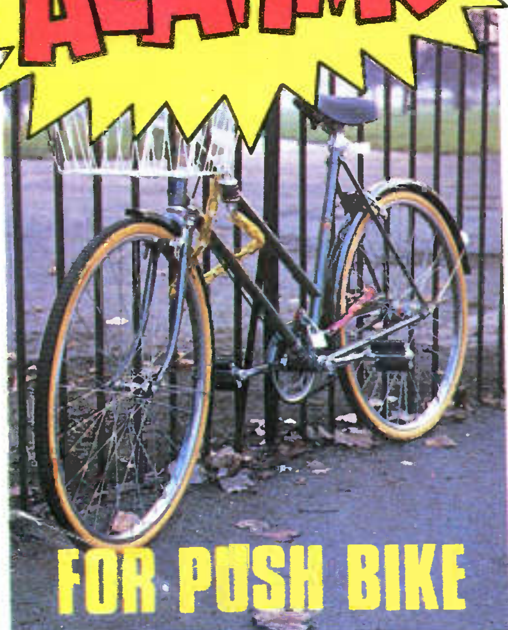
Easy to build projects for everyone

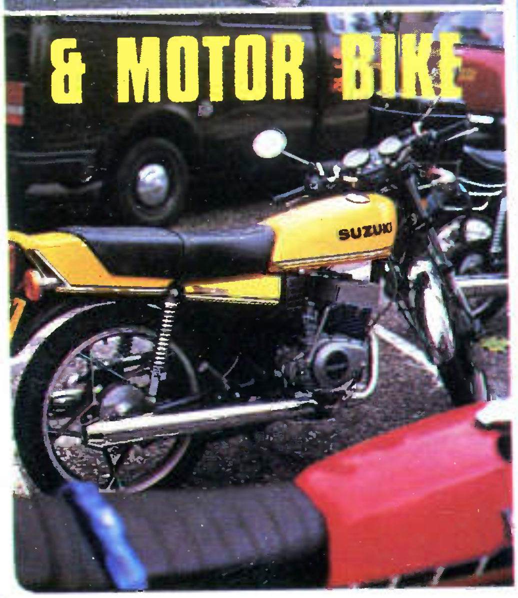
Everyday ELECTRONICS

FEB. 83
80p

ALARMS

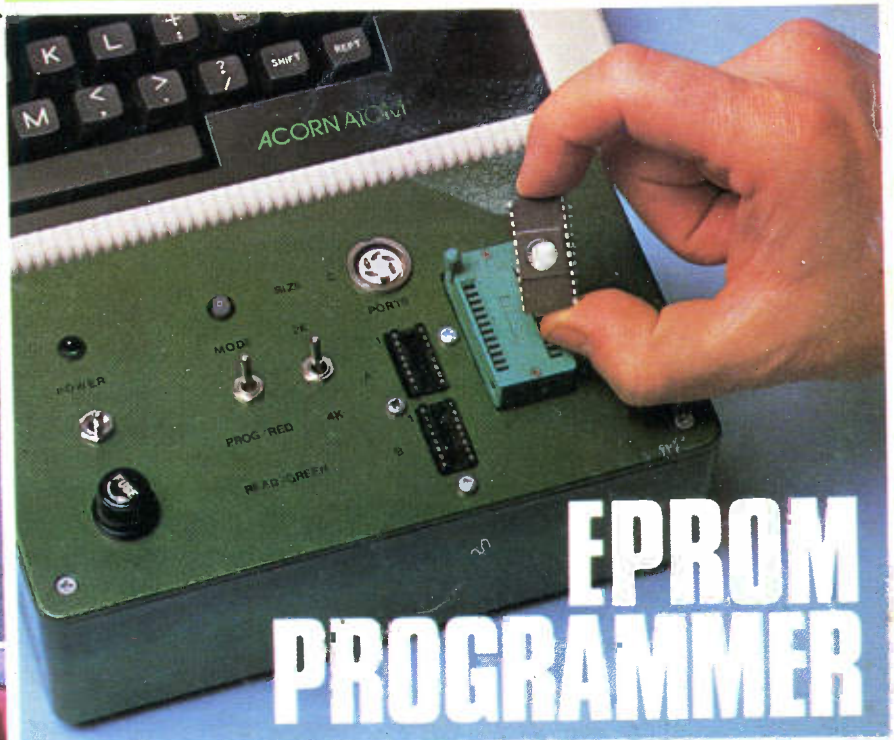


FOR PUSH BIKE



& MOTOR BIKE

BEE HIVE TEMPERATURE METER



EPROM PROGRAMMER

ZX81 SPEED COMPUTING SYSTEM

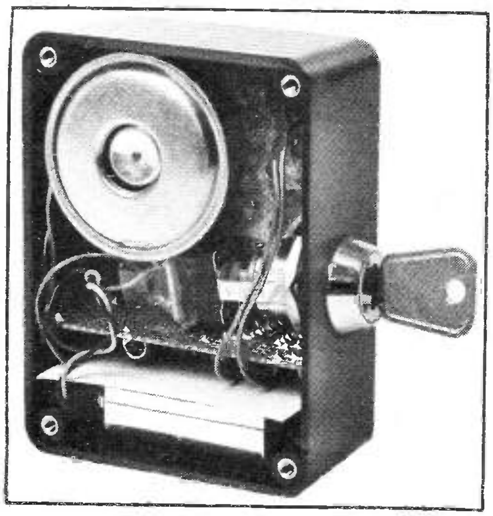
INTERVAL TIMER

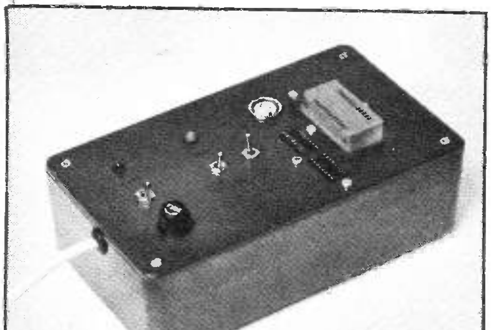
Australia $1·35 Malaysia $4·95 IR £1·19 (inc. V.A.T.)

Everyday ELECTRONICS

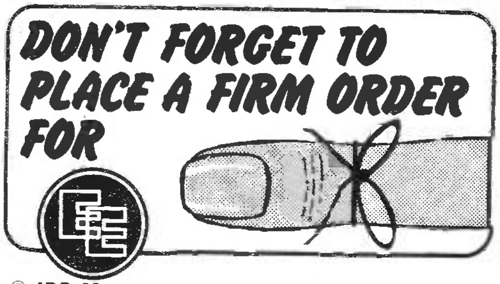
VOL. 12 NO. 2 FEBRUARY 1983

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .





COVER: Acorn Atom
courtesy Technomatic Ltd



PROJECTS

SERIES

FEATURES

Our March 1983 issue will be published on Friday, February 18. See page 99 for details.

CRICKLEWOOD ELECTRONICS LTD.

40 Cricklewood Broadway, London NW2 3ET tel 01-452 0161 tlx 914977

This is a small list from our vast stocks. Full price list free on request. You may order by phone quoting Access, Visa or American Express no. or by nominal mail order. Callers welcome. All in stock items (95% ex stock) go out same day. Please add 15% VAT & 70p p&p. Govt Depts, schools etc. orders welcome. Overseas orders no VAT but allow extra p&p. Qty discounts negotiable.

ALL STOCK BRAND NEW FRANCHISED ORIGIN

CRICKLEWOOD—STOCKING PARTS OTHER STORES CANNOT REACH

SUPERIOR QUALITY CARBON FILM RESISTORS, HI STAB LOW NOISE

¼W 10Ω-1MΩ 5% E24	2p
½W 10Ω-10MΩ 5% E24	3p
1W 10Ω-10MΩ 5% E12	8p
2W 10Ω-10MΩ 5% E12	15p

METAL OXIDE/FILM RESISTORS

Very high thermal & electrical stability. Extremely low noise

0.4W 10Ω-1MΩ 2% E24	6p
0.4W 10Ω-1MΩ 1% E24	8p

LOW OHMIC VALUE RESISTORS (¼W OR ¼W)

0.22Ω 8.2Ω E12	11p

WIREWOUND RESISTORS 5%

2.3W 0.22Ω - 330Ω E12	28p
4.7W 0.47Ω - 6K8 E12	33p
10-11W 1.0Ω - 33K E12	37p

Rechargeable Batteries:

Guaranteed minimum 500 charges

HP2(2AH)	2.10
HP11(4AH)	4.75
HP7(½AH)	99p
HP11(1.2AH)	2.29

Chargers
TYPE H: Adjustable to 8 of any HP type Above £15.59
TYPE P: PP3 £5.50
TYPE A: HP7 (Up to 4 at a time) £5.86

GRAPHIC PROCESSORS

EF9365	45.00
EF9366	45.00

LOW NOISE ROTARY POTS

E3 Series

4.7K 2M Lin	32p
4.7K 2M Log	32p
As above with DP switch	80p
As above but stereo (no switch)	90p

MICRO-MINI 100V CERAMIC PLATE CAPS

5% or better

E12 Series 1pF 10nF	7p

DISCOUNTS ON QUANTITY PLEASE PHONE

SIEMENS POLY-C 5% 7.5mm 250V CAPACITORS E12

1nF-68nF	10p
82nF-150nF	18p

5% 7.5mm 100V CAPACITORS E12

100nF 180nF	12p
220nF, 270nF	16p
330nF, 390nF	20p
470nF, 560nF	27p
680nF	32p
1µF (10mm)	38p

Complete range of other voltages & spacings in stock. Please phone

TANTALUM BEADS

1/35V	14p
22/35V	14p
33/35V	14p
47/35V	14p
68/35V	14p
1.0/35V	14p
2.2/16V	14p
2.2/35V	22p
3.3/35V	22p
4.7/16V	22p
4.7/35V	24p
6.8/25V	26p
6.8/35V	25p
10/16V	25p
10/35V	34p
15/10V	22p
15/16V	30p
15/25V	32p
22/6.3V	26p
22/16V	32p
33/10V	38p
47/6.3V	43p
100/3V	37p

Feedthrough Capacitor 1000pF 500V 7p

Fully enclosed Piher Pre-sets

E3 Series 100Ω-10M

Mini Vert	14p
Mini Horiz	14p
Standard Vert	17p
Standard Horiz	17p
Thumbwheel or ¼" Spindle for Standard Pre sets only	8p

C280 or Equiv Polyester Caps Radial Long Leads

10nF, 15nF, 22nF, 33nF, 47nF, 68nF, 100nF	9p
150nF, 220nF,	11p
330nF, 470nF	16p
680nF, 1µF	24p
1.5µF, 2.2µF	44p

Veroboard 0.1" Copper Clad

2.5 × 3.75	72p
2.5 × 5	80p
3.75 × 3.75	80p
3.75 × 5	93p
2.5 × 17	2.50
3.75 × 17	3.30
4.79 × 17	4.20
VQ Board	1.76
Dip Board	3.25
Track Cutter	1.15
Pin Insertor	1.59
100 Pins	50
Verobloc	3.70
Vero Wiring Pen + Spool	3.00
Spare Spool	72p
Combs	8p

BOOKS (no VAT) (Post inc. prices)

Towers Transistor Manual (Bible)	10.50
TTL Data	3.95
Data conversion	4.50
Volt Reg Data	3.95
Interface Data	3.95
Memory applic	4.95
Audio Radio Hbk	4.50
Special function handbook	3.95

Texas Data Book in stock send for free list

Quality Electrolytics

By Matsushita or Siemens (other good makes may be sent only in the rare event of supply difficulty)

AXIALS

uFd	V	
47	63	8p
47	100	9p
47	350	30p
1	63	8p
1	100	9p
1	500	40p
2.2	25	8p
2.2	63	9p
2.2	100	11p
2.2	350	30p
3.3	25	10p
3.3	40	11p
3.3	63	12p
4.7	16	8p
4.7	25	9p
4.7	40	11p
4.7	63	12p
4.7	100	14p
10	25	8p
10	40	12p
10	63	14p
10	100	16p
22	25 RCA	185
22	40	10p
22	63	15p
22	100	21p
47	25	14p
47	40	17p
47	63	26p
47	100	28p
68	25	18p
68	63	25p
100	16	14p
100	25	16p
100	40	22p
100	63	25p
100	100	30p
220	10	16p
220	16	17p
220	25	22p
220	40	25p
220	63	30p
220	100	40p
330	16	19p
330	25	22p
330	63	38p
470	16	22p
470	25	28p
470	40	33p
470	63	43p
470	100	60p
1000	16	30p
1000	25	38p
1000	40	48p
1000	63	65p
2200	16	40p
2200	25	63p
2200	40	70p
2200	63	134p
4700	16	75p
4700	25	90p

Beautiful Mini Radial Low Voltage

Matsushita only

uFd	V	
10	16	6p
22	16	6p
22	16	7p
47	10	7p
47	16	8p
100	10	9p
100	16	10p
220	10	11p
220	16	12p
470	10	17p
470	16	18p
1000	10	20p
1000	16	24p
2200	10	34p
2200	16	44p

Grade One Glass PCB

Single Sided

178 × 240mm	95p
420 × 195mm	130p
420 × 245mm	195p

Ferric Chloride 60% Solution 250ml bottle £1.60

ETCH RESIST TRANSFERS

1 Thin lines
2 Thick lines
3 Thin bends
4 Thick bends
5 DIL pads
6 Transistor pads
7 Dots + holes
8 0.1" edge cons
9 Mixture

Any sheet of above 30p
Set of 13 sheets £3.00

PHOTO SENSITIVE PCB

1st Class Epoxy Glass For better results than spraying Expose to UV

Single sided	
100 × 160	1.56
100 × 220	1.90
203 × 114	1.86
233 × 220	3.99
Double sided	
100 × 160	1.66
100 × 220	2.15
203 × 114	2.21
233 × 220	4.56

Developer for above (do not use Sodium Hydroxide) 500ml 2.50

DALO ETCH RESIST PEN

spare nib 90p

ANTEX SOLDERING IRONS

C240 (15W)	4.59
X25 (25W)	4.99
Iron stand	1.66
C240 Element	1.99
X25 Element	2.05
Bits C240	
No2 (Small)	65p
No3 (Med)	65p
No6 (Lge)	65p
Bits X25	
No50 (Small)	65p
No51 (Med)	65p
No52 (Lge)	65p
SOLDER 125gms	
18 swg	2.95
22 swg	3.10

Wire & Cable

Prices per metre

Solid Hook up Wire Any colour 5p

Mains/Speaker Cable (per metre)	
Twin 1 amp	14p
Twin 2½ amp	16p
3 Core 2½ amp	18p
3 Core 6 amp	31p
3 Core 13 amp	56p
Solid Multicore	
4 Core	33p
8 Core	39p
12 Core	46p
50 Core	1.37
Screened Cable	
Single	14p
Stereo	27p
Mini Single	12p
Mini Stereo	15p
4 Core 4 Screens	44p
4 Core 1 Screen	54p
8 Core	61p
12 Core	80p
Aerial Cable	
50Ω RG58A	36p
75Ω UHF	36p
75Ω VHF	28p
300Ω Flat	14p
Rainbow Ribbon Cable	
10 Way	84p
24 Way	166p
40 Way	270p

Glass fuses range 1 to 5 amps, state value in amps and we send nearest above

1-2.5 amp slow	17p
1-2.5 amps quick	10p
2D mm slow	17p
2D mm quick	10p

ICE MULTI-METERS

Microtest 80	£16.00
Supertest 680R	£32.00

Pocket size Multimeter

VALVES

DY86/87/802	1.32
ECC82	1.22
ECC83	1.22
ECC84	1.22
EF86	1.80
EL34	2.89
EL84	2.50
KT66	10.75
KT88	12.50
PC900	1.76
PCC84	3.00
PCC85	3.40
PCC89	1.89
PCF86	2.20
PCF201	3.00
PCF801	2.57
PCF802	2.11
PCL82	1.80
PCL85	2.20
PCL86	2.10
PCL805	2.20
PD510	4.95
PFL200	2.95
PL504	2.11
PL508	2.36
PL509	[illegible]
PL802	4.17
PY88	1.62
PY500A	2.63
6L6	2.58
5S27	2.59
6V6	2.59

TRANSISTORS

Probably the largest retail variety in UK. If you don't see what you want please phone or write as this is not a full list

2N404	1.50
2N914	20p
2N916	39p
2N917	65p
2N918	33p
2N929	36p
2N929A	45p
2N930	20p
2N930A	30p
2N1893	30p
2N1974	1.50
2N2060	7.14
2N2102	39p
2N2217	39p
2N2218	33p
2N2218A	25p
2N2219	27p
2N2219A	28p
2N2220	22p
2N2221	22p
2N2221A	23p
2N2222	24p
2N2222A	25p
2N2223	2.60
2N2223A	4.15
2N2303	39p
2N2368	25p
2N2369	19p
2N2369A	18p
2N2646	46p
2N2647	98p
2N2904A	27p
2N2905	28p
2N2905A	29p
2N2906	25p
2N2906A	30p
2N2907	25p
2N2907A	26p
2N2920	3.47
2N2923	25p
2N2924	15p
2N2925	15p
2N2926	10p
2N3019	50p
2N3053	27p
2N3054	56p
2N3055RCA	80p
2N3055H	1.20
2N3108	42p
2N3109	48p
2N3232	1.50
2N3250	36p
2N3251	36p
2N3439	98p
2N3440	80p
2N3441	1.25
2N3442	1.35
2N3442RCA	1.85
2N3444	1.70
2N3445	4.80
2N3446	6.09
2N3447	5.72
2N3448	6.56
2N3468	1.00
2N3512	1.06
2N3553	2.30
2N3632	9.88
2N3638	35p
2N3638A	27p
2N3694	30p
2N3702	10p
2N3703	10p
2N3704	10p
2N3705	10p
2N3706	10p
2N3707	10p
2N3708	10p
2N3709	10p
2N3710	10p
2N3711	10p
2N3712	2.00
2N3713	1.38
2N3714	2.98
2N3715	3.31
2N3716	3.60
2N3819	21p
2N3820	38p
2N3821	1.84
2N3822	90p
2N3823	80p
2N3824	1.70
2N3860	31p
2N3866	90p
2N3877A	25p
2N3902	6.65
2N3903	15p
2N3904	15p
2N3905	15p
2N3906	15p
2N4030	66p
2N4031	56p
2N4032	65p
2N4033	58p
2N4036	56p
2N4037	40p
2N4239	1.00
2N4240	3.00
2N4347	2.26
2N4351	1.16
2N4400	15p
2N4401	27p
2N4402	20p
2N4403	30p
2N4409	30p
2N4410	30p
2N4427	75p
2N4440	12.58
2N4870	80p
2N4871	56p
2N4888	92p
2N4898	1.29
2N4901	1.69
2N4902	3.52
2N4903	3.24
2N4904	2.75
2N4905	3.25
2N4906	3.42
2N4907	3.20
2N4908	3.70
2N4909	2.90
2N4918	95p
2N4919	1.28
2N4920	1.34
2N4921	55p
2N4922	69p
2N4923	99p
2N5086	39p
2N5087	37p
2N5088	37p
2N5089	37p
2N5190	69p
2N5191	70p
2N5193	90p
2N5194	79p
2N5209	24p
2N5245	37p
2N5246	40p
2N5247	45p
2N5248	45p
2N5249	48p
2N5266	2.88
2N5293	98p
2N5294	1.28
2N5295	1.37
2N5401	35p
2N5415	1.10
2N5416	1.54
2N5447	16p
2N5448	19p
2N5449	21p
2N5450	23p
2N5451	25p
2N5457	29p
2N5458	29p
2N5459	29p
2N5460	72p
2N5543	5.00
2N5551	37p
2N6082	11.99
2N6121	54p
2N6122	56p
2N6123	59p
2N6124	56p
2N6125	59p
2N6126	71p
2N6129	79p
2N6130	93p
2N6131	98p
2N6132	83p
2N6133	1.14
2N6134	1.16
2N6253	1.45
2N6254	1.55
2SC1306	95p
2SC1444	2.50
2SC2078	1.70
2SJ49	3.98
2SK134	3.98
3N128	1.12
3N138	3.50
3N139	3.30
3N140	2.37
3N143	2.85
3N152	3.00
3N153	2.47
3N154	2.56
3N200	6.93
3N201	2.98
40360	60p
40361	67p
40362	67p
40363	2.22
40406	1.39
40407	75p
40408	1.50
40410	1.80
40411	2.85
40412	90p
40673	83p
40822	1.80
40871	89p
40872	89p
AC125	25p
AC126	25p
AC127	25p
AC128	25p
AC132	39p
AC151	51p
AC152	45p
AC153	55p
AC153K	64p
AC176	27p
AC176K	37p
AC187	26p
AC187K	28p
AC188	25p
AC188K	40p
ACY17	70p
AF239	1.24
AF240	1.80
AF279B	75p
AF279G	75p
AL102	3.49
AU110	2.20
AU113	2.30
BC107	10p
BC107A	12p
BC107B	12p
BC108	10p
BC108A	12p
BC108B	12p
BC108C	14p
BC109	10p
BC109B	12p
BC109C	12p
BC140	30p
BC141	37p
BC142	29p
BC143	34p
BC147	10p
BC147A	10p
BC147B	10p
BC147C	20p
BC148	10p
BC148A	10p
BC148B	10p
BC148C	10p
BC149	10p
BC149B	12p
BC149C	12p
BC152	15p
BC153	23p
BC154	27p
BC157	11p
BC157A	10p
BC157B	10p
BC158	10p
BC158A	10p
BC158B	10p
BC159	11p
BC159A	12p
BC159B	13p
BC159C	10p
BC160	18p
BC161	42p
BC167	48p
BC167A	10p
BC167B	10p
BC168	13p
BC168B	10p
BC168C	10p
BC169	10p
BC169B	10p
BC169C	10p
BC177	16p
BC177A	25p
BC177B	26p
BC178	16p
BC178A	24p
BC178B	25p
BC179	20p
BC179A	25p
BC179B	25p
BC179C	27p
BC182	10p
BC182A	12p
BC182B	13p
BC182L	10p
BC182LA	13p
BC182LB	14p
BC183	10p
BC183A	11p
BC183B	12p
BC183C	13p
BC183L	10p
BC183LA	13p
BC183LB	13p
BC183LC	14p
BC184	10p
BC184B	12p
BC184C	13p
BC184L	10p
BC184LB	13p
BC184LC	14p
BC186	24p
BC187	24p
BC212	10p
BC212A	12p
BC212B	12p
BC212L	10p
BC212LA	13p
BC212LB	13p
BC213	10p
BC213A	11p
BC213B	12p
BC213C	13p
BC213L	10p
BC213LA	12p
BC213LB	13p
BC213LC	14p
BC214	10p
BC214B	12p
BC214C	13p
BC214L	10p
BC214LB	13p
BC214LC	14p
BC237	14p
BC237A	16p
BC237B	17p
BC237C	18p
BC238	14p
BC238A	15p
BC238B	16p
BC238C	17p
BC239	15p
BC239A	16p
BC239B	17p
BC239C	18p
BC300	45p
BC301	44p
BC302	43p
BC303	47p
BC327	14p
BC328	14p
BC337	15p
BC338	15p
BC440	32p
BC441	33p
BC460	32p
BC461	33p
BC516	40p
BC517	40p
BC547	13p
BC547A	14p
BC547B	14p
BC548	12p
BC548A	13p
BC548B	14p
BC548C	15p
BC549	13p
BC549B	14p
BC549C	15p
BC550	30p
BC550C	33p
BC557	15p
BC557A	16p
BC557B	16p
BC558	14p
BC558A	15p
BC558B	16p
BC558C	17p
BC559	15p
BC559B	16p
BC559C	17p
BC560	32p
BC560C	34p
BCY70	16p
BCY71	16p
BCY72	19p
BD131	44p
BD132	44p
BD135	40p
BD136	40p
BD137	40p
BD138	42p
BD139	39p
BD140	39p
BD237	98p
BD238	98p
BD239A	57p
BD239C	64p
BD240A	59p
BD240C	73p
BD241A	61p
BD241C	67p
BD242A	65p
BD242C	70p
BD243A	72p
BD243C	85p
BD244A	82p
BD244C	1.00
BD245A	1.14
BD245C	1.30
BD246A	1.20
BD246C	1.50
BD249A	2.00
BD249C	2.31
BD250A	2.11
BD250C	2.46
BD437	88p
BD438	88p
BD439	91p
BD440	91p
BD441	91p
BD442	93p
BD529	1.20
BD530	1.30
BD535	75p
BD536	75p
BD537	80p
BD538	80p
BD539	80p
BD539C	1.10
BD540	85p
BD540C	1.20
BD675	72p
BD676	77p
BD677	78p
BD678	83p
BD711	1.32
BD712	1.32
BDX14	1.30
BDX18	1.59
BDX32	3.47
BDY54	1.70
BDY55	1.75
BDY56	1.80
BDY57	5.25
BDY58	6.15
BF194	12p
BF195	12p
BF196	12p
BF197	12p
BF198	15p
BF199	15p
BF200	1.49
BF224J	32p
BF225J	35p
BF240	38p
BF241	38p
BF244A	35p
BF244B	39p
BF245A	30p
BF245B	51p
BF246	52p
BF246A	39p
BF246B	53p
BF247A	54p
BF247B	56p
BF254	39p
BF255	42p
BF256A	35p
BF256B	46p
BF256C	62p
BF257	30p
BF258	32p
BF259	35p
BC207	19p
BC208	19p
BC209	19p
BF457	46p
BF458	56p
BF459	62p
BF469	86p
BF470	86p
BFR39	25p
BFR40	25p
BFR41	25p
BFR79	25p
BFR80	25p
BFR81	25p
BFR90	2.11
BFS28	2.95
BFS61	1.00
BFS98	1.10
BFX29	26p
BFY50	27p
BFY51	23p
BFY52	23p
BFY53	31p
BSX19	24p
BSX20	24p
BSX21	40p
BU104	2.22
BU105	1.70
BU109	3.29
BU126	1.47
BU204	2.25
BU205	1.75
BU206	1.89
BU208	1.98
BU326S	2.36
BU406	1.45
BU407	1.45
BU408	1.35
BU500	2.96
BUV20	11.00
BUV20	11.00
BUV21	10.90
BUV23	13.60
BUV24	12.10
BUV25	15.00
BUX20	17.00
BUY18S	3.95
E430	5.60
J300	48p
J310	53p
MJ802	3.99
MJ900	2.90
MJ901	3.10
MJ1000	2.50
MJ1001	3.00
MJ1800	3.60
MJ2500	2.19
MJ2501	2.25
MJ2955	1.00
MJ3000	2.19
MJ3001	2.25
MJ3701	2.56
MJ4502	3.99
MJ15003	4.85
MJ15004	5.55
MJ15015	2.45
MJ15016	3.34
MJE340	53p
MJE350	1.50
MJE2955	99p
MJE3055	69p
MPSA05	23p
MPSA06	25p
MPSA10	28p
MPSA12	29p
MPSA13	48p
MPSA14	46p
MPSA16	30p
MPSA18	66p
MPSA20	48p
MPSA42	49p
MPSA43	49p
MPSA55	28p
MPSA56	30p
MPSA65	40p
MPSA66	47p
MPSA70	45p
MPSA92	39p
MPSA93	39p
MPSL01	42p
MPSL51	48p
MPSU01	84p
MPSU04	1.32
MPSU05	55p
MPSU06	56p
MPSU07	75p
MPSU51	88p
MPSU55	58p
MPSU56	59p
MPSU57	1.20
OC20	2.30
OC22	2.00
OC23	2.00
OC25	2.50
OC28	1.70
OC29	2.35
OC35	2.35
OC41	80p
OC43	70p
OC44	82p
OC70	50p
OC71	50p
OC72	50p
OC82	50p
OC82D	70p
OC83	75p
TIP29A	32p
TIP29C	38p
TIP30A	35p
TIP30C	38p
TIP31A	38p
TIP31C	39p
TIP32A	38p
TIP32C	42p
TIP33A	65p
TIP33C	78p
TIP34A	74p
TIP34C	88p
TIP35A	1.09
TIP35C	1.28
TIP36A	1.29
TIP36C	1.39
TIP41A	49p
TIP41C	55p
TIP42A	55p
TIP42C	66p
TIP49	1.20
TIP50	1.40
TIP53	1.57
TIP54	1.58
TIP110	74p
TIP112	90p
TIP115	81p
TIP117	96p
TIP120	69p
TIP122	73p
TIP125	1.20
TIP127	1.27
TIP130	1.50
TIP132	1.60
TIP135	1.60
TIP137	1.80
TIP140	1.04
TIP142	1.04
TIP145	1.19
TIP147	1.19
TIP2955	77p
TIP3055	70p
TIS43	40p
TIS45	66p
TIS46	66p
TIS47	49p
TIS88A	62p
VN10KM	60p
VN46AF	84p
VN66AF	85p
ZTX107	10p
ZTX108	10p
ZTX109	10p
ZTX300	13p
ZTX301	15p
ZTX302	15p
ZTX303	23p
ZTX304	15p
ZTX310	15p
ZTX311	32p
ZTX312	35p
ZTX313	36p
ZTX314	24p
ZTX320	35p
ZTX330	35p
ZTX341	28p
ZTX500	14p
ZTX501	14p
ZTX502	14p
ZTX503	15p
ZTX504	24p
ZTX510	34p
ZTX530	24p
ZTX531	25p

