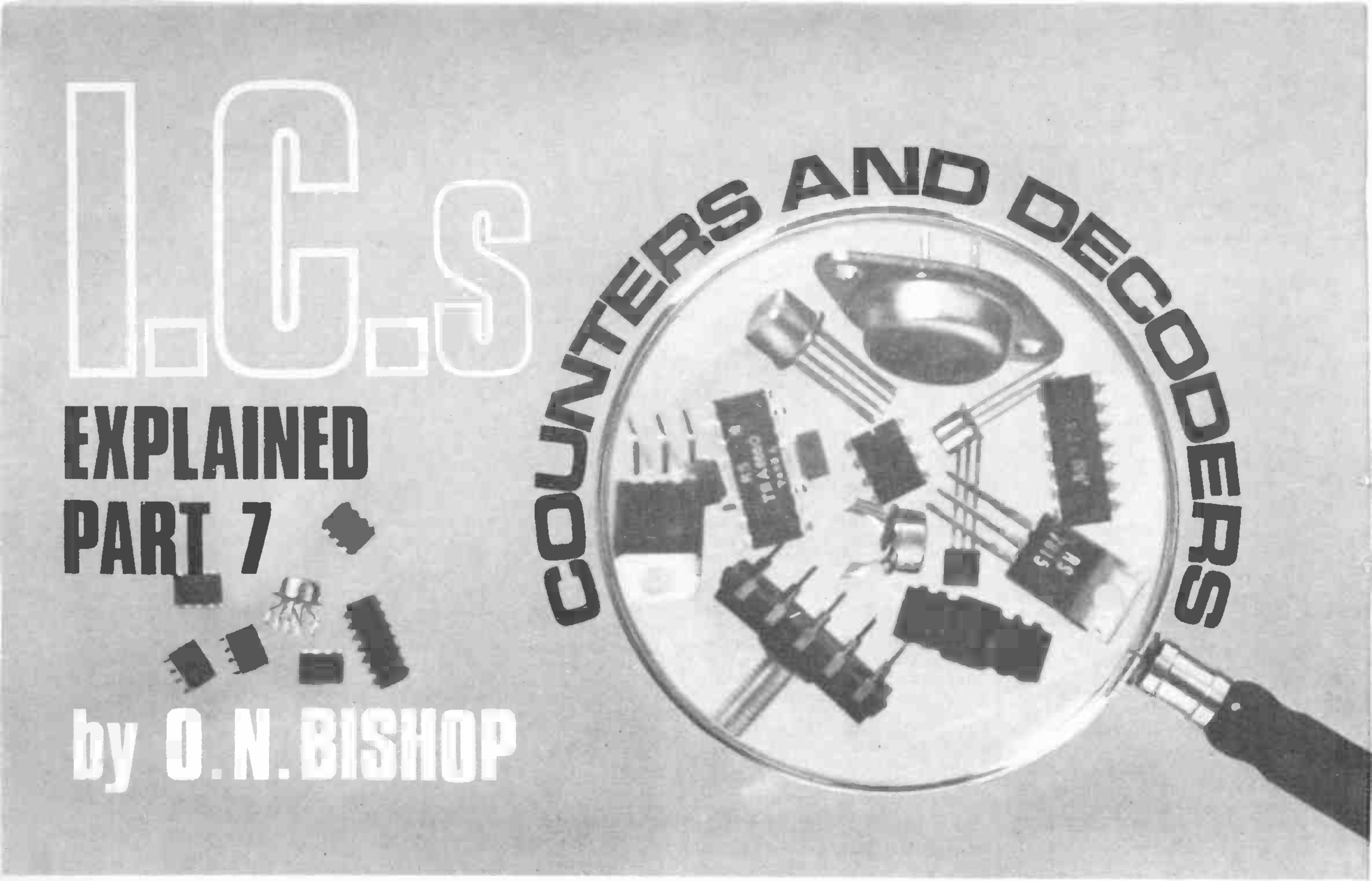
Potential applications include transducer and bridge linearisation, process control and bio-medical instrumentation.

Push-button Telephone i.c.

The heart of every telephone is the interrupt current loop dialling system. A new low power CMOS device from **Mullard,** the MH321, is designed to fulfil this role and convert pushbutton telephone keyboard entries into correctly timed line current interruptions.

Additional facilities available with this chip include the ability to redial a previously dialled complete number string. The circuit remembers up to 23 digits and will also insert pauses if necessary.

The MH321 requires a low voltage supply and is available in the standard 18 pin d.i.l. package.



I.C.s EXPLAINED PART 7
COUNTERS AND DECODERS
by O. N. BISHOP

LAST MONTH we looked at some sequential circuits—those whose state now depends partly on what their state was in the past. Counters also belong to this class of circuit.

A counter changes from one state to another every time it receives a pulse at a particular input terminal. This terminal is usually called the *clock* terminal. The outputs of the counter indicate a number, in one of various ways that will be described presently. As each successive pulse arrives, the outputs of the counter go through a series of states representing, for example, the numbers 0, 1, 2, 3, 4, and so on. Eventually the counter has gone through all possible states and returns to the state at which it began.

The number of pulses required to take the counter through all its states is the *modulus* of the counter. Most CMOS counters have a fixed modulus of 10, 16 or one of the higher powers of 2 (see Table 1). In a few cases the modulus can be set to a required value.

BINARY COUNTERS

Many counters consist of a chain of *J-K* flip-flops or their CMOS equivalents. In Fig. 7.1 we see how three flip-flops can be joined to make a modulo-8 counter. Their *J-K* inputs are all held high which, as explained last month, makes the outputs change state whenever clock input goes from high to low (the negative-going edge of a pulse). A high pulse on the clear (or reset) line forces all Q outputs to low (0) and all $\overline{Q}$ outputs to high (1).

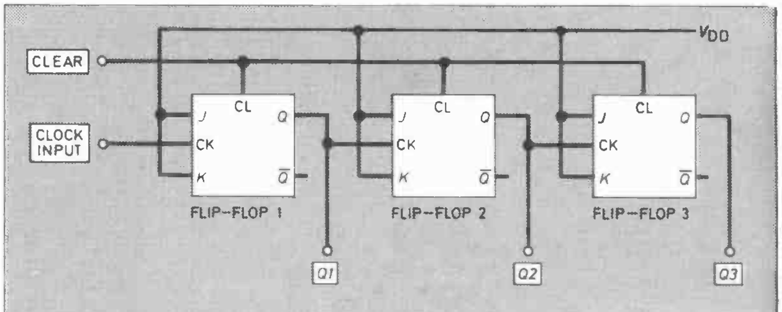


Fig. 7.1. A chain of flip-flops that makes up a counter.

Consider what happens as a chain of pulses arrives at the clock input (Fig. 7.2). At the first negative-going edge, flip-flop 1 changes state (*A*). Nothing happens on a positive-going edge, but on the next negative-going edge (*B*), flip-flop 1 changes back again. The negative-going pulse from its output (*Q1*) causes flip-flop 2 to change state (*C*). As the clock pulses arrive, flip-flop 1 changes state at half the rate of the clock, while flip-flop 2 changes state at a quarter of the rate of the clock. Negative-going edges from *Q2* cause flip-flop 3 to change state (*D*). Thus flip-flop 3 runs at one-eighth of the rate of the clock.

If we consider the outputs to represent a series of "0"s or "1"s, as at the bottom of Fig. 7.2, and read them in the order *Q3-Q2-Q1*, we obtain a series of numbers in the binary scale. This series has 8 members running from 000 to 111, or from 0 to 7 in the decimal scale. This is a modulo-8 counter. In general, a chain of n flip-flops produces a modulo-2^n binary counter.

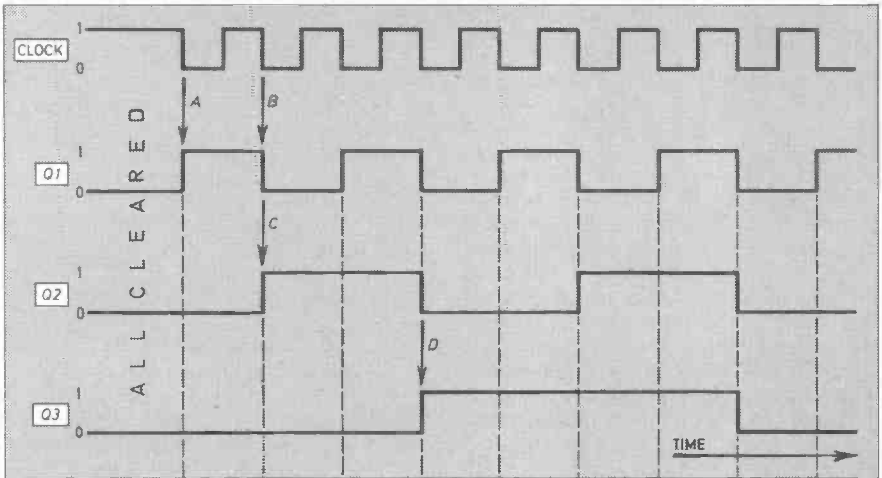
Before leaving this counter there are two further points to note. The first is that each flip-flop changes state at exactly half the rate of the flip-flop before it (or of the clock, if it is the first flip-flop). The frequency is halved at each stage. To put it another way, while the clock produces eight pulses, flip-flop 1 produces four, flip-flop 2 produces two, and flip-flop 1 only one.

As their name implies, counters can count pulses. They can also be used to divide. If x clock pulses are fed in, we obtain $x/8$ pulses from *Q3*. As will be seen, many counters are specially designed for dividing rather than for counting.

The second point applies only to this particular kind of counter. The change of state of any stage follows *after* the change of state of the stage before it. There is a small but definite gap between the time when the clock causes *Q1* to change (*B*) and the time when *Q1* causes *Q2* to change (*C*).

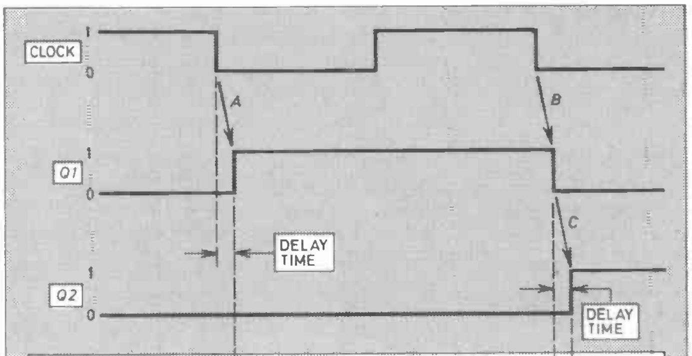
INVALID COUNTS

Fig. 7.3 shows the time-scale enlarged. Instead of counting "0, 1, 2" the chain actually counts "0, 1, 0, 2". The invalid "0" is present for only a microsecond, perhaps less, and is often unimportant. For instance, if we are counting a series of events (e.g. cars going into a car-park) and showing the results on a l.e.d. display, the invalid "0" will not be seen. The count will appear to be correct and, for practical purposes, is correct.



Q1	0	1	0	1	0	1	0	1	0	1
Q2	0	0	1	1	0	0	1	1	0	0
Q3	0	0	0	0	1	1	1	1	0	0
DECIMAL EQUIVLENT	0	1	2	3	4	5	6	7	0	1

Fig. 7.2. Waveforms of the counter of Fig. 7.1.



Q1	0	1	0	0
Q2	0	0	0	1
DECIMAL EQUIVALENT	0	1	0	2

INVALID

Fig. 7.3. Invalid counts produced by delays in the counting chain.

In other instances the invalid state can cause trouble. Suppose we want to flash a "Full" sign when there are eight cars in the park. This is the stage at which the counter returns from 7 back to 0 again. We could detect this stage by wiring a 3-input NOR gate to *Q1*, *Q2*, and *Q3*. Such a gate would detect the invalid "0" state and trigger the sign to switch on as soon as the second car entered the park.

The invalid "0" is not the only unwanted state. One or more invalid states occur at every count. At the final transition, 7 to 0, the output goes from 7 to 6 to 4 to 0. In a counter with more stages there are more invalid states.

A counter in which each stage is changed by the one before it is called a *ripple counter*. A change at the clock input causes a ripple of changes to run along the chain. If our application will not tolerate this effect, we must employ a counter in which all outputs change state at *exactly* the same time. This is what is called a *synchronous* counter.

SYNCHRONOUS COUNTERS

In synchronous counters the clock inputs of all flip-flops are connected to one line (Fig. 7.4). Consequently, all flip-flops change state simultaneously. Flip-flop 1 changes state at every negative-going pulse, as before. Other flip-flops change state only if their *J* and *K* inputs are high.

For example, if *Q1* is high and *Q2* is low, the next clock pulse will change *Q1* to low and *Q2* to high—we go from 01 to 10 (or 1 to 2 in decimal).

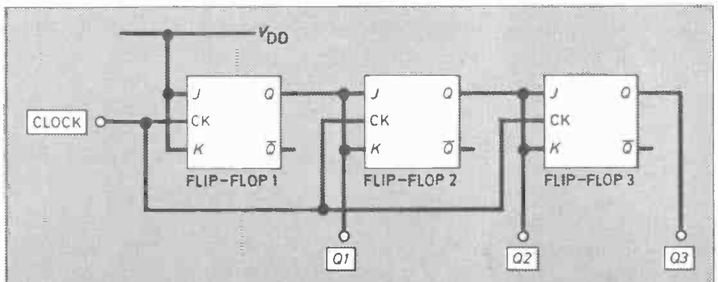


Fig. 7.4. A walking ring or Johnson counter.

If $Q1$ and $Q2$ are both low, the next pulse changes $Q1$ to high, but $Q2$ remains unchanged as its J and K inputs were both low at the instant of change. We go from 00 to 01.

JOHNSON COUNTER

Another type of synchronous counter is based on what is known as a *walking-ring counter*, or *Johnson counter*. This consists of a chain of D-type flip-flops (Fig. 7.5). As explained last month, a D-type flip-flop is a bistable latch. As the clock input goes low, the output Q stays at whatever state input D is at. To begin with all Q outputs are 0 (Fig. 7.6). This means that the $\overline{Q}$ output of flip-flop 4 is at 1 (see lowest waveform); $Q4$ is the data input to flip-flop 1. Consequently, as clock goes high, $Q1$ takes the state of $Q4$, becoming high. At the next positive-going clock pulse, $Q2$ changes because $Q1$ is now high. In this way the "1" travels down the chain. When it reaches flip-flop 4, $Q4$ becomes "0". Now a "0" travels down the chain, clearing away all the "1"s.

Like the counter of Fig. 7.1 this counter has eight stages, so is modulo-8. In a walking-ring counter the modulus is double the number of stages. The output sequence is not a binary number sequence but, by suitable logic, we can decode the outputs to produce any required output.

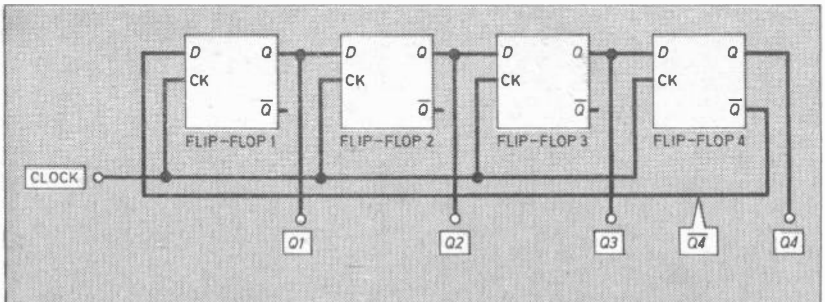


Fig. 7.5. A synchronous counter (clear inputs omitted).

For instance, if we AND $Q1$ with $Q4$ we get a high output only at stage 0. If we AND $Q1$ and $Q2$ we get a high output only at stage 1. It is easy to arrange for eight outputs, each of which goes high at only one stage of the count. This is done in the 4017 and 4022 i.c.s, which have 5 and 4 flip-flops with 10 and 8 decoded outputs respectively, see Table 7.1.

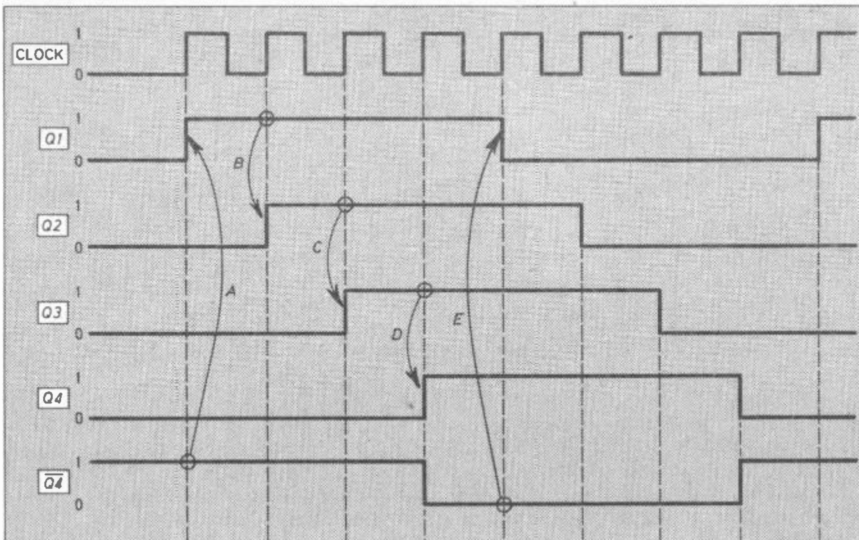
When a walking-ring counter is first switched on, the flip-flops may assume states such that the output of the counter is not one of those shown in Fig. 7.6. The counter would not work. In most practical counters, a few additional logic gates are included to reset flip-flops that are in unallowable states.

THE CMOS RANGE OF COUNTERS

The information in Table 7.1 is a selection guide to the 26 most commonly used CMOS counters. The meaning of entries in the "modulus" and "synchronous/ripple" columns has already been explained. The 4045 is a ripple counter but the only output available is from the last stage so

Table 7.1. Selection guide to some common CMOS counters/dividers.

Device Type No.	Modulus	Sync/ Ripple	Up/ Down	Output: Direct	Output: Decoded	Inputs: Clock edge + Rising − Falling	Inputs: Reset or clear (Yes/ No)	Inputs: Enable (Yes/ No)	Inputs: Preset (load) (Yes/ No)	Other features/remarks
4017	10	S	U	—	1-of-10	+	Y	Y	N	—
4018	N(2 to 10)	S	U	5	—	+	Y	N	Y	—
4020	2^{14}	R	U	14-stages (except 2 and 3)	—	−	Y	N	N	—
4022	8	S	U	—	1-of-8	+	Y	Y	N	—
4024	2^{7}	R	U	7-stages	—	−	Y	N	N	—
4026	10	S	U	—	7-segment	+	Y	Y	N	Display enable
4029	10/16	S	UD	4-stages/ b.c.d.	—	+	N	Y	Y	Settable to binary/b.c.d. and Up/down
4033	10	S	U	—	7-segment	+	Y	Y	N	Ripple-blanking: drives low power l.e.d.s
4040	2^{12}	R	U	12-stages	—	−	Y	N	N	Input pulse shaper
4045	2^{21}	(R)	U	Last stage + invert	—	*	N	N	N	*Crystal driven
4060	2^{14}	R	U	Stages 4 to 10 and 12 to 14	—	−	Y	N	N	Contains oscillator
40102	N(1 to 100)	S	D	Last stage	—	+	N	Y	Y	—
40103	N(1 to 256)	S	D	Last stage	—	+	N	Y	Y	—
40110	10	S	UD	—	7-segment	+	Y	Y	Y	Drives l.e.d.s. Separate up and down clocks. Latched outputs
40160	10	S	U	b.c.d.	—	+	Y	Y	Y	Asynchronous reset
40161	16	S	U	4-stages	—	+	Y	Y	Y	Asynchronous reset
40162	10	S	U	b.c.d.	—	+	Y	Y	Y	Synchronous reset
40163	16	S	U	4-stages	—	+	Y	Y	Y	Synchronous reset
40192	10	S	UD	b.d.c.	—	+	Y	N	Y	Separate up and down clocks
40193	16	S	UD	4-stages	—	+	Y	N	Y	Separate up and down clocks
4510	10	S	UD	b.c.d.	—	+	Y	Y	Y	Up/down input
4516	16	S	UD	4-stages	—	+	Y	Y	Y	Up/down input
4518	10	S	U	b.c.d.	—	+/−	Y	Y	N	Dual counter
4520	16	S	U	4-stages	—	+/−	Y	Y	N	Dual counter
4522	N(1 to 10)	R	D	b.c.d.	—	+	Y	Y	Y	—
4526	N(1 to 16)	R	D	4-stages	—	+	Y	Y	Y	—



Q1	0	1	1	1	1	0	0	0	0	1
Q2	0	0	1	1	1	1	0	0	0	0
Q3	0	0	0	1	1	1	1	0	0	0
Q4	0	0	0	0	1	1	1	1	0	0
STAGE	0	1	2	3	4	5	6	7	0	1

Fig. 7.6. Waveforms of a walking ring counter.

flip-flops are fed to logic circuits that decode them to produce outputs of a different form. We have already mentioned the 1-of-10 and 1-of-8 decoded outputs from the 4017 and 4022 walking-ring counters.