DIODES

1N34A	30p
1N821	70p
1N823	92p
1N914	5p
1N916	10p
1N1190	1.47
1N4001	4p
1N4002	4½p
1N4003	5½p
1N4004	5½p
1N4005	6p
1N4006	6½p
1N4007	7p
1N4009	20p
1N4148	6p
1N4150	18p
1N4448	22p
1N4517	22p
1N5172	30p
1N5176	94p
1N5400	12p
1N5401	13p
1N5402	14p
1N5403	15p
1N5404	16p
1N5405	17p
1N5406	18p
1N5407	19p
1N5408	20p
1N5024	52p
1N5625	60p
1N5626	62p
1N5627	68p
1S44	10p
BA102	25p
BA115	25p
BA133	40p
BA138	30p
BA142	20p
BA144	15p
BA155	18p
BA156	38p
BA157	30p
BA158	30p
BA159	32p
BA182	40p
BA201	18p
BA202	26p
BA316	25p
BA317	25p
BA318	30p
BAV10	16p
BAV19	15p
BAV20	15p
BAV49	15p
BAX13	10p
BAX16	11p
BY126	20p
BY127	22p
BY134	52p
BY182	1.26
BY188A	65p
BY206	36p
BY207	36p
BY223	1.56
BY297	48p
BY299	55p
MZ2361	1.80
OA10	70p
OA47	10p
OA90	10p
OA91	10p
OA95	10p
OA200	20p
OA202	20p

DIACS

BR100	40p
ST2	25p

THYRISTORS

4, 8 & 12 Amps Texas TO220

Suffix: A = 100V, B = 200V, C = 300V, D = 400V, M = 600V

4A	TIC106A	46p
	TIC106B	47p
	TIC106C	48p
	TIC106D	59p
	TIC106M	68p
8A	TIC116A	66p
	TIC116B	68p
	TIC116C	71p
	TIC116D	73p
	TIC116M	80p
2A	TIC126A	72p
	TIC126B	72p
	TIC126C	73p
	TIC126D	77p
	TIC126M	95p

TRIACS

Texas 400V TO220 Case

TIC206D(4A)	66p
TIC216D(6A)	74p
TIC226D(8A)	88p
TIC236D(12A)	1.16
TIC246D(16A)	1.22
TIC253D(20A)	1.90
TIC263D(25A)	2.11

BRIDGE RECTIFIERS

(PIV shown in brackets)

1½ amp type	
W01 (100)	20p
W02 (200)	26p
W04 (400)	28p
W08 (800)	40p
2 amp type Square with hole	
S01 (100)	37p
S02 (200)	40p
S04 (400)	40p
S08 (800)	55p
6 amp type Square with hole	
PW01 (100)	50p
PW02 (200)	78p
PW04 (400)	85p
PW06 (600)	90p
25 amp type Metal clad with hole	
K01 (100)	2.20
K02 (200)	2.30
K04 (400)	2.80
K06 (600)	3.40
Proprietory Bridges	
B40C1500	1.20
B80C3700	1.80
BY164	55p
BY179	92p

ZENER DIODES

400-500mW E24 Series 2.4-47V	8p
1.3 Watt E24 Series 3.3-82V	15p
2.5 Watt E24 Series 7.5-75V	1.10

NEW OPTO DEVICES

New LEDs Now in stock
R = red
G = green
Y = yellow

	1-	50+
Large diffused		
R5D	9p	7p
G5D	15p	12p
Y5D	15p	12p
Small diffused		
R2D	8p	6p
G2D	12p	10p
Y2D	12p	10p
Micro 0.1"		
R1D	25p	22p
G1D	27p	25p
Y1D	27p	25p
Large clear		
R5C	12p	10p
G5C	17p	13p
Y5C	17p	13p
Super bright Large (100 times brighter)		
R5U	38p	29p
G5U	42p	34p
Y5U	42p	34p
Tri-colour flat		
RGY8	83p	78p

LINEAR ICs

AN103	2.20
AY1.5D5D	95p
AY3.8910	5.39
AY3.8912	5.59
AY5.1013A	3.00
CA3048	2.99
CA3049	3.21
CA3059	2.80
CA3060	4.08
CA3090AQ	3.70
CA3130E	87p
CA3130T	1.80
CA3140E	38p
CA3140T	85p
HA1366W	2.40
HA1388	2.54
LC7120	3.20
LC7130	3.20
LF351	47p
LF353	92p
LF355	83p
LF356	92p
LF357	1.09
LM348N	62p
LM349N	1.16
LM350K	4.60
LM379S	4.79
LM380N14	75p
LM380N8	1.50
LM381AN	2.26
LM381N	1.40
LM382N	1.20
LM383T	3.40
LM384N	1.40
LM386N1	88p
LM386N4	1.20
LM388N	2.43
LM391N60	1.70
LM391N80	1.93
LM723CH	1.21
LM723CN	40p
LM725CH	3.40
LM725CN	3.19
LM733	69p
LM741CH	99p
LM741CN	15p
LM741CN14	80p
LM747CN	69p
LM748CN	35p
LM1303N	1.20
LM1304N	2.50
LM1305N	3.10
LM1307N	2.75
LM1310N	1.45
[illegible]	2.25
LM1871	4.39
LM1872	4.39
LM1886	7.44
LM1889	3.77
LM2907N	2.75
LM2907N8	2.60
LM2917N	1.89
LM2917N	1.89
NE531N	1.36
NE543N	2.50
NE544N	1.80
NE555	16p
NE556	46p
NE558	1.89
NE560	3.25
NE565	1.18
NE5661	1.49
NE567	1.37
NE570	3.75
NE571	3.75
NE5534A	1.25
PLL02A	4.95
PLL03A	12.75
RC4136	59p
RC4194	3.95
SL470	3.47
SL490	3.47
TBA500	2.97
TBA500C	3.11
TBA510	2.95
TBA510Q	3.05
TBA520	2.57
TBA520Q	2.75
TBA530	2.55
TBA530Q	2.76
TBA540	2.72
TBA540Q	2.74
TBA550	3.25
TBA550Q	3.27
TBA560C	2.87
TBA570	2.37
TBA570Q	2.48
TCA910	2.19
TCA940	1.69
TDA1002	3.39
TDA1003	3.94
TDA1004	2.87
TDA1005	3.94
TDA1010A	2.25
TDA1022	4.95
TDA1024	1.19
TDA2610	3.90
TDA2611A	2.50
UAA170	1.69
UAA180	1.69
ULN2003	85p
UPC575C2	2.86
UPC1156	2.75
XR2206	2.92
ZN414	79p
ZN419	2.25
ZN1034	1.99
ZN1040	6.69
ZTK22	89p
ZTK33	89p

CPUs

1802	7.00
2650A	11.90
6502	3.24
6800	2.74
6802	2.80
6809	8.50
8035	3.48
8060	10.90
8080A	2.79
8085A	3.48
8900	57.75
9980	21.00
SCMP1	17.86
Z80A	2.96

LOGIC ICs including COMPUTER SUPPORT

ADC0804	.395
ADC0816	14.90
ADC0817	10.06
AY5-2376	5.90
ICM7555	80p
INS1671	20.00
INS1771	20.00
RO2513LC	6.90
RO2513UC	7.50
SAA5000	3.00
SAA5010	7.10
SAA5012	7.10
SAA5020	5.50
SAA5030	9.00
SAA5040	15.00
SAA5041	15.00
SAA5050	8.50
SAA5052	8.50
TMS6011	3.65
8T26	1.36
8T28	1.35
8T95	1.35
8T97	1.35
81LS95	90p
81LS96	1.20
81LS97	90p
81LS98	1.20
6522	3.19
6532	6.95
8154	9.42
8155	3.50
Z80ACTC	2.86
Z80ADART	8.00
Z80ADMA	10.00
Z80APIO	2.80
ZN425E8	3.38

VOLTAGE REGULATORS

— Positive — 100mA	
78L05A	30p
78L12A	30p
78L15A	30p
78L24A	30p
1 Amp TO220	
7805T	39p
7812T	39p
7815T	39p
7824T	39p
— Negative — 100mA T092	
79L05	59p
79L12	59p
79L15	59p
1 Amp TO220	
7905T	44p
7912T	44p
7915T	44p
7924T	44p

ZERO INSERTION OIL SOCKETS

24 pin	4.99
40 pin	5.30

40 CMOS

4000	10p
4001	10p
4002	11p
4006	48p
4007	15p
4008	32p
4009	24p
4010	10p
4011	10p
4012	15p
4013	20p
4014	45p
4015	58p
4016	20p
4017	32p
4018	46p
4019	26p
4020	44p
4021	39p
4022	48p
4023	12p
4024	32p
4025	12p
4026	79p
4027	20p
4028	29p
4029	29p
4030	14p
4031	1.19
4032	80p
4033	1.20
4034	1.29
4035	58p
4036	2.49
4037	1.30
4038	99p
4039	2.80
4040	46p
4041	40p
4042	39p
4043	46p
4044	41p
4045	99p
4046	44p
4047	39p
4048	39p
4049	22p
4050	23p
4051	44p
4052	49p
4053	49p
4054	79p
4055	83p
4056	89p
4059	4.35
4060	42p
4063	79p
4066	22p
4067	2.49
4068	14p
4069	13p
4070	13p
4071	13p
4072	13p
4073	13p
4075	13p
4076	46p
4077	13p
4078	13p
4081	12p
4082	12p
4085	49p
4086	53p
4089	1.50
4093	20p
4094	69p
4095	68p
4096	90p
4097	2.88
4098	74p
4099	90p

For higher numbers in 40 Series, substitute 74C for 40 prefix. eg 40107 = 74C107

45 CMOS

4502	98p
4503	29p
4507	33p
4508	1.19
4510	36p
4511	48p
4512	39p
4514	1.17
4515	1.17
4516	58p
4518	39p
4519	29p
4520	48p
4521	99p
4526	59p
4527	59p
4528	46p
4532	69p
4534	4.28
4536	2.58
4538	66p
4539	98p
4543	85p
4553	2.26
4555	36p
4556	36p
4560	1.40
4566	1.40
4569	1.58
4584	39p
4585	79p

MEMORIES

2101	4.00
2102AL2	1.36
2111-1	3.00
2114 (200ns)	80p
2532	3.60
2708	2.25
2716 (5V)	2.11
4027	3.00
4044	7.00
4060	9.50
4116 (200ns)	75p
4118-3	3.25
4164	4.50
S101	1.95
5204	7.50
6116	4.40
6514	3.30
6810	1.15
7489	4.20
74189	4.00
74LS289	3.25
74LS188	2.25
74LS287	3.06
74LS288	2.25

TTL

7400	10½p
7401	11p
7402	11p
7403	12p
7404	12p
7405	15p
7406	20p
7407	20p
7408	14p
7409	14p
7410	15p
7411	16p
7412	18p
7413	18p
7414	25p
7416	20p
7417	20p
7420	15p
7421	20p
7422	20p
7423	20p
7425	24p
7426	28p
7427	22p
7428	26p
7430	14p
7432	22p
7433	22p
7437	25p
7438	25p
7440	15p
7441	65p
7442	32p
7443	90p
7444	90p
7445	50p
7446	60p
7447	40p
7448	44p
7450	15p
7451	15p
7453	15p
7454	14p
7460	15p
7470	34p
7472	25p
7473	25p
7474	20p
7475	25p
7476	28p
7480	49p
7481	1.19
7482	68p
7483	38p
7484	69p
7485	60p
7486	20p
7489	2.20
7490	20p
7491	35p
7492	25p
7493	25p
7494	38p
7495	38p
7496	40p
7497	90p
74100	80p
74104	50p
74105	55p
74107	22p
74109	25p
74110	35p
74116	50p
74118	59p
74119	80p
74120	59p
74121	25p
74122	40p
74123	40p
74125	35p
74126	34p
74128	36p
74132	29p
74136	30p
74141	56p
74142	1.99
74143	2.48
74144	2.10
74145	50p
74147	89p
74148	70p
74150	49p
74151	40p
74153	40p
74154	48p
74155	40p
74156	40p
74157	30p
74159	75p
74160	80p
74161	48p
74162	48p
74163	48p
74164	48p
74165	48p
74166	48p
74170	1.25
74172	2.75
74173	60p
74174	54p
74175	49p
74176	39p
74177	45p
74178	79p
74180	40p
74181	1.15
74182	60p
74184	90p
74185	90p
74186	4.69
74188	2.50
74190	48p
74191	48p
74192	46p
74193	46p
74194	46p
74195	46p
74196	46p
74197	48p
74198	83p
74199	83p
74221	53p

74H TTL

74H00	1.45
74H01	1.45
74H04	1.55
74H05	1.55
74H10	1.45
74H11	1.45
74H20	1.45
74H21	1.45
74H30	1.45
74H40	1.55
74H51	1.75
74H53	1.65
74H54	1.45

74LS TTL

74LS00	11p
74LS01	11p
74LS02	11p
74LS03	12p
74LS04	12p
74LS05	12p
74LS08	12p
74LS10	12p
74LS11	12p
74LS12	12p
74LS13	19p
74LS14	30p
74LS15	12p
74LS20	12p
74LS21	12p
74LS22	12p
74LS27	12p
74LS28	14p
74LS30	12p
74LS32	13p
74LS33	14p
74LS37	14p
74LS38	15p
74LS40	13p
74LS42	28p
74LS47	35p
74LS51	14p
74LS54	14p
74LS55	14p
74LS73	18p
74LS74	18p
74LS75	20p
74LS76	20p
74LS78	18p
74LS80	1.20
74LS83	36p
74LS85	48p
74LS86	16p
74LS90	24p
74LS92	25p
74LS93	24p
74LS95	38p
74LS96	98p
74LS107	20p
74LS109	27p
74LS112	22p
74LS113	22p
74LS114	22p
74LS122	36p
74LS123	36p
74LS124	89p
74LS125	24p
74LS126	25p
74LS132	39p
74LS136	29p
74LS138	32p
74LS139	30p
74LS145	70p
74LS147	1.57
74LS148	75p
74LS151	39p
74LS153	39p
74LS154	79p
74LS155	29p
74LS156	36p
74LS157	27p
74LS158	29p
74LS160	35p
74LS161	35p
74LS162	35p
74LS163	36p
74LS164	40p
74LS165	59p
74LS168	84p
74LS169	85p
74LS170	70p
74LS173	56p
74LS174	45p
74LS175	39p
74LS181	99p
74LS183	1.79
74LS190	36p
74LS191	36p
74LS192	36p
74LS193	37p
74LS194	32p
74LS195	32p
74LS196	46p
74LS197	48p
74LS221	50p
74LS240	56p
74LS241	56p
74LS242	56p
74LS243	56p
74LS244	60p
74LS245	70p
74LS247	50p
74LS248	56p
74LS249	56p
74LS251	30p
74LS253	32p
74LS257	35p
74LS258	36p
74LS259	56p
74LS261	1.36
74LS266	18p
74LS273	60p
74LS275	2.25
74LS279	30p
74LS280	1.60
74LS283	40p
74LS289	4.70
74LS290	46p
74LS293	40p
74LS295	89p
74LS298	89p
74LS299	2.50
74LS323	1.76
74LS324	1.45
74LS325	2.96
74LS326	2.39
74LS327	2.39
74LS347	95p
74LS348	1.00
74LS352	79p
74LS353	79p
74LS362	7.25
74LS365	29p
74LS366	29p
74LS367	29p
74LS368	29p
74LS373	59p
74LS378	58p
74LS386	1.14
74LS390	46p
74LS393	42p
74LS395	88p
74LS396	1.90
74LS398	2.70
74LS399	1.58
74LS445	98p
74LS490	2.20
74LS540	1.60
74LS541	98p
74LS640	1.69
74LS641	1.69

ELECTROVALUE

- 24 HOUR NORMAL DESPATCH TIME
- ESTABLISHED 1965
- ALL GOODS GUARANTEED BRAND NEW AND TO SPECIFICATION
- APPOINTED SIEMENS DISTRIBUTORS

I.Cs – DIGITAL & ANALOGUE

DIGITAL

74LS

74LS00	11
74LS02	11
74LS04	12
74LS05	12
74LS08	12
74LS10	12
74LS11	12
74LS14	30
74LS20	12
74LS30	12
74LS32	14
74LS37	14
74LS38	15
74LS42	28
74LS47	56
74LS51	14
74LS73	18
74LS74	18
74LS75	22
74LS76	19
74LS85	48
74LS86	20
74LS90	27
74LS92	32
74LS93	24
74LS107	40
74LS112	22
74LS123	38
74LS125	29
74LS126	27
74LS132	40
74LS136	25
74LS137	110
74LS138	30
74LS139	35
74LS145	70
74LS148	89
74LS151	40
74LS153	40
74LS153	40
74LS155	38
74LS156	36
74LS157	30
74LS161	37
74LS163	36
74LS164	43
74LS165	60
74LS166	90
74LS173	55
74LS174	45
74LS175	40
74LS191	50
74LS193	40
74LS195	39
74LS196	48
74LS197	60
74LS221	51
74LS240	56
74LS241	55
74LS242	75
74LS243	75
74LS244	60
74LS245	85
74LS251	55
74LS253	43
74LS257	35
74LS259	84
74LS266	28
74LS273	60
74LS279	40
74LS299	250
74LS367	34
74LS368	24
74LS373	84
74LS374	68
74LS378	60
74LS393	60

7400

7400	11
7401	11
7402	12
7403	12
7404	13
7405	15
7406	20
7407	20
7408	14
7409	14
7410	14
7413	18
7414	20
7420	15
7430	14
7440	14
7442	32
7443	60
7444	60
7447	36
7448	40
7450	14
7451	14
7453	14
7454	14
7460	14
7470	24
7472	26
7473	26
7474	23
7475	32
7476	30
7480	35
7482	65
7482	65
7483	38
7485	60
7486	20
7489	159
7490	28
7491	35
7492	25
7493	25
7494	35
7495	35
7496	40
74100	80
74104	40
74107	22
74121	24
74123	40
74125	34
74126	33
74141	51
74151	40
74154	60
74155	39
74156	40
74157	30
74190	48
74192	48
74193	48
74393	95

CMOS

4000	10
4001	10
4002	12
4006	50
4007	14
4008	40
4009	24
4010	24
4011	12
4012	15
4013	20
4014	46
4015	40
4016	20
4017	35
4018	45
4019	25
4020	42
4021	40
4022	35
4023	14
4024	32
4025	14
4026	80
4027	20
4028	39
4029	45
4030	16
4041	44
4042	40
4043	40
4044	40
4046	45
4049	23
4050	23
4060	45
4069	14
4070	14
4071	14
4072	14
4081	14
4082	14
4093	20
4510	46
4511	46
4511	120
4516	53
4518	40
4520	60
4543	120
4583	130

All above prices are NET and shown in pence

ANALOGUE

709C5	49
709C14	44
723C14	36
741C5	57
741C8	18
741C14	47
747C14	65
748C8	35
1458C5	62
1458C14	40
7106	450N
7107	500N
555	23
7555	86
556	45
CA3046	78
CA3080E	86
CA3130E	99
CA3140E	55
LM301AN	26
LM308N	60
LM317K	321
LM324N	45
LM348N	66
LM380N	75
LM380N8	104
LM381N	145
LM382N	115
LM3900N	50
LM3914N	200
LM3915N	200
NE555V	23
NE556A	45
NE567N	104
RC4151NB	80
S041E	290
S041P	121
S042E	364
S042P	138
S89	11.23
S178B	31.00
S187	13.28
S566B	214
S576A	235
S576B	236
S576C	236
S576D	225
S1469	468
SAB0600	302
SAB3209	497
SAB3210	311
SAB3211	168
SAB3271	329
SAB4209	497
SAB8256C	35.40
SAD1024	15.50
SAJ131	238
SAJ141	224
SAJ205	810
SAS231W	260
SAS251	142
SAS580	196
SAS590	196
SDA5680A	15.55
TAA761	104
TAA761A	49
TAA765A	62
TAA861	103
TAA865A	59
TAA2761A	72
TAA4761A	113
TAA4765A	120
TAB1041W	187
TBA120AS	62
TBA120U	72
TBA400	100N
TBA800	75
TBA10S	75
TBA820	75
TBB1458	62
TBB1458B	40
TCA105	120
TCA105B	108
TCA105G	140
TCA250A	185
TCA205K	200
TCA335A	66
TCA345A	109
TCA345W	177
TCA671	131
TCA780	211
TCA871	114
TCA955	228
TCA965	136
TCA965K	170
TCA971	92
TCA991	80
TCA991K	100
TDA2002	120
TDA2003	126
TDA2030	150
TDA4050B	144
TDA4290	169
TDA4600	184
TDA4700A	546
TDA4713A	435
TFA1001W	252
TL071CP	45
TL072CP	75
TL074CN	120
TL081CP	46
UAA170	165
UAA170L	152
UAA180	165
UAA190	141
XR2206	520
ZN414	85
ZN424P	99
ZN425E	350

CRYSTALS
(in MHz)

0.032768	102	4.433	128
0.100000	453	4.915	157
1.000	453	5.000	157
1.8432	320	5.026	128
2.000	268	6.000	157
2.4576	268	6.5536	128
3.2768	188	8.000	1.88
3.579	128	8.867	128
4.000	102	10.000	157
4.194	128	18.432	188

ZENER DIODES

400mW/2.7-30V	7p
1-3W/3.3-100V	15p
20W/7.5-75V	£1.98

CONNECTORS

DIN AUDIO

Pins	plug	skt
2	8p	8p
3	14p	8p
4	15p	14p
5 (180°)	17p	11p
5 (240°)	20p	8p
6	18p	20p
7	19p	30p

PARALLEL TYPE

	Plug	Skt
2 · 8 way	192	184
2 · 10 way	225	205
2 · 13 way	279	258
2 · 17 way	333	299
2 · 20 way	382	315

Plugs have retainers Sockets have strain relief

IC Sockets

Pins	each	25 for
8	8p	1.60N
14	12p	2.40N
16	14p	2.90N
18	18p	2.20N
20	18p	3.60N
22	21p	4.20N
24	21p	4.20N
28	22p	4.40N
40	30p	6.00N

JACK PLUGS, SKTS

MONO ¼"			
chrome P1	53p	34p	42p
plastic P2	32p	14p	20p
STEREO ¼"			
chrome P3	81p		52p
plastic P4	60p	15p	20p
Mono 3.5mm	18p		14p
Stereo	23p		42p

TERMINALS
Plastic screw 15A several colours 24
S14 4mm socket 12
P14 4mm plug 10
Wander plugs & sockets red/black only ea 14
PC Mounting terminal blocks 60am
2 way 17p 4 way 33p 6 way 49p 8 way 66p 10 way 82p

D-SERIES

	Plug	skt	hood
9	78p	104p	92p
15	106p	140p	96p
25	141p	205p	110p
37	199p	298p	122p

IDC Connectors DIL

14 way	103p
16 way	117p
24 way	170p
40 way	265p

QUICK TEST Mains connector block fused 525

Very wide range of many other types in stock – see latest price list.

RF Chokes
1, 1.1, 4.7, 10, 47μH ea **42p**, 100, 22μH **53p**, 470μH, 1mH **73p**.

CAPACITORS

Polystyrene, Siemens 5% Tolerance 160V
5, 7, 10, 12, 15, 18, 22, 27, 33, 39pF **15p**; 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820pF, 1n, 1n2, 1n5, 1n8, 2n2, 2n7, 3n3, 3n9, 4n7, **10p**; 5n6, 6n8, 8n2, 10n, **13p**
Ceramic Very small 1.8, 2.2, 2.7 etc, up to 1n **5p each**. 1n5, 2n2, 3n3, 4n7, 6n8, **5p**; 10n, 22n, **6p**; 33n, 47, **7p**; 100n, **8p**
Polyester, Siemens Layer Type 7.5mm lead spacing 100V
1n, 1n5, 2n2, 3n3m **6p**; 4n7, 6n8, 8n2, 10n 12n, 15n, 18n, 22n, 33n, 47n, **7p** 56n, 68n, **7p**; 82n, 100n, **9p** 120n, 150n, **15p**; 180n, 220n, **12p**; 270n, 330n, 330n, 390n, 470n, **15p**; 560n, 680n, **24p**; 10mm spacing 1uF **25p**; 15mm spacing 2u2 **35p**; 22.5mm, spacing 1uF 400V **50p**; 3.33uF 100V **69p**; In depth stocks.

ELECTROLYTICS

1/63	10	1000/10	19
2.2/25	13	1000/16	26
2.2/63	10	1000/25	36
4.7/63	11	1000/40	44
4.7/100	14	1000/63	76
6.8/40	10	2200/6	09
10/6	13	2200/16	44
10/25	10	2200/25	
10/40	11	2200/40	73
10/63	14	4700/16	72
10/100	15	4700/25	90
22/10	10		
22/25	11		
22/40	14		
22/63	15		
22/100	16		
47/3	03		
47/10	11		
47/25	12		
47/40	15		
47/63	17		
47/100	18		
100/3	03		
100/10	13		
100/16	14		
100/25	15		
100/40	15		
100/63	20		
100/100	27		
220/10	16		
220/16	17		
220/25	18		
220/40	20		
220/28	28		
220/100	42		
470/10	19		
470/16	19		
470/25	19		
470/40	27		
470/63	45		
470/100	73		

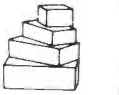
TANTALUM BEADS

0.1/35	13
0.22/35	13
0.47/35	13
1.0/35	13
2.2/16	13
2.2/35	16
4.7/16	16
4.7/35	18
6.8/16	16
6.8/25	24
10/6.3	16
10/16	18
10/25	18
22/6.3	18
22/16	30
22/25	30
33/6.3	24
33/10	30
47/6.3	30
100/10	80

For full ranges of very many other types please see Cat 82 and/or current price list.

BOXES

High quality Black ABS plastic or die-cast plain or stove grey.



L	W	D	ABS		Plain		Stove Gr	
50	50	25	—		5001P	90p	5001	123p
100	60	25	2002	96p	5002P	117p	5002	154p
113	63	31	2003	109p	5003P	143p	5003	184p
121	66	40	2004	115p	5004P	162p	5004	210p
152	82	50	2005	134p	5005P	216p	5005	268p
192	113	61	2006	235p	5006P	314p	5006	401p

VERO RANGE plastic boxes

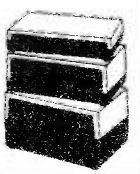
L	W	D		
72	47	25	21024	51p
120	50	35	21390	83p
180	110	55	21391	151p

G RANGE professional Instrument Cases

134	90	44	21089	£7.28N
224	140	64	21090	£11.02N
302	170	84	21091	£14.96N

VEROBOX CASES

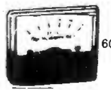
to give a completely professional finish to a much valued project.
ABS, light grey top, dark grey bottom + 2 anodised panels



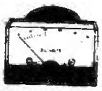
L	D	H	TYPE	PRICE
205	140	40	21034	£4.52
205	140	75	21035	£5.02
205	140	110	21036	£6.54
180	120	39	21037	£4.11
180	120	65	21038	£4.40
180	120	90	21039	£4.69
155	85	39	21040	£3.31
155	85	60	21041	£3.31
155	85	80	21042	£4.30
125	65	30	21047	£2.35
125	65	39	21048	£2.99
125	65	50	21049	£3.37

METERS

Large range of types in stock; also probes, leads, accessories, etc.
PANEL MOUNTING in 50, 100, 500μA; 1, 5, 10, 50, 100, 500mA; 1A either model.



T Range 60 × 45mm **£5.95**



MU Range 50 × 45mm **£2.68**

MULTIMETERS

NH56A NEW – 20KΩ/V AC/DC/-RES/dB in 23 ranges: 130 × 88 × 37mm £11.20N

YN360TR 20KΩ/V: AC/DC/R/dB/Transistor Test: in 21 ranges: 145 × 96 × 45mm **£16.45N**

PANEL LAMPS

LED chrome, red 54
LED yellow or green 70 (high efficiency)
Filament in red, amber, green or clear
6V 60 mA 48
14V 40 mA 54

5V filament
3015F 8 mA 255
3015F 15 mA 256

LED's
5mm red 10
yellow 19
green 16
Mountings, B65 3

KNOBS black plastic
K1 skirted with spot 16
K2 as K1, 35mm 21
K3 pointer 15
K7 19 mm knurled 23
K8 as K7 + skirt 23

DISPLAYS
7-segment
Common anode
MAN72A red 75
MAN82A yellow 110
MAN52A green 110
Common cathode
MAN74A red 85
MAN84A yellow 110
MAN54A green 110

RECHARGEABLE CELLS
AA **99p** C **227p** D (4AH) **376p** PP3 cell (7-2V) PP3 charger **495N 410**
CHARGERS FOR ABOVE
for any two pairs AA, C or D No NC1230 **820N**

BUZZERS
6-15V solid state 70

SOLDERING IRONS

Also large stocks of bits, desoldering devices, accessories, etc.
ANTEX C 240V **£4.60N**; X.25 240V **£5.30N**; CSBP **£5.45N**; XSBP **£5.56N**; ST4 Stand £1.70N
ORYX 50 watt temp. controlled **£13.75N**
SOLDER 500gm/18SWG **£7.80N**; Desolder braid 1.5m **54p**

SWITCHES

Type CK – 1P/12 way, 2P/6 way, 3P/4 way, 4P/3 way **48p**; Min Toggles – S7101 SPDT **57p**; S7201 DPDT **80p**; S7301 3PDT **£1.64**; S7203 DPDT **96p**; Push Button min. 8531 make/8533 break **62p**; 8225 DPDT **£1.34**.
DUAL IN LINE ERG colour coded 0.3" × 0.1" format. On/Off single throw 2P SDS2 **54p**; 4P SDS4 **95**; 6P SDS6 **£1.38**; 8P SDS8 **£1.87**; 10P SDSO **£2.10**. *Low cost* D-I-L 4P DNS04 **65p**; DNS08 **£1.00**

LATEST PRICE LIST
includes many new additions to items in our catalogue. Large S.A.E. brings price list FREE.
CATALOGUE incl 70p refundable voucher, 70p post free U.K. with price list.

RESISTORS

1/4, 1/3, 1/2, 3/4 watt – **all 2p each**, 10 of one value **15p**
2% Mullard metal film 5.1 ohms – 300K **5p each**, 10 of one value **40p**
5% wire wound 3W or 7W, most E12 values 1.2ohms to 8K2 **9p each** 10 for **70pN**

POTENTIOMETERS

Carbon Rotary (P20) 100ohms – 4M7 lin. 220ohms – 2M2 log. **32p each** w.switch **87p**. Dual gang (JP20) 4K7 – 1M2 lin. or log **95p** w.switch **£1.50**

SLIDERS
58mm, low cost 10K 1M log only **29p**. Std 58mm mono 4K7 – 1M lin. or log 74p stereo matched **£1.25**. Graduated bezels **34p each**.

PRESET
Min. 10mm dia. Hrix. or Vert. 100ohms – 1M **13p**
Preset Cermet rectilinear type 89P 100ohm – 1m **£1.06 each**
Preset Cermet 10mm dia. Horiz. or Vert. 100ohm – **29p**
Plesseyu MPW T moulded carbon 47ohms – 2M2 **59p each.**

SEMICONDUCTORS

1N914	03
1N914B	10
1N916	06
1N4007	06
1N4148	03
1N5402	14
1N5407	18
2N697	23
2N706	18
2N930	20
2N1132	23
2N1302	110
2N1303	58
2N1304	62
2N1305	62
2N1306	90
2N1307	67
2N1308	147
2N1309	99
2N1599	100
2N1613	25
2N1711	25
2N1893	32
2N2218A	31
2N2219A	25
2N2222A	25
2N2369A	21
2N2484	25
2N2646	45
2N2904	28
2N2904A	25
2N2905A	25
2N3053	23
2N3054	56
2N3055	48
2N3405	64
2N3663	15
3702-11	09
2N3771	180
2N3794	21
2N3819	22
2N3820	40
3823	60N
2N3904	15
2N3906	15
2N4036	46
2N4058-62	09
2N4124	25
2N4126	25
2N4284	30
2N4286	18
2N4289	23
2N4291	24
2N4292	21
2N4991	62
2N5062	32
2N5192	110
2N5195	106
2N5457	32
2N5458	32
2N5459	36
2N6050	380
2N6057	375
6F40	152
16F40	185
40HF40	225
40361	DIS
40362	65
40406	71
40408	95
40412	108
40430	100
40594	123
40595	123
40636	147
40673	146
A9903	16
AA113	13
AA116	13
AA117	13
AA118	14
AA119	13
AC126	25
AC127	25
AC128	25
AC151R	55
AC153K	20
AC176	25
ACY17	155
ACY18	120
ACY19	99
ACY20	90
ACY21	85
ACY39	170
ACY41	10
AD136	530
AD142	90
AD149	88
AD161	35
AD162	35
AF114	37
AF115	37
AF116	57
AF117	110
AF124 AF125	37
AF126	37
AF127	37
AF200	10
AF239	114
AF279	30
AFY12	204N
AFY16	327N
AFY180	310N
AFY18E	615N
AFY42	461N
AU106	240
AU111	(use
AU116)	
AUY22	10.96
BO140	25N
BO146	30N
BO226	46N
B1906	38
BA379	25
BAS40-03	36
BAS70-03	41
BAT14-036	11.75
BB409	33
BC107A,B	16
BC108A,B,C	16
BC109B,C	18
BC121W	30N
BC122Y	100
BC125	20
BC125	20
BC140	30
BC141	30
BC147A	10
BC149	10
BC154	25
BC160	30
BC161	30
BC167A	09
BC167B	09
BC168A	09
BC168B	09
BC169B	09
BC169C	09
BC177B	16
BC178B	16
BC179B	16
BC182	09
BC182L	09
BC183	09
BC183L	09
BC184	09
BC184L	09
BC202Y	120
BC212	09
BC212L	09
BC213	09
BC213L	09
BC214	09
BC214L	09
BC238C	09
BC239C	09
BC258B	09
BC267B	16
BC300	26
BC301	26
BC303	30
BC327	16
BC328	11
BC337	14
BC338	11
BC413	09
BC414	09
BC477	29
BC546	10
BC547	09
BC548	09
BC549	09
BC550	10
BC556	10
BC557	09
BC558	09
BC559	09
BC560	10
BC879	38
BC880	43
BCY31A	157
BCY58	18
BCY70	18
BCY71	18
BCY72	18
BD130	45N
BD131	48
BD132	48
BD135	27
BD136	27
BD139	30
BD140	32
BD644	42N
BD679	62
BD680	64
BF115	35
BF167	25
BF173	25
BF177	25
BF178	25
BF244B	40
BF254	14
BF255	14
BF420	31
BF421	34
BF457	35
BF458	36
BF459	35
BF597	12N
BFR34A	84
BFR39-41	23
BFR79-81	23
BFT65	119
BFT66	192
BFX29	24
BFX84	24
BFX85	24
BFX87	28
BFX88	26
BFY50	24
BFY51	24
BFY52	24
BFY90	143
BR34	70
BR64	110
BRY39	45
BSX20	22
BSX26	22
BSX63	769N
BT106	147
BT108	136
BU105	170
BU124	85
BU208	180
BUX26	350N
BUX28	545
BUX81	744
BUX85	249
BUZ10A	478
BUZ15	12.27
BUZ20	523
BUZ23	787
BUZ24	12.50
BUZ32	625
BUZ33	844
BUZ41A	637
BUZ44A	9.67
BUZ45	12.76
BUZ48	18.94
BUZ50A	763
BUZ54A	21.43
BUZ80	739
BUZ83	11.29
BUZ83A	11.95
BUZ84A	12.75
BY164	48
C106D1	45
C0326	460N4
C0340	490N4
C407	17
C0546	126N1
C762	40
C1406	77
D4 clip	for
C1406	and
E2506	10
D1046	88
E1110	76
E1210	[illegible]
E2506	154
EB383	20
MJ2955	90
MJE340	55
MJE2955	95
MJE3055	70
MPF102	40
MPS6531	40
MPS6534	42
MPSA12	36
MPSA63	38
NAS206S5	81
OA47	12
OA90	10
OA91	10
OA95	DIS
OA202	14
OC28	75
OC29	75
OC35	75
OC36	90
OC84	25
PM7A2	373
PN70	10
PN72	05
Q4006LT	104
Q4010LT	115
Q4025H	450
T2700D	189
T2800D	104
TAG3-400	100
TAG209-400	85
TAG209-600	130
TIC106D	48
TIC106M	55
TIC126D	64
TIC206D	54
TIC226D	61
TIC236D	96
TIC246D	105
TIP31A	35
TIP32A	36
TIP41A	45
TIP41C	60
TIP42A	46
TIP42C	60
TIP150	75
TIP2955	55
TIP3055	55
TIS43	50
U763	50
VN10KM	55
VN46AF	93
VN66AF	105
VN88AF	123
W02	25

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BEST PRICES ANYWHERE!

2114L-2	75	Z80A CPU	290	81LS96	85
2716	205	Z80A P10	260	81LS97	85
2532	340	Z80A CTC	260	1488	55
2732	340	Z80A S10	900	1489	55
4116 P20	70	Z80A DMA	1150	Epson Printers and D	
6116-P3 150nS	365	Z80A DART	500	Connectors now avail-	
4164	440	81LS95	85	able at low low prices.	

CRYSTALS

100KHz	235	4.43M	100
1MHz	275	6.0M	140
1.8432M	200	7.0M	150
2.0M	225	8.0M	140
2.4576M	200	10.0M	170
3.579M	95	12M	170
4.0M	140	16M	200

CMOS

		4016	20	4034	140	4054	78	4081	12	40193	65	4528	45
		4017	30	4035	249	4055	80	4082	12	4502	60	4529	150
		4018	45	4039	280	4059	430	4085	48	4503	32	4532	60
4000	10	4019	25	4040	40	4060	42	4086	50	4507	35	4534	400
4001	10	4020	42	4041	40	4063	80	4089	125	4508	110	4538	60
4002	12	4021	40	4042	38	4066	22	4093	18	4510	45	4543	50
4006	50	4022	45	4043	40	4067	225	4094	68	4511	40	4549	360
4007	14	4023	16	4044	40	4068	14	4095	65	4512	40	4553	215
4008	36	4024	33	4046	40	4069	13	4097	290	4514	115	4555	35
4009	24	4025	12	4047	35	4070	13	4098	70	4515	115	4556	35
4010	24	4026	75	4048	38	4071	13	4099	70	4516	55	4559	390
4011	10	4027	20	4049	21	4072	13	40106	40	4518	40	4560	140
4012	15	4028	40	4050	21	4073	13	40109	110	4520	50	4584	35
4013	20	4029	45	4051	42	4075	13	40163	60	4521	130	4585	60
4014	45	4030	14	4052	48	4076	[illegible]	40173	100	4526	60	4724	140
4015	40	4031	125	4053	48	4077	14	40175	75	4527	50		

LS TTL

		LS20	12	LS75	20	LS123	34	LS160	35	LS197	45	LS353	60
		LS21	12	LS76	17	LS125	24	LS161	35	LS221	50	LS365	28
		LS22	12	LS78	17	LS126	25	LS162	35	LS240	60	LS366	28
LS00	11	LS26	14	LS83	35	LS132	35	LS163	35	LS241	55	LS367	28
LS01	11	LS27	12	LS85	48	LS136	30	LS164	40	LS242	55	LS368	29
LS02	11	LS30	12	LS86	16	LS138	26	LS165	55	LS243	55	LS373	58
LS03	12	LS32	13	LS90	24	LS139	30	LS166	60	LS244	55	LS374	60
LS04	12	LS37	14	LS92	25	LS145	70	LS170	75	LS245	70	LS375	43
LS05	12	LS38	15	LS93	24	LS147	150	LS173	60	LS247	48	LS377	60
LS08	12	LS40	13	LS95	38	LS148	75	LS174	45	LS251	28	LS378	57
LS09	12	LS42	28	LS96	95	LS151	38	LS175	45	LS257	32	LS390	45
LS10	12	LS47	35	LS107	40	LS153	38	LS190	35	LS258	32	LS393	40
LS11	12	LS48	45	LS109	21	LS154	75	LS191	35	LS259	55	LS399	156
LS12	12	LS51	14	LS112	21	LS155	33	LS192	35	LS266	20	LS541	78
LS13	19	LS55	14	LS113	21	LS156	36	LS193	36	LS273	58	LS670	135
LS14	30	LS73	18	LS114	22	LS157	26	LS195	32	LS279	30		
LS15	12	LS74	17	LS122	35	LS158	29	LS196	45	LS283	38		

TTL

		7413	17	7444	85	7483	30	74122	38	74161	46	74190	40
		7414	23	7446	58	7485	60	74123	38	74162	46	74191	40
		7416	19	7447	36	7486	19	74125	33	74163	46	74192	40
7400	11	7417	19	7448	43	7489	180	74126	33	74164	46	74193	40
7401	11	7420	14	7450	14	7490	19	74132	30	74165	46	74194	40
7402	11	7421	19	7451	14	7491	34	74141	54	74167	150	74195	40
7403	12	7422	19	7453	14	7492	24	74145	48	74170	115	74196	40
7404	12	7427	18	7454	14	7493	24	74147	75	74173	58	74197	40
7405	14	7428	25	7460	14	7494	33	74148	60	74174	53	74198	80
7406	19	7430	13	7472	22	7495	33	74150	48	74175	45	74199	80
7407	19	7432	20	7473	24	7496	38	74153	38	74176	35		
7408	13	7433	20	7474	19	7497	86	74154	47	74177	42		
7409	13	7437	23	7475	26	74100	78	74155	36	74179	75		
7410	13	7438	24	7476	25	74107	22	74156	36	74180	38		
7411	15	7440	14	7480	45	74109	24	74157	28	74181	100		
7412	17	7442	30	7482	65	74121	24	74160	55	74182	55		

SWITCHES

Submin toggle:
SPST 55p. SPDT 60p. DPDT 65p.
Miniature toggle:
SPDT 80p. SPDT centre off 90p.
DPDT 90p. DPDT centre off 100p.
Standard toggle:
SPST 35p. DPDT48p
Miniature DPDT slide 12p.
Push to make 12p.
Push to break 22p.
Rotary type adjustable stop.
1P12W, 2P6W, 3P4W all 55p each.
DIL switches:
4SPST 80p 6 SPST 80p. 8SPST 100p.