Another useful type of decoding is to provide the seven outputs needed for driving 7-segment displays. At each count the outputs are such as to cause the appropriate segments to light up to produce the corresponding numeral. Some of these i.c.s can drive l.e.d. displays directly making for economy and for simplicity of wiring.

In the 4033 a ripple-blanking input can be used to automatically blank all leading zeros. Thus a 4-digit display would show "25" instead of "0025".

The 40110 i.c. has latches, which hold the outputs and so hold the display, even though counting may be continuing meanwhile. This function is used for sampling and holding a rapid count in a digital voltmeter, for example.

DECODERS

A list of decoding circuits that are available as separate i.c.s is seen in Table 7.2. These may be used to decode the direct outputs from counters, as in the project seen in Fig. 7.8 and in many other applications. The 4511 has 25mA outputs for driving large l.e.d. displays. The 4055 and 4056 provide the alternating output required for driving liquid crystal displays.

Table 7.2. A selection of CMOS decoding i.c.s.

Device Type No.	Input	Output	Latched Output	Other features
4028	3-bit binary or 4-bit b.c.d.	1-of-8 or 1-of-10	N	—
4055	4-bit b.c.d.	7-segment	N	l.c.d. driver
4056	4-bit b.c.d.	7-segment	Y	l.c.d. driver
4511	4-bit b.c.d.	7-segment	Y	l.e.d. driver, blanking, lamp test
4514	4-bit binary	1-of-16	Y	Selected output high
4515	4-bit binary	1-of-16	Y	Selected output low
4555	2-bit binary	1-of-4	N	Dual decoder: selected output high
4566	2-bit binary	1-of-4	N	Dual decoder: selected output low

there is no disadvantage in its ripple action. This i.c. is used for dividing the high-frequency oscillation of a crystal by 2^{21}, or 2,097,152 to give an accurate low-frequency oscillation.

UP AND DOWN COUNT

The counters we have previously described have all been *up-counters*, counting from zero upward to 10, 16 or more, before returning to zero. It is possible to make *down-counters*. These are usually preset to a given value and then count down toward zero. When zero is reached a special zero-output goes high.

The 4522 can count down from any number in the range 1 to 10 giving a b.c.d. (binary coded decimal) output on the way. The 4526 ranges from 1 to 16 with a 4-bit binary output. The 40102 and 40103 can be preset to much higher values if required, but give indication only when the zero count is reached.

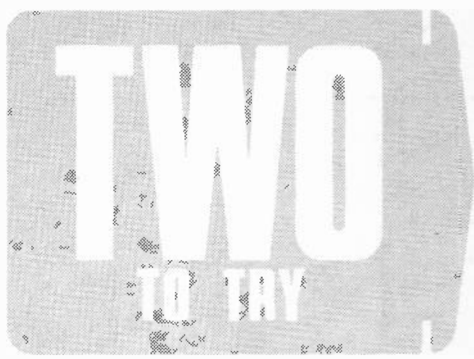
There are a number of up/down counters that can be made to run in either direction. Some of these have two clock inputs, one for counting up and one for counting down. It must be arranged so that it is not possible for both clocks to operate at once. Other counters have a special up/down-control input.

The outputs of most of the counters come directly from the flip-flops, though in the high-value binary counters (e.g. 4060) there may not be enough pins on the i.c. to provide an output from every stage. Some four-stage counters run up to 10 and then automatically reset to zero giving a b.c.d. output. Others run through the full 4-bit binary sequence from 0 to 16 before returning to zero.

Counters vary in their control inputs. Some step on at a positive-going pulse, others at a negative-going pulse. The 4518 and 4520 may be wired so as to step on at either, as selected. Most counters have a reset input. Many have a clock-enable, which can stop the counter at any stage, without resetting and losing the count. The facility to preset the counter to a given value present on a number of data inputs is a feature of many counters.

DECODED OUTPUTS

Several of the counters of Table 7.1 do not take their outputs direct from the flip-flops. Instead, outputs of the



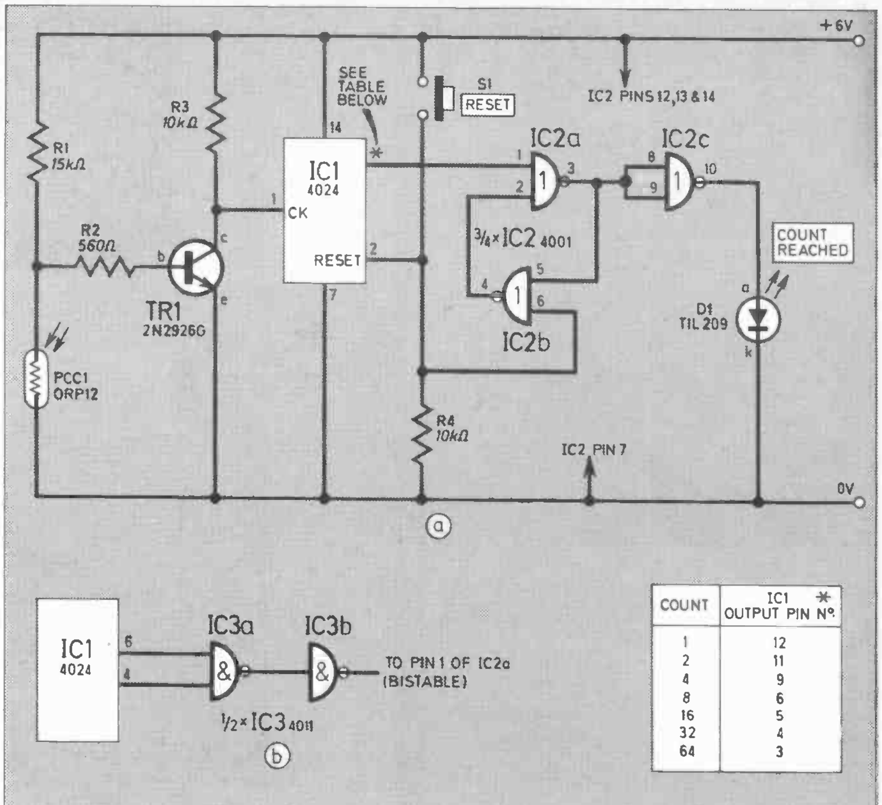
LIGHT TRIGGERED COUNTER

Fig. 7.7 shows the 4024 being used to count a series of events and indicating when a given number of events has occurred. The counter is stepped on whenever there is an interruption of the beam of light falling on the light dependent resistor, PCC1.

The circuit can count cars entering a car-park, people entering an exhibition, or objects on a conveyor belt. It can also be used as a lap-counter for model racing cars, though a photodiode would be faster-acting.

The count at which the bistable is triggered and the l.e.d. comes on is determined by which output of IC2 is connected to the bistable. The table in Fig. 7.7 shows which pins to use. Pressing S1 resets both the counter and the bistable.

Since this circuit is only triggered by the *first* occurrence of a given *high* output or combination of *high* outputs, it is not affected by the invalid "0"s that occur in ripple-counting.



COUNT	IC1 * OUTPUT PIN Nº
1	12
2	11
4	9
8	6
16	5
32	4
64	3

Fig. 7.7a. Light triggered counter, (b) decoding two outputs to light the l.e.d. when a count of 40 is reached.

ELAPSED TIME INDICATOR

The use of a counter as a divider is illustrated in Fig. 7.8. The clock frequency of IC1 is about 17Hz. At pin 15 we have this frequency divided by 2^{11} which is 1 cycle per 2 minutes.

The binary count from the 4 outputs runs from 0 to 16, changing once a minute. It is decoded by IC3 to light each one of the l.e.d.s for a minute each during the first 10 counts.

The advantage of using a clock of relatively high frequency is that we can use a polystyrene capacitor which has much greater stability than the electrolytic capacitors so frequently used in timing circuits. Also there is no need to reset the timer i.c. When S1 is pressed, the timer i.c. may be at any stage of its cycle, and timing begins at the next negative-going edge. Since a whole cycle takes only 0·06 seconds the error is negligible.

This circuit indicates how many complete minutes have elapsed since S1 was pressed. If a 4514 is used instead of the 4028 the timing period can be extended to 16 minutes.

Next Month:
Special function i.c.s.

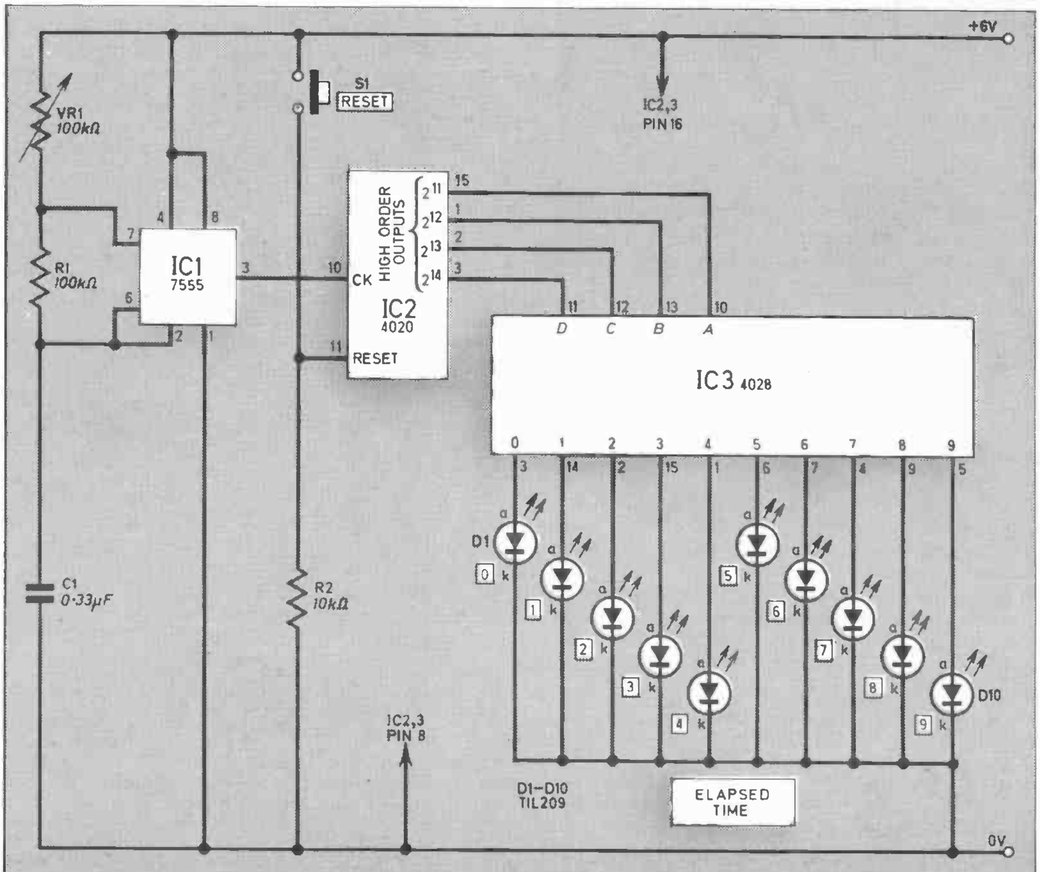


Fig. 7.8. A 10-minute timer.

Everyday News

MOBILE POLICE TO GET COMPUTER BACK-UP

Soon it will be no use arguing a point with your friendly mobile policeman. Thanks to microelectronic technology, he will soon be in possession of the latest aid to crime fighting in the shape of an in-car digital data terminal with TV type screen readout on which he will be able to call up all sorts of information, including registration details and points of law.

This breakthrough in police and emergency services communications is expected with the introduction of the new Plessey Universal Mobile Communications Terminal (UMCT). The dashboard mounted unit allows transmission of digital data and computer information retrieval over speech band radio from all types of vehicles.

Already undergoing field trials in Europe, and operational in the United States and Canada the initial reaction has been extremely enthusiastic. There is also strong support for the unit from Belgium, Spain and Italy.

The UMCT allows an operator to transmit digital data messages at 4,800 bits per second. It is claimed that a full screen text message of 315 characters can be transmitted in 0·6 seconds, therefore allowing up to 300 out-stations or vehicles to operate on one radio channel. Automatic retransmission, memory storage, and graphic transmissions are a few of the unit's capabilities.

The ability to access information from a central data base over the normal radio link has far-reaching implications in emergency, police, security, public utility and purely commercial fields. The time taken to access information can be as fast as two seconds.

The UMCT can be easily installed in a vehicle requiring only the connection of two leads, one to the battery and one to the mobile radio. No extras or vehicle rewiring are required and the unit can be transferred from one vehicle to another fairly quickly.

Acquisition of particulars of vehicles and property, registered owners and secure communications for the police are of great importance. Maps and diagrams of streets and buildings for fire and emergency services, accessed in seconds and displayed in vehicles at the scene of an incident, could save lives. Also, more efficient resource deployment and instant computer update from the cab of an express delivery vehicle, where immediate receipts could be given from a hard copy printer on the side of the UMCT, could cut costs of road haulage operators.

Who knows, perhaps the next stop will be the "back-seat courtroom" with the mobile terminal linked, by radio, to a central computer control where a residing judge/s or magistrate/s will deal out instant justice. Of course, the poor old patrol man will have to be a computer programmer, lawyer and in emergencies a doctor.

HELP FOR COMPUTER USERS

Small businesses and professional people are to be offered help in choosing computer systems to suit their needs through the Microsystems Centre set up in January.

This new centre is an extension of the National Computing Centre which was founded in 1966 and provides assistance to larger businesses and industry. The Microsystems Centre aims to advise, educate and provide some hands-on experience for potential small computer users.

Part-time, evening, weekend courses and even lunch time courses are envisaged. A Federation is to be formed for the benefit of those microcentres which already exist throughout the country, at educational establishments and elsewhere. The development of standards and codes of practice will be encouraged, as will the exchange of software and information between the various centres.

The Minister for Information Technology has welcomed the setting up of this Small Systems Centre, and said it was of vital importance both for their own well-being and for that of the country as a whole that small businesses recognise these potential benefits of new technology and that they act promptly to take advantage of them.

Robots in Parliament

The British Robot Association is to stage a robot exhibition in the Houses of Parliament from April 13-17. This should give a further boost to government support for the greater use of robots in British industry.

BUSINESS DISH

Ferranti is first in the field with small dish terminals for the user trials of the British Telecom business satellite service through the European Space Agency's Orbital Test Satellite (OTS). Tenders from other manufacturers have been invited and when the service starts in 1983 some 25 to 30 terminals will have been installed.

Watch out for these terminals near the premises of some of the larger companies.

Audio Discs

It now seems probable that the Philips compact digital audio disc will become the world videodisc standard system. The probability has been enhanced through its adoption by Matsushita in Japan who own trade names Technics and Panasonic.

As official UK importers of OHIO Scientific products Watford Electronics have just introduced the new Superboard II Series 2 single board computer.

—ANALYSIS

SPACE INVADERS

Science fiction does not inevitably become science fact but is often not too far off the mark.

Take the death ray, already popular when I was a boy. When war was approaching in the late 1930s there were rumours that the death ray had already been achieved. The sudden appearance of unusual antenna arrays encouraged the idea that enemy bombers might be vaporized in flight by a lethal radiation.

Official denials could not be made without revealing the true nature of the new invention which happened to be radar. The radiation was certainly high-powered by the standards of the day but nowhere near sufficient to destroy an aircraft, only to detect its presence and fix its location.

Today, over 40 years later, the death ray is within reach. Its final form has not yet been decided but defence scientists in the United States and the Soviet Union are known to be working on what are called directed energy weapons, the most promising employing high energy lasers. These would be deployed in space and used against enemy ballistic missiles as well as spy-in-the-sky and communications satellites.

Turning to more peaceful applications of electronics I notice that one electronics manufacturer who has just installed automatic test equipment has cut down test time of a complex PC board by a skilled engineer from 3½ hours to 5 minutes by an unskilled operator.

When you look at growing unemployment one begins to wonder whether electronics for peace is not just as "lethal" in its way as electronics for war.

Brian G. Peck

Help for Disabled

A two-pronged attack is in motion to implement the "Year of Disabled People".

On the one hand there is momentum to apply microelectronics to various aids, on the other to examine how employment possibilities for the disabled can be expanded in the microelectronics manufacturing industry.

TRAINING OUR NEXT GENERATION

The Minister for Information Technology made an important statement concerning computer training in schools, when he attended the launch of the Microsystems Centre in London recently.

"A reorganisation of my Department has taken place and I am giving urgent consideration to the role which central Government can play in encouraging the entrepreneurial spirit which characterises so many British Information Technology companies. And it must be stressed that urgency is the key word, for, though very significant business opportunities exist, we are not the only country to appreciate them. If we are to be truly competitive, both domestically and internationally, we must move quickly.

I am, however, concerned that this process of acclimatisation should not have to be repeated for our next generation of businessmen. We must, I firmly believe, ensure that our young people are offered, as early as possible in their school life, the chance to use and to be taught in the use of computers. It is, however, a very disquieting fact that only about one-quarter of the nation's secondary schools have computer facilities on which to train the citizens of tomorrow. I intend as Minister for Information Technology to encourage and promote a much wider appreciation of the importance and value of a familiarity with computers to a young person in today's changing technological environment."

CB GETS BIG FOUR!

Operation authorised (from August 1981) on 27MHz F.M. and 930MHz F.M.

Moves to stop illegal shop sales and advertising being considered.

Shuttle Service for Experimenters

Plans to carry small self-contained payloads (SSCP) on Space Transportation System flights for educational, commercial and government experimenters have been announced by NASA.

The SSCP must weigh less than 200lb and occupy less than 5cu ft of space. The cost of $10,000 per payload is fixed for a three year period. Reflight guarantees are given in case of mission failure.

Experimenters who are interested should contact Dr L. Goldstone of the Research and Technology Requirements and Space Division, Department of Industry, from whom full details are available.

Speech Recognition Club

Speech is man's primary means of communication. Direct input of speech into a machine is therefore an important element in the range of man-machine interfaces. Advantages include the possibility of use by untrained people, the potential speed of interaction (again especially with untrained people) and the ease with which a person can talk and listen while simultaneously carrying out some other task.

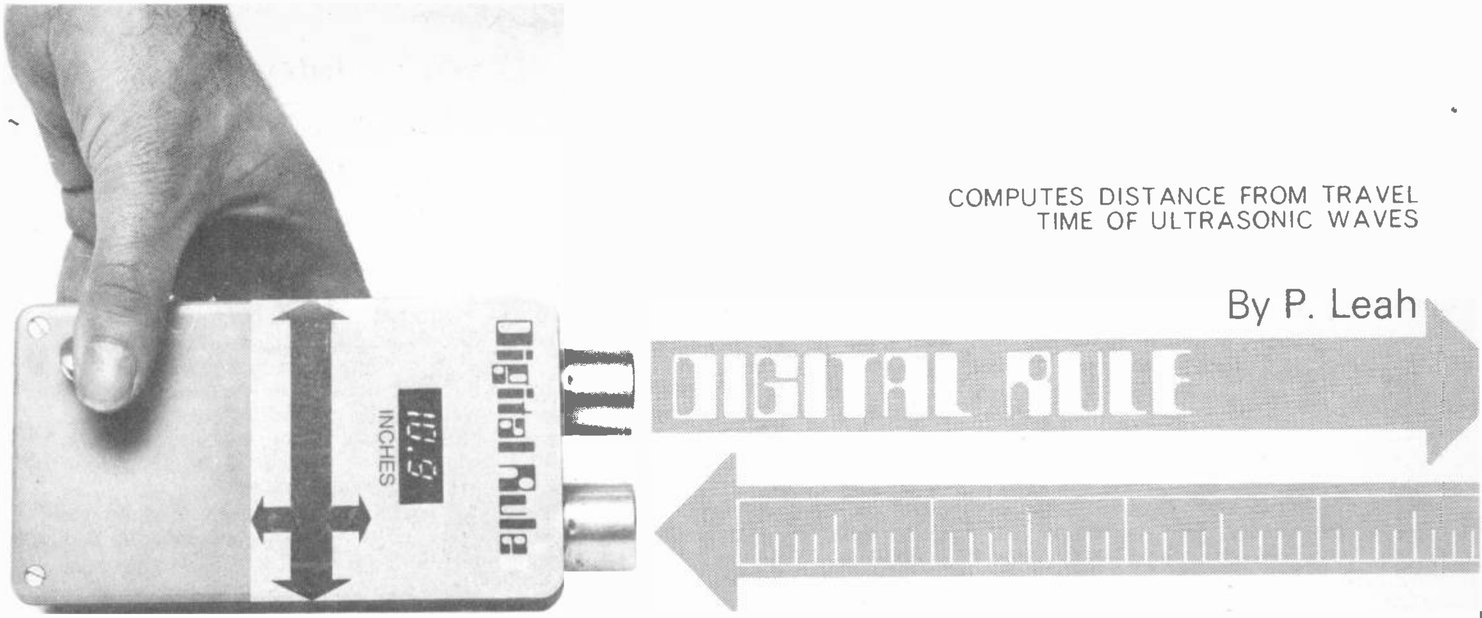
To develop and exploit the direct input of speech from man to machine, the National Physical Laboratory has formed a speech recognition club in collaboration with leading UK electronics firms and systems houses. It has been formed to assist the transfer of the considerable technology already developed by NPL and subscribers will help formulate the continuing research and development programme to meet their requirements.

Members of the club include Ferranti Computer Systems, Plessey, Systems Designers, Quest Automation Research and Nexos Office Systems.

COMPUTES DISTANCE FROM TRAVEL TIME OF ULTRASONIC WAVES

By P. Leah

DIGITAL RULE



THIS project should appeal to all those Do-It-Yourself enthusiasts who would prefer to stay in their armchairs reading their latest copy of EVERYDAY ELECTRONICS than perform the usual acrobatics and contortions required when measuring a room for either wallpapering or carpeting. Using this Digital Rule it is possible to measure those distances without rising from that armchair by merely pointing the instrument directly at the wall or ceiling to be measured and reading the distance directly from the digital display on the front panel.

PRINCIPLE OF OPERATION

The general principle of operation is shown in the block diagram, Fig. 1 and is based on a simple radar technique. The output from the Transmitter Oscillator is tuned to the 40kHz resonant frequency of the transducer. This output waveform is gated with a short enable pulse of approximately 0·2 milliseconds from the Control. Consequently the Transmitter sends only a short burst lasting 0·2 milliseconds (equivalent to eight pulses). This transmitted waveform is reflected off an object back to the Receiver transducer to be shaped and amplified before the Receiver sends a Pulse Received signal to Control.

Control enables the Counter to count for the period between the pulses being propagated and being received and this is displayed on a three-digit display. A separate Calibration Oscillator is provided to clock the Counter at the desired rate depending on whether inches or centimetres are to be measured. After approximately one second, Control resets the Counter and the measurement is repeated.

The period between the pulses being propagated and being received is directly proportional to the distance the pulse has travelled. This depends on the speed of sound in air. At sea level this is approximately 13,543 inches per second. Hence the transmitted pulses will take 7·38 milliseconds to travel from the Rule to an object 100 inches away, and a further 7·38 milliseconds to be reflected back, giving a total period the Counter is enabled to count of 14.76 milliseconds.

During this time the Counter must count 1,000 pulses (assuming the instrument is calibrated to measure to 0·1 inch). The frequency of the calibration frequency should be 17·2kHz.

Similarly the transmitted waveform will take a total of 7·38 milliseconds to be propagated from the instrument to an object 50 inches away and be reflected back to the instrument, while the total count displayed will be 500.

The receiver and transmitter ultrasonic transducers are purpose built for this type of application. Their operation relies on a conical aluminium resonator which vibrates a piezoelectric ceramic element to produce a high sensitivity, wide bandwidth device and smaller in size than a conventional microphone.

TRANSMITTER AND RECEIVER CIRCUIT

The Transmitter circuit is shown in Fig. 2 and comprises gates IC1a, IC1b, IC1c and TR1. IC1b and IC1c are used as straightforward inverters in the oscillator circuit. The frequency of the oscillator is controlled by the *RC* time constant of C3 and the series value of R3 and VR1. VR1 is variable to permit calibration of the transmitter oscillator so that it oscillates at the resonant frequency of the transducer, that is, 40kHz. Resistor R4 is a compensating resistor which provides stability to the oscillator.

The output from the oscillator is gated with the 0·2ms pulse from the control circuit *B* via IC1a which only allows a burst of eight pulses at 40kHz to the transmitter transistor TR1. TR1 is used in the emitter follower mode for maximum current gain to drive the transmitter transducer X1. R1 provides d.c. bias for the transistor as the resistance of the transducer varies with frequency. At resonance it is approximately 500 ohms.

The Receiver circuit is also shown in Fig. 2 and comprises the three

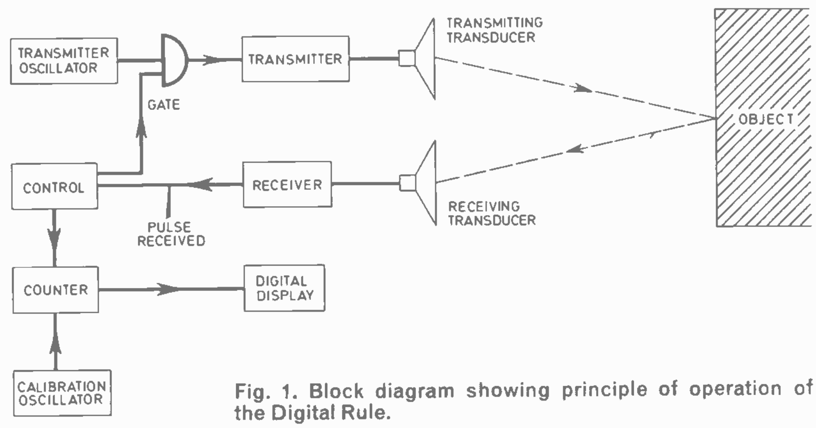
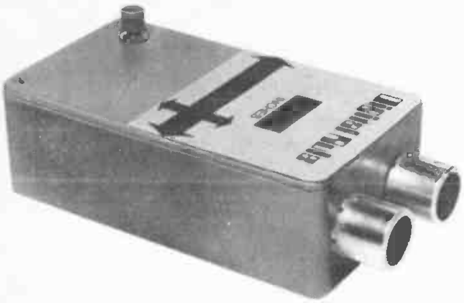


Fig. 1. Block diagram showing principle of operation of the Digital Rule.



common emitter amplifier circuits using transistors TR2, TR3 and TR4. Resistors R9 and R10 provide the d.c. bias for TR2 and provide a high input impedance for connection to the receiver transducer X2. The second common emitter amplifier is d.c. coupled to the previous stage to provide high voltage amplification of the waveform appearing at the transducer. The third amplifier stage is a.c. coupled to the previous stage via C8.

Transistor TR4 is biased using resistors R15 and R16 to operate in the switching mode, and is in the off condition when no input signal is present but switches hard on when the input signal is detected.

Capacitors C7, C9 and C12 provide a.c. voltage gain to these amplifier circuits, in addition to the normal d.c. voltage gain provided by the d.c. biasing emitter resistors R12, R14 and R18.

As the gain is frequency dependent, spurious low frequency noise which is picked up by the receiver transducer will be filtered out. Capacitor C10 filters out the 40kHz signal which has previously been amplified, to leave the envelope shape of the received waveform.

This envelope will vary in duration depending on the strength of the received signal, from a narrow pulse of 0·2ms due to a single relatively weak signal, to several milliseconds duration from a very strong signal made up of multiple reflections from a number of objects which have reflected the transmitted pulse back to the receiver.

To ensure that a standard width "pulse received" signal is sent to Control, the Receiver waveform appearing at the collector of TR4 is *RC* coupled via R19 and C11 before connection to IC1d. Resistor R20 and capacitor C13 are used to decouple noise appearing on the supply rail.

CONTROL AND COUNTER CIRCUITS

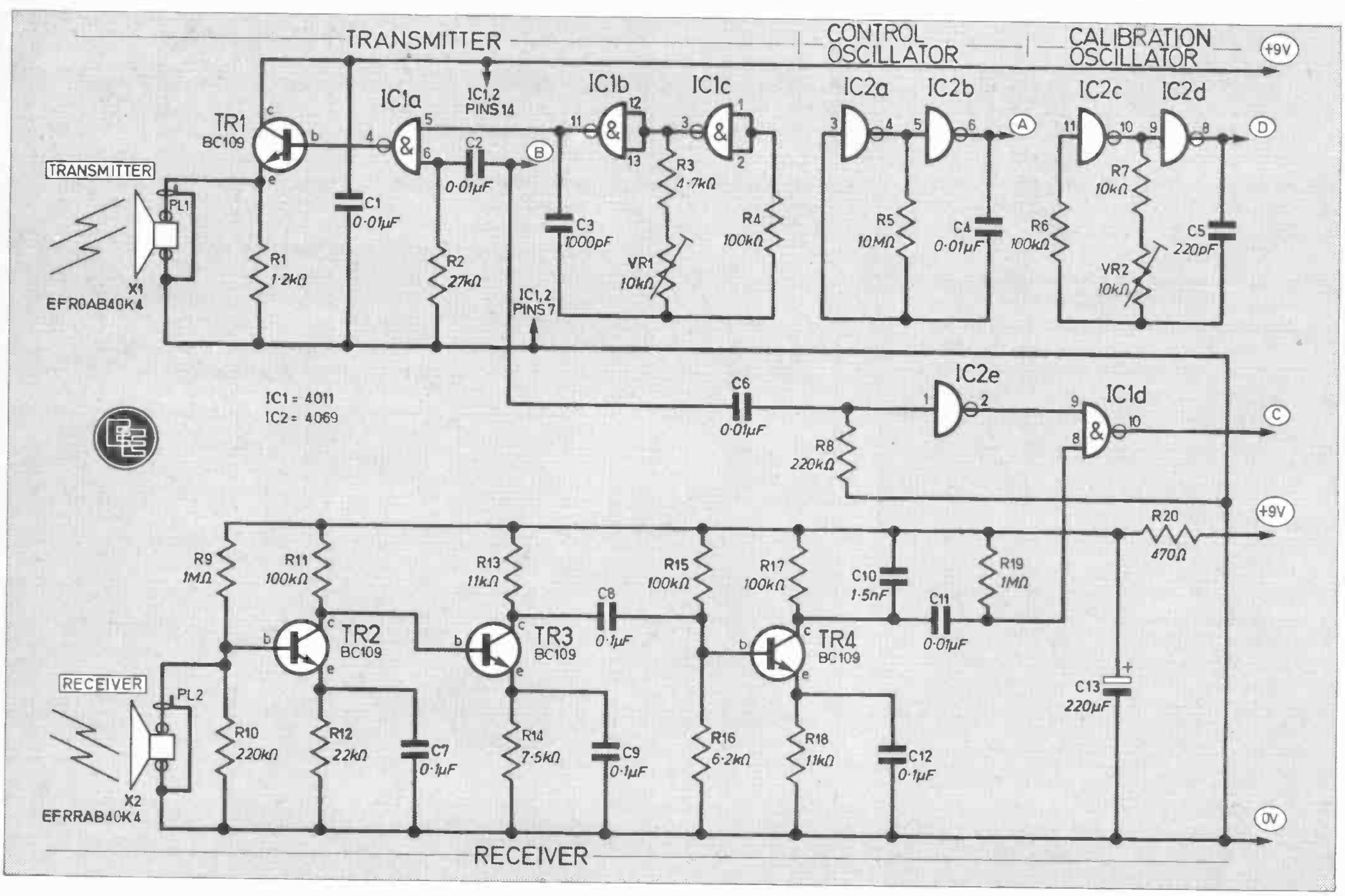
The Control circuit is regulated by the Control oscillator comprising IC2a and IC2b. It is similar to the Transmitter oscillator. Capacitor C4 and resistor R5 provide the *RC* time constant for the oscillator which oscillates at approximately 10Hz. The actual frequency of oscillation is not critical and hence no calibration or compensating resistor is required. The output from the oscillator, *A*, is connected to the clock input of a decade counter IC3 shown in Fig. 3.

This counter is not binary coded but provides ten decoded outputs which are normally "low" and go "high" only for their appropriate time period which in this case is 100ms. After the fifth clock pulse the "5" output goes high and sends a reset pulse to the dual *J-K* flip-flop IC4, and the counter IC5. At the sixth clock pulse, the "6" output goes high and initiates the measurement sequence by enabling the transmitting gate IC1a via interconnection *B*.

As only a short enable pulse of 0·2ms is required rather than the 100ms available, the enable pulse is *RC* coupled via R2 and C2 so that at the rising edge of the pulse, the input (pin 6) to gate IC1a will rise but exponentially decay to its steady state value of 0V in approximately 0·2ms. The transmitter is activated only for this brief period as explained earlier.

The pulse occurring at *B* also initiates the Counter circuit by initially

Fig. 2. Shows the circuit diagram of the Transmitter, Receiver, Calibration and Control Oscillator in the Digital Rule.



being reduced in duration to 0·2ms via the R8 and C6 coupling network and then being inverted by IC2e. The output is connected directly to the NAND gate IC1d.

A negative going pulse on either of the inputs to IC1d will cause a positive going output pulse from the gate on interconnection *C*. This pulse is connected to the clock input of one of the *J-K* flip-flops in IC4, which will change output states with the initial output pulse on *C* caused by the transmitted pulse. The *Q2* output hence switches from the high to the low state and thus enables the counter IC5.

RECEIVED PULSE

When the transmitted pulse has been reflected back to the Receiver and then amplified and shaped, the input (pin 9) to IC1c will go "low" which will send another pulse to *C* to clock the *J-K* flip-flop which will revert to its original states and disable the counter IC5. The positive going edge of this disable command will also clock the other *J-K* flip-flop in IC4 which will disable the first flip-flop by placing a low state on input *J2*.

Hence, any further clock pulses from the receiver on *C* caused by later reflections of the transmitted pulse will be ignored, so that the counter IC5 will only be enabled for the period between the pulse being propagated and its first reflection being received.

During this enable period IC5 is clocked from the Calibration oscillator, IC2c and IC2d. This is again similar to the Transmitter oscillator and the time constant of the series combination of R7 and VR2 and C5 allows the oscillator frequency to be set at 67·8kHz. R6 provides the compensation resistance. The output of this oscillator *D* connects directly to the counter clock input pin 12 of IC5. This counter is a three digit b.c.d. counter which provides a multiplexed output ideal for use with l.e.d. displays. The four b.c.d. outputs are connected to IC6, a b.c.d. seven segment decoder driver, which drives the l.e.d.s directly via the current limiting resistors R22-R28. R21 provides the current limit for the decimal point.

DIGIT DRIVERS

The digit driver transistors TR5, TR6 and TR7 operate directly from the digit select output of IC5 to switch on the displays as appropriate. The l.e.d.s are the principle current drain from the battery and therefore a capacitor C14 is required to smooth the supply. Capacitor C16 controls the multiplexing frequency of IC5 while capacitor C15 filters out noise spikes appearing from the output of IC1d.

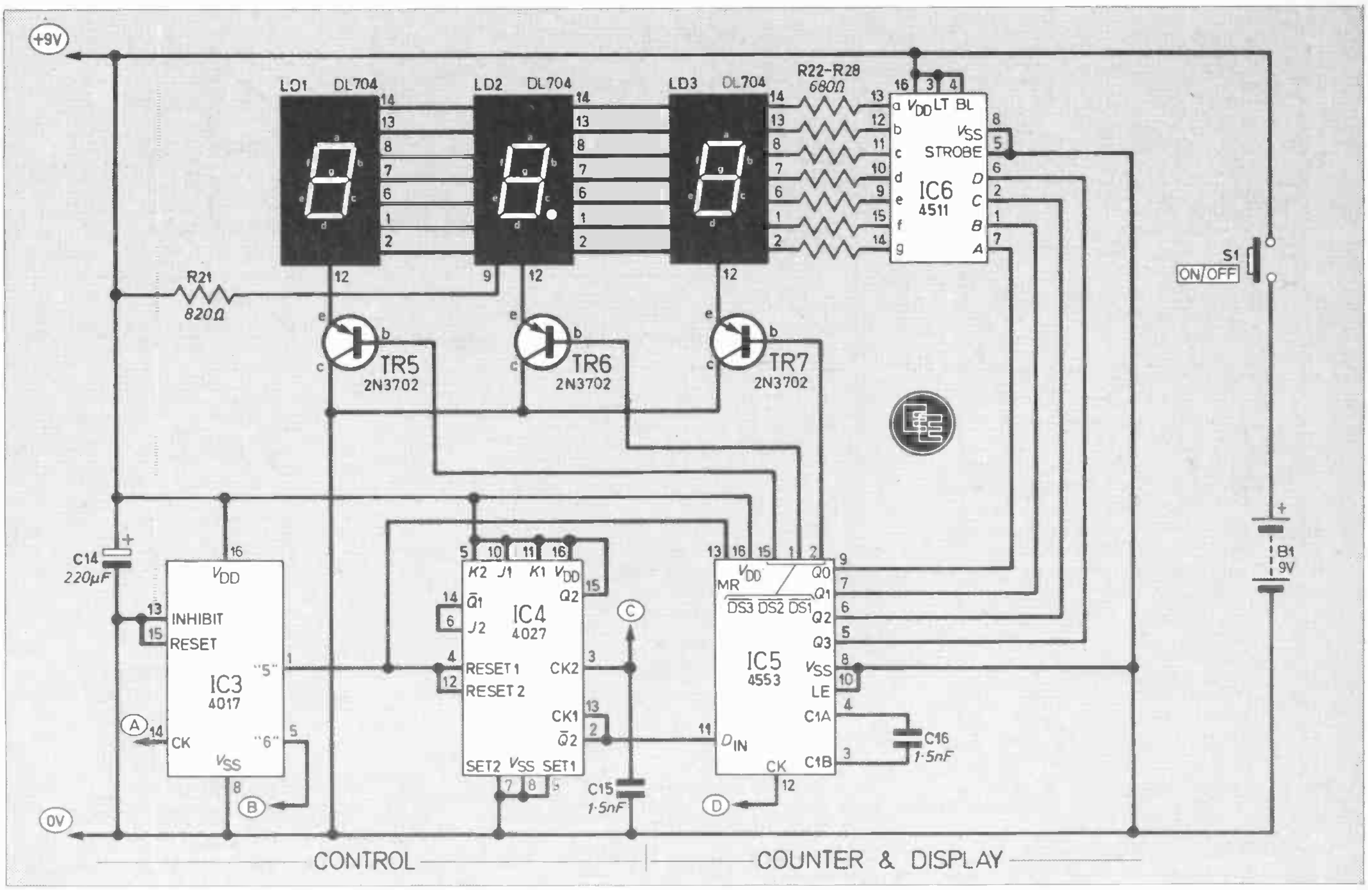
The measured distance is displayed for approximately 900 milliseconds while the control counter IC3 continues to count up to *Q9* and around to *Q5* again when IC4 and IC5 are reset and the measurement is retaken. If no received signal is detected the count will continue until the reset pulse occurs, while the display will appear to show "888" due to the speed the counter is being clocked.

CONSTRUCTION starts here

PRINTED CIRCUIT BOARDS

The circuits are laid out on two separate single-sided printed circuit boards, which are mounted one above the other in a plastic instrument case.

Fig. 3. The remainder of the circuit diagram for the Digital Rule containing Control, Counter and Display sections.



The component layout and solder side of board *A* is shown in Fig. 4, while the component layout and solder side of board *B* is shown in Fig. 5.

Board *A* mounts the predominantly discrete components of the circuit shown in Fig. 2 while board *B* mounts the predominantly digital components of the circuit shown in Fig. 3. The p.c.b. patterns are shown full size.

Begin construction by assembling the components on both boards. The use of sockets for the CMOS devices is advised, and if these are used, order of assembly is unimportant.

Due to limited space around the i.c. positions, low profile sockets or Soldercon pins will be required. Do not insert the i.c.s. until all soldering work has been completed to eliminate iron "leakage" damage. Veropins are advised for connection to the screened cable for ease of construction and a strong anchorage.

With the components soldered in place interconnect the two boards and solder the phono plugs on the ends of the screened cable. Finally, connect the battery terminal and switch.