TRANSFORMERS

Please add carriage charges to our normal post charges.

Miniature mains:
606V, 909V, 12012V all @ 100mA 100p each.
PCB mounting. Miniature:
3VA 0-6, 0-6 @ 0.25A; 0-9, 0-9 @ 0.15A; 0-12, 0-12 @ 0.12A 200p each.
6VA 0-6, 0-6 @ 0.5A; 0-9, 0-9 @ 0.3A; 0-12, 0.12 @ 0.25A 270p each.
High quality. Split bobbin construction
6VA 0-6, 0-6 @ 0.5A; 0-9, 0-9 @ 0.4A; 0-12, 0-12V @ 0.3A 220p each.
12VA 0-6, 0-6 @ 1A; 0-9, 0-9 @ 0.8A; 0-12, 0-12 @ 0.5A; 0-15, 0-15 @ 0.4A 295p (plus 40p carriage).
25VA 0-6, 0-6 @ 1.5A; 0-9, 0-9 @ 1.2A; 0-12, 0-12 @ 1A; 0.15, 0-15 @ 0.8A 330p each (plus 60p carriage).
50VA 0-12, 0-12 @ 2A, 0-15, 0-15 @ 1.5A 440p each (plus 75p carriage)

VERO

VEROBLOC◀		350
Size 0.1 matrix:		
2.5 x 1		22
2.5 x 3.75		75
2.5 x 5		85
3.75 x 5		95
VQ board		160
Veropins per 100		
Single sided		50
Double sided		60
Spot face cutter		105
Pin insertion tool		162
Wiring pen and spool		310
Spare spool 75p	Combs	6

HARDWARE

PP3 battery clips	6
Red or black crocodile clips	6
Black pointer control knob	15
Pr Ultrasonic transducers	350
▶6V Electronic buzzer	60
▶12V Electronic buzzer	65
▶PB2720 Piezo transducer	75
▶64mm 64 ohm speaker	70
▶64mm 8 ohm speaker	70
20mm panel fuseholder	25

CONNECTORS

DIN	Plug	Skt	Jack	Plug	Skt
2 pin	9p	9p	2.5mm	10p	10p
3 pin	12p	10p	3.5mm	9p	9p
5 pin	13p	11p	Standard	16p	20p
Phono	10p	12p	Stereo	24p	25p
1mm	12p	13p	4mm	18p	17p

UHF (CB) Connectors:
PL259 Plug 40p. Reducer 14p.
SO239 square chassis skt 38p.
SO239S round chassis skt 40p.
IEC 3 pin 250V/6A.
Plug chassis mounting . . 38p
Socket free hanging . . 60p
Socket with 2m lead . . 120p

BOXES

Plastic with lid + screws		Aluminium	
		3x2x1"	70
		4x3x1½"	85
3x2x1"	55	4x3x2"	100
4½x3x1½"	88	6x4x2"	120
7x4x2	160	6x4x3"	150

MULTIMETERS

HT-120 4,000 opv
A smart looking 11 range pocket sized multimeter with an impressive spec. Complete with battery, etc. 650p each.
HT-320 20,000 opv.
Highly sensitive 19 range multi-meter including transistor tester. Overload protection. DC volts – 1000, AC volts – 1000; DC current 0.25A. 4 resistance ranges. Complete with batteries, leads, etc. 1395p

DIODES

BY127	12	▶1N4001	3
OA47	10	1N4002	5
OA90	8	1N4006	7
OA91	7	1N4007	7
OA200	8	1N5401	12
OA202	8	1N5404	16
1N914	4	1N5406	17
▶1N4148	2	400mWzen	6

SCRs

▶C106D	30
400V 8A	70
400V 12A	95

BRIDGE RECTIFIERS

		2A 200V	40
		2A 400V	45
		6A 100V	80
		6A 400V 95	
1A 50V	20	VM18 DIL 0.9A	
1A 400V	35	200V	50

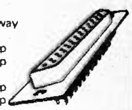
CABLES

20 metre pack single core connecting cable ten different colours 65p

Speaker cable	10p/m
Standard screened	16p/m
Twin screened	24p/m
2.5A 3 core mains	23p/m
10 way rainbow ribbon	65p/m
20 way rainbow ribbon	120p/m

MIN. D CONNECTORS

	9 way	15 way	25 way	37 way
Plugs				
Solder lugs	75p	110p	150p	240p
Right angle pcb mount	150p	200p	240p	350p
Sockets				
Solder lugs	105p	200p	240p	350p
Right angle pcb mount	160p	210p	290p	440p
Covers	100p	90p	100p	110p



CAPACITORS

Polyester, radial leads. 250v. C280 type: 0.01, 0.015, 0.022, 0.033 - 6p; 0.047, 0.068, 0.1 - 7p; 0.15, 0.22 - 9p; 0.33, 0.47 - 13p; 0.68 - 20p; 1u - 23p.
Electrolytic, radial or axial leads: 0.47/63V, 1/63V, 2.2/63V, 4.7/63V, 10/25V - 7p; 22/25V, 47/25V - 8p; 100/25V - 9p; 220/25V - 14p; 470/25V - 22p; 1000/25V - 30p; 2200/25V - 50p.
Tag end power supply electrolytics: 2200/40V - 110p; 4700/40V - 160p 2200/63V - 140p; 4700/63V - 230p
Polyester, miniature Siemens PCB: 1n, 2n2, 3n3, 4n7, 6n8, 10n, 15n, 7p; 22n, 33n, 47n, 68n, 8p; 100n, 9p; 150n, 11p; 220n, 13p; 330n, 20p; 470n 26p; 680n, 29p; 1u 33p; 2u2, 50p.
Tantalum bead: 0.1, 0.22, 0.33, 0.47, 1.0 @ 35V - 12p. 2.2, 4.7, 10 @ 25V - 20p; 15/16V - 30p; 22/16V - 27p; 33/16V - 45p; 47/6V - 27p; 47/16V - 70p; 68/6V - 40p; 100/10V - 90p.
Cer. disc. 22p-0.01u 50V, 3p each.
Mullard miniature ceramic plate: 1.8pF to 100pF 6p each.
Polystyrene, 5% tol: 10p-1000p, 6p; 1500-4700, 8p; 6800 0.012u, 10p.
Trimmers. Mullard 808 series: 2-10 pF. 22p; 2-22pF, 30p; 5.5-65pF, 35p

POTENTIOMETERS

Rotary. Carbon track Log or Lin 1K - 2M2. Single 32p. Stereo 85p. Single switched 80p. Slide 60mm travel single Log or Lin 5K - 500K 63p each.
Preset submin. hor. 100 ohms - 1M 7p each.
Cermet precision multiturn, 0.75W ¾" 100 ohms to 100K - 88p each.

TOOLS

Small trimming tool	22
Small pocket screwdriver	16
Large pocket screwdriver	13
6 piece precision screwdriver set in plastic case	170
Low cost side cutters	160
High quality side cutters	650
Low cost pliers	160
High quality pliers	650
Wire strippers	120
Expo reliant drill	695
Expo Titan drill	1025
Drill stand	1200
Reduced shank drill bits for above 0.8mm, 1mm, 1.4mm	60

REGULATORS

78L05	30	79L05	65
78L12	30	79L12	65
78L15	30	79L15	65
7805	35	7905	40
7812	35	7912	40
7815	35	7915	40
LM309K	130	LM723	35
LM317K	270	LM338K	475
LM317T	120	78H05 5A	
LM323K	350	▶5V	550

OPTO

▶3mm red	7	▶5mm red	7
▶3mm green	10	▶5mm green	10
▶3mm yellow	10	▶5mm yellow	10
Clips to suit - 3p each			
Rectangular		TIL32	40
▶red	12	TIL78	40
green	17	▶TIL111	60
yellow	17	ORP12	85
▶TIL38	40	TIL100	90
2N5777	45	Dual colour	60

Seven segment displays:

Com cathode		Com anode	
DL704 0.3"	95	DL707 0.3"	95
▶FND500 0.5"	100	FND507 0.5"	100
TIL313 0.3"	115	TIL3120.3"	115
TIL3220.5"	115	TIL3210.5"	115

LCD: 3½ digit 580p. 4 digit 620p.

SOLDERING IRONS

Antex CS 17W Soldering iron	460
2.3 and 4.7mm bits to suit	65
CS 17W iron: 450, element:	210
Antex XS 25W	480
3.3 and 4.7mm bits to suit	65
Solder pump desoldering tool	480
Spare nozzle for above	70
10 metres 22swg solder	100

PCB MATERIALS

Alfac transfer sheets – please state type (e.g. DIL pads etc.)	45
Dalo etch resist pen	100
Fibre glass board 3.75"x8"	80
Ferric chloride 250ml bottle.	100

TRIACS

		400V 8A	65
		400V 16A	95
400V 4A	50	BR100	25

RESISTORS

¼W 5% Carbon film E12 series 4.7 ohm - 1M . . . 1p each.
½W 5% Carbon film E12 series 4.7 ohm to 4M7 . . . 2p each.
¼W 1% metal film E24 series 10 ohm - 1M . . . 6p each

SOCKETS

	Low profile	Wire wrap
8 pin	6p	25p
14 pin	8p	35p
16 pin	9p	42p
18 pin	12p	52p
20 pin	13p	60p
22 pin	16p	70p
24 pin	18p	70p
28 pin	23p	80p
40 pin	25p	98p

Soldercon pins 60P/100

COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. ¼W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 650 resistors) 480
Ceramic Cap. kit. 5 of each value - 22p to 0.01u (135 caps) 370
Polyester Cap. kit. 5 of each value from 0.01 to 1uF (65 caps) 575
Preset kit. Contains 5 of each value from 100 ohms to 1M (total 65 presets 425
Nut and Bolt kit (total 300 items): 180p

25 6BA ¼" bolts	50 6BA washers	50 6BA nuts
25 6BA ½" bolts	25 4BA ¼" bolts	50 6BA washers
50 6BA nuts	25 6BA ½" bolts	

LINEAR

555CMOS	80	ICL7106	790	LM339	45	LM3911	120	NE566	140	TL064	96
556CMOS	150	ICL7611	95	LM348	60	LM3914	175	▶NE567	100	TL071	30
709	25	ICL7621	180	LM358	50	LM3915	195	▶NE570	370	TL072	50
▶741	14	ICL7622	180	LM377	170	LM13600	105	NE571	370	TL074	95
748	35	ICL8038	295	▶LM380	65	MC1496	68	▶RC4136	55	▶TL081	25
9400CJ	350	ICL8211A	200	▶LM381	120	MC3340	135	▶RC4558	60	TL082	45
AY-3-1270	720	ICM7224	785	LM382	120	▶MF10CN	350	SL480	170	TL084	95
AY-3-8910	370	ICM7555	80	LM384	130	ML922	400	SL490	250	TL170	50
AY-3-8912	540	▶LF351	45	LM386	65	ML924	195	SL76018	150	UA2240	120
CA3046	60	LF353	85	LM387	120	ML925	210	▶SN76477	380	ULN2003	85
▶CA3080	65	LF356	90	LM393	100	ML926	140	SP8629	250	ULN2004	90
CA3089	190	LM10	360	LM709	25	ML927	140	TBA120S	70	XR2206	290
CA3090AQ	375	LM301A	25	LM711	60	ML928	140	▶TBA800	75	ZN414	100
CA3130E	85	LM311	70	LM725	350	ML929	140	▶TBA810	96	ZN423	135
▶CA3140E	36	LM318	120	LM733	75	MM5387A	465	TBA820	70	ZN424	135
CA3161E	100	LM324	40	LM741	14	NE529	225	TBA950	220	ZN425E	350
CA3189	290	LM334Z	100	LM747	60	NE531	150	TDA1008	320	ZN426E	330
▶CA3240E	110	LM335Z	125	LM1458	40	NE544	205	▶TDA1022	490	ZN427E	650
				LM2917	200	▶NE555	16	TDA1024	125	ZN428E	480
				LM3900	45	▶NE556	45	TL061	40	ZN459	285
				▶LM3909	70	NE565	110	TL062	60	ZN1034E	200

TRANSISTORS

AC125	35	BC149	9	BC517	40	BF337	40	MPSU56	60	ZTX108	8	2N3055	50
AC126	25	BC157	8	BC547	7	BFR40	23	TIP29A	30	ZTX109	12	2N3442	120
AC127	25	BC158	10	BC548	10	BFR80	23	TIP29B	55	ZTX300	14	▶2N3702	6
▶AC128	20	BC159	8	BC549	10	▶BFR81	20	TIP29C	37	ZTX301	16	2N3703	9
AC176	25	BC160	45	BC558	10	BFX29	25	TIP30A	35	ZTX302	15	▶2N3704	6
AC187	22	BC168C	10	BCY70	18	BFX84	25	TIP30B	50	ZTX304	17	2N3705	9
AC188	22	BC169C	10	BCY71	18	BFX85	25	TIP30C	37	ZTX341	30	2N3706	9
AD142	120	BC170	8	BCY72	18	BFX86	28	TIP31A	35	ZTX500	15	2N3707	10
AD149	80	BC171	10	BD115	55	BFX87	25	TIP31C	37	ZTX501	15	2N3708	10
AD161	40	BC172	8	BD131	35	BFX88	25	TIP32A	35	ZTX502	15	2N3709	10
AD162	40	BC177	18	BD132	35	BFY50	23	TIP32C	37	ZTX503	18	2N3772	170
AF124	60	BC178	18	BD133	50	BFY51	20	TIP33A	50	ZTX504	25	2N3773	195
AF126	50	BC179	18	BD135	40	BFY52	23	TIP33C	75	2N697	20	▶2N3819	18
AF139	40	BC182	10	BD136	30	BFY53	32	TIP34A	60	2N698	40	2N3820	40
AF186	70	▶BC182L	8	BD137	30	BFY55	32	TIP34C	85	2N706A	20	2N3823	65
AF239	75	BC183	10	BD138	30	BFY56	32	TIP35A	105	2N708	20	2N3866	90
BC107	10	BC183L	10	▶BD139	35	BRY39	40	TIP35C	128	2N918	35	2N3903	10
BC107B	12	BC184	10	▶BD140	35	BSX20	20	TIP36A	125	2N1132	22	2N3904	10
▶BC108	9	BC184L	7	BD204	110	BSX29	25	TIP36C	135	2N1613	30	2N3905	6
BC108B	12	BC212	10	BD206	110	BSY95A	25	TIP41A	45	2N2218A	45	2N3906	10
BC108C	12	BC212L	10	BD222	85	BU205	160	TIP42A	46	2N2219A	25	2N4037	45
▶BC109	9	BC213	10	BF180	35	BU206	180	TIP120	90	2N2221A	25	2N4058	10
BC109C	12	BC213L	10	BF182	35	BU208	170	TIP121	90	2N2222A	20	2N4060	10
BC114	18	BC214	10	BF184	25	MJ2955	99	TIP122	90	2N2368	25	2N4061	10
BC115	22	▶BC214L	8	BF185	25	MJE340	50	TIP141	98	2N2369	16	2N4062	10
BC117	18	BC237	8	BF194	12	MJE520	65	TIP142	98	2N2484	25	2N5457	36
BC119	35	BC238	14	BF195	12	MJE521	95	TIP147	110	2N2646	45	2N5458	36
BC137	40	BC308	12	BF196	12	MJE3055	70	TIP2955	60	2N2904	20	2N5459	30
BC139	40	BC327	14	BF197	12	MPF102	40	TIP3055	55	2N2904A	20	2N5485	36
BC140	28	BC328	14	BF198	10	MPF104	40	TIS43	40	2N2905	22	2N5777	45
BC141	30	BC337	14	BF199	18	MPSA05	22	TIS44	45	2N2905A	22	2N6027	30
BC142	25	BC338	14	BF200	30	MPSA06	25	TIS90	30	2N2906	25	40360	40
BC143	25	BC477	30	▶BF244B	22	MPSA12	30	TIS91	30	2N2906A	25	40361	50
BC147	8	BC478	30	BF245	30	MPSA55	30	VN10KM	45	2N2907	25	40362	50
BC148	8	BC479	30	BF256B	45	MPSA56	30	VN46AF	75	2N2907A	25	40408	70
				BF257	32	MPSU05	55	VN66AF	85	2N2926	9		
				BF258	25	MPSU06	55	VN88AF	95	▶2N3053	23		
				BF259	35	MPSU55	60	ZTX107	8	2N3054	55		

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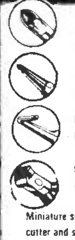

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ALUMINIUM BOXES

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Coloured Black. Close fitting Flanged Lid, fixing screws into brass bushes

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6	3¼	2	144	£1.50
Plastic as above but with aluminium top panel				
4	2¾	1	146	£1.40
Plastic sloping front				
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All measurements for boxes are shown in inches. L = Length. W = Width. H = Height

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O/NO SX57A
Valued – Normal Retail £12.00
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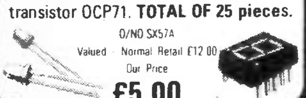

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Power supply fits directly into 13 amp socket. Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug. Input – 240V AC 50HZ. Output – 3, 4.5, 6, 7.5, 9 & 12V DC. Rating – 300 ma MW88

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Order as CV7644

Silicon General Purpose PNP Transistors TO-5 Case Lock fit leads coded CV9507 similar 2N2905A to BFX30 VC 60 IC 600mA Min Hfe 50 ALL NEW!

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PRICE	£2.50	£4.00	£19.00	£35.00

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TO-92 Plastic centre collector
Like BC182L — 183L — 184L
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ALL perfect devices — uncoded ORDER AS SX183L

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VCEO 40 VCBO 35 Ic 300mA Hfe 50-400
Brand New — Uncoded — Pefect Devices

50 off	100 off	500 off	1000 off
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3 x 7 segment displays Basic Circuit 0-2V± instructions provided to extend voltage & current ranges. Operating voltage 9/12v. Typ. Power Consumption 50mA
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Red plastic case with adjustable fixing bracket. Emits high-pitched wailing note of varying pitch – 100 cycles per minute. Dims – 90mm (dia.) 60mm (depth). Power – 12 v DC

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Comprising 4 × 1½ amp rectifiers mounted on PCB.
VRM – 150 vlts
IFM – 1.5 Amps
Size: 1 inch square
10 off **£1.00**
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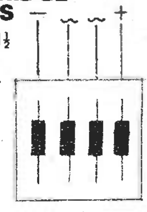

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1,000 opv Including test leads & Battery
AC volts – 0-15-150-500-1,000
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Dims. – 90 x 61 x 30mm.
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30,000 opv Including test leads and case
AC volts – 0-2.5-10-25-100-250-500-1,000
DC volts – 0-0.25-1-2.5-10-25-100-250-1,000
DC current – 0-50ua 0-5ma-50ma 0-12amps.
Resistance – 0-6K ohms-70K ohms-6meg ohms-60meg ohms
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REGULATED VARIABLE *Stabilised* POWER SUPPLY

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 wirebound potentiometer, Wiring Diagram. included. Order No. VPS30 KIT **£20.**

MINIATURE FM TRANSMITTER

Freq: 95-106MHz. Range: ¼ mile
Size: 45 × 20mm. Add: 9v batt.
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ONLY £5.50
Ideal for: 007-MI5-FBI-CIA-KGB etc.

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T.V. SOUND TUNER BUILT AND TESTED

In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are common and all this is really quite sad, as the TV companies do their best to transmit the highest quality sound.

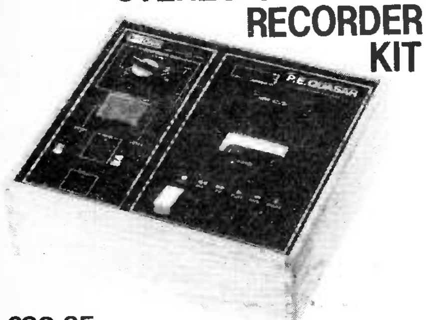
Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains operated.

This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder. Dimensions: 11¾" x 8½" x 3¼".

£22.95 + £2.00 p&p.

E.T.I. kit version of above without chassis, case and hardware. **£12.95** plus £1.50 p&p.

PRACTICAL ELECTRONICS STEREO CASSETTE RECORDER KIT



£32.95 + £2.75 p&p.

• NOISE REDUCTION SYSTEM • AUTO STOP • TAPE COUNTER • SWITCHABLE E.Q. • INDEPENDENT LEVEL CONTROLS • TWIN V.U. METER • WOW & FLUTTER 0.1% • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING • FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TAPES.

Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts. i.e. semiconductors, resistors capacitors, hardware top cover, printed scale and mains transformer. You only supply solder and hook-up wire.

Featured in April issue P.E. Reprint 50p. Free with kit.

Self assembly simulated wood cabinet - £4.50 + £1.50 p&p.