MECHANICAL ASSEMBLY

The prototype was mounted in a plastics case measuring 150×80×50mm. The two p.c.b.s are mounted

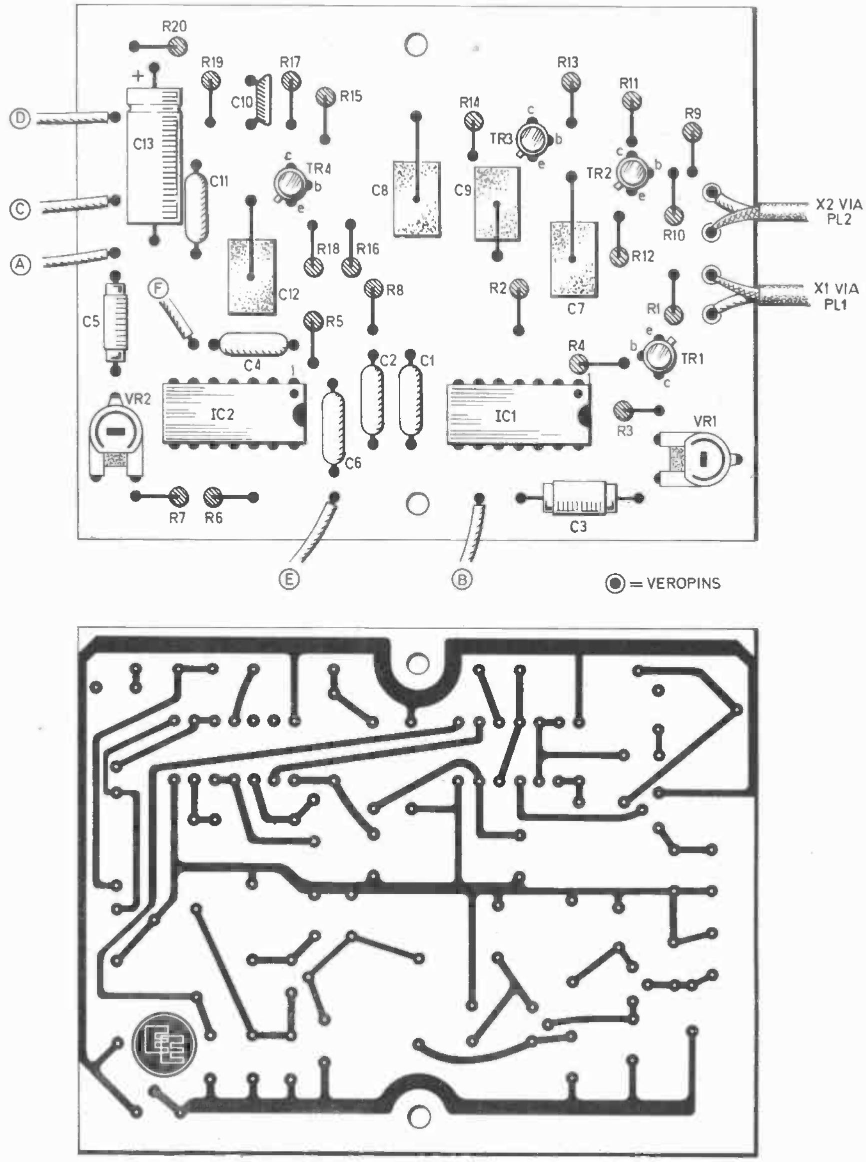


Fig. 4. The layout of the components on the top side of board *A* and connection details to board *B*. Lower diagram shows full-size master of the p.c.b. pattern for this board.

COMPONENTS

Resistors

R1	1·2kΩ	R12	22kΩ
R2	27kΩ	R13	11kΩ
R3	4·7kΩ	R14	7·5kΩ
R4	100kΩ	R15	100kΩ
R5	10MΩ	R16	6·2kΩ
R6	100kΩ	R17	100kΩ
R7	10kΩ	R18	11kΩ
R8	220kΩ	R19	1MΩ
R9	1MΩ	R20	470Ω
R10	220kΩ	R21	820Ω
R11	100kΩ	R22 to 28	680Ω (7 off)

All ¼W carbon ± 5%

Capacitors

C1 0·01μF polyester
C2 0·01μF polyester
C3 1000pF polystyrene
C4 0·01μF polyester
C5 220pF polystyrene
C6 0·01μF polyester
C7 0·1μF polyester
C8 0·1μF polyester
C9 0·1μF polyester
C10 1·5nF disc ceramic
C11 0·01μF polyester
C12 0·1μF polyester
C13 220μF 10V elect.
C14 220μF 10V elect.
C15 1·5nF disc ceramic
C16 1·5nF disc ceramic

Semiconductors

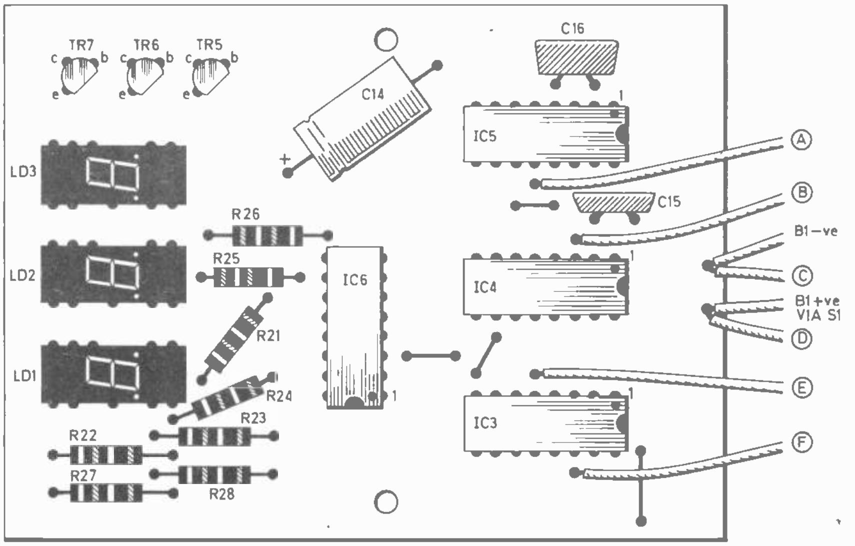
TR1-TR4 BC109 silicon *npn* (4 off)
TR5-TR7 2N3702 silicon *pnp* (3 off)
IC1 4011 CMOS quad 2-input NAND gates
IC2 4069 CMOS hex inverters
IC3 4017 CMOS decade counter
IC4 4027 CMOS dual J-K flip-flop
IC5 4553 CMOS three-digit counter
IC6 4511 CMOS b.c.d./seven segment decoder
LD1-LD3 DL704 common cathode seven segment display (3 off)

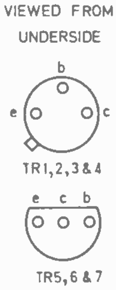
Miscellaneous

VR1, 2 10kΩ sub-miniature horizontal preset (2 off)
S1 momentary action push-to-make
B1 9V type PP3 (Duracell preferred)
X1 EFR-OAB 40K4 40kHz ultrasonic transmitting transducer
X2 EFR-RAB 40K4 40kHz ultrasonic receiving transducer
PL1, 2 phono plugs (2 off)
Printed circuit boards (2 off) approximate size 95 × 70mm and 90 × 70mm; PP3 battery clip; red Perspex sixe 40 × 20 × 1mm; case, Bimbox type BIM 2005/15 size 150 × 80 × 50mm; 6BA fixings; foam rubber.

COMPONENTS approximate cost £19 excluding p.c.b.s

See **Shop Talk** page 247





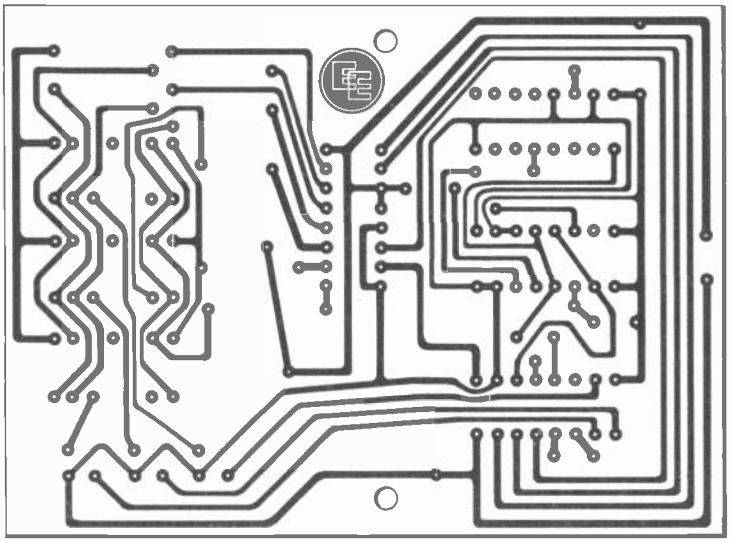


Fig. 5. The layout of the components on board *B*. The lower half shows the full size pattern required on the underside of board *B*.

on top of each other supported from the lid of the case, such that the solder sides of the p.c.bs face each other, but obviously do not touch each other. This is seen in the photographs. A rectangular hole 35×13mm was cut into the lid of the case for the display, and is backed with a red Perspex lens, Araldited to the lid, to emphasise the display digits.

Two holes 10mm in diameter need to be drilled in the side of the instrument case for the transducer connectors, while the body of the transducers are firmly attached on the side of the case using Araldite. It is essential that the transducers are mounted squarely on the surface of the case to ensure that both the transmitter and the receiver are pointing in exactly the same direction.

Connection to the transducers is made using phono plugs which are connected to the p.c.b. using approximately 100mm of screened cable. This length allows the instrument lid to be removed and gain comfortable access to the p.c.b.s for calibration, or to change the battery.

PRACTICAL CONSIDERATIONS

Sound waves cannot be directed as easily as light waves or microwaves, and they tend to quickly disperse over a relatively wide angle.

As mentioned previously, the ultrasonic transducers are particularly sensitive and the transmitter is in such close proximity to the receiver that the transmitted pulse disperses such that it is picked up by the receiver transducer.

Also the ceramic transducers rely on vibrating an aluminium cone which resonates at 40kHz and for optimum effect, this cone is very lightly damped. Consequently, the receiver transducer tends to continue vibrating for a relatively long period after the incident sound wave has declined which causes the duration of any received signal such as the initial transmitted pulse to be extended and a false reading could result if the distance between the instrument and the object to be measured is too short.

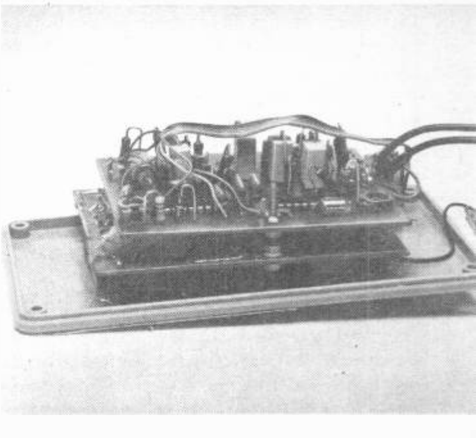
A further point to be aware of is that the sound wave can be propagated both inside the instrument case as well as towards a distant object. Unfortunately the completely closed instrument case provides an ideal resonant chamber for sound waves and if these waves would also cause false readings on the instrument.

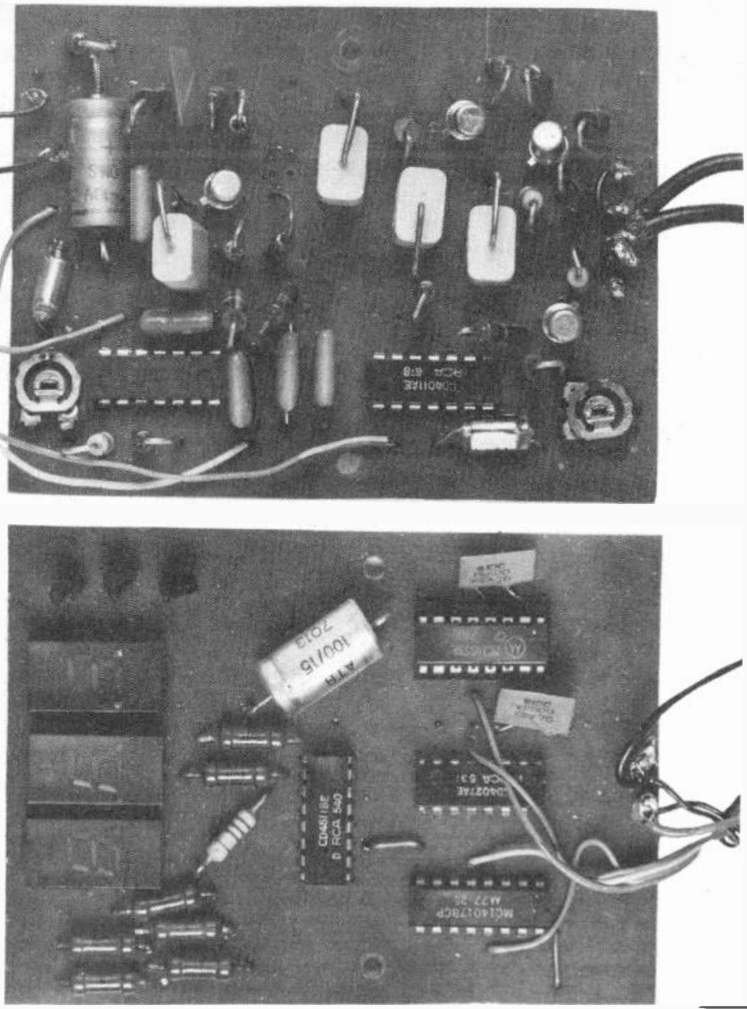
To prevent the sound waves propagating in the case, it is necessary to surround both the phono plug connectors to the transducers, and the battery, position at the other end of the instrument case, in foam rubber which absorbs the sound waves. It also provides a means of securing the battery in position.

LOWER LIMIT

To overcome these potential false readings occurring immediately after the transmitted pulse is propagated, the time constant of the *RC* network used to initiate the enable pulse (R8 C6) for the display counter is relatively long and overrides any received signal for a period of approximately 1·5 milliseconds. However, while this precaution inhibits false readings, it also prohibits the measurement of objects less than 10 inches away from the instrument.

Completed prototype showing tier construction method of mounting the two boards to the specified case.





Close-up view of the two prototype printed circuit boards with all components in position.

The 9V PP3 battery, although physically small and ideal for a portable instrument has a limited capacity and would be unsuitable for this application if the instrument was in constant use. Current requirements are 50 to 60 milliamps under normal load which is predominantly required to drive the l.e.d. display.

A push-button on-off switch is provided to ensure that the instrument is on only when measurements are being taken and as this takes only a few seconds to perform, the push-button has not been found to be a disadvantage, and certainly extends the life of the battery. Even with this precaution, the use of a Duracell battery is strongly recommended.

TESTING AND SETTING UP PROCEDURE

Testing and setting up of the Rule is greatly eased if an oscilloscope is available, but it can be accomplished using a voltmeter. Only two adjustments are required to set up the instrument: (1) the tuning of the transmitter oscillator to 40kHz, and (2) the calibration of the counter oscillator. It may be a good idea to short out the push-button on-off switch while setting up and testing.

The transmitter oscillator should be tuned by varying VR1 and monitoring the received signal. If a voltmeter is used, the Rule should be pointed at a large flat surface about 12 inches away and the received signal at the collector of TR4 should be monitored.

The voltage at this point will normally be about 8V but will dip to 0V only when a received signal appears which should occur approximately once per second. VR1 should be adjusted until the maximum dip is detected.

If an oscilloscope is used, the Rule should be moved approximately 24 inches from a large flat surface and the peak-to-peak waveform occurring at either the collector of TR2 or TR3 should be displayed. VR1 should be adjusted to give a maximum peak-to-peak voltage waveform.

The Calibration oscillator is readily calibrated by placing the Rule directly in front of a large flat surface so that there is exactly 24 inches between the surface and the *face* of the instrument which mounts the transducers. A tape measure should be used to measure this length. VR2 should then be adjusted until the display reads exactly "24·0."

If the instrument is required to display in metres, C5 should be replaced by a 2,000pF polystyrene capacitor and the distance between the surface and the Rule face increased to 50cm. VR2 should then be adjusted until the display measures "0·50".

Also, the decimal point on the display should be moved. The track to LD2 pin 9 should be changed to reach LD1 pin 9.

FAULT FINDING

There is, unfortunately, no easy method of fault finding if the Ruler fails to operate correctly and it is a case of laboriously plodding through the circuitry. Check for the obvious things first, such as ensuring that the supply voltage has not fallen below about 8V.

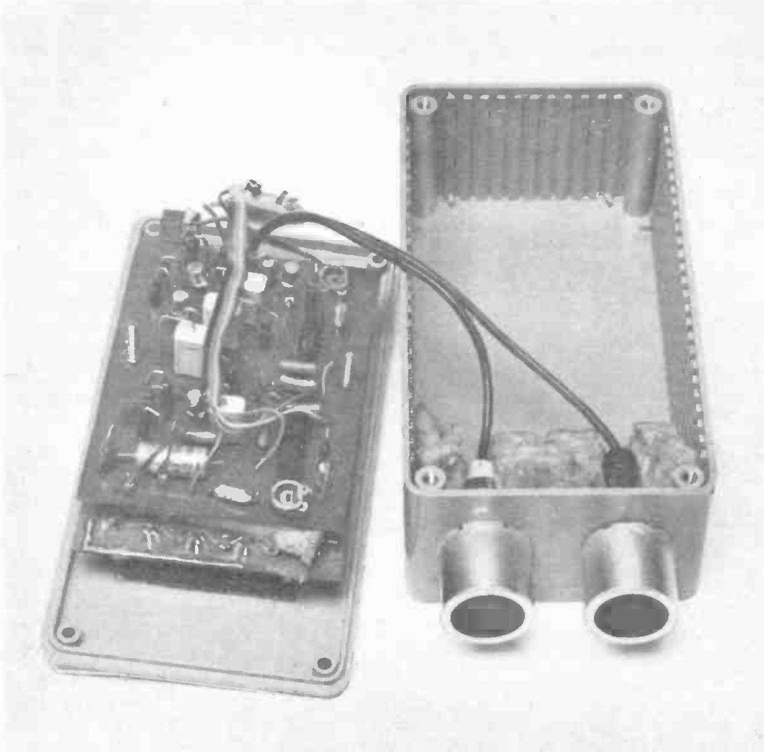
Next test the oscillators by monitoring their outputs at interconnections *D*, *A* and IC1 pin 11. The waveforms should switch between the supply rails and will read approximately 4·5 volts if using a voltmeter. The receiver and transmitter stages may be tested more readily if interconnection *B* is disconnected at board *B* and connected to 9V directly while capacitor C6 is short circuited. This permanently enables IC1a which consequently enables the transmitter and a 40kHz pulse train is propagated and therefore received, all of the time, rather than briefly once per second.

When fault-finding in the CMOS control or display areas, the low logic state should be at 0V while the high voltage state should be +9V, the supply voltage. However, any voltage below approximately 4V will appear as a low logical state, while any voltage in excess of 5V will appear as the high logical state to the input of a CMOS device.

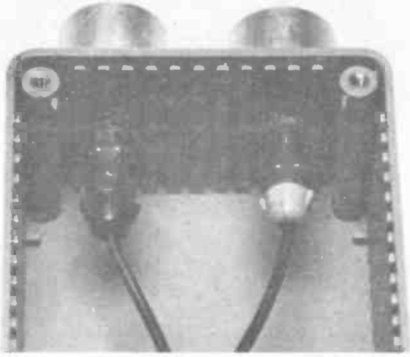
USE OF THE DIGITAL RULER

As explained previously, the instrument relies on picking up a reflected ultrasonic pulse, and hence the stronger the reflected pulse, the greater the distance may be between the instrument and the object to be measured. Large flat surfaces such as walls and ceiling are ideal but smaller solid objects may be detected within a shorter range.

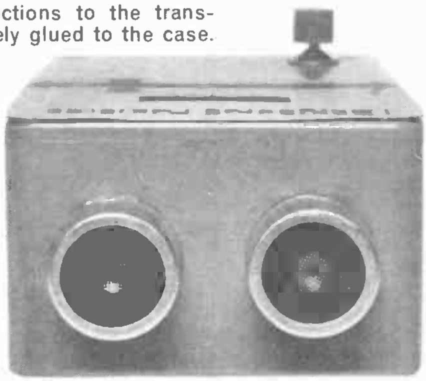
The Ruler should be pointed directly at the object, not at an angle,



The two transducers specified have integral phono socket connections. Screened cable fitted with phono plugs is required to connect these to the rest of the circuitry. You can see some of the foam rubber filling mounted directly behind the transducers to absorb any sound waves entering the case cavity.



Phono connections to the transducers securely glued to the case.



Close-up view of the transducers squarely mounted on the outside of the case.

so that the pulse is reflected directly back to the instrument. Uneven surfaces or absorbent surfaces such as curtains, do not reflect well but tend to diffuse or absorb the sound waves, so that the range is again limited.

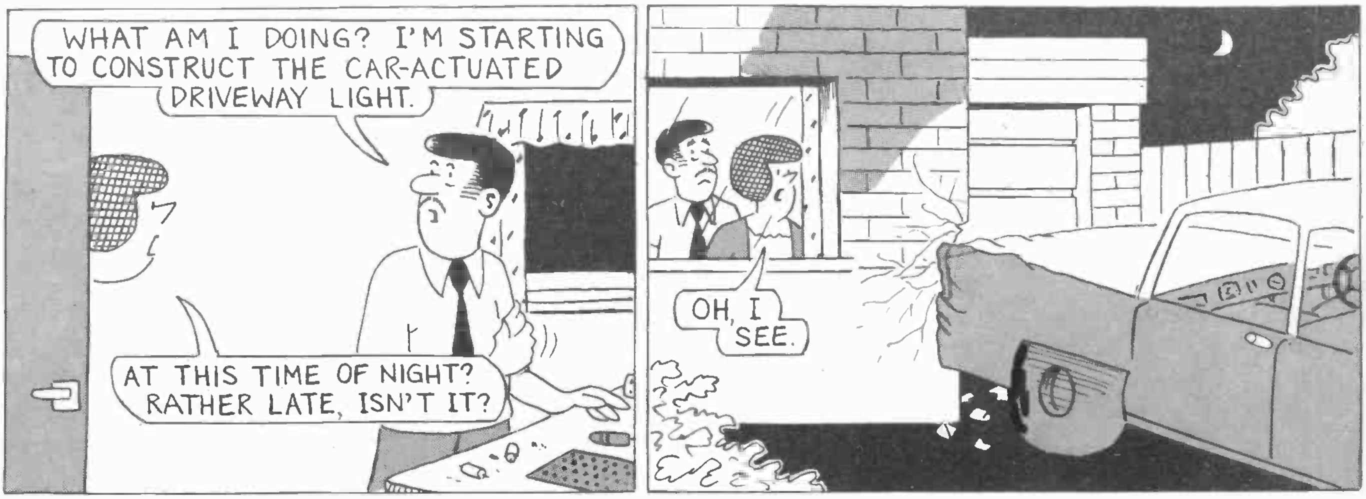
The transmitter propagates the sound waves over an angle of at least 50 degrees of arc to the left and right of the transducer axis and reflections may be picked up from objects which do not appear to be in direct line with the transmitter, and may cause the user to falsely believe the instrument is reading incorrectly.

Any sonic or ultrasonic wave propagates through air and a disturbance in the flow of air will cause variations in the time taken for the pulse to be transmitted and reflected. In normal household use such variations may be ignored but if the instrument is used for outside use, the accuracy may be affected by wind speed by as much as 5 per cent in a strong breeze, and up to 10 per cent in a gale force wind.

Most objects greater than 2 square feet will be detected up to a distance of 60 inches, and detection will be extended to the full range of 99·9 inches if a large flat surface is to be measured. The overall accuracy of measurement has been observed by the designer to be within 2 per cent. ⌑

JACK PLUG & FAMILY...

BY DOUG BAKER



RADIO WORLD

By Pat Hawker, G3VA

Finding Undercover Transmitters

Many of the 27MHz "CB" operators who, during the past year or so, have been hauled into the Magistrates Courts are there because some police forces have taken to the habit of looking over any vehicles seen to be carrying unusual aerials (a practice that has given many unhappy moments to licensed amateurs of whom the police seem often to have little knowledge). Relatively few owe their appearances to the use of sophisticated direction-finding techniques (D/F)—although the story still arouses chuckles of how one journalist "offender" was actually spotted using a hand-held 27MHz unit from the windows of the Home Office Radio Regulatory Department of whose location he was apparently ignorant!

The seemingly low risk of being successfully tracked down by D/F when operating mobile has made many people wonder what has happened to the craft of hunting down hidden transmitters, and whether it would not be equally simple to get away with using two-way radio for more serious purposes. If 100,000 or so CB "pirates" can get away with all the activity one now hears on 27MHz then what, it is argued, has happened to radio security and surveillance?

The radio amateurs retain an interest in D/F contests, mostly on 1·8MHz, where with the help of loop and ferrite-loop aerials it is possible to track down as many as three carefully hidden transmitters in a single afternoon. And indeed direction-finding was one of the earliest applications of radio in the heady days of 1900—1910 when pioneers such as S. G. Brown, E. Bellini, A. Tosi and H. J. Round were all making history.

The 1914-18 war also gave a tremendous fillip to the craft as it did to so many other aspects of radio. The naval Battle of Jutland was brought about by a skilful and effective combination of D/F, interception, codebreaking and human deduction.

High Frequency D/F

Short wave (h.f.) D/F proved a more difficult nut to crack, though the 1919 patent of F. Adcock for "an improvement in means of determining the direction of a distant source of electromagnetic radiation" formed the basis for many later installations, while the introduction some 40 years ago of the cathode-ray tube display as a result of American, French and British work led to the so-called "Huff-Duff" system, that enabled bearings to be taken on fleeting signals. In their turn, the Germans developed the "Wullenweber ring" or wide-aperture-aerial technique as one of their least publicised but most effective weapons of World War 2.

In recent years the massive Wullenweber circular aerials have been further improved by the use of high-speed electronic scanning and digital computers. A really large modern h.f. system can measure the incoming direction of a signal to better than 0·1 degrees which is an order of magnitude less than the deviations that can occur on distant signals due to the effects of the ionosphere.

For smaller installations it is now possible to locate these in remote places and operate them entirely unattended with all information brought back to base using telemetry systems. Combined with modern band-scanning techniques it is possible to check hundreds of frequency channels per second and to select for bearings only stations of interest.

City Reflections

However, despite the fantastic accuracy of modern D/F techniques there is a particular problem when taking bearings on v.h.f. transmitters located in city streets, due to the many reflections and changes in polarisation caused by buildings and high structures. But "pirates" should not rely on this.

A recent publication by the German firm of Rohde & Schwarz provides a graphic illustration of what can now be achieved, by using extremely sophisticated equipment, in difficult circumstances. In trials in Munich they installed Doppler wide-aperture D/F systems in two of their premises 1360 metres apart and these were used to track vehicles moving around the city at distances up to about 5km. The transmitters were in the frequency range 20 to 1000MHz.

On average, the position of the transmitter was determined to within 200 metres of its correct position, with a spread of individual bearings of about 2·5 to 3 degrees. Accurate bearings can be obtained with such systems provided the transmitter is active for more than just one-tenth of a second—and even in that short time the results are the average of a considerable number of electronic sweeps or scans of the aerial system.

Such installations, in radio contact with police or security vehicles, could undoubtedly quickly account for a lot of illegal operation, although one doubts if many authorities would wish to mount such an elaborate and expensive operation unless the objective was something more serious than CB chatter. The German firm points out the value of such techniques for keeping track of police, fire or rescue vehicles, to allow them to be guided to their destinations.

Rather more specialised and intriguing are such suggested applications as "personal protection" and "trailing" prepared vehicles. By this one assumes they mean that a vehicle containing a VIP could be followed on its passage through a city, or the police or security services could fix a small beacon transmitter to a suspect vehicle and then, by "radio shadowing", find out exactly where it goes.

On v.h.f. a wide-aperture Doppler D/F aerial involves only a compact ring of dipoles but some very complex electronics.

Black Aspidistra

Being one of those insomniacs who spend part of most nights listening to the BBC World Service transmissions on its 648kHz medium wave channel, I have been following with interest the agitation in the press over the change later this year from its present transmitter site at Crowborough, Sussex to more directional aerials at Orfordness in Suffolk; a fact that may make it more difficult for some UK listeners to receive the service.

Those who have been appealing to the BBC to change its plans all seem to overlook one important but relatively little known, though not secret, fact. Neither the Crowborough nor the Orfordness transmitters are owned, engineered or operated by the BBC, but belong to the Foreign and Commonwealth Office.

Although the BBC seldom draws attention to the subject, the present Crowborough 600kW transmitter is the famous wartime "Aspidistra" transmitter purchased in the USA in 1941 at the order of the Ministry of Economic Warfare without the knowledge of the BBC. It was operated from January 1943 until the end of the war by the Political Warfare Executive as a "black" propaganda station, making full use of its ability rapidly to change frequency in order, when required, to "intrude" on German broadcasts. Then (and since) Aspidistra and the other FCO broadcast transmitters overseas have been the cause of much discussion and quite a bit of friction between "Auntie" BBC and the Government.

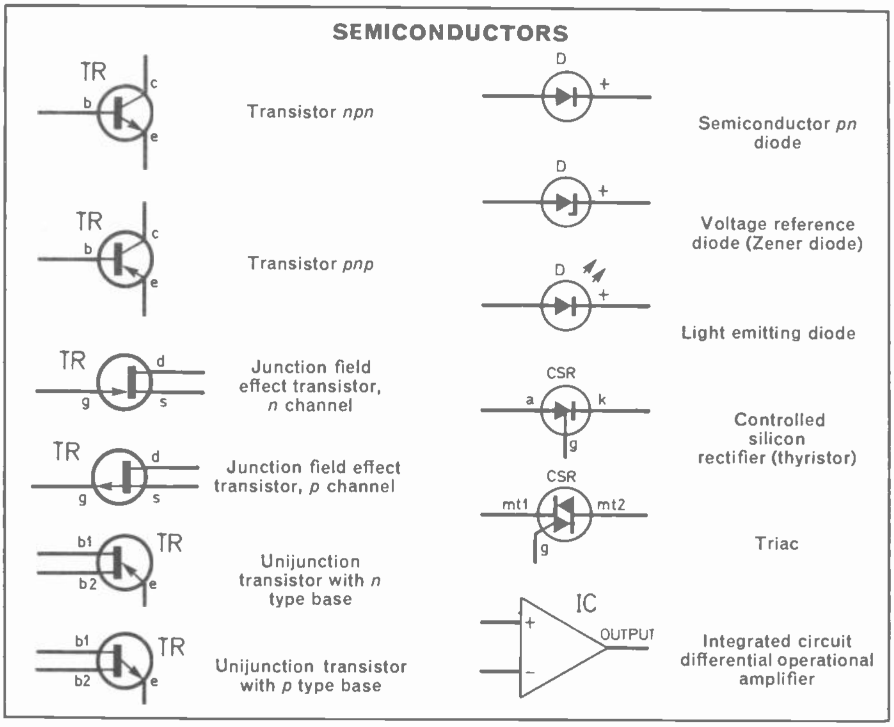
In 1968, I became one of the very few journalists ever to be invited to look at Aspidistra in its underground transmitter hall at Crowborough. This building bears a remarkable resemblance to some of the old 1930s super cinemas—a fact that may not be unconnected with the coincidence that the same architect was involved.

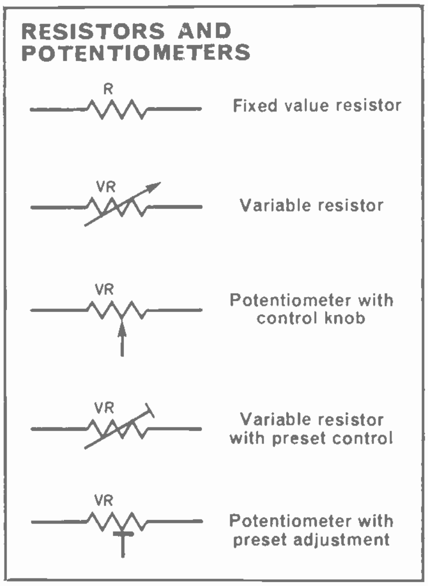
Although ancient in broadcasting terms, the FCO have always kept the "Largest Aspidistra in the World" (in the words of the old Gracie Fields song from which the name was derived) in good shape. It was, for example, the first high-power broadcast transmitter in this country to be modified to use an all-solid-state power supply.

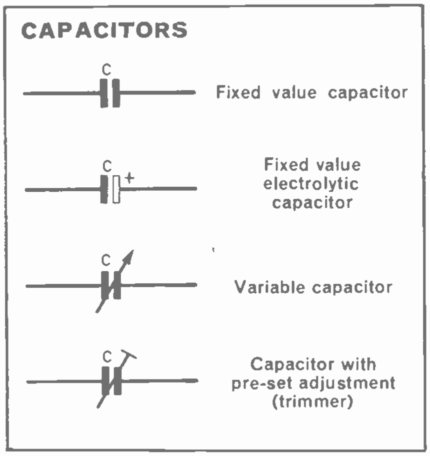
Soon to be retired, Crowborough still puts out a potent signal and I suppose that not one in a thousand listeners ever realise that over many years the FCO and not the BBC have been responsible for the highest power m.f. transmitter in the UK, something that seems to have led from time to time to more than a little professional jealousy and friction, although since the FCO foots the bill the BBC engineers cannot really complain!

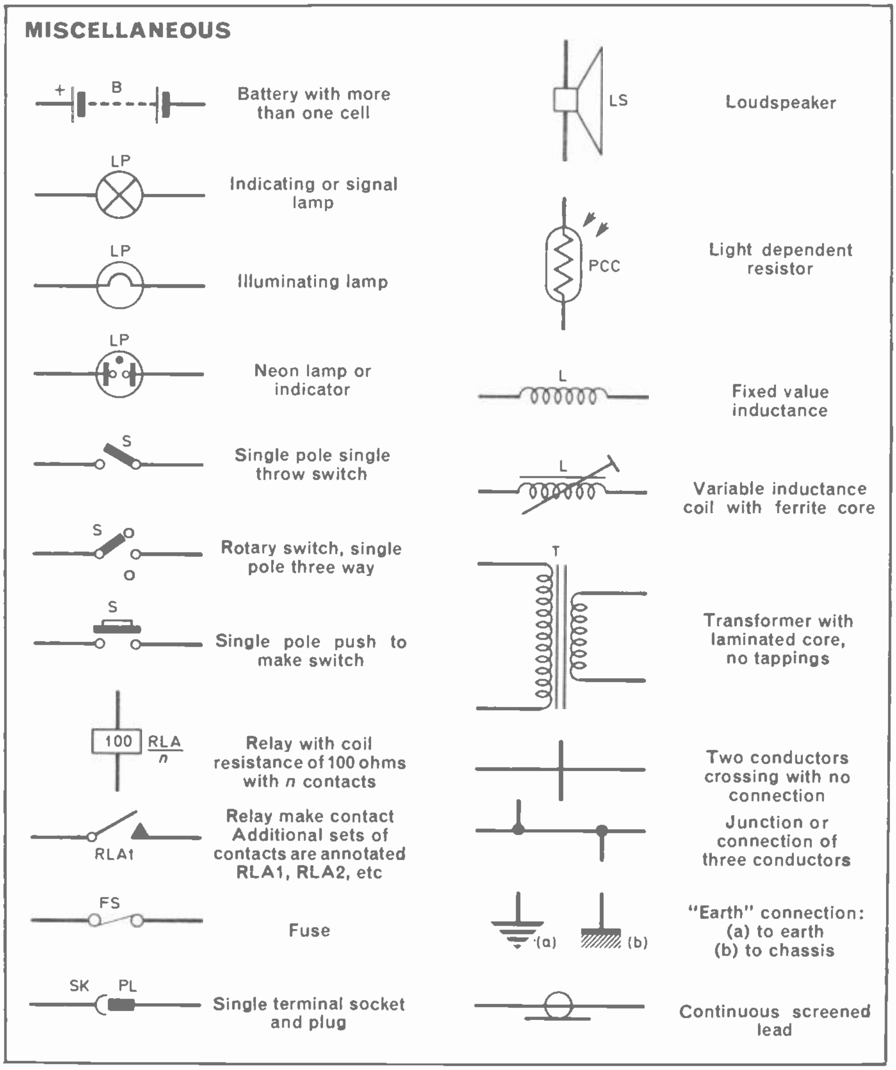
SQUARE one

ONE of the first things that the newcomer to electronics must learn is how to "read" circuit diagrams. This requires an understanding of the symbols that are used to represent electronic components in such diagrams. This month we present the most commonly used symbols. Study these symbols and memorise what they stand for.









CIRCUIT EXCHANGE

MULTI-CHANNEL CHASER

Reading through the "Chaser Light Display" (September '79), it seemed rather limited with only three lights so I decided to design a multichannel chaser.

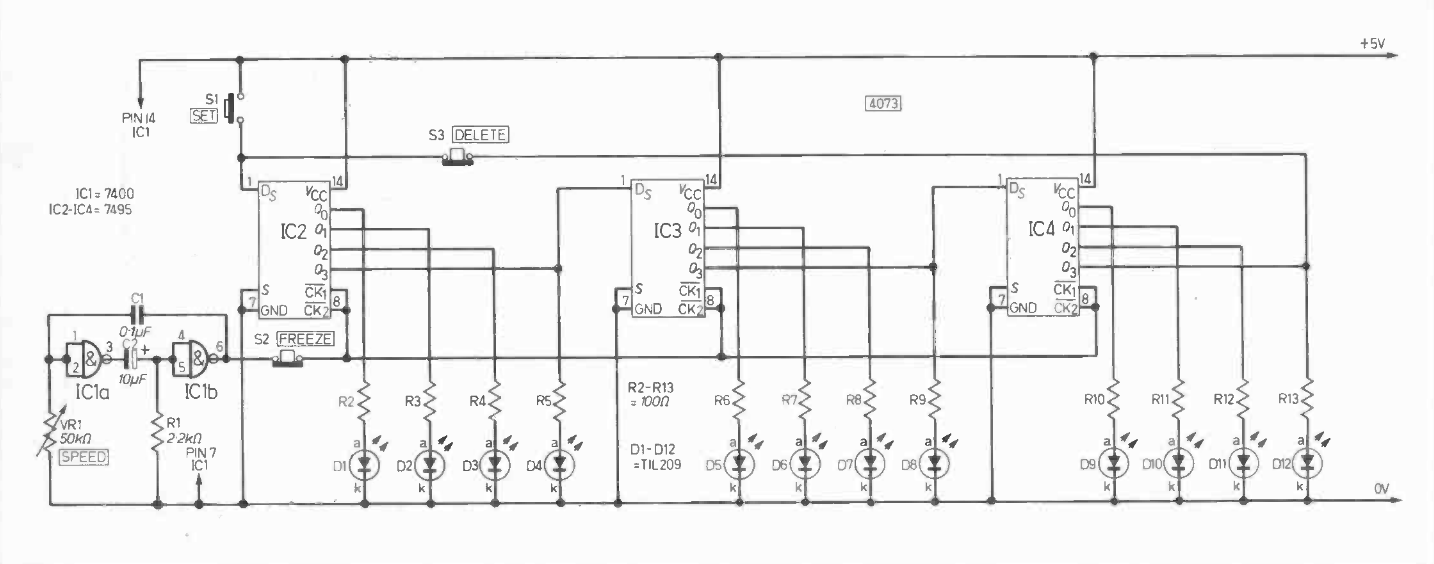
My idea is to use 7495 shift registers controlled by an astable multivibrator built from two gates of a 7400. The circuit is shown below. This was 16 l.e.d.s but could easily be expanded by adding more 7495 devices.

The user then has to program in his own pattern. By pressing S1 at the correct time the l.e.d.s will come on in turn and it is a simple matter to leave gaps to establish the pattern.

If S3 is pressed this will disconnect the output of the last shift register from the input of the first so an output pulse illuminating D12 will not be passed on to D1 so there will be a gap in the pattern—part of the pattern will have been deleted.

The oscillator (IC1) is disconnected from the shift register by pressing S2 and this freezes the display.

Hugh Pyle,
Dorking,
Surrey



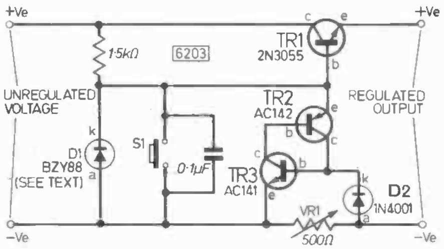
ELECTRONIC FUSE

An immediate spin-off from a power supply I have been designing is an electronic fuse. Many circuit designs have been published but none has been fully satisfactory using solid-state devices.

I think I have solved the problem by the addition of a single diode to divert the currents that occur, enabling a very fast fuse action to be achieved with a very low current consumption when the fuse circuit has latched.

The fuse works as a switch to reduce the voltage reference in a regulated supply to near zero when a limit current has been detected. A practical circuit is shown in Fig. 1 for a simple follower-amplifier. (The value of D1 will be set by the output voltage you require.) It may work just as well with feedback regulators.