SPECIAL OFFER! £31.00 plus £2.75 p&p Complete with case.

BSR RECORD DECK

Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco.

13"x 11" approx. **£12.95** + £1.75 p&p.

SPECIAL OFFER! Replacement stereo cassette tape heads – £1.80 ea. Mono £1.50 ea. Erase 70p ea. Add 50p p&p to order.

PRACTICAL ELECTRONICS CAR RADIO KIT

SERIES II

2 WAVE BAND MW — LW

• Easy to build • 5 push button tuning • Modern design • 6 watt output • Ready etched and punched PCB • Incorporates suppression circuits.

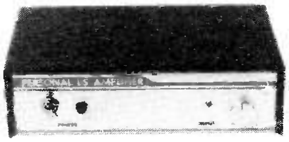
All the electronic components to build the radio, you supply only the wire and the solder, featured in Practical Electronics March issue. Features: pre-set tuning with 5 push button options, black illuminated tuning scale. The P.E. Traveller has a 6 watt output neg. ground and incorporates an integrated circuit output stage, a Mullard IF Module LP1181 ceramic filter type pre-aligned and assembled, and a Bird pre-aligned push button tuning unit.

£12.95 Plus £2.00 p&p.

BIRD AUDIO STEREO CAR RADIO BOOSTER

To boost your car radio or radio cassette to 15W rms per channel. **£9.95** + £1.50 p&p.

PERSONAL LS AMP KIT

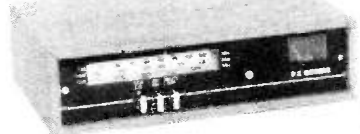


Amplifier for your personal stereo cassette player as featured in January issue of Everyday Electronics. Turn your personal stereo into a mains powered home unit.

Parts: Stereo power amp PCB with all components, **£3.50 + 75p p&p.** Power supply unit, **£1.95 + £1.50 p&p.** Pair of 4½" eliptical speakers, **£1.50 the pair, + £1.00 p&p.** Input & output sockets & plugs, **£1.50.** Recommended case (for the power supply and amp only), **£2.95 + 80p p&p.**

P&P inclusive price of £1.75 for two or more articles.

P.E. STEREO TUNER KIT



This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July '81 issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.

FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabalised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification, Front scale size: 10½" x 2½" approx. Complete with diagram and instructions.

£17.95 Plus £2.50 p&p.

Self assembly simulated wood cabinet sleeve to suit tuner only. Finish size: 11¼"x 8½"x 3¼". **£3.50** Plus £1.50 p&p.

SPEAKER KIT

2 WAY 10 WATT

8" bass/mid range and 3¼" tweeter. Complete with screws, wire, crossover components and cabinet. All wood precut — no cutting required. Finish - chipboard covered wood simulate. size 14½"x 8¾"x 4". PAIR for ONLY

£12.50 plus £1.75 p&p.

125W HIGH POWER AMP MODULES

KIT **£10.50** + £1.15 p&p

BUILT **£14.25** + £1.15 p&p

The power amp kit is a module for high power applications – disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use.

Supplied with all parts, circuit diagrams and instructions.

ACCESSORIES: Suitable mains power supply kit with transformer: **£8.50** plus £2.00 p&p.

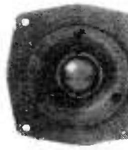
Suitable LS coupling electrolytic. **£1.00** plus 25p p&p.

SPECIFICATIONS:

Max. output power (RMS): 125W.
Operating voltage (DC): 50 - 80 max.
Loads: 4 - 16 ohms.
Frequency response measured @ 100 watts: 25Hz - 20KHz.
Sensitivity for 100 watts: 400mV @ 47K.
Typical T.H.D. @ 50 watts, 4 ohms: 0.1%.
Dimensions: 205 x 90 and 190 x 36 mm.

HI-FI SPEAKERS AT BARGAIN PRICES

GOODMANS TWEETERS

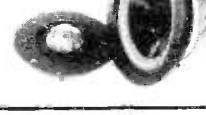


8 ohm soft dome radiator tweeter (3¾"sq.) for use in up to 40W systems; with 2 element crossover.

£3.95 each (p&p £1) or

£6.95 pair (p&p £1.50)

35 WATT MICRO 2-WAY SPEAKER SYSTEM



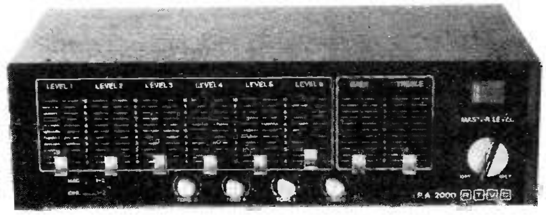
Unit comprises one 50w (4"app.) Audax soft dome tweeter HD100. And one 5" Audax bass/midrange 35w driver HIFIIJSM. Complete with 2 element crossover. Total impedance of system 4 ohms.

£8.95 PER SET + £2.70 p&p.

MONO MIXER AMP

Ideal for Church halls & Club houses.

£45.00 + £2.00 p&p.



50 WATT Six individually mixed inputs for two pick ups (Cer. or mag.), two moving coil microphones and two auxiliary for tape tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic. and aux. inputs. Size: 13¼"x6½"x3¾" app. Power output 50 watts R.M.S. (cont.) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

Matching AKG Microphone to suit (with speech and music filter). Complete with lead. ONLY £9.95 plus 75p p&p.

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Everyday ELECTRONICS

VOL. 12 NO. 2 FEBRUARY 1983

THE COMPUTER AS ALLY

WITHOUT doubt, 1982 was the year of the home computer. The only other innovatory electronic consumer product in a similar price bracket likely to have equalled it in popularity was the video-recorder; but the latter is more rightly considered as an extension of home entertainment, and not an inter-active device opening up an entirely new field like a computer.

The sales of home computers must have gladdened the hearts of manufacturers and retailers alike, providing (as they did) welcomed bright spots in an otherwise dull scene. It speaks volumes for the fascination of computers that in a time of recession thousands of customers have emerged to buy a piece of equipment they can have initially little understanding about and are prepared to venture upon a journey into the unknown, seeking—what? For many new computer owners, the destination will be simply "games". Just how many will persevere with the writing of programs for personal needs and thereby justify the considerable financial outlay is a matter for conjecture.

Be that as it may, what is now happening on a grand scale is the development of computer consciousness and "hands on" experience amongst a broad selection of the general public. For the younger generation in particular, all this can be extremely valuable since many of the jobs likely to be on offer in the future will require familiarity with computers and computing.

While there is bustle in the computer field, the home construction scene appears to be a trifle stagnant. One cannot be too sure and claim that the one is a consequence of the other. But even if so, it is likely to be but a transitory fall-off; in the longer term some of the interest now developing in computers will percolate into electronic technology itself, and produce new recruits for the hobby of circuit construction. Curiosity in the technology behind the keyboard could encourage a wish for practical involvement with electronics in general.

Support for this view was to be found at the Electronic Hobbies Fair last November (see review in this issue). It seemed that a very considerable proportion of visitors were interested in electronics, but *indirectly*. That is to say they were interested in (or attracted by) the ends, rather than the means—computers, of course, providing the chief and most striking example. But during their tour of the Fair awareness of the scope and possibilities of electronic construction must have been created in the minds of many non-technical visitors. Proof that converts were made is found in the large sales of educational kits reported by exhibitors. Similarly, much interest was shown in the *Introducing Electronics* series as featured on the EE stand. The solderless technique employed was favourably commented on and seems likely to win quite a few new recruits to our hobby.

The coming of the home computer and the new field of interest it creates should in no way detract followers of electronics from the practical business of designing and building circuits. In fact, the computer can become a valuable aid and ally to the electronics experimenter, by testing ideas and solving problems—as well as to the practically inclined at large, by controlling small machines such as the wood-turning lathe demonstrated on the EE stand.

Fred Bennett

Readers' Enquiries

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We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

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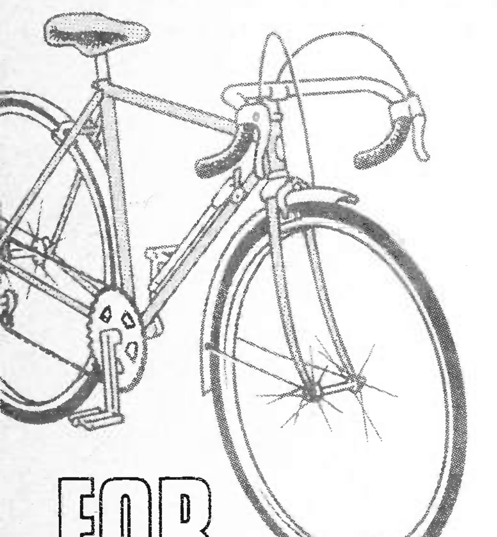
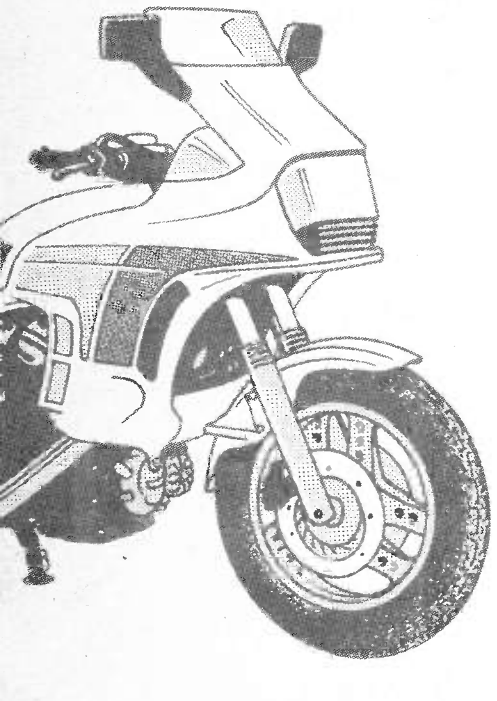
ALARMS



FOR PUSH BIKE OR MOTOR BIKE

BY J. DUFFY



TODAY, when enough money has been saved to buy and insure a bike the last thing on the owner's mind is theft. Unfortunately, it is all too common but this project should set the minds of some readers at rest.

Two bike alarms are described—one for a motorbike and the other for a pushbike. They both use the same circuit employing a mercury tilt-switch, which triggers the horn and lights of the motorbike version, or an integral alarm unit on the pushbike version.

The motorbike unit also has an external trigger facility from a microswitch for further protection.

A pulsed output is more effective than a steady output and, apart from being easier to locate, reduces battery consumption.

CIRCUIT DESCRIPTION

The circuit diagram of the two versions of the Bike Alarm is shown in Fig. 1. The system has three basic sections: the trigger; low frequency oscillator; and the alarm output.

The first section consists of a monostable multivibrator which is triggered by the mercury switch, S2 (and in the case of the motorbike version, microswitch S3 will also trigger it). The time constant of this monostable circuit is governed by R3 and C2 and it functions as follows:

The monostable consists of two CMOS 2-input NOR gates and in the quiesent state, the output of IC1a (pin 3) is at logic 1 as both inputs (pins 1 and 2) are at logic 0. As a result, the output of IC1b (pin 4) is held low as both its inputs (pins 5 and 6) are high (this gate is acting as an inverter).

Upon receipt of a positive pulse to pin 1 from the mercury switch, the output of IC1a will go low causing the output of IC1b to go high. The low on pin 1 provides a charge path for C2 via R3 and when this capacitor has charged to a sufficiently high voltage, the input of IC1b reads this as a logic 1 and the output (pin 4) of this inverter is therefore returned to a logic 0.

With the values given, the period of this monostable is in the region of one minute.

OSCILLATOR

When the output of the monostable is high, it enables a low frequency oscillator consisting of NOR gates IC1c and IC1d. The output of this section is a squarewave of approximately one hertz. This frequency is controlled by R4 and C3.

When the output of the monostable is low, the oscillator cannot function since the time constant capacitor C3, will not charge up as current flows through D1 to the low (effective earth) on pin 4 of IC1b.

ALARM OUTPUT

On the motorbike version, the alarm output is in the form of a relay, activated by a high pulse from the oscillator and driven by TR1. D3 protects the transistor from the back e.m.f. from the coil.

The contacts of this relay are used to control the horn and headlight from the host motorbike. Note that the positive supply to the light and horn is taken to the relay before the Alarm unit on/off switch.

COMPONENTS

MOTORBIKE

Resistors

R1,2	100kΩ (2 off)
R3,4	10MΩ (2 off)
R5	10kΩ

All $\frac{1}{2}$W carbon ±5%

Capacitors

C1	100μF 16V elect. axial lead
C2	15μF 16V elect. axial lead
C3	0·1μF polyester

Semiconductors

D1	1N4148
D2,3	1N4001 (2 off)
TR1	BC107 *npn* silicon
IC1	4001UB CMOS quad 2-input NOR gate

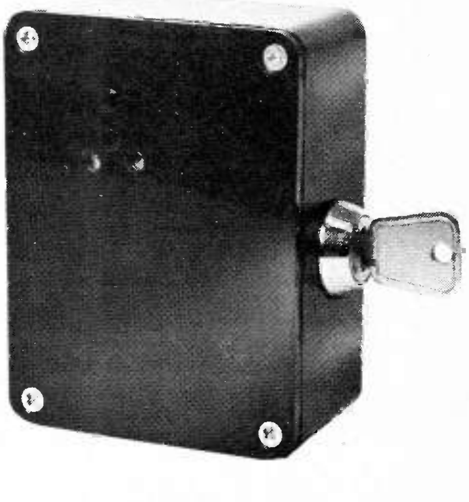
Miscellaneous

S1	s.p.s.t. key-switch
S2	mercury tilt-switch
S3	microswitch
RLA	miniature relay, 12V, 130Ω coil with 30A rated contacts

0·1 inch matrix stripboard 11 strips by 28 holes; plastic case; 100 × 76 × 41mm (ABS case type MB2); M2 mounting screws 13mm long; 14-pin d.i.l. i.c. holder; terminal block 6-way; 7/0·2mm connecting wire; 24/0·2mm wire.

Approx. cost Guidance only £12

Completed alarm for a pushbike with the key-operated switch mounted on the side.



The pushbike version of the alarm has its own integral buzzer (WD1), and this is driven, again on a high pulse from the oscillator, by Darlington pair, TR1 and TR2. This is shown on the additional section of the circuit diagram, Fig. 1.

This unit has its own supply, a 9V PP3 type battery.

COMPONENTS

PUSHBIKE

See Shop Talk page 85

Resistors
- R1,2 100kΩ (2 off)
- R3,4 10MΩ (2 off)
- R5 10kΩ
- All $\frac{1}{2}$W carbon ±5%

Capacitors
- C1 100µF 16V elect. axial lead
- C2 15µF 16V elect. axial lead
- C3 0·1µF polyester

Semiconductors
- D1 1N4148
- D2 1N4001
- TR1 BC441 *npn* silicon
- TR2 BC107 *npn* silicon
- IC1 4001UB CMOS quad 2-input NOR gate

Miscellaneous
- S1 s.p.s.t. key-switch
- S2 mercury tilt-switch
- WD1 9V buzzer
- B1 9V PP3 battery

0·1 inch matrix stripboard, 11 strips by 28 holes; battery clip; plastic case, 100 × 76 × 41mm (ABS case type MB2); M2 mounting screws 13mm long; 14-pin d.i.l. i.c. holder; 7/0·2mm connecting wire.

Approx. cost Guidance only £10

CONSTRUCTION starts here

CIRCUIT BOARD

A plastic case measuring about 100 × 75 × 41mm is used for both tbe motorbike and pushbike projects. Although any plastic or metal boxes around this size should be acceptable.

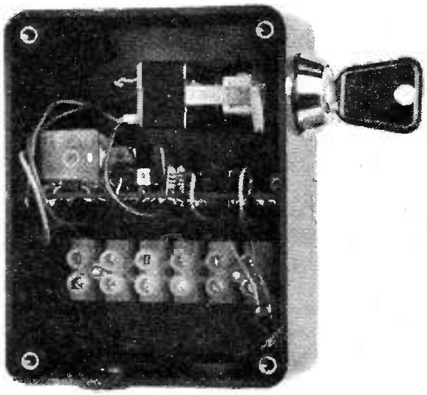
The component panel for both versions is a 0·1 inch matrix stripboard having 28 holes by 11 strips, and these are shown in Figs. 2 and 3. Construction of the board follows the normal pattern with the breaks in the copper strips being made first. Next, solder in all the links and the i.c. socket, after which the components may be soldered into place and Veropins fitted where connections to off-board components are to be made. Take care with the CMOS i.c. since it may be destroyed by static.

In both units the board fits easily into the slots in the plastic case. In the motorbike version the holes for the key-switch, grommet, and the mounting holes for the terminal block should be made first. In the pushbike version only sound holes for WD1 and a key-switch hole are required. Care must be taken not to let the metal case of the buzzer touch any connections or switch terminals.

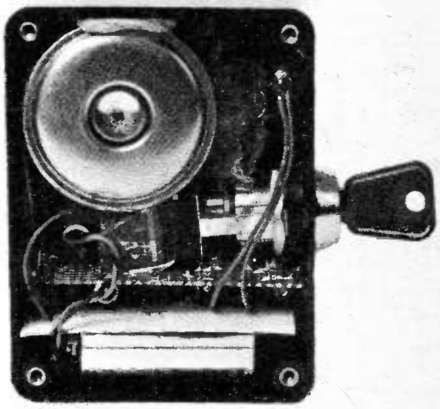
MERCURY SWITCH

The mercury switch, S1, should be soldered to the component board on leads approximately 100mm long and temporarily attached to the side of the box with a small piece of Plasticine or Blu-Tak.

This is necessary, as the final position of this switch can only be determined after the Alarm unit has been mounted on

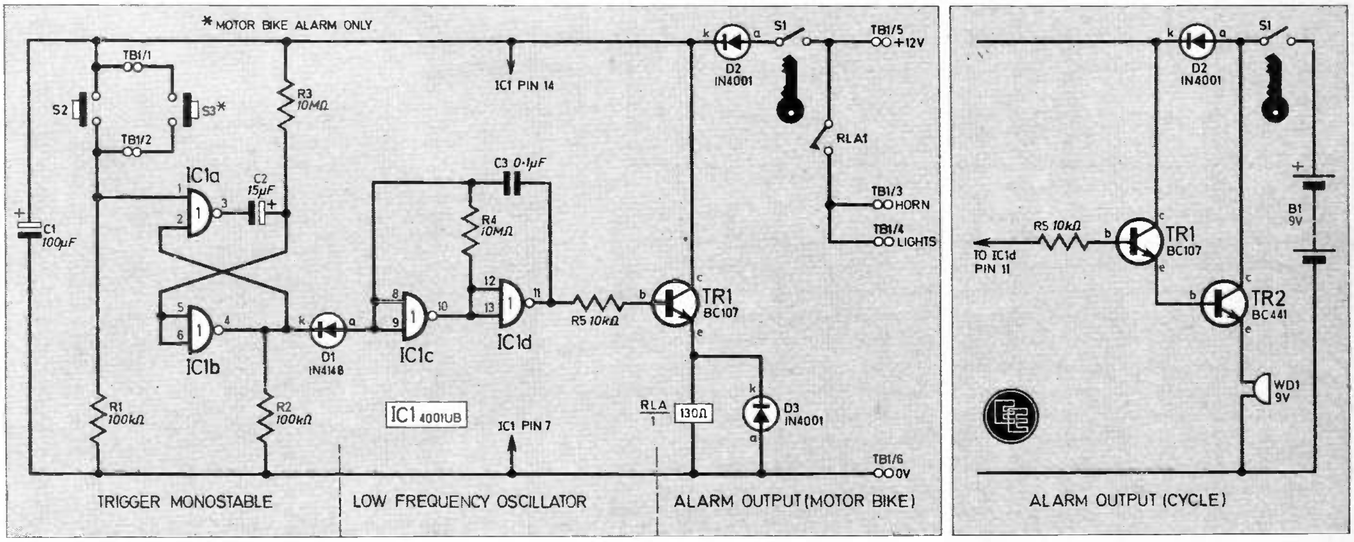


The motorbike alarm with lid removed to show positioning of the terminal block, circuit board and key-switch. The mercury "trip" switch is mounted in the bottom right corner.



Layout of components inside the case of the pushbike alarm. The siren is temporarily held in position by Blu-Tak. The leads to the mercury switch can be seen top right.

Fig. 1. Circuit diagram of the two versions of the Bike Alarm. The siren circuit for the pushbike is shown on the right.



ALARMS FOR PUSH BIKE OR MOTOR BIKE

BY J. DUFFY

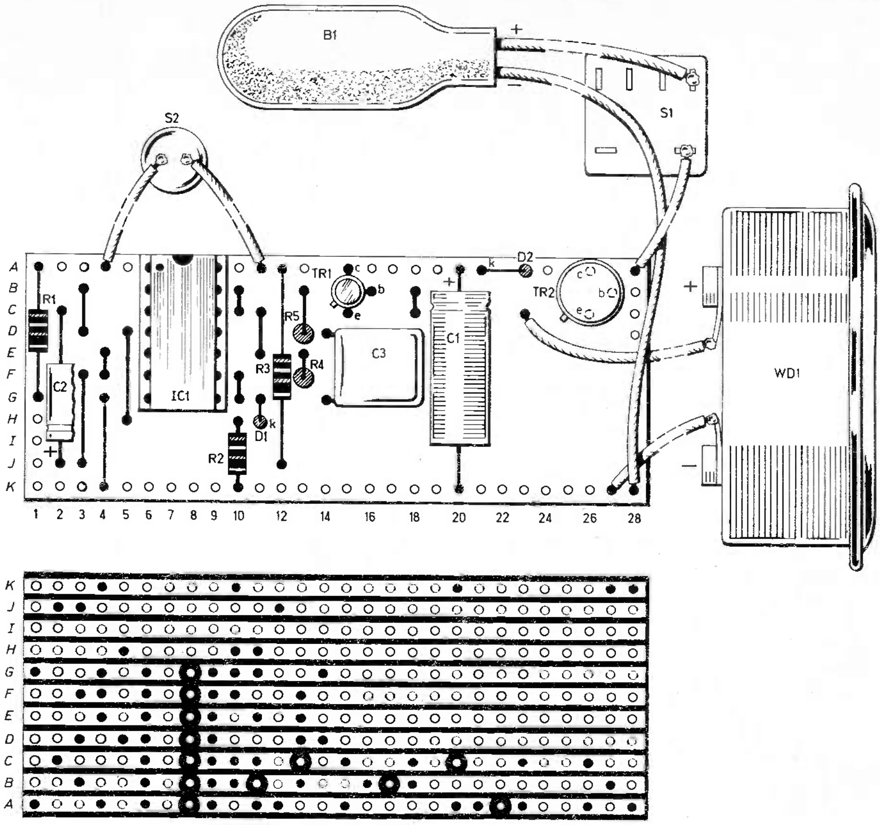


Fig. 2 (Right). Component layout, underside, showing breaks in the copper strips and interwiring details for the Pushbike Alarm.