The important new component is D2 as you will see if you trace the current paths out. It causes the latch formed by TR2 and TR3 to operate when the voltage across VR1 attains approximately (0·55+0·6)V and then isolates the latch from VR1 so current from TR2 collector goes only into the base of TR1.



In previous designs without D2 the latch is quenched because the latch could not sustain the high current needed through VR1 to maintain the p.d. across it. Here it is not required.

The supply goes into a complete shutdown. Latching action is quenched by using a normally open push button switch providing an even lower impedance path than the electronic switch. The current limit level can be varied by altering the resistance value set by VR1.

P. J. Ratcliffe,
Stevenage, Herts

Sorry Mark!
Our apologies to Mark Davidson whose name was incorrectly given under his contribution Diode Polarity Tester in the February issue.
(We got it right on the cheque though!)

CIRCUIT EXCHANGE

SUPERSOUND 13 HI-FI MONO AMPLIFIER

A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz-30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £18·40, P. & P. £2·50.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200-240 volts. Size approx. 12½in wide × 5in high × 7½in deep.

Special price £29·00 + £3·25 carriage and packing.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11¾" × 14 11/16" × 1 7/16" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.

Only £9·20 each + p. & p. (one £1·40, two £1·80).

A brand new 22 transistor hi-fi stereo amplifier of superior design made by a well-known British manufacturer, for a now cancelled contract order. The unit is supplied new & tested on a printed circuit panel size approx. 6¾" × 4¾" × 1½" h. using high grade discrete components. Brief specification: 15 watts r.m.s. per channel O/P into 8 ohms. (o/p stages fully protected against s/c) I/P 60mV. for *ceramic cartridge. Provision for tape i/p & o/p. Only requires the addition of a 40 volt @ 2 amp. power supply & the bass, treble, balance & vol. control, (standard types). FULL Circuit diagram & connection details supplied. Price with edge connectors, Only £9.00 + 80p p & p.

IF ORDERED WITH AMPLIFIER:

—*2 stage pre-amp for Mag. Cart. RIAA corrected £2·50—Mains Transformer, Rectifier, Smoothing Condenser £4·00 + £2·50 p. & p.—Set of 4 pots £2·50 (while stocks last).

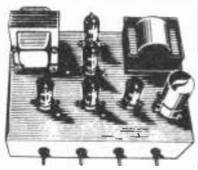
MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State FM/AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz.

Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8¼"w × 4"h × 9½"d approx.

LIMITED NUMBER ONLY at £29·00+£2·60 P. & P.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monoaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet. 50p + SAE (Free with parts). All parts sold separately. ONLY £18·40, P. & P. £3·20. Also available ready built and tested £22·50, P. & P. £3·20.

STEREO DECODER MK.II

SIZE 1½" × 2 5/16" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied. £7·00 plus 30p. P. & P. Stereo beacon light if required 40p extra.

Mullard LP1159 RF-IF module 470kHz £2·50 + P. & P. 50p Full specification and connection details supplied. Pye VHF FM Tuner Head covering 88-108 MHz, 10.7 MHz I.F. output, 7.8V + earth. Supplied pre-aligned, with full circuit diagram with precision geared F.M. gang and 323PF + 323PF A.M. Tuning gang only £3.40 + P. & P. 60.p

STEREO MAGNETIC PRE-AMP. Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ± 1dB from 20Hz to 20KHz. Input impedance 47K. Size 1¾" × 2¾" × ¾" H. £3·20 + 30p P. & P.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modity to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response: ±3dB 12-30,000Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ±3dB 12-15,000Hz. Bass boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.

Overall Size 12"w. × 8"d. × 2½"h.

Fully detailed 8 page construction manual and parts list free with kit or send 50p plus large S.A.E.

AMPLIFIER KIT	£14·95 P. & P. £1·20
(Magnetic input components 33p extra)	
POWER PACK KIT ..	£6·20 P. & P. £2·00
CABINET	£6·20 P. & P. £2·00

SPECIAL OFFER—only £25·80 if all 3 items ordered at one time plus £3·00p p. & p.

Full after sales service

Also avail. ready built and tested £32·20, P. & P. £3·00.

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9½" × 2½" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only £10·40 plus 90p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at £2·15 + 70p P. & P. if required. Full connection details supplied.

All prices and specifications correct at time of press and subject to alteration without notice.

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. SEND SAE WITH ALL ENQUIRIES. BARCLAYCARD WELCOME.

HARVERSON SURPLUS CO. LTD. (Dept. E.E.) 170 MERTON HIGH ST., LONDON, S.W.19. Tel.: 01-540 3985

A few minutes from South Wimbledon Tube Station. Open 9.30-5.30 Mon. to Fri. 9.30-5 Sat. Closed Wed.

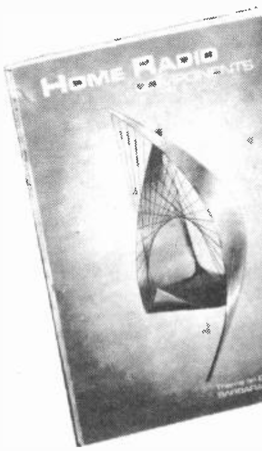
Rapid Electronics

Pack No.			Pack No.		
A10	10 PP3 battery leads	50p	F331	1 BD139 transistor	45p
A72	10 3.5mm jack plugs	80p	F421	1 MJ2955 transistor	110p
A73	10 3.5mm jack sockets	80p	F43	5 78L05 regulators	130p
A74A	5 Standard jack plugs	80p	F46A	1 7805 regulator	70p
A75A	5 Std. jack sockets	90p	F47A	1 7812 regulator	70p
A84A	5 5 pin 180 DIN plugs	70p	F49A	1 7905 regulator	75p
A85A	5 5 pin 180 DIN sockets	55p	F53	1 LM317T variable reg.	200p
C21	5 Min. slide switches	75p	F54	1 LM323K 3A 5V reg.	500p
C28	5 Push to make switches	70p	H11	20 1N4002 diodes	75p
C29	5 Push to break switches	90p	H30	2 W005 bridge rectifiers	45p
C50	20 8 pin DIL sockets	170p	H60	100 1N4148 diodes	180p
C51	20 14 pin DIL sockets	200p	H73	2 C106D thyristors	90p
C52	20 16 pin DIL sockets	220p	J5	10 0.2in red LEDs	100p
E10	Resistor kit. 650 resistors ¼W		J25	10 0.2in green LEDs	150p
	10 ea value 4.7 to 1M	480p	J45	10 0.2in yellow LEDs	150p
—	Single potentiometers		J70	20 0.2in LED clips	60p
	5K-1M log or lin	35p	J7	10 0.125in red LEDs	100p
—	Slide potentiometers. 60mm		J27	10 0.125 green LEDs	150p
	travel. 5K-500K log or lin	65p	J47	10 0.125 yellow LEDs	150p
E26	10 100K min. presets	70p	J72	20 0.125 LED clips	60p
E31	10 1u 63V electrolytics	50p	J75	1 FND500 CC display	100p
E33	10 4u7 63V radial elec.	50p	K5	5 741 op amps.	90p
E34	10 10u 25V radial elec.	50p	K20	5 CA3140 op amps.	225p
E37	10 100u 25V radial elec.	75p	K30	5 LM301A op amps.	140p
E44	10 1u 35V bead tants.	100p	K40	1 LM324 op amp.	50p
E50	10 0.01 C280 polyester	50p	K50	1 LM380 2W amp.	70p
E54	10 0.1 C280 polyester	50p	K75	1 LM3914 LED bar graph	320p
E10	10 BC107 transistors	90p	K85	5 NE555 timers	110p
F11	10 BC108 transistors	90p	K90	1 NE556 timer	50p
F12	10 BC109 transistors	90p	K100	5 TL081 op amps.	175p
F17	10 BC214L transistors	90p	L8	5 4011 CMOS	130p
F27A	5 2N3819 transistors	100p	L9	1 4013 CMOS	40p
F311	1 BD131 transistor	45p	L11	1 4017 CMOS	75p
F312	1 BD132 transistor	45p	L22	1 4049 CMOS	45p

All prices include VAT. Please add 50p postage and packing. Send SAE for our complete catalogue.

Rapid Electronics Limited
Hillcroft House, Station Road, Eynsford, Kent

TOP PRIORITY for every constructor...



HOME RADIO CATALOGUE

- About 2,000 items clearly listed.
- Profusely illustrated throughout.
- Large catalogue, A-4 size pages.
- Bargain List, Order Form and Pre-paid Envelope included. Also 2 coupons each worth 25p if used as directed.
- Catalogue £1, plus 50p for post, packing and insurance.

HOME RADIO (Components) LTD.,
Dept. EE., P.O. Box 92, 215 London Road, Mitcham, Surrey.
Phone 01- 543 5659

POST THIS COUPON with cheque or P.O. for £1·50

Please write your Name and Address in block capitals

NAME..

ADDRESS..

....

....

HOME RADIO (Components) LTD. Dept. EE
P.O. Box 92, 215 London Road, Mitcham, Surrey

(Regn. No London 912966)

LETTERS

P.C.B. Repair

Some years ago I built a radio control system for my model aeroplanes. However I have recently discovered that the copper on the printed circuit board has "corroded" in places and this of course has affected the equipment.

I think that the "corrosion" was caused by dampness. Can you give any advice on how to "re-copper" the corroded parts of the p.c.b.

James McQueen,
Portadown, N. Ireland

A damaged p.c.b. can usually be repaired by replacing the missing copper with silver conductive paint. The surface of the board must be clean and grease free before starting and the paint is then applied with a soft bristled brush to obtain a thin coating. It takes about fifteen minutes to dry.

The board can be further protected by applying a coat of plastic seal. This is available in Aerosol form and keeps away the moisture and dirt which can lead to corrosion.

Ultrasonics and Small Animals

Would you please advise if the *Ultrasonic Intruder Detector*, which appeared in the January 1981 issue of *E.E.* can be adjusted to ignore small moving things like cats or birds whilst still retaining the ability to register human movement.

P. Bullard,
Petts Wood, Kent

For a position within the transmitter main beam, the size of the object plays little part in causing a trigger pulse to be generated through the receiver section. It is the velocity of the object which determines this and its magnitude. Even a tiny object moving within this area will cause the alarm to be triggered.

Decreasing the sensitivity by means of VR3 will require an object at a set distance from the unit to move faster to produce the same trigger amplitude. On the periphery however, the body size will play a more dominant role, where the larger the body size, the more "disturbance" it can create.

If the bird referred to is in a cage, it should be possible to find a low sensitivity spot in the room, certainly by adjusting VR3 and positioning the unit and/or transducers, without interfering with the ability of the device to detect a person moving in or out of the room. Certainly if the bird was "covered up" (assuming you are concerned about this problem during the dark hours) this could be realised.

Cats (and dogs for that matter) present a different problem as they usually stay close to the ground. It may be possible to reduce the sensitivity at ground level by suitable positioning of the unit and/or transducers. However, if the cat jumps up on the furniture or leaves the ground for any other reason, then your efforts would have been wasted. The only sure answer is to prevent the cat from entering the guarded area if you want to install this device.

In Defence of Stripboard

In reply to the readers in Australia (Feb. 81 edition), who asked why circuits were not printed in p.c.b. fashion, I feel that having used both systems, I must jump to the defence of Veroboard designs.

I am sure that part of the reason for the popularity of EVERYDAY ELECTRONICS is the detail provided, and the ease with which projects may be constructed. There can surely be little doubt that a Veroboard project is both cheaper and quicker than its equivalent p.c.b. layout. I wonder how many readers would really want to bother with the etch resist pens and/or transfers required, not to mention the hazardous etching chemicals, and drilling required to produce a p.c.b.?

I would agree that a *well made* p.c.b. looks more professional than its Veroboard equivalent, but surely the p.c.b. is really intended for mass production rather than a "one off" home constructed project.

Mention was also made of your policy of pricing each project—and the need for accuracy in this respect. Having been a reader of *Practical Wireless* and *Practical Electronics* I found the inclusion of estimated costs one of the most helpful aspects of EVERYDAY ELECTRONICS when it first appeared. Long may this practice continue.

This, combined with the helpful advice offered in *Shop Talk* should enable even the most inexperienced constructor to tackle a project with confidence—and keep EVERYDAY ELECTRONICS at the top.

M. P. Horsey,
Chatham, Kent

No Stock

I am prompted to write to you, having read Mr. Paul Young's comments in *Counter Intelligence* in the February 1981 edition of EVERYDAY ELECTRONICS in which he says he takes exception to Mr. E. F. Good's view that catalogues show goods which are not available.

In this connection you may find of interest the enclosed (copy) invoice which shows items I ordered approximately February 1980 from this company's then recently supplied 1980 catalogue. (*See note below*).

In this month's (Feb. 81) edition I have also read your well considered advice on page 130 "Letters" regarding the matter of costs and in this connection I would add that in instances where a components supplier "takes a bite out of an order" the balance of the order may then become subject to the addition of postage and packing charges by that supplier who supplies what is left of the order.

This is a point concerning Mail Ordering that Mr. Good may have been intending to convey. I do not think Mr. Good would write contrary to his experience.

G. K. D. Lester,
Leicester

This invoice shows three items (out of a total of eight) marked "No Stock—Cancelled".

We do not mention the name of the supplier in question since it could be unfair to single out one company in this way; this particular kind of complaint is by no means uncommon and could be directed towards other component retailers, on occasions. See Editorial article in this issue.

A Garrulous C.B. Buff

I am a regular reader of your magazine and am of the opinion it is one of the best around. I read with interest the editorial of February. As I am a "garrulous C.B. buff" I was particularly interested. Interference can nearly always be eliminated by using a suppressor but an effective one costs £15-£20. As this is out of reach of a lot of schoolboys who enjoy C.B. why not include a suppressor project in one of your projects. I know it would be well received here in West Clare and I presume it would also be welcome to fellow buffs in England.

Francis Keane,
Kilrush, Co. Clare, Eire

There will be something to interest you in next month's EE.

Sensible Decision

I have just started to get into electronics and I have been reading some of the magazines supposedly devoted to this subject, and I reckon that yours is the best for the money. It has plenty of interest for both the beginner and professional alike. I especially like the *Square One* series for beginners. Unfortunately I have only been able to scrounge, October 78, January 79, January 1980 and February 1981 (which I bought myself) off my brother. I am now going to buy your excellent publication myself every month.

T. Fellow,
Telford, Shropshire

Sound-to-Light

I have been reading E.E. for many months now, and I think it's a great magazine. However having decided to build the Sound-to-Light unit in the November 1980 issue, I came across a few problems when trying to buy all the components.

Firstly looking through various catalogues, the type number of the toroidal ferrite core you had given didn't appear to be there (Siemans type 29830).

Secondly, I have looked through many catalogues, and haven't been able to locate a 0·15µF plastic 630V a.c. capacitor.

I also have two other minor points. I would like to know if the 6V secondary transformer you have listed can be a 6-0-6V or is that the same as a 0-6V secondary? Finally, concerning the Bulgin socket—why do pins 7 and 8 have to be joined when pin 8 isn't used from what I can see of the diagrams?

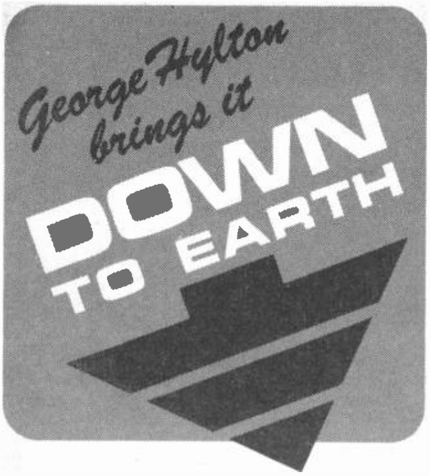
Mr. A. Buchinger,
Wimbledon, London

The part number printed for the ferrite ring came from the Siemens catalogue and later turned out to be its computer sorting code. The correct retail part number is B64290-J0046-X830.

As for the capacitor, perhaps we were rather optimistic and a 400V a.c. polyester type will be satisfactory.

A 6-0-6V secondary transformer is not the same as a 0-6V type (see Down to Earth, March 1981) but in this case can be used provided you make connections to one of the 6V tags and the 0V tag.

Finally the wiring of SK3 follows a standard pattern used by manufacturers of this sort of equipment and is designed to give interchangeability between light boxes designed for different numbers of channels.



Laws

A frequent question from my postbag is: Why are some potentiometers specified as "log. law"? What is a law, and why "log"?

A *law*, in this sort of context, just means the way in which different things are related. Ohm's Law, for instance, says how voltage, current, and resistance are related in a d.c. circuit. The *law* of a potentiometer says how the resistance varies as the wiper is moved over the "track".

Linear Law

The simplest kind of law is the one which applies to a potentiometer whose resistive track is uniform along its whole length. This is the *linear* law and is illustrated by the straight line in Fig. 1.

Here the amount of resistance between the wiper contact and the bottom end of the track is exactly proportional to the distance through which the wiper is moved. So moving the wiper through 20 per cent of its possible travel puts in 20 per cent of the total track resistance and so on.

Linear potentiometers like this are useful for many purposes. They are the easiest to make and for this reason they tend to be more precise than other types. This shows up even among the usual cheap carbon-track potentiometers, where it is common to find that the linear types have a resistance tolerance of 20 per cent while the other types have a tolerance of 30 per cent.

The effect shows up particularly clearly in wire wound potentiometers. These are made by close-winding resistance wire on an insulating "former". The resulting coil of resistance wire is usually bent into a circle and mounted rigidly so that the wiper, pivoted at the centre, can slide along its circumference.

So long as the wire and the former are uniform and the wiper arm central the percentage change of resistance is accurately related to the amount of wiper rotation.

For applications where very fine adjustment is called for a multi-turn potentiometer is often used. This is often also a *helical* potentiometer because screw-thread spiral shaping is used in some way to arrange that not one but several turns of the control shaft are needed to propel the wiper from one end of the track to the other.

Potentiometers with three, five, ten, twenty and even more turns are made. The percentage of resistance is often related to the percentage of spindle rotation to within a tenth of one per cent.

Non-linear

Unfortunately, there are many applications in which a linear law gives the wrong kind of performance. The best-known example is the volume control.

An ideal volume control should produce a steady increase in volume as the wiper is moved. If moving the wiper up 10 per cent from minimum produces a certain volume, and moving it on by another 10 per cent (to 20 per cent) doubles the volume, then at 30 per cent the volume should be trebled, at 40 per cent quadrupled, and so on.

A linear potentiometer cannot produce this result. What it does is to make the *voltage* between wiper and the "earthy" end of the track increase smoothly. If the voltage at the 10 per cent mark is 1V, then at 20 per cent it is 2V, at 30 per cent 3V, and so on.

This sounds fine, but unfortunately volume is not the same as voltage and with a linear law the rate of increase in volume is far from smooth. There is a very rapid increase as the wiper is moved up from minimum then less and less increase.

The reason is that volume is not an electrical quantity but a human quantity. It depends on the human sense of hearing. Hearing is not linear. Doubling the amount of sound energy does not double the volume.

To double the volume it is necessary to increase the sound energy (or the power from the amplifier) about nine times. To produce equal increases in volume for every 10 per cent of wiper movement the resistance must roughly treble for each 10 per cent of movement. (This trebles the voltage and since power is proportional to voltage squared it gives the required ninefold power increase.)

Putting in some actual numbers, if the resistance at the 10 per cent mark is 10kΩ then for double the volume at 20 per cent it must then be 30kΩ and so on, trebling for every additional 10 per cent of movement.

This rate of increase is very far from linear but it is needed because the human ear is not linear either. The *law* of a potentiometer used for a volume control must match the ear's own *law*.

One word for describing the ear's response to sound intensity is *logarithmic*. The ear responds, not to the simple increase of audio energy but to the logarithm of the increase.

If, for example, an amplifier's output were raised in three steps, each giving a little more than double the volume of the last, the actual power outputs might be say 10W, 100W and 1000W. Now the logarithms of these numbers are just 1, 2 and 3. The *logs* increase smoothly, in linear steps, just like the ear's sense of volume. They match, in this respect.

A practical, commercial *log law* carbon-track volume control potentiometer is supposed to behave in just the way needed to produce the smooth increase in volume we've been talking about. It doesn't, in practice, because a precise "log law" is difficult to engineer. Practical carbon-track volume controls are really combinations of two (occasionally three) linear sections of track which together approximate to the desired non-linear track.

The lowest two curves in Fig. 1 are typical examples of two-section log law volume controls. You can see that they are really made up of two straight (linear) sections, with a bent transitional section in the middle where they join.

The potentiometer specification tells you how far the resistance has got at the 50 per cent of movement mark. In a 10 per cent log law potentiometer it has got to 10 per cent of the total track resistance; in a 20 per cent log law potentiometer" to 20 per cent.

The upper two curves are "inverse log law" potentiometers, used for jobs where the resistance has to *decrease* in a non-linear fashion as the wiper is moved in the usual direction for an increase in volume.

Other Laws

For analogue computing there are *sine/cosine* potentiometers. *Square* law potentiometers are sometimes used in *RC* oscillators.

Air-spaced tuning capacitors are made with vanes of different shapes to provide different laws. A straight line capacitance (s.l.c.) capacitor has semicircular moving vanes and is the equivalent of a linear potentiometer.

This law gives fierce tuning at the high-frequency end of the range when the capacitor is used in a tunable *LC* circuit. So instead of an s.l.c. law a straight line frequency (s.l.f.) law is often used. In this case the tuned frequency scale is linear, though the capacitance change is very non-linear.

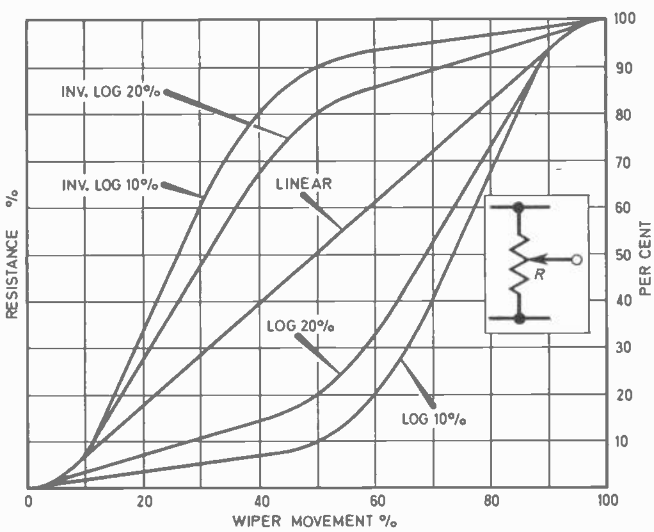


Fig. 1. Potentiometer "laws", connecting the amount of wiper movement with the amount of resistance change.

ILP

SIMPLY AHEAD and staying there

The range grows bigger...better...

New Profile Amplifiers - Two New Series

HY120

HY60

MOSFET

CHOOSE AN I.L.P MOSFET POWER AMP when it is advantageous to have a faster slew rate, lower distortion at higher frequencies, enhanced thermal stability, the ability to work with complex loads without difficulty and complete absence of cross-over distortion. I.L.P's exclusive encapsulation technique within fully adequate heatsinks has been taken a stage further with specially developed computer-verified 'New Profile' extrusions. These ensure optimum operating efficiency from our new MOSFETS, and are easier to mount. Connection is via five pins on the underside. **I.L.P MOSFETS ARE IDENTICAL IN PERFORMANCE TO THE COSTLIEST AMPLIFIERS IN THIS EXCITING NEW CATEGORY BUT ARE ONLY A FRACTION OF PRICES CHARGED ELSEWHERE.**

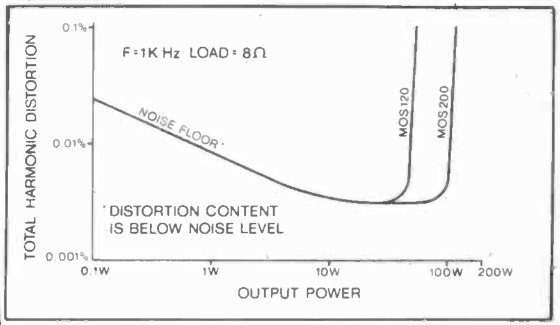
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
MOS120	60W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£25.88 + £3.88
MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

BIPOLAR *(Standard o/p transistors)*

CHOOSE AN I.L.P BIPOLAR POWER AMP where power and price are first consideration while maintaining optimum performance with hi-fi quality and wide choice of models. From domestic hi-fi to disco and P.A., for instrument amplification, there is an I.L.P Bipolar to fill the bill, and as with our new Mosfets, we have encapsulated Bipolars within our New Profile extrusions with their computer-verified thermal efficiency and improved mounting shoulders. Connections are simple, via five pins on the underside and with our newest pre-amps and power supply units, it becomes easier than ever to have a system layout housed the way you want it.

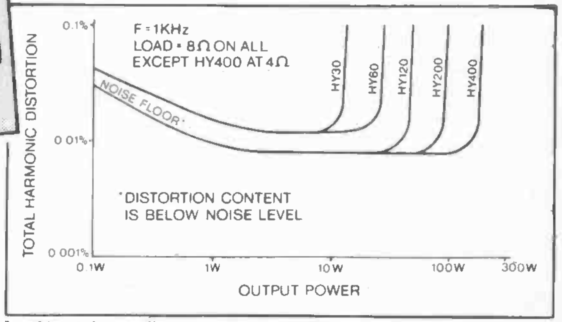
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£7.29 + £1.09
HY60	30W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£8.33 + £1.25
HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£17.48 + £2.62
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£21.21 + £3.18
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£31.83 + £4.77

ILP POWER AMPS ARE ENCAPSULATED FOR THERMAL STABILITY AND LONGER LIFE



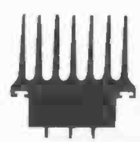
Load impedance both models 4Ω - ∞. Input sensitivity both models 500mV

Input impedance both models 100KΩ. Frequency response both models 15Hz-100KHz – 3dB



Load impedance all models 4Ω - ∞. Input sensitivity all models 500mV

Input impedance all models 100KΩ. Frequency response all models 15Hz-50KHz – 3dB

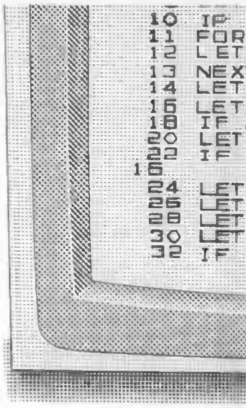


THE NEW PROFILE EXTRUSIONS

The introduction of standard heatsink extrusion for all I.L.P power amplifiers achieves many advantages: – Research shows they provide optimum thermal dissipation and stability. Slotted shoulders allow easy mounting; standardisation enables us to keep our prices competitive. Surfaces are matt black, anodised for higher thermal conductivity. Extrusions vary in size according to module number.

New! Sinclair ZX81 Personal Computer.

Kit: £49.95 complete



Reach advanced computer comprehension in a few absorbing hours

Built: £69.95 complete

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. At £99.95, the ZX80 offered a specification unchallenged at the price.

Over 50,000 were sold, and the ZX80 won virtually universal praise from computer professionals.

Now the Sinclair lead is increased: for just £69.95, the new Sinclair ZX81 offers even more advanced computer facilities at an even lower price. And the ZX81 kit means an even bigger saving. At £49.95 it costs almost 40% less than the ZX80 kit!

Lower price: higher capability
With the ZX81, it's just as simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, or to select a program off a cassette through the keyboard.

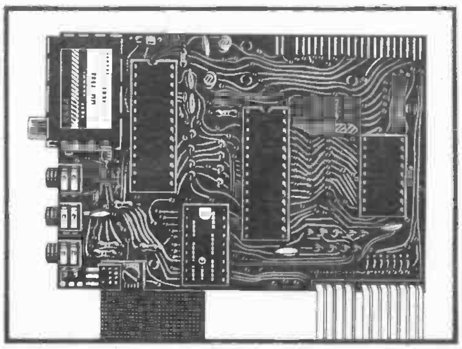
Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

Kit or built – it's up to you!

The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



Proven micro-processor, new 8K BASIC ROM, RAM – and unique new master chip.

New Sinclair teach-yourself BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs. You need no prior knowledge – children from 12 upwards soon become familiar with computer operation.

New from Casio, world leaders in creative technology combined with high quality and reliability

A CLASSIC IN IT'S TIME

You don't have to be a highbrow to appreciate the beauty of this clock. Battery powered, it is ideal for office, lounge, bedroom, caravan or boat.

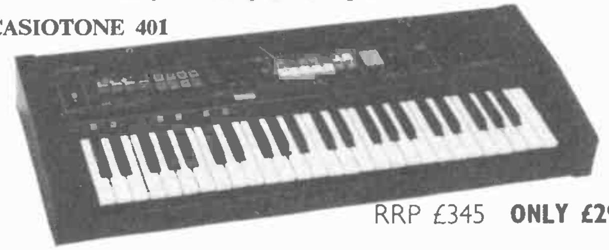
MA-1 ALARM CLOCK **ONLY £9·95**

Large blue LCD display of full digital time. Symphonic alarm or buzzer, with snooze facility. Hourly time signal. Integral loudspeaker and amplifier with 3 position volume control. Built-in night time illumination. Alarm: "Symphonie Nr. 40 G moll" (W. A. Mozart, K.550) for about 30 seconds, or buzzer for 60 seconds. Three AA size batteries last approx 15 months. Quartz accuracy. Dims: 43 × 115 × 76mm (1¾ × 4½ × 3 inches).

JOIN THE KEYBOARD REVOLUTION

By closely analysing the natural sound variations in the waves and pitches of different instruments, Casio have been able to trace the characteristics peculiar to each traditional instrument. Pitch, timbre and harmonics have been measured, digitalised and stored in electronic chip memory for faithful and exciting reproduction of the clarity and beauty of the originals.

CASIOTONE 401



RRP £345 **ONLY £295**

Full polyphonic. 8-note playing of 14 instruments and sounds over 4 octaves. **Rhythm accompaniment.** 16 different rhythms with full-in auto-rhythm.

Casio Auto Chord. Allows one finger accompaniment. Just press one, two or three keys and play major, minor and seventh chords, with bass accompaniment, automatically. Combines with auto-rhythm for professional sounds.

Vibrato, delayed vibrato, sustain and hold are incorporated in the at-a-glance, simple to use operational panel. Pitch control makes group tuning easy.

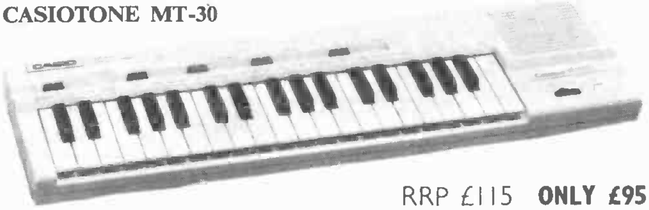
Compact 4⅝ × 31⅛ × 12⅞ inches with integral amplifier and speaker. The light weight (28·2lb) allows playing anywhere there is an A.C. socket. **Stand £39.**

CASIOTONE 301

The same size and basic specification as the 401 above, the 301 does not have Casio Auto Chord or built-in sustain and hold facilities. There are 8 rhythm voices with a variation on each. Weight 27lbs.

£245

CASIOTONE MT-30



RRP £115 **ONLY £95**

Full polyphonic playing of 22 instruments and sounds over 3 octaves. 4-position sound memory lets you switch between pre-selected sounds without pause. Built-in vibrato and sustain functions greatly enhance the overall musical effect.
Compact 2⅞ × 22⅞ × 6⅞ inches, with built-in amplifier and loudspeaker.
Battery/mains power source and light weight (6lb) allows playing anywhere.

CASIOTONE 201 and M-10

Please telephone for availabililty.
201 Mains version of the MT-30. 29 instruments over 4 octaves. £245.
M-10 Four instruments over 2½ octaves. Battery/mains. £69.

CASIO CALCULATORS

BQ-1100 Biolator calculator with calendar, two alarms, countdown alarm, stopwatch, time memory, three date memories (£17·95) £14·95

MG-880 Digital space invader game and calculator £10·95

SEND 20p (postage) for our illustrated catalogue of Casio watches and calculators and selected Seiko watches.

KEEP A DATE WITH CASSIO

You always wanted a musical calculator with date memories and date/time alarms—HERE IT IS!

UC-365 UNIVERSAL CALENDAR

Clock, universal calendar, date memories, daily alarm, 2 daily or date/time alarms, hourly chimes, stopwatch, countdown alarm, time memory, calculator.

Clock display: Hours, minutes, seconds, am/pm, or hours, minutes, full calendar.

Calendar: Pre-programmed from 1901 to 2099. Full month display.

Date memories: Any day or days pre-settable within 12 month period. (Birthdays etc.)

Alarms: Alarm 1—Daily alarm. Alarm 2 & 3—Daily alarms or time alarms on pre-set dates. (Pre-programmed melodies or electronic buzzer).

Stopwatch: 1/10 second to 24 hours; net, lap and first and second place. Or

Time memory: 24 hour system. The time of any other zone can be stored.

Calculator: Optional musical keys, full memory and percentage.
Two silver oxide batteries last approx 1 year. RRP £22·95 **£19·95**
¼ × 4½ × 2¼ inches. Leatherette wallet with window.

UC-360 Card sized version of above. 7/32 × 3⅜ × 2⅛" £19·95
UC-3000 Office desk version. Angled display. 1⅞ × 4 × 6⅞" £27·95

CASIO'S AMAZING NEW FX-3500P

Programmable. Non-volatile memories and stores. Statistical regression and integrals.

38 functional (non-volatile) steps. 2 programme storage capability. Unconditional and conditional jumps. 7 (non-volatile) memories; one independent, 6 constant memories. 18 pairs of parentheses, nestable in 6 levels.

61 built-in functions, including: Integrals (Simpson's rule). Linear regression, logarithmic regression, exponential regression and power regression.

Hyperbolics, sexagesimal and co-ordinates conversions. 10 digit mantissa or 10+2 exponent. Two silver oxide batteries give approximately 1,000 hours continuous use with power-saving automatic cut-off, with data and memory protection.

Dims: 9/32 × 2⅞ × 5⅛ inches. Supplied with leatherette wallet.

ALL THIS FOR ONLY £22·95

FX180P. Hand held version without hyperbolics. 2 × AA batteries, ⅞ × 3 × 5⅞. £19·95
FX-2700P. As FX3500P but 8+2; without integrals, regression, 1 program £19·95
FX-8100 scientific with clock, calendar, alarm, chimes, stopwatch etc. £24·95

CASIO'S BEST SELLING WATCHES

AA81

M1200

W150B

LCD ANALOGUE/DIGITAL ALARM CHRONOGRAPH with countdown alarm. AA-81 chrome, s/s bracelet £29·95. AA-81G Gold plated £49·95. AA-82 All stainless steel £39·95.

12 MELODY ALARM CHRONOGRAPHS with countdown alarm. M-12 resin case/strap £24·95. M-1200 all stainless steel £29·95.

100 METRE WATER RESISTANT Alarm chronographs with countdown alarm. W-100. Resin case/strap £19·95. W-150C Stainless steel case/resin strap. £25·95. W-150B Stainless steel case/bracelet £32·50.

NEW F-500 sports chronograph. Resin case/strap £9·95

Price includes VAT and P&P. Send your company order, cheque, P.O. or phone your ACCESS or BARCLAYCARD number to:

TEMPUS

Dept. E.E., FREEPOST, 164-167 East Road, Cambridge CB1 1DB. Tel. 0223 312866.

CLASSIFIED

The prepaid rate for classified advertisements is 24 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £6·16 per single column centimetre (minimum 2·5cm). All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.

(B) That you have enclosed the right remittance.

(C) That your name and address is written in block capitals, and

(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

Receivers and Components

GEARED MOTORS 1 R.P.M. to 120 R.P.M.
TRANSFORMERS, RELAYS, SOLENOIDS,
TIME SWITCHES, METERS.

QUANTITY DISCOUNT

Quotations and details:
Dept. S.T., 16 Vine Close, Ramsgate, Kent CT11 7BJ
Phone: Thanet 52293 (0843)

100 resistors 85p, 100 diodes £1·00, 100 transistors £5·00, 25 I.C.s £1·50, 50 C280 £1·00. Lists 15p. Pre-war onward valves, wireless. SAE SOLE ELECTRONICS, (EE), 37 Stanley Street, Ormskirk, Lancs L39 2DH.

P.C.Bs. PAXOLIN 11¼" × 8" 80p. 16" × 11¼" £1·40. ILB WT ASSORTED PIECES 80p. D.S. 10" × 8¼". 85p. FIBREGLASS 12" × 8" £1·70. 14" × 6" £1·50. D.S. 10½" × 7" £1·35. 8" × 7" £1·10. PANEL WITH 40 ASSORTED 74 SERIES I.Cs. £1·60. 20 WIRE ENDED NEONS £1·20. SMALL 3 TRANSISTOR AUDIO AMPS 40p. 3—£1. 300 SMALL COMPONENTS, TRANS, DIODES £1·60. 7 LBS ASSORTED COMPONENTS £3·95. 3 ASSORTED M.C. METERS £3. LIST 20p. REFUNDABLE. POST 50p. INSURANCE ADD 20p.

J. W. B. RADIO
2 BARNFIELD CRESCENT, SALE, CHESHIRE
M33 1NL

TURN YOUR SURPLUS capacitors, transistors etc., into cash. Contact Coles Harding & Co., 103 South Brink, Wisbech, Cambs. 0945 4188. Immediate settlement.

Software

THIRTY ZX80 program listings only £4·95, includes a multitude of games, home finance, basic maths, chequebook and more in our publication, ZX80 programs Part I. Also includes hints and tips, from Sussex Software, Wallsend House, Pevensey Bay, Sussex.

CARDBOARD COMPUTER: Learn Assembly Language Programming and Computer Architecture. £8·97 inc VAT. Also Solar Cells, Science Kits, Energy Books, Stirling Engines, Space Blankets etc. etc. Send 25p for lists. Edencombe Ltd., Dept PM., 34 Nathans Road, North Wembley, Middlesex HA0 3RX.

Books and Publications

LEARN ELECTRONICS FAST. New, unique, brilliantly simple Tutronik system. Selected by BBC TV. No soldering. 30-kwikbuild electronics projects. Speedilearn way to identify components, read circuit diagrams, break the colour code and connect circuits that really work. Kit complete with simple-to-follow instructions, circuit plans, components in compact storage wallet. Only £12·95 plus 95p P&P UK (P&P £2·75 elsewhere). Only from Dept. EE, TECHNOCENTRE LTD, 140 Norton Road, Stockton-on-Tees 2BG.

For Sale

NEW BACK ISSUES OF "EVERYDAY ELECTRONICS". Available 85p each Post Free, cheque or uncrossed PO returned if not in stock. BELL'S TELEVISION SERVICES, 190 Kings Road, Harrogate, Yorkshire. Tel: (0423) 55885.

FOR SALE—surplus components, to pay for my future projects. Pots, semiconductors, switches, ex-equipment p.c.b.s packed with i.c.s etc. £6·00 per bag of assorted goodies, CANT, 83 Malone Road, Woodley, Reading, Berks.

A SET OF BACK ISSUES of "Everyday Electronics" from 1972. £45 including postage. Heathkit oscilloscope and manual, £85. Delivery extra. Maldon (Essex) 740755.

EVERYDAY ELECTRONICS, 96 copies, December 1971 to March 1981. £45·00. Phone 0734 760068 after 6 p.m.

Service Sheets

BELL'S TELEVISION SERVICE for service sheets on Radio, TV etc. £1 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd, Harrogate, N. Yorkshire. Tel: 0423 55885.

Any single service sheet £1/L.S.A.E. Thousands different Repair/Service Manuals/Sheets in stock. Repair data your named T.V. £6 (with circuits £8). S.A.E. Newsletter, Price Lists. Quotations.

AUSEE, 76 CHURCHES, LARKHALL, LANARKSHIRE
(0698 883334).

SERVICE SHEETS from 50p and SAE. Catalogue 25p and SAE. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

Veteran & Vintage

"SOUNDS VINTAGE"

The only magazine for all vintage sound enthusiasts, packed with articles by top writers, covering gramophones, phonographs, 78s, wireless, news, history, reviews, etc.

Bi-monthly. Annual subscription £6·60 (airmail extra). Send 75p for sample copy.

28 Chestwood Close, Billericay, Essex

Situations Vacant

NORTH EAST LONDON POLYTECHNIC

Faculty of Engineering—
Barking Precinct, Longbridge Road, Dagenham, Essex

SCHOOL OF CHEMICAL & SYSTEMS ENGINEERING

Senior Technician T5

Ref: 83/E/80

Required to control and supervise technicians working within the microprocessor laboratory, under the supervision of the Principal Technician. Other duties will include planning and progression of technician work, maintenance of progress and financial reports, and development, including design assistance, of equipment within the laboratory. Candidates should hold a full technological certificate and/or HNC/HND qualifications, and have had 5-10 years experience in a technical environment.

The inclusive annual salary will be on a scale from £7,233 to £7,695 according to age, qualifications and experience.