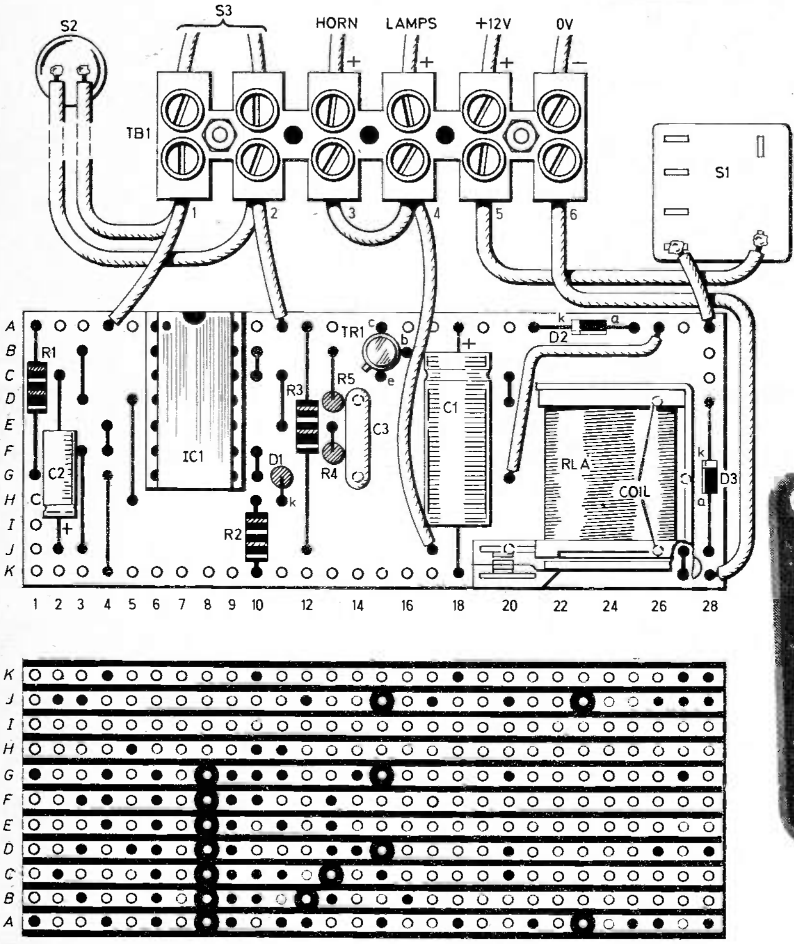
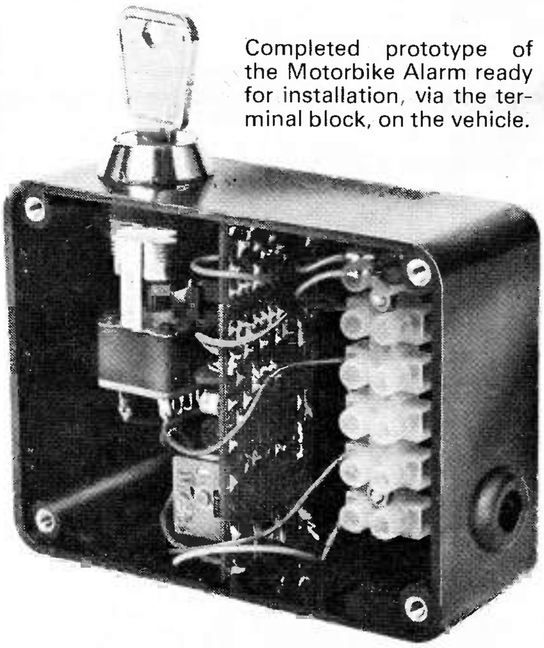
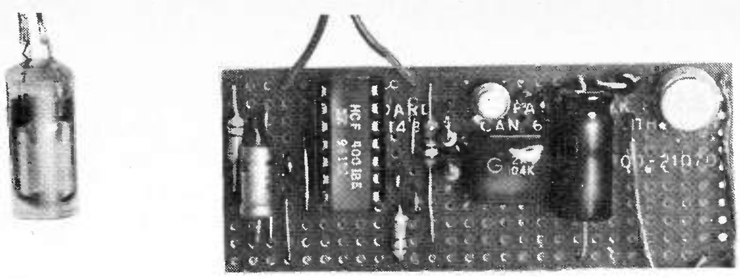


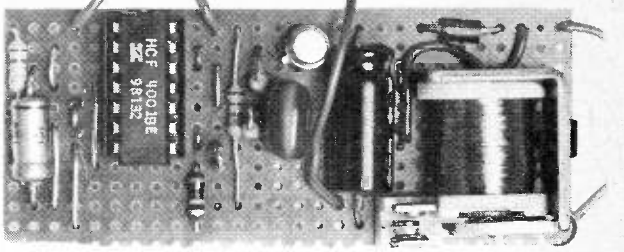
Fig. 3 (Left). Circuit board for the Motorbike Alarm showing component layout and wiring to the terminal block for connecting to the bike. The relay is directly wired to the circuit board by connecting pins. These are shown dotted.



Completed prototype of the Motorbike Alarm ready for installation, via the terminal block, on the vehicle.



Finished circuit board for the Pushbike Alarm. The leads to the mercury switch, shown left, should be approximately 100mm long.



The completed Motorbike Alarm circuit board.

the bike frame. A certain amount of experimentation will be required in order to achieve the optimum switch position to trigger the alarm when the bike is moved by an unauthorised rider.

The final location of the mercury switch is largely dependant on two factors, whether the alarm is to be triggered by a side-to-side movement or a forward and backward motion. Bearing in mind that a bicycle (or motorbike) is often left in an inclined position, for example against a wall or on a kick-stand, the former consideration can be utilised so that the alarm triggers when the bike is returned to the upright position.

Mercury switches of this type activate at around 10 degrees from the horizontal (that is, at this angle the mercury blob will roll to the end of the device and short out the contacts) so it will need to be mounted at something like this angle inside the case.

This type of triggering does mean that the bike will always have to be inclined to the same side.

MOUNTING

When locating the Alarm unit on the bike, it is important to keep it as discrete as possible; a box that looks like an alarm could be removed and rendered inoperational by the prospective thief.

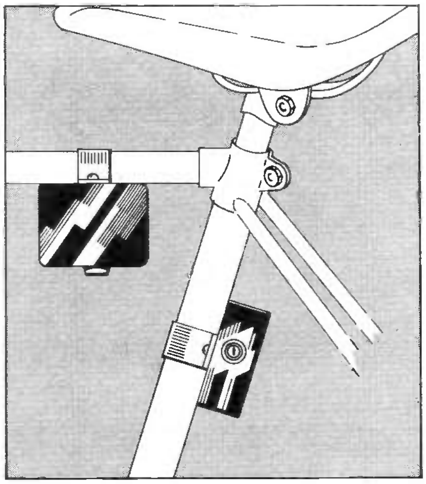


Fig. 4. Two suggested mounting positions for the completed Pushbike unit. Final arrangement will be governed by placement of the mercury switch.

For this reason, the lock of the key-switch should not be visible but it must be accessible. The ideal orientation of the key-switch is downward facing.

The finished Alarm unit should be securely fixed to a frame member with a fixing bracket obtained from the local bicycle shop. A suitable position is on the down tube just below the saddle or under the cross-bar as shown in Fig. 4.

For additional reliability, the Alarm unit can be water-proofed. The simplest way to do this is with a plastic bag or "Clingfilm" wrapped around the case. Another alternative would be to use a more expensive enclosure with a sealing gasket or to use a commercially available sealing compound.

MICROSWITCH

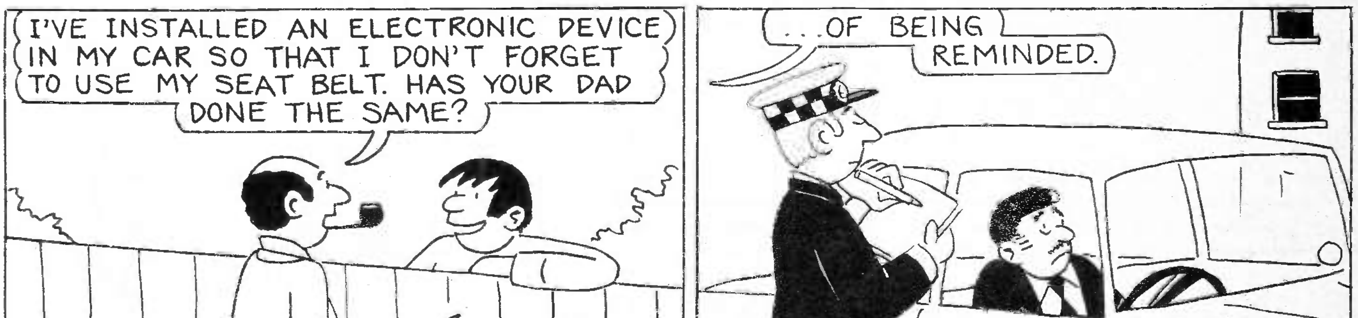
The motorbike version of the Alarm has the option of an additional microswitch to trigger the circuit and this is connected in parallel with the mercury switch (via TB1 terminals 1 and 2).

The normally open contacts are used and the switch is placed where it will be activated when the motorbike is moved. One position could be under the seat so that when someone sits on it, the lever of the microswitch is depressed.

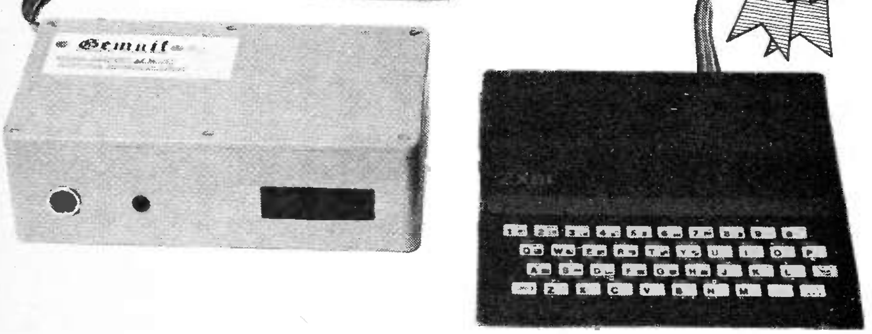
The additional wiring required for this version, that is the wires to the headlight and horn and to the 12V supply, must be carried out with a stranded wire of sufficient current rating. A 24/0·2mm wire is suitable and should be fitted with the correct type of connector to mate with the terminals on the electrical system of the bike. □

JACK PLUG & FAMILY...

BY DOUG BAKER



ZX81 SPEED COMPUTING SYSTEM



BY D. WILKES & A. WILLIAMS

ONE PIECE of laboratory apparatus still frequently used in experiments concerning the general equations of motion is the "ticker-tape timer". This electro-mechanical device consists of a mains solenoid inducing a pointer in its magnetic field to oscillate at 50Hz. A strip of paper passes between the oscillating pointer and a disc of carbon paper to produce a series of dots, the distance between each consecutive dot representing the distance the paper strip has travelled in 1/50th of a second.

In this way, a plot of distance against time can be recorded for an object rolling down an inclined surface, when that object is secured to the length of paper tape and is pulling it through the ticker-tape timer as it falls.

INACCURATE

This method of timing motion does, however, have inherent inaccuracies. Firstly, the oscillating pointer does not always make positive contact with the ticker-tape. Secondly, and perhaps more importantly, two dots in rapid succession caused by slackness in the tape could be interpreted as a single mark. Finally, the tape itself could cause some resistance to the free motion of the object pulling it.

These three factors, combined with the cumbersome operation and wasteful use of paper necessitated the design of an electronic method of timing the motion. Without changing the basic experiment, that is, a trolley (the "object") rolling down an inclined surface, the ZX81 Speed Computer System was designed.

The trolley is linked to the main unit via a pulsed ultrasonic transmitter thus eliminating the errors associated with the ticker-tape method. The ultrasonic receiver amplifies the pulses and feeds them to a Sinclair ZX81 microcomputer to be processed and the results displayed on a 4-digit 7-segment display on the main unit.

The system has been code named G.E.M.N.I.F. for General Equations of Motion Notational Information Finder.

BASIC THEORY

The trolley provides the information with which the ZX81 will perform the calculations to determine velocity and acceleration.

The basic formulae of motion are as follows:

$$\text{velocity} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

So, to calculate the velocity, the computer needs to know the distance travelled (this will be constant) and the time taken to travel that distance. In order to do this, the trolley will send 30 ultrasonic pulses and the computer measures the time taken for them to arrive. As previously stated, the distance the trolley moves to generate 30 pulses is always constant.

For the acceleration calculation, as the trolley starts from standstill, that is 0m/s, the change in velocity will equal the total velocity and since this has already been calculated by the computer it can now calculate the maximum acceleration.

However, computers can be programmed to do much cleverer things so in this circuit, on obtaining the set number of pulses, it can time each individual pulse and provide acceleration figures for any point during the trolleys voyage, thus enabling a pupil to plot a graph from selected notational information; which is neatly displayed on the digital display.

THE TROLLEY

As already mentioned, the microcomputer relies on a set number of pulses which are linked directly to the distance the trolley moves.

The trolley produces pulses whose rate of production is proportional to the speed of the trolley, that is, the faster the trolley moves, the more pulses are produced per second. It achieves these linked pulses by utilising its back wheel. First, however, the basic circuit of the pulse producer and ultrasonic transmitter will be explained. See Fig. 2.

Ultrasonics are a range of frequencies just beyond the limit of human hearing, normally about 30 to 50kHz. This circuit transmits 40kHz pulses to the receiver.

The 555-timer IC1, is connected in an astable mode, oscillating at approxi-

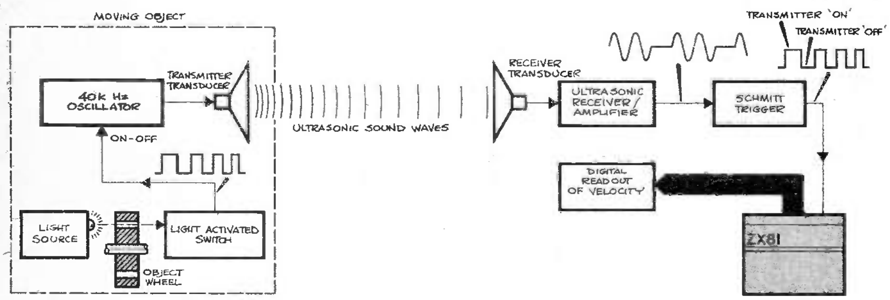
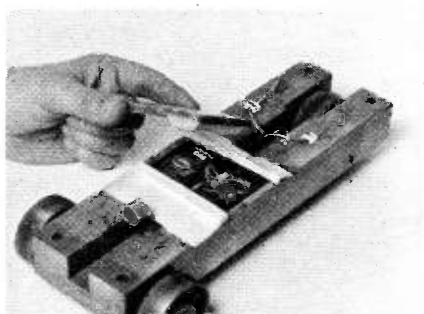
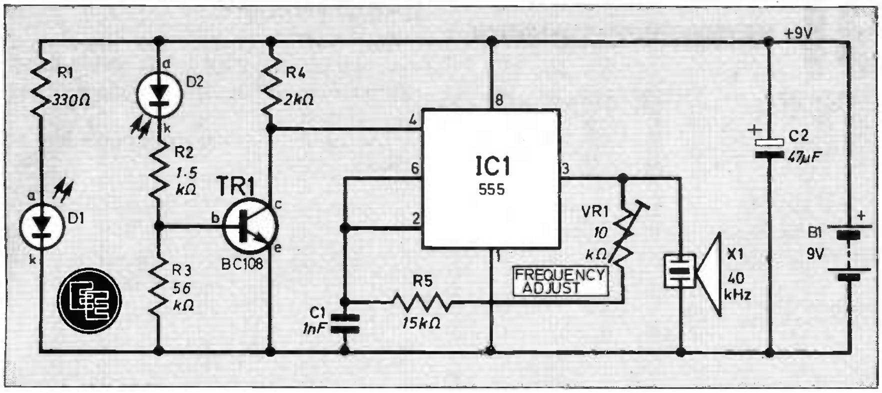


Fig. 1. Block diagram of the SEDAC runner-up design for the ZX81 Speed Computing System (G.E.M.N.I.F.). Note that the moving object represents the trolley.



The three-wheeled trolley assembly.



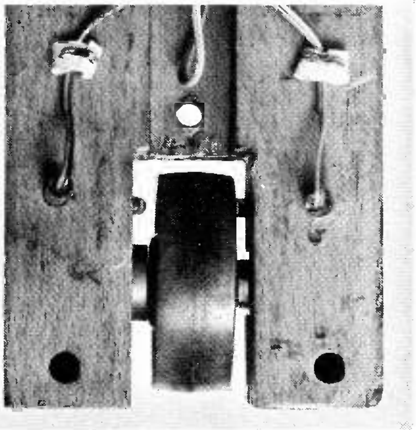
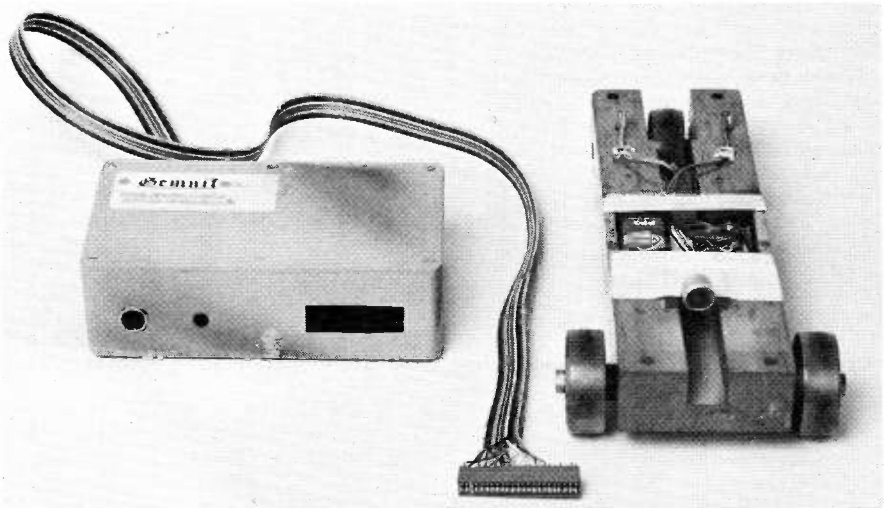


Fig. 2 (Above). Circuit diagram of the trolley mounted ultrasonic transmitter. D1, D2, TR1 and associated components form an infra-red light activated switch to enable IC1.

Photograph (left) shows a close up of the rear wheel of the trolley. The infra-red emitter and receiver D1 and D2 can be seen set into the wooden body of the trolley either side of wheel.

(Below). The main unit and trolley showing the mounting of the ultrasonic transducer X1 and X2. Note how SK1 is soldered to a length of 14-way ribbon cable.



mately 40kHz. An infra-red l.e.d. and an infra-red photodiode (D1 and D2) are positioned either side of the back wheel. The wheel itself has a hole bored through it. D2 is designed so that when infra-red light reaches it, it switches on allowing current to flow through it. In this circuit the light comes from D1.

As both D1 and D2 are on either side of an opaque material (in this case the rear wheel), the only time D2 conducts is when the hole in the rear wheel aligns itself between them. When this takes place, TR1 switches on generating a negative pulse. It is only a pulse since the light is cut off by the wheel's rotation.

This negative pulse gates the 555 off, stopping momentarily the 40kHz transmission. Thus, as the wheel rotates the hole aligns and dis-aligns, the 555 astable switches on and off. An ultrasonic transducer X1 is used to transmit the pulses.

The ultrasonic transducer is mounted, forward facing, on the front of the trolley as shown in the photographs. A compartment can be made for the electronics in the wooden body of the trolley.

When mounting D1 and D2, the single rear wheel of the trolley is drilled and the hole elongated (so as to produce a longer pulse) and the infra-red devices are mounted in the trolley body so as to align with the hole.

COMPONENTS

Resistors

R1,13–19	330Ω (8 off)
R2	1·5kΩ
R3	56kΩ
R4	2kΩ
R5,10	15kΩ (2 off)
R6	4·7kΩ
R7	1MΩ
R8,9	560Ω (2 off)
R11	10kΩ
R12	470Ω

All ¼W carbon ±5%

Capacitors

C1	1nF polystyrene
C2	47µF 16V tantalum
C3,7	22pF ceramic (2 off)
C4,6,8	10nF polyester (3 off)
C5	10pF ceramic
C9	0·1µF polyester

Semiconductors

D1	Infra-red emitter
D2	Infra-red receiver
D3–5	BAX13 silicon (3 off)
TR1–3	BC108 silicon *npn* (3 off)
IC1	555 timer
IC2	TAA960 triple amplifier
IC3	74LS132 TTL low power Schottky quad 2-input NAND Schmitt gate
IC4	74LS04 TTL low power Schottky hex inverter/buffer
IC5	74LS08 TTL low power Schottky quad 2-input AND gate
IC6	74LS10 TTL low power Schottky triple 3-input NAND gate
IC7,8	74LS373 TTL low power Schottky octal latch (2 off)
LED1	4-digit, 7-segment common cathode display (R.S. 587–507)
X1	40kHz ultrasonic transmitter transducer
X2	40kHz ultrasonic receiver transducer

Miscellaneous

VR1	10kΩ miniature preset
VR2	1MΩ miniature preset
VR3	100kΩ miniature preset
B1	9V PP3 battery
SK1	23 + 23-way double sided 0·1in. pitch edge connector (to suit finger set on ZX81)

COMPONENTS approximate cost £20 excluding hardware

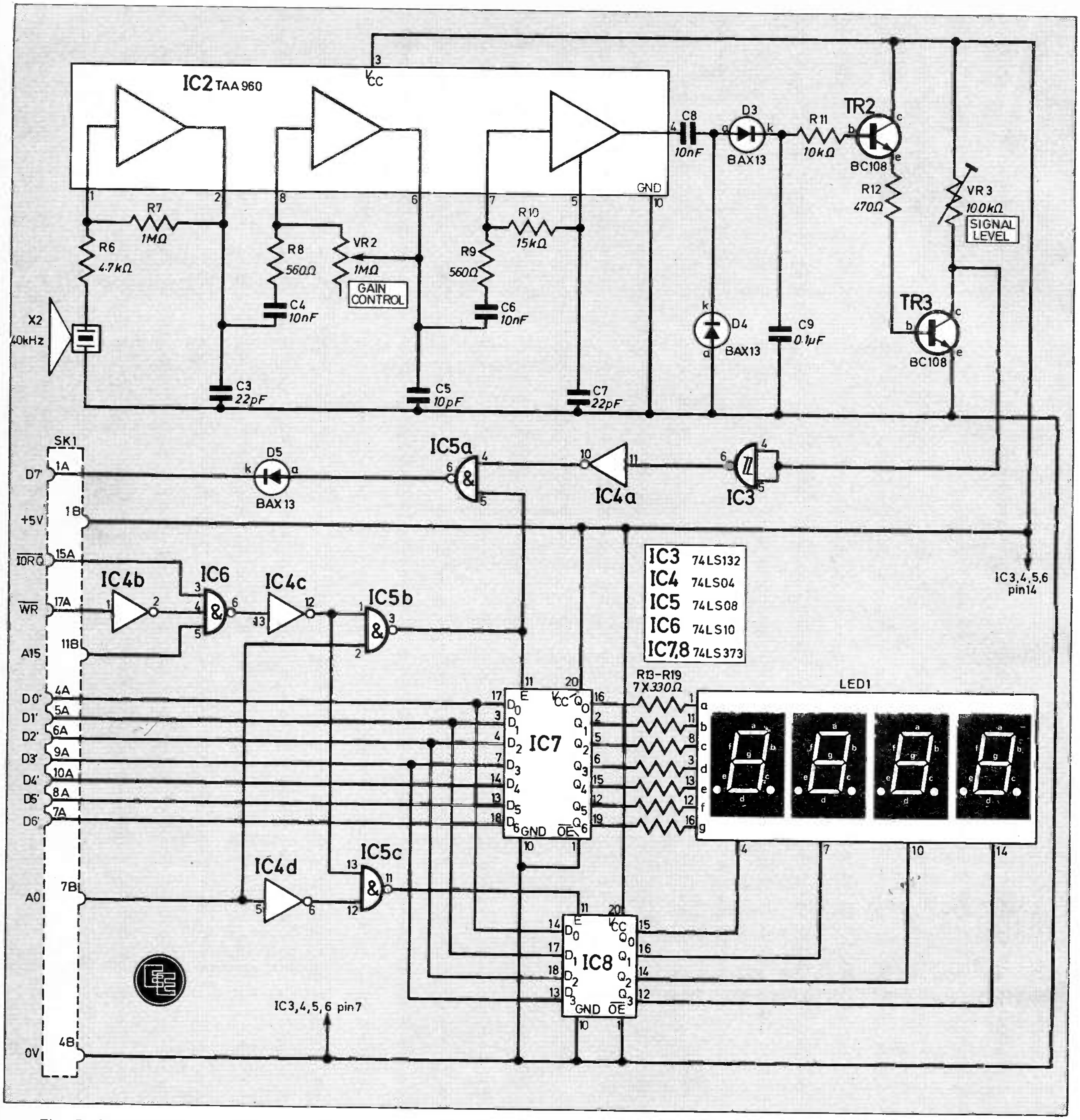


Fig. 3. Circuit diagram of the receiver, computer interface and display sections of the ZX81 Speed Computing System.

THE RECEIVER

The complete circuit diagram of the receiver unit and the ZX81 interface is shown in Fig. 3. The Ultrasonic pulses from the trolley-mounted transmitter are received by a second transducer, X2, and this is coupled to the first stage of IC2, a triple amplifier. This i.c., the TAA960, is specially designed for use with high impedance receivers.

The input impedance is high to ensure that the transducer has peak response at its anti-resonant frequency.

The combined three stages and supporting circuit gives the amplifier a gain of about 100dB, and the receiver is efficient up to a range of 8 metres.

The power supply for this circuit and for the interface circuitry is taken from the ZX81 finger set at the back of the computer. The +5V and 0V come from pins 1B and 4B, respectively.

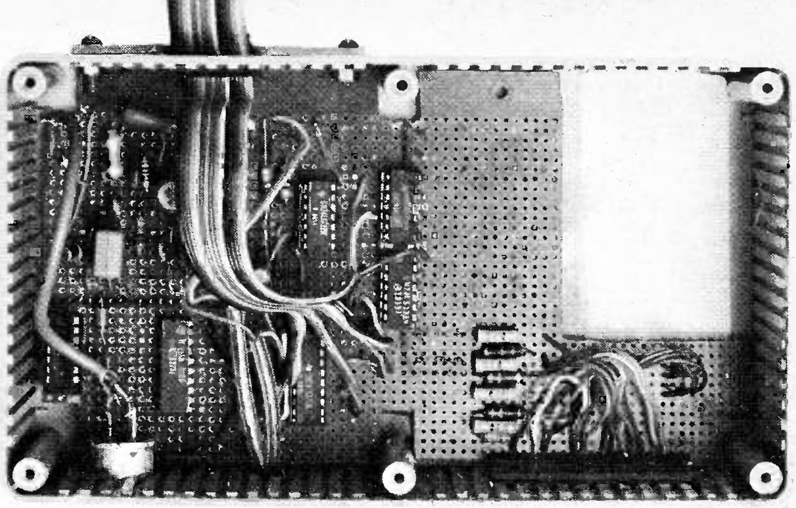
The output from the receiver amplifier is fed to TR2 and TR3 and the resulting pulses are fed to a Schmitt trigger NAND gate, IC3. This gate produces a clean 5V pulse to be fed to the ZX81 to be processed. Fig. 1 (block diagram) shows the resulting waveform.

COMPUTER INTERFACE

The G.E.M.N.I.F. unit is connected to the ZX81 computer via the 23 + 23-way finger set on the printed circuit board at the back of the computer.

A program, written in machine code, instructs the computer to read the data being inputed from the ultrasonic receiver and calculate the trolley velocity. The computer will only accept a set number of pulses (in this case, 30) as the number of pulses corresponds to the distance travelled and this must be constant in order to perform the calculations.

Main unit plus Sinclair ZX81 computer.



View inside prototype showing circuit board and ribbon cable connections.

When the 30 pulses have been received, the counting procedure stops and the display routine commences operation.

Six values of velocity of the trolley are taken at intervals of multiples of five pulses. So, for example, after five pulses the first velocity is calculated, again after 10 pulses, after 15 pulses and so on up to 30 pulses.

Once received, the stored values are used to provide the outputs to the display. They are both on screen (if a TV is being used) and on the integral 4-digit display on the main unit (LED1).

DISPLAY

Initially the display reads four flashing "eights". Whilst the trolley is actually rolling down the track and the computer is receiving data, the display will automatically blank. When all 30 pulses have been received, the display will read "VEL1", whereupon it will go on to display the velocity calculated from the first five pulses. It will proceed to display the next five values under the headings of "VEL2", "VEL3" and so on up to "VEL6".

It continues in a loop displaying these values of velocity until the unit is reset. It will then show flashing "eights" until the trolley starts sending pulses once again.

The gates IC4, IC5 and IC6 and the octal latches IC7 and IC8 are used to decode and display the information received from the ZX81 on the multiplexed display.

PROGRAM

As previously stated, the computer program for use on the ZX81 in conjunction with the G.E.M.N.I.F. Speed Computing System is written in machine code but unfortunately space does not permit the reproduction of it here.

However, interested parties can contact the editorial offices of EVERYDAY ELECTRONICS and arrangements can be made to supply a transcript or tape copy of the program along with more detailed instructions.

CONSTRUCTION

No detailed constructional information is given for the building of the Speed Computing System as it was felt that, armed with the circuit diagram and background information, it should not prove too difficult to complete.

The original prototype was assembled in a plastic case 190 × 110 × 60mm housing a single stripboard circuit panel. The transducer was mounted in one side and the 23 + 23-way edge connector was soldered to a length of 14-way ribbon cable.

The trolley was converted from a standard three-wheel trolley of the type found in the physics laboratory and runs on any flat track of minimum length two metres. □

BOOK REVIEWS

TELEVISION AND RADIO 1983

Editor Eric Croston
Price £3.50 limp
Size 190 × 230mm. 224 pages
Publisher Independent Broadcasting Authority
ISBN 0 900485 43 3

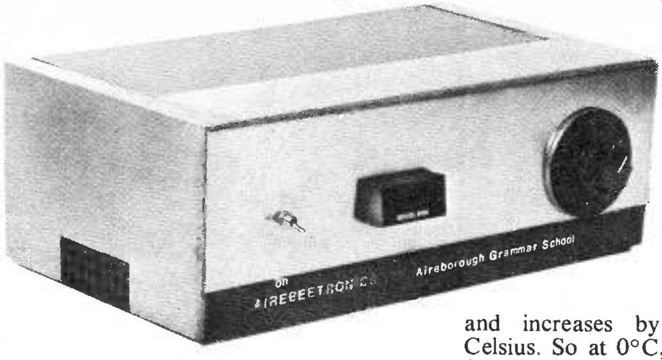
WITH our television viewing habits about to be changed beyond recognition with the advent of the fourth channel, breakfast viewing, satellite broadcasting and cable TV, this annually produced volume makes interesting reading.

1982 saw the birth of the first new national television service for 20 years—Channel 4—and 1983 will be the year of TV-am, an additional three hours of programmes to wake-up to. This handbook discusses both these new services as well as the established ITV companies and sets out to illustrate the function of a nation-wide broadcasting network.

Many pages are dedicated to the programmes themselves, with sections on sport, drama, science, the arts and of course, news coverage, to name but a few. With over 400 illustrations, many in full colour, the scope and quality of Independent Television can be seen.

Not to be forgotten is the constantly expanding independent local radio coverage, currently at 47 stations and new contracts are being granted all the time. Other chapters in this compulsive coffee-table book include advertising, finance, Oracle (teletext) and working in broadcasting.

G.P.H.



Completed prototype of the Beehive Temperature Meter. The frame selector switch is on the right and the remote sensor input socket can be seen on the side of the case.

REFERENCE VOLTAGE

Resistor R1 and IC1, a programmable Zener diode, provide the reference voltage for the main circuitry. VR1 is set (programmed) to provide a stabilised voltage across IC1. R2 and R3 are padding resistors for VR1 to give finer sensitivity to VR1 wiper variation.

The potential divide effect of R4 and R5 across IC1 produces a value of 2·73 volts at their junction. This feeds the negative input of ME1, a 3-digit, 999mV full-scale digital voltmeter. The significance of 2·73 volts will become apparent later.

SENSOR CIRCUIT

The other side of ME1, the +ve input, is fed by the outputs (one at a time) from each temperature sensor circuit. Each sensor is wired as seen in Fig. 2. The output at *X* varies linearly with temperature, and increases by 10mV per degree Celsius. So at 0°C, the output would be 2·73V. Each output needs to be trimmed in using its associated preset, VR2 to VR11. All *X*'s are commoned at the negative end of R6, but only one sensor is "on" at one time; which one is on, is determined by the setting of S1, which connects the sensor V^- terminal to 0V.

The sensors should be set up after the monitoring unit and remote sensors are in

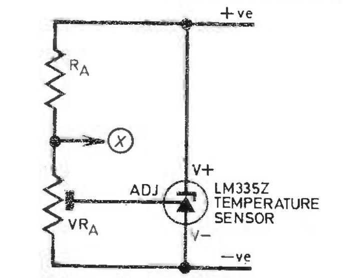


Fig. 2. Temperature sensor circuit. The output at *X* varies 10mV/°K.

COMPONENTS

See Shop Talk page 85

Resistors

R1	1·8kΩ
R2	120Ω
R3	10kΩ
R4	330Ω
R5	2·7kΩ
R6	5·6kΩ

All ¼W carbon ±5%

Potentiometers

VR1	2·2kΩ miniature horizontal preset
VR2–11	10kΩ miniature horizontal presets (10 off)

Semiconductors

IC1	TL430C programmable Zener diode
IC2–11	LM335Z precision temperature sensor (10 off)

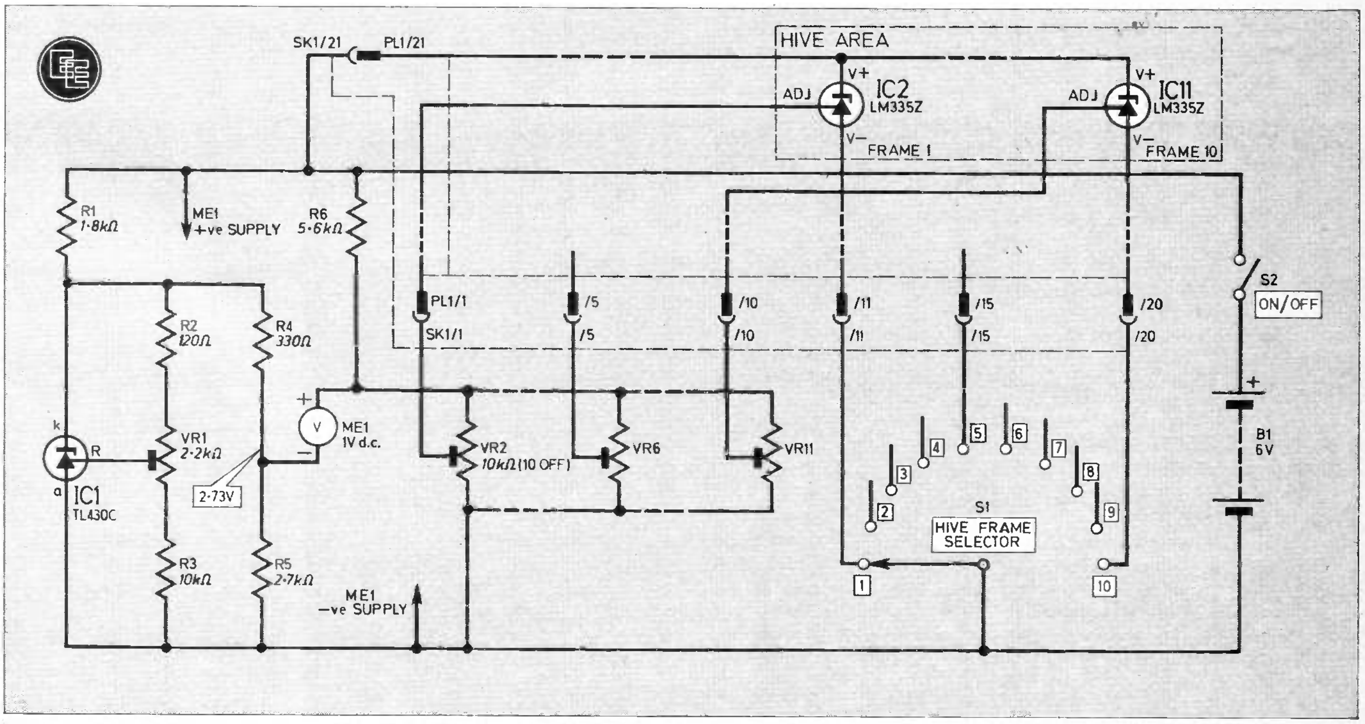
Miscellaneous

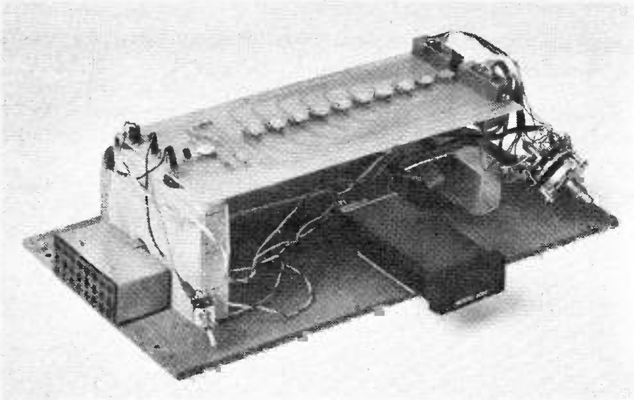
ME1	1V d.c. digital (Digitron model 8000)
SK1	21-way socket
PL1	21-way plug
S1	1-pole 10-way rotary
S2	miniature on-off toggle
B1	6V, 4 x 1·5V (HP11)

Pointer knob for S1; 21-way cable; battery holder for 4 x HP11 cells.

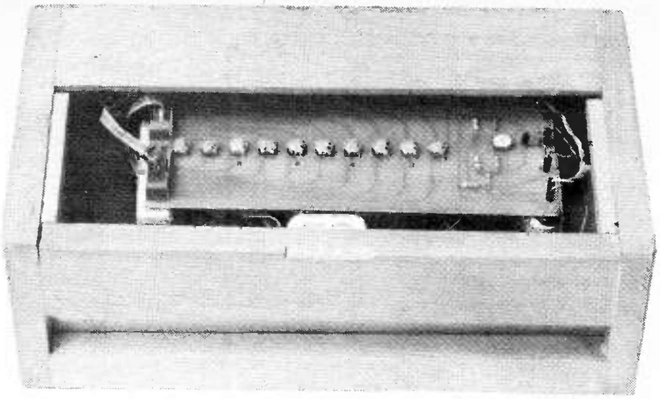
Guidance only Approx. cost **£15** excluding connectors and meter

Fig. 1. Complete circuit diagram for the Beehive Temperature Meter. The circuit is drawn to include ten temperature sensors, but this number may be reduced or increased as required.





The "baseboard" removed from the case to show positioning of the main components. Four HP11 batteries are located in a holder which is sited across the rear of the baseboard.



Access to the temperature "trimming" potentiometers is gained via a removable lid in the top of the case. The reference voltage "programming" preset VR1 can be seen on the far right.

their final positions. The sensor temperatures should be given time to stabilise. Place a thermometer beside a sensor when it is being calibrated, and adjust its preset until the readout on ME1 equals the thermometer reading. Repeat for all other sensors. Leave for a while and repeat the operation.

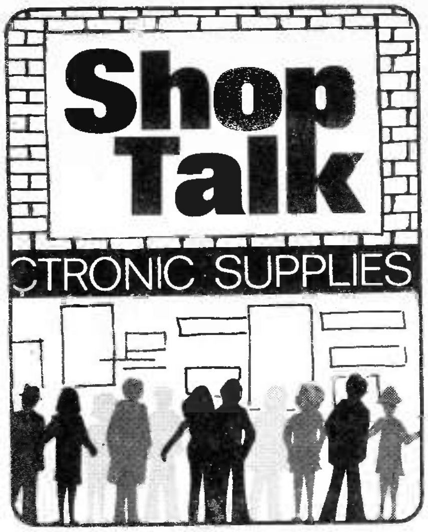
To read the temperature of each sensor, set S1 to the appropriate position. In the prototype, the reading was given directly in degrees Celsius, where the position of the decimal point could be selected on the rear of the specified meter. Any digital voltmeter could be used here which is capable of displaying up to 1V in 10mV steps. Sockets could be fitted in place of ME1 to allow any suitable meter to be plugged in when required.

USES

By monitoring the temperature in the hive, it is expected to be able to determine cluster movement (if any) during cold winter conditions. In such environments bees must cluster to keep alive. Disturbances, such as those from a nearby busy woodpecker could easily upset the bees and cause them to disperse and so lose the heat generated by clustering.

Regular monitoring of the hive temperature in various positions within the hive would alert the keeper who could then take early measures to remove the disturbance and pacify the bees.

An interesting plan now being considered by the team who produced this unit is to connect it directly to a personal computer. With suitably developed software there are many possibilities including a display of the hive spatial density. □



By Dave Barrington

Sounds of ZON

All the latest reports indicate that probably the most popular gift this festive season will have been one of the ZX81 or Spectrum home computers. It is equally likely that thousands of people spent most of their holiday period mastering the wonders of their new acquisitions.

Having been hooked on their possible capabilities, owners will, by now, have soon spot-lighted any limitations and are eagerly seeking the add-on units available to expand their system. These will include printers and increased memory or RAM packs.

Although it does not expand the system, a wide range of sound effects can be added with the ZON X-81 Sound Box from Bi-Pak Semiconductors.

The unit is based on a three-channel-plus-noise sound chip and is so designed that the pitches and volumes of the three channels and overall attack/decay envelope can be controlled by simple BASIC instructions to the computer.

This means that piano, organ, bells, helicopters, lasers, explosions, space invaders, and so on, can be simulated and easily added to existing programs.

The circuit board is housed in a black plastics case with loudspeaker and manual volume control (in addition to programmed volume) and simply plugs in between the rear ZX81 "finger" set and its RAM pack and/or printer. The power supply for the unit is taken from the internal power supplies of the computer, via the computers bus outlet or finger set.

For use with the ZX Spectrum a special adaptor is required. This is available for the sum of £5.50 plus VAT.

Included with the ZON X-81 are operating details which take the user through its operation step-by-step and also contain a number of example programs of useful sound effects.

The ZON X-81 Sound Unit costs £25.95 including postage and VAT. For more details, readers should contact: Bi-Pak Semiconductors, Dept. EE, P.O. Box 6, Ware, Herts.

Drilling Machine

With the increase in designs built on printed circuit boards (p.c.b.), many readers must have tried their hand at making their own p.c.b.s and encountered particular problems. From the letters received, the most common and annoying of these would appear to be the accurate and time consuming task of drilling the component holes in the board.

This can now easily be accomplished with the latest addition to the Toolrange stocks. It is the ORYX Model B10 drilling machine designed for small-scale production work on p.c.b.s.

A feature of the drill is a built-in mains power supply which provides a low voltage source to an illumination "torch" for the work surface. The power supply also feeds the 24V motor, which direct drives a quill spindle at a speed of 14,500 r.p.m.

An adjustable magnifier enables accurate location of the workpiece to drill point and there are adjustable depth stops for hand feeding. The maximum chuck-to-table distance is $1\frac{1}{2}$in (32mm).

Drills of up to $\frac{1}{8}$in shank diameter can be held in the interchangeable collet chucks. Three collets are supplied as standard, allowing drills from 0·6mm to 2mm shank to be used.

More details and price can be obtained from Toolrange Ltd., Dept EE, Upton Road, Reading RG3 4JA.

CONSTRUCTIONAL PROJECTS

Alarms for Push-Bike and Motor Bike

When ordering the 4001 i.c. for the *Alarms for Push-Bike and Motor Bike* project, be sure to ask for the "unbuffered outputs" type. This will have the suffix UBE or UB after the type number. This device should be stocked by most advertisers but in case of difficulty it is listed by Maplin.

The mercury switch used in our models are available from Magenta Electronics. This switch is also available from Tandy shops (order code 275-025).

Note that mercury is a toxic substance, therefore be careful not to break the glass encapsulation when installing in the case.

The 9V buzzer used in the prototype was purchased from Tandy and is listed as D.C. Buzzer 273-052. Other suitable mechanical sirens are stocked by Electrovalue, Magenta, TK Electronics and J. Bull.

The 12V 30A miniature relay is available from Maplin and listed as YX99H (12V 30A Relay). This relay is listed for use in automotive applications.

The type of case used is not critical, but should be made weather-proof from the elements. An old cycle lamp could be adapted and the bulb reflector area used to house the siren; the glass being replaced by some gauze.

Interval Timer

The 4-digit common cathode multiplex display, Type DL340M, used in the *Interval Timer* is available from TK Electronics.

They also supply a 9-digit Bowmar display that could be used in this project for the sum of 55p plus VAT. However, the pinning for this device is different and will have to be "hard-wired" to the board.

ZX81 Speed Computer System

The ultrasonic transducers for the *ZX81 Speed Computer System* are available from Electrovalue, Magenta, Maplin and Rapid Electronics. When ordering ask for transmitter and receiver transducers with pin terminations.

The 4-digit 7-segment common cathode display is a RS Components device, stock code 587-507. The diodes D3 to D5, Type BAX13, are stocked by Cricklewood Electronics.

The 23+23-way ZX81 edge connector is available from Maplin.

Beehive Temperature Meter

The "programmable" Zener diode called for in the *Beehive Temperature Meter* is likely to cause purchasing problems. This is a three-terminal type with excellent temperature stability. Two external resistors set the Zener voltage to any desired value in the range 3 to 30V.

The only source we have been able to locate for the TL430C is Maplin Electronic Supplies: Order code YY77J. However, RS Components stock an equivalent to this device which is listed as a programmable Zener diode and should be ordered as RS 283-227.