For further details and application forms please contact the Personnel Office (R), North East London Polytechnic, Asta House, 156/164 High Road, Chadwell Heath, Romford, Essex, RM6 6LX. Telephone 01-590 7722 Extn. 3121 or 3135, quoting the above reference number.

Closing date for receipt of applications: 3rd April, 1981.

PLEASE MENTION EVERYDAY ELECTRONICS WHEN REPLYING TO ADVERTISEMENTS

INDEX TO ADVERTISERS

"SPECIAL PRICES" POST £1-50
BAKER LOUDSPEAKERS

Model	Ohms	Size Inch	Power Watts	Type	Our Price
Major	4, 8, 16	12	30	HI-FI	£12
Deluxe Mk II	8	12	15	HI-FI	£14
Superb	8, 16	12	30	HI-FI	£20
Auditorium	8, 16	12	45	HI-FI	£20
Auditorium	8, 16	15	60	HI-FI	£35
Group 45	4, 8, 16	12	45	PA	£15
Group 75	4, 8, 16	12	75	PA	£22
Group 100	8, 16	12	100	PA	£26
Group 100	8, 16	15	100	PA	£29
Disco 100	8, 16	12	100	Disco	£26
Disco 100	8, 16	15	100	Disco	£29

4 CHANNEL MIXERS £8·00
Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated with switch for four channel mono or two channel stereo working.

DE-LUXE DISCO MIXER 240V. 4 Stereo Channels plus Mike, 2 Vu meters, Headphone Monitor. £48. Post £1.

MINI MODULE LOUDSPEAKER KIT £10-95
EMI 15 × 8½in. 3-way Loudspeaker Baffle, 5in. Bass, 5in. Middle, 3in. Tweeter; 3-way Crossover & Ready Cut Baffle. Full assembly instructions supplied. Response 60 to 20,000 c.p.s. 12 watt RMS 8 ohms £10·95 per kit. Two kits £20. Suitable Bookshelf Cabinet £9·50 each. Post £1·50

GARRARD 6-200 SINGLE PLAYER.DECK
Brushed Aluminium Arm with stereo ceramic cartridge and Diamond Stylus, 3-speeds. Manual and Auto Stop/Start. Large Metal Turntable. Cueing Device and Pause Control. **£22.** Post £2.

ISKRA SINGLE RECORD PLAYER £8
Fitted with auto stop, stereo cartridge. Baseplate. Size 11 × 8½in. Turntable size 7in. diameter. a.c. mains 240V 3 speed plays all size records. Post £1.

B.S.R. SINGLE PLAYER P170/2 £21·00
3-speeds 11in. aluminium turntable. "slim" arm, cueing device, stereo ceramic cartridge, silver trim, bias compensator, adjustable stylus pressure, plays all records, spring suspension, 240V AC. Post £2.

B.S.R. DE-LUXE AUTOCHANGER £20
with stereo cartridge, plays all size records. Post £2

WOODEN PLINTHS CUT FOR B.S.R. £4
Size: 15 × 15 × 3in. Teak effect. Post £1.

BSR P200. Belt drive deck, snake arm, cueing device. £28. Post £2.

METAL PLINTH CUT FOR GARRARD
Size: 16 × 14 × 3in. £5.00 Silver or Black finish. Post £2.

TINTED PLASTIC COVERS POST £1·50
Sizes: 14½ × 12½ × 3in. £4. 16 × 14 × 3½in. £6. 17¼ × 9½ × 3½in. £3. 18 × 13½ × 3in. £6. 18 × 12½ × 3in. £6.

R.C.S. LOW VOLTAGE STABILISED POWER PACK KITS £2·95 Post 45p
All parts and instructions with Zener diode printed circuit, mains transformer 240V a.c. Output 6 or 7½ or 9 or 12V d.c. up to 100mA or less. Please state voltage required.

PP BATTERY ELIMINATOR BRITISH
Mains stabilized power-pack 9 volt 400mA max. with overload cut out. Size 5 × 3½ × 2½in. £4·50. Post 50p.

MAINS TRANSFORMERS POST 99p

250-0-250V 70mA 6·3V, 2A	£4·50
250-0-250 80mA 6·3V, 3·5A, 6·3V 1A	£5·00
350-0-350V 150mA 6·3V 5A, 5V 2A	£10·50
350-0-350V 250mA 6·3V 5 amp, 5V 2A	£12·50
300-0-300 120mA 2 × 6·3V 2A C.T.; 6·3V 2A	£10·00
220V 45mA, 6·3V 2A	£2·50
250V 60mA, 6·3V 2A	£2·75

GENERAL PURPOSE LOW VOLTAGE

2A, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V	£6·00
1A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£8·00
2A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£9·50
3A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£12·50
5A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£18·00

5, 8, 10, 16V ½A £2·50 12V 100mA £1·30 12V 300mA £1·50. 12V 750mA £2·25. 40V 2A tapped 10V or 30V £3·50. 10-0-10V 2A £3. 6V 500mA £2·00. 30V 5A + 34V 2A CT £4, 2 × 18V 6A £11. 12-0-12V 2 amp £3·50. 25-0-25V 2A £4·50. 20-0-20V 1A £3·50. 30V 1½A £3·30. 20V 1A £3. 9V 3 amp £3·50. 60V, 40V, 20V 1A £4. 15/0/15V 2A £3·75. 32-0-32V 6½A £11. 9V 250mA £1·50. 30V 2A £3·50.

AUTO TRANSFORMERS 115V to 240V 500W £12·00

CHARGER		*RECTIFIERS*		METERS	
6-12v-3A	£4·00	6-12v-1A	90p	5amp	£2
6-12v-4A	£6·50	6-12v-2A	£1·10		
6-12v-6A	£8·50	6-12v-4A	£2·00		

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides; 6 × 4in. £1·20; 8 × 6in. £1·50; 10 × 7in. £1·90; 14 × 9in. £2·50; 16 × 6in. £2·40; 12 × 3in. £1·50; 16 × 10in. £2·70; 12 × 8in. £2·20. **ANGLE BRACKET,** 6 × ½ × ¾in. 25p.
ALUMINIUM PANELS, 18 s.w.g. 6 × 4in. 36p; 8 × 6in. 60p; 10 × 7in. 80p; 12 × 5in. 63p; 12 × 8in. 90p; 16 × 6in. 90p; 14 × 9in. 1·20; 12 × 12in. £1·30; 16 × 10in. £1·40.
ALUMINIUM BOXES, MANY OTHER SIZES IN STOCK 4 × 2 × 2in. £1·00; 3 × 2 × 1in. 80p; 6 × 4 × 2in. £1·30; 8 × 6 × 3in. £2·10; 9 × 4 × 4in. £2·30; 10 × 7 × 3in. £2·50; 12 × 8 × 3in. £3·00; 12 × 5 × 3in. £2·30.

HIGH VOLTAGE ELECTROLYTICS

8/450V	45p	8+8/450V	75p	50+50/300V	50p
16/350V	45p	8+16/450V	75p	32+32/500V	£1·80
32/500V	75p	20+20/450V	75p	100+100/275V	65p
50/500V	£1·20	32+32/350V	75p	150+200/275V	70p
8/800V	£1·20	32+32+32/325V	90p	220/450V	95p

Post 50p Minimum. Callers Welcome. Access-Barclay-Visa. Lists 20p. Closed Wed.

Radio Components Specialists
337 WHITEHORSE ROAD
CROYDON, SURREY, U.K. Tel. 01-684 1665

It's easy to complain about advertisements.

Every week, millions of advertisements appear in the press, on posters or in the cinema.

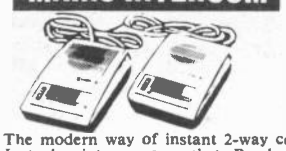
Most of them comply with the rules contained in the British Code of Advertising Practice and are legal, decent, honest and truthful.

But if you find one that, in your opinion, is wrong in some way, please write to us at the address below.

We'd like you to help us keep advertising up to standard.

The Advertising Standards Authority.
A.S.A. Ltd, Brook House, Torrington Place, London WC1E 7HN.

MAINS INTERCOM



NO BATTERIES NO WIRES
ONLY **£37.99** PER PAIR
+ VAT £5·70
+ P & P £1·95

The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ¼-mile on the same mains phase. On/off switch. Volume control, with 'buzzer' call and light indicator. Useful as inter-office intercom. between office and warehouse, in surgery and in homes.
Also F.M. 2 channel "touch" model £55·95 per pair + VAT £8·40 + P&P £2·15.

NEW AMERICAN TYPE CRADLE
TELEPHONE AMPLIFIER

£18.95
+ VAT £2·85
+ P & P £1·65

Latest transistorised Telephone Amplifier, with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume control, Conversation recording, model at £20·95 + VAT £3·15. P&P £1·65.

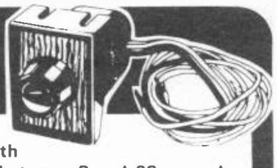
DOOR ENTRY SYSTEM
No house / business / surgery should be without a DOOR ENTRY SYSTEM in this day and age. The modern way to answer the door in safety to unwanted callers. Talk to the caller and admit him only if satisfied by pressing a remote control button which will open the door electronically. A boon for the invalid, the aged, and busy housewife. Supplied complete d.i.y. kit with one internal Telephone, outside Speaker panel, electric door lock release (for Yale type surface latch lock): mains power unit, cable (4 pairs) 50ft and wiring diagram. Price £59·95 + VAT £9·00 + P&P £2·25. Kit with two phones £69·95 + VAT £10·50 + P&P £2·45.

10-day price refund guarantee on all items
Access and Barclaycard welcome.

WEST LONDON DIRECT SUPPLIES (EE3)
169 KENSINGTON HIGH STREET,
LONDON, W8 Tel: 01-937 5548

PLEASE MENTION *EVERYDAY ELECTRONICS* WHEN REPLYING TO ADVERTISEMENTS

VARI WIPE
WIPER DELAY CONTROL



The Vari Wipe provides intermittent operation of the windscreen wipers with adjustable control to delay each wipe between 3 and 60 seconds. Set the control to suit the conditions to clear light drizzle, fog, snow, sleet or spray. Easily fitted to British, Continental & Japanese cars with 12 volt self park wipers. Complete kit contains all components, including timer chip, PCB, case, mounting panel, wire, etc., with full instructions.

VARI WIPE KIT £6.95 inc. P & P
ASSEMBLED £9.25 inc. P & P

or send large s.a.e. for details

Spimin DEVELOPMENTS Dept EE 4
Card Holders Phone 0253 27244
FREEPOST Thornton Cleveleys, Blackpool FY5 2BR

ENGINEERING REFERENCE BOOKS
E. R. BOOKS, PO BOX 47, PAIGNTON, DEVON TQ3 1TE
ITT COMPONENTS GROUP M & OE DIVISION, DEPT 52732
BRIXHAM RD., PAIGNTON TQ4 7BE

TEXAS INSTRUMENTS
SEMICONDUCTOR BOOKS

TTL Data Book	£7·50
Optoelectronics Data Book	£4·50
Opto Theory & Practice	£6·50
9900 Family Systems Design Book	£8·50
Software Design Guide for Microprocessors	£11·50
Linear Control Circuits	£3·50
Interface Circuits Data Book	£5·50
Bipolar Microcomputer Data Book	£4·50
Voltage Regulator Data Book	£4·50
MOS Memory Data Book	£4·50

UNDERSTANDING SERIES

Microprocessors	£4·00
Digital Electronics	£4·00
Solid State Electronics	£4·00
Calculator Math	£4·00
Communications Systems	£4·00

TEXAS INSTRUMENTS
CALCULATOR BOOKS

Sourcebook for Programmable Calcs	£9·50
Calculator Analysis Business & Finance	£7·50
Math on Keys	£4·00

RCA

Audio Amplifier Manual	£4·00
C/Mos IC Technical Manual	£4·50
Electro-optic Handbook	£4·50
Solid State Devices Manual	£4·50
Linear Devices Databook	£5·00
Microprocessors Memories and Support Systems Databook	£6·50

NATIONAL

Audio Handbook	£4·50
Fet Handbook	£3·20
Linear Data Catalogue	£7·30

ALL PRICES QUOTED INCLUDE POSTAGE/PACKING.

Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £9.00, Overseas £10.00 per annum payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. Everyday Electronics is sold subject to the following conditions namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, excluding Eire where the selling price is subject to V.A.T., and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

E.E. PROJECT KITS

Audio Effects Unit	ZB122	Oct. 80	£12·25
Phone Call Charge Jogger	ZB121	Oct. 80	£6·00
Darkroom Controller	ZB123	Oct. 80	£17·25
Bicycle Alarm	ZB124	Oct. 80	£9·25
Precision Parking Pad	ZB73	Sept. 80	£3·50
Lights Failure Monitor	ZB77	Sept. 80	£8·75
TTL Power Supply Unit	ZB78	Sept. 80	£9·50
Duo-Deci Timer	ZB75	Sept. 80	£8·50
*TTL Logic Probe	ZB76	Sept. 80	£3·25
Bedside Radio	ZB74	Sept. 80	£14·25
Auto Lighting-Up Warning	ZB71	Aug. 80	£5·65
Audio Millivoltmeter	ZB70	Aug. 80	£17·75
Weather Centre (Electronics only)	ZB72	Aug. 80	£47·50
Brakesafe Monitor	ZB68	Aug. 80	£7·50
Cricket Game	ZB69	Aug. 80	£14·95
Zener Diode Tester	ZB79	July 80	£5·00
Signal Tracer	ZB80	July 80	£5·00
General Purpose Amplifier	ZB81	July 80	£6·00
Voltage Converter	ZB82	July 80	£4·75
Autowaa	ZB83	July 80	£19·25
A.F. Signal Generator	ZB84	July 80	£20·00
Courtesy Light Delay	ZB85	July 80	£5·25
Auto Phase	ZB86	July 80	£19·25
Battery Voltage Monitor	ZB64	May 80	£4·80
Lights Warning System	ZB63	May 80	£3·60
Autofade	ZB66	May 80	£10·25
*Dual Line Game	ZB65	May 80	£25·00
Audio Tone Generator	ZB67	May 80	£3·50
*Pre-tuned 4-Station Radio	ZB62	May 80	£14·00
Gas Sentinel	ZB61	April 80	£27·00
Automatic Level Control	ZB60	April 80	£8·00
Cycle Direction Flasher	ZB59	April 80	£14·50
Cable and Pipe Locator	ZB54	March 80	£3·75
Stereo Headphone Amplifier	ZB57	March 80	£15·25
Doorbell Register	ZB58	March 80	£3·60
Five Range Current Limiter	ZB53	March 80	£4·50
Kitchen Timer	ZB55	March 80	£12·75
Touch Switch	ZB56	March 80	£9·00
Micro Music Box	ZB45	Feb. 80	£17·00
Simple Short Wave Receiver	ZB44	Feb. 80	£18·00
Morse Practice Oscillator	ZB43	Feb. 80	£6·00
Slide/Tape Synchroniser	ZB42	Feb. 80	£11·50
Spring-Line Reverb Unit	ZB49	Jan. 80	£22·50
Mains on/off Timer	ZB48	Jan. 80	£30·00
Power Supply 3-9V	ZB47	Jan. 80	£4·50
Loft Alert	ZB46	Jan. 80	£33·00
Lightcall	ZB103	Dec. 79	£6·25
Burglar Alarm	ZB51	Dec. 79	£5·00
Baby Alarm	ZB40	Nov. 79	£8·50
Opto Alarm	ZB41	Nov. 79	£5·00
Radio Tuner MW/LW	ZB108	Nov. 79	£14·75
3-Function Generator	ZB52	Nov. 79	£25·00
One Armed Bandit	ZB33	Oct. 79	£21·00
Lights-on Reminder	ZB34	Oct. 79	£4·60
Signal Level Indicator	ZB36	Oct. 79	£4·50
High Impedance Voltmeter	ZB35	Oct. 79	£14·50
Universal Oscillator	ZB37	Oct. 79	£3·50
Chaser Light	ZB4	Sept. 79	£17·50
Low Power Audio Amplifier	ZB3	Sept. 79	£3·75
Simple Transistor Tester	ZB2	Sept. 79	£5·50
Varicap MW Radio	ZB1	Sept. 79	£8·50
Quiz Referee	ZB12	Aug. 79	£4·75
Touch-on Pilot Light	ZB10	Aug. 79	£2·00
Trailer Flasher	ZB9	Aug. 79	£3·00
Swanee Whistler	ZB8	Aug. 79	£3·50
Electronic Tuning Fork	ZB7	Aug. 79	£8·90
Power Supply 9V	ZB6	Aug. 79	£8·25
Warbling Timer	ZB5	Aug. 79	£5·80
Water Level Indicator	ZB111	July 79	£4·50
Dolls House Lights Economiser	ZB107	July 79	£4·50
Darkroom Timer	ZB17	July 79	£2·50
Soldering Iron Bit Saver	ZB13	July 79	£9·25
Voltage Splitter	ZB15	July 79	£3·25
Conference Timer	ZB14	July 79	£38·00
Electronic Canary	ZB19	June 79	£4·50
Tremolo Unit	ZB18	June 79	£10·00
Meter Amplifier	ZB21	June 79	£3·50
Quad Simulator	ZB22	June 79	£8·00
Short Wave Converter	ZB25	May 79	£13·75
Electronic Dice	ZB24	May 79	£13·50
Intruder Alarm	ZB23	May 79	£23·00
Shaver Inverter	ZB26	April 79	£8·00
Touch Bleeper	ZB27	April 79	£3·25
Choke Warning Device	ZB28	April 79	£7·50
Transistor Tester	ZB100	April 79	£4·00
One Transistor Radio MW/LW	ZB104	March 79	£7·25
Time Delay Indicator	ZB98	March 79	£4·00
Micro Chime	ZB96	Feb. 79	£12·00
Lights Reminder for Car	ZB32	Jan. 79	£4·50
Headphone Enhancer	ZB101	Jan. 79	£4·00
Solid-State Roulette	ZB95	Jan. 79	£18·25
I'm First	ZB105	Jan. 79	£3·70
Continuity Tester	ZB115	Jan. 79	£4·30
Fuzz Box	ZB106	Dec. 78	£5·00
Vehicle Immobiliser	ZB110	Dec. 78	£5·00
Audio Effects Oscillator	ZB109	Nov. 78	£3·50
Tele-Tel	ZB94	Nov. 78	£17·80
Radio MW/LW	ZB116	Oct. 78	£7·00
Sound to Light	ZB112	Sept. 78	£7·00
R.F. Signal Generator	ZB93	Sept. 78	£20·50
Guitar Tone Booster	ZB117	Sept. 78	£5·00
A.F. Signal Generator	ZB119	Aug. 78	£10·00
Quagmire	ZB120	July 78	£9·50
Tele-Bell	ZB118	June 78	£12·25
Weird Sound Effects Generator	ZB113	March 78	£3·50
Catch-a-Light	ZB102	March 78	£6·00
Chaser Light Display	ZB97	Feb. 78	£22·00
Car System Alarm	ZB92	Feb. 78	£4·50

★ TEACH-IN 80 ★

This popular monthly constructional series started in E.E. in 1979 and is a must for beginners to electronics. The sheer simplicity of the whole project experiments lends itself to be made by any beginner young or old. Basic technical principles and symbols explained in great detail. Start at the beginning with a hobby that could become a worthwhile career, our kit comes complete with all parts as specified by E.E.

List A, B and C £22·50. Monthly reprints from October 1979 available at 40p each per month extra or £4·50 for whole series.

***All E.E. project kits supplied with cases except items marked *. All kits come complete with items as specified plus Texas i.c. sockets where required, also veroboard connecting wire etc.**

If you do not have the issue of E.E. which contains the project we can supply a reprint at 40p extra.

Personal callers please ring to check availability of kits.

All prices include post, packing and 15% V.A.T.

LATE EXTRA

MINI I.C. RADIO OCTOBER '80 ZB126	£10·35
DUSK/DAWN RELAY OCTOBER '80 ZB125	£7·45
SOUND TO LIGHT ZB127 NOV. '80	£19·00
GUITAR PRACTICE AMPLIFIER ZB128 NOV. '80	£16·85
REACTION TESTER ZB129 NOV. '80	£10·25
PRECISION TIMER ZB130 NOV. '80	£21·00
TRANSISTOR TESTER ZB131 NOV. '80	£8·00
SOIL MOISTURE MONITOR ZB132 NOV. '80	£5·00

OTHER THAN STATED, PRICES ON APPLICATION.

Shop Hours Mon-Friday 9–5.30 p.m. Sat. 9–4.30 p.m.
Telephone: 01–226 1489

T. POWELL

306 St. Pauls Road, Highbury Corner, London N.1.

Visa/Access cards accepted

Minimum telephone Orders £5·00

Minimum Mail Order £1·00