Once again, we would point out that RS Components will only supply to *bona fide* traders and readers should order this item through their component supplier.

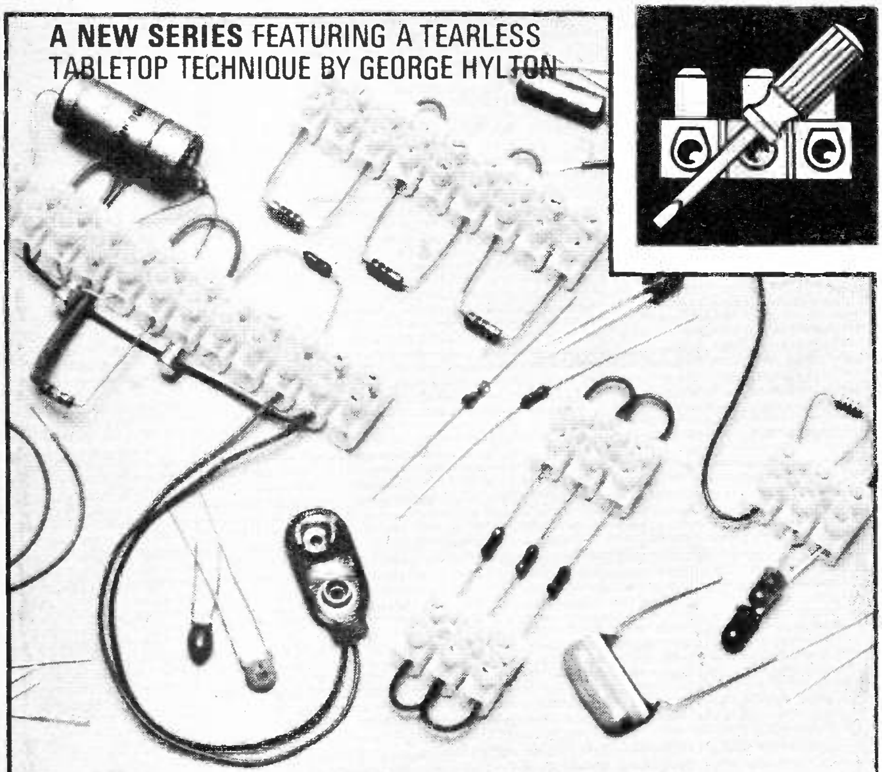
The temperature sensor Type LM335Z is available from Europa, Maplin and Rapid Electronics.

A 12-way rotary switch with an adjustable end-stop will need to be used to make up the single-pole 10-way switch S1. Alternatively, a single-pole 12-way switch can be used with two tags of the switch left unconnected or joined to the tenth position.

EPROM Programmer for the Acorn Atom

It is not essential to use a zero insertion force (z.i.f.) socket for the *EPROM Programmer for the Acorn Atom* "Program" socket. This socket plugs into the low profile socket mounted on the circuit board and protrudes through the top of the case. The Vero 24-pin Miniwrap i.c. socket, type 200-2133B, has been found to have a low insertion and withdrawal force and could be used as a cheaper replacement for "expensive" z.i.f. sockets.

A NEW SERIES FEATURING A TEARLESS TABLETOP TECHNIQUE BY GEORGE HYLTON



INTRODUCING ELECTRONICS

Part 5 RADIO RECEIVERS

LAST month we built amplifiers and oscillators. This time we'll extend our experiments from audio to radio frequencies and make a rather crude but reasonably effective a.m. receiver.

DISTORTION

To make it work we'll turn to good account something which is usually regarded as an unmitigated nuisance: distortion. Distortion, in amplifiers, means a departure from perfection. In a perfect amplifier the output would be an exact reproduction, in enlarged form, of the input.

Let's take a closer look at what this means. The "signals" which most amplifiers have to deal with are mixtures. They contain many different frequencies (in a hi fi music signal, from about 20Hz to 20kHz). They contain mixtures of intensities (from pianissimo to fortissimo). There are all sorts of time relationships between components of the mixture and these may be important for stereo reproduction, for example. All these characteristics would be preserved in an ideal amplifier.

No real-life amplifier is perfect. It may not amplify all frequencies equally well. It may not preserve the original time ("phase") relationships between components of the mixture. Above all, it may not reproduce the intensities faithfully.

In electronic terms this means that the shapes of the signal waveforms may be distorted. For hi fi, this *amplitude distortion* is by far the most serious kind.

OVERLOAD

When we turned amplifiers into oscillators by feeding back the output to the input positively we saw how oscillations can build up rapidly, starting with only the tiny amount of "noise" present in all circuits. This is amplified, fed back, amplified again, and so on, getting bigger and bigger.

Why doesn't this process of magnification go on for ever, eventually producing infinitely large voltages and currents? Because a point is soon reached where the transistors just can't handle larger signals. They overload. They can't deliver the output demanded of them.

If you repeat (in thought, at least) an earlier experiment (Fig. 5.1) you'll see why. Suppose we give R1 a lowish value, say 1kΩ. Then with VR1 slider at the positive end, several milliamps of current flow into TR1 base. TR1 will try to pass several hundred milliamps of collector current. It can't, because at a mere 20mA or so all the battery voltage is used up in the Indicator, leaving nothing for the transistor. So as you turn up VR1 the lamp reaches full brightness and gets no brighter as VR1 is turned up further. TR1 is no longer following the input signal (the base current).

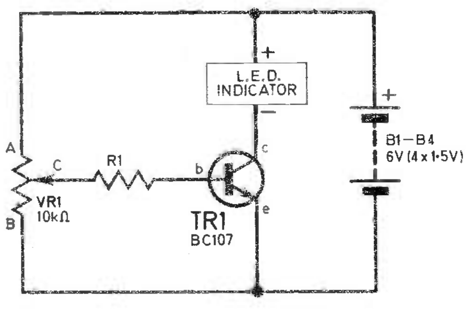


Fig. 5.1. A low value for R1 allows the transistor to be driven into overload.

LOW DISTORTION AMPS

In low-distortion amplifiers the transistors are given enough steady (d.c.) bias to turn them part-way on. The a.c. signals are added to the bias and as they swing positive or negative the transistors are turned on further or the reverse. Provided they don't get too large the output current and voltage can follow the input as required.

Figure 5.2 shows how the collector current and voltage of a transistor with a resistance load (1kΩ) vary as the d.c. base-to-emitter voltage is varied. With no input there is no collector current, hence no voltage drop across R1 so the collector voltage is the same as the battery voltage. As the collector current approaches 6mA nearly all the battery voltage is dropped by R1 and the collector voltage falls to zero, nearly. It can go no further, whatever you do to the base.

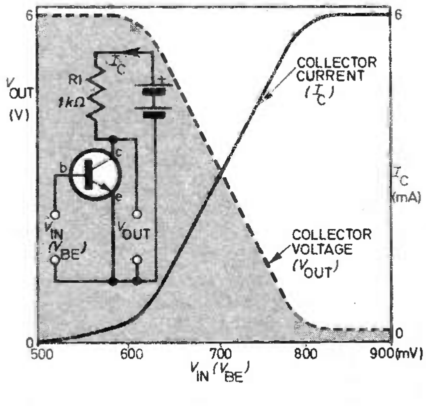


Fig. 5.2. How collector current and voltage change as the base voltage changes.

For minimum distortion the transistor is biased to say 700mV and a.c. signals added to the d.c. bias. So long as they are not too large the collector current never gets increased to its maximum (here 6mA) or reduced to zero and distortion is minimised (as shown in Fig. 5.3).

DETECTION

In amplitude-modulated radio there is a high-frequency "carrier wave" whose strength (amplitude) is made to vary in sympathy with the audio (programme) signals (Fig. 5.4 a and b). (For clarity, far fewer cycles of carrier are shown than with real radio signals.)

To recover the audio from the modulated carrier, two steps are taken. First all the negative half-cycles of the carrier are suppressed (c). This leaves a train of pulses whose amplitudes are in step with the original audio. They form a sequence of *samples* of the audio.

To re-form the audio the gaps between samples must be filled in. This is done with the help of a capacitor which is charged by the pulses and retains charge when a pulse has ended.

There's a snag. A perfect capacitor will charge to the biggest pulse amplitude and stay like that, ignoring any smaller ones which follow. Goodbye, audio. To avoid this a resistance is connected across the capacitor, to allow it to discharge slowly. This gives it enough "memory" to bridge the very short time gaps between sample pulses while allowing the slow audio changes to be followed.

TRANSISTOR DETECTOR

To use a transistor as a detector it is biased to a point such as *X* in Fig. 5.3. Negative carrier half-cycles then reduce the collector current towards zero but positive ones increase it according to their size. The collector current is a train of sample pulses like Fig. 5.4c.

In our receiver (Fig. 5.5a) TR1 is the detector. Its collector current is low (about 20μA). Gap-filling is done by C3. This is normally charged to about 1·3V in this circuit. If this voltage changes it can restore itself slowly by charging more via R1 or discharging via TR1 collector and TR2 base.

The incoming signal appears across L1. TR2 amplifies the programme audio.

CONSTRUCTION

The terminal-block connections (Fig. 5.5b) are similar to last month's amplifiers. You need resistors of 33kΩ and 220kΩ and polystyrene capacitors of 39pF, 390pF and 1nF (1000pF). The other components you should have from before, except L1, which you make. For this you need a rather long piece of insulated hook-up wire (4 metres) but it can be re-used later if need be.

Another new component is a ferrite aerial rod. Get a blank (unwound) rod 100mm long (or longer). (If you have two shorter rods tape them end to end.)

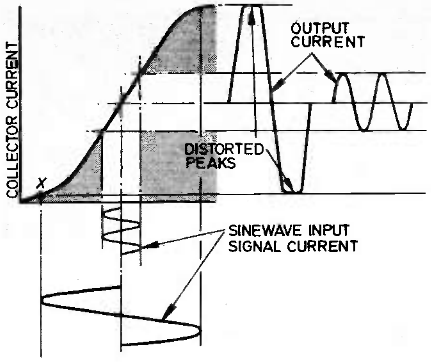


Fig. 5.3. Biasing the transistor to a partly-on state enables small a.c. signals to be amplified with low distortion, but large ones get "clipped".

The coil L1 is wound on a hollow cardboard or plastic tube wide enough for the ferrite rod to slide easily inside. I used an empty *Smarties* tube. Most ferrite aerial rods are 6mm or 9mm diameter, which is a lot less than my tube but that doesn't matter.

To wind L1, fix one end of your wire to your tube, leaving about 100mm free for connecting. Wind, spacing the turns to cover about 100mm. My coil has 42 turns but anything between 30 and 60 will do. Tape the loose end to the tube, again leaving enough spare for connecting to your terminal block.

If the rod goes right inside the tube tape a handle to it: I used the barrel of an old ball pen. Wood can also be used, but not metal.

OPERATING

Turn VR1 spindle fully clockwise. This puts the full 10kΩ in circuit and TR1 oscillates. Moving the ferrite rod slowly into the coil should produce a sequence of whistles. Each whistle results from the

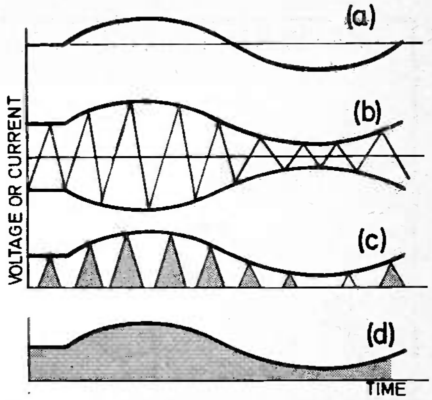


Fig. 5.4. Amplitude modulation of a radio transmission. (a) Audio (programme) signal; (b) Amplitude-modulated carrier frequency waveform; (c) First step in recovering the audio: the negative half-cycles of the a.m. waveform are suppressed; (d) Second step: The gaps are filled in, leaving the original audio plus d.c.

oscillation interacting with an incoming carrier frequency. This produces a *beat tone* whose frequency is the difference between the carrier frequency and the local oscillation.

Tune in a strong beat then turn down VR1 until oscillation just stops. Slight retuning should then give you the station.

TUNING RANGE

My coil tunes from 1·2MHz to 2·5MHz, which embraces the high frequency end of the medium-wave band of 0·52MHz to 1·65MHz (550kHz to 1650kHz) where (in Britain) many of the local radio stations are to be found. After dark more distant ones can be heard.

You may be able to pick up a few more with the aid of a metre of wire connected as a vertical aerial (dotted in Fig. 5.5). Have fun!

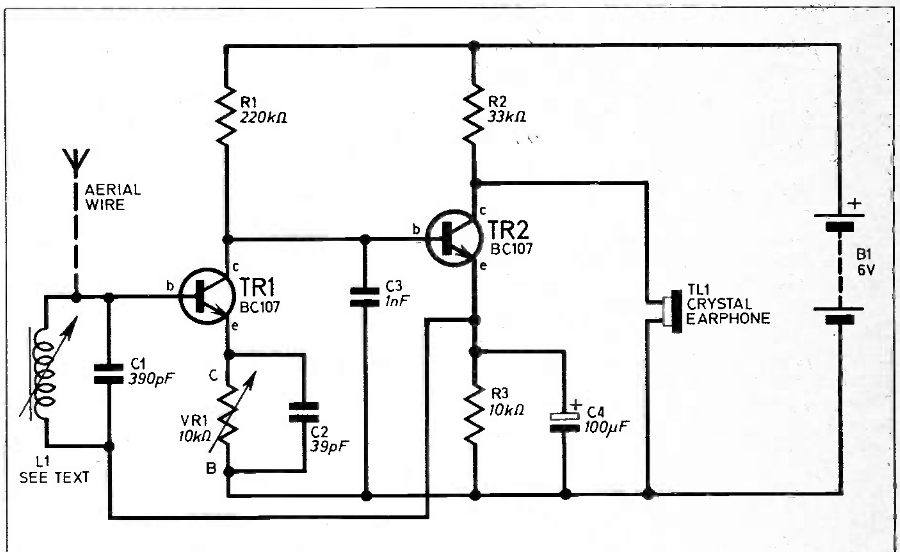
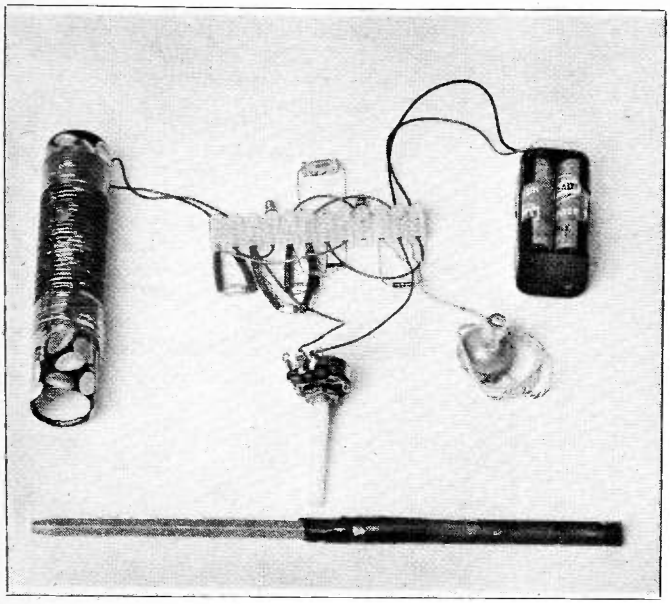
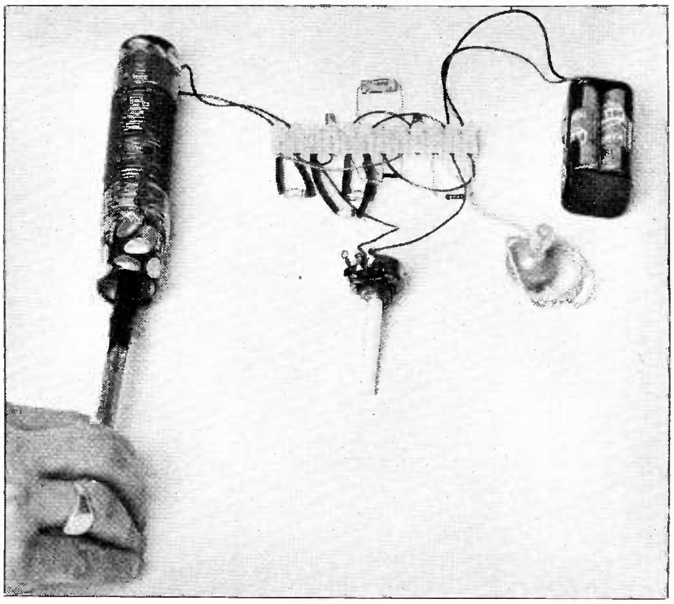


Fig. 5.5. An a.m. receiver circuit.





The a.m. receiver wired up on the screw terminal block with the ferrite rod taped to a plastic pen case. Moving the rod in and out of the coil which is wound on an empty "Smartie" tube, tunes the receiver.

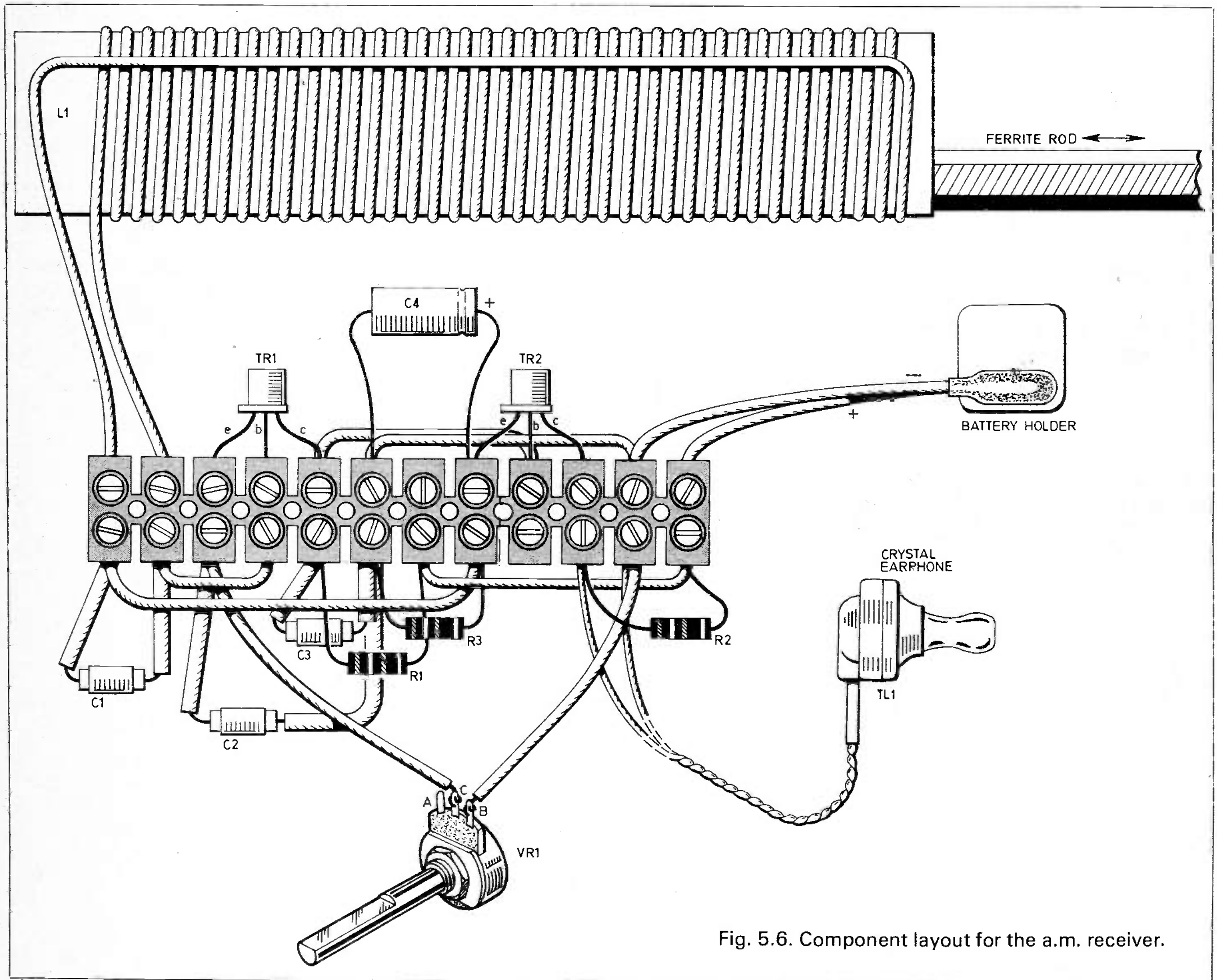


Fig. 5.6. Component layout for the a.m. receiver.

TUNED CIRCUIT

L1 and C1 form a *tuned circuit*. Earlier we saw how inductors and capacitors can store energy as fields and charges. We learned that when combined with resistors these energy-storage devices can give time delays. Here, however, an inductor and capacitor are connected to one another. This has a striking effect on the time behaviour.

If C1 is charged, it discharges through L1, and a magnetic field is set up. When C1 is empty the field collapses, inducing a voltage which drives current from L1 into C1 (in the opposite direction from before). This to-and-fro oscillation of current goes on, gradually dying away because part of the energy is lost in the resistance of L1 each time current flows.

This *damped* (dying) oscillation occurs at one special frequency, the *natural frequency* of the tuned circuit. If the circuit is energised from outside, by a signal whose frequency matches the natural frequency the oscillation keeps on getting little pushes which keep it going. Just as somebody on a swing can go higher and higher by moving in step with the natural motion of the swing so small input signals can produce large voltages and currents in the tuned circuit.

As the signal frequency is removed from the natural frequency the effect diminishes. Only signals close to the natural frequency get built up. Hence a tuned circuit is frequency-selective. In our receiver we enhance the selectivity (and the sensitivity) by positive feedback (also called "reaction" or "regeneration").

SIDEBANDS

When a carrier frequency is modulated by an audio frequency extra frequencies on each side (above and below) the carrier frequency are created. These "side frequencies" are known collectively as *sidebands* and in an amplitude-modulated (a.m.) transmission they extend to each side of the carrier by the same amount as the audio frequency.

To transmit the full audio band, calls for some 20kHz of space on each side of the a.m. carrier. Tough, as the stations are spaced only 9kHz apart in the medium-wave band. Their sidebands overlap.

The only thing to do about it is to keep adjacent-frequency stations apart geographically and remove the higher audio frequencies before transmitting, to restrict the sideways spread to, say, 10kHz, which still gives reasonable music quality.

The carrier frequency itself contains no programme information. It is needed merely to "decode" the sidebands. Moreover, the sidebands duplicate the programme. Each one contains all the audio "information."

The carrier and one sideband can be removed before transmission leaving only a single-sideband. This halves the bandwidth of the transmission and avoids the "waste" of carrier frequency energy. The price is that special and at present expensive techniques are needed to get back the audio at the receiver. Ordinary detection doesn't work.

At very high frequencies (v.h.f.) transmitters have a short range so if spaced well apart don't interfere with one another. It is then feasible to use a bandwidth-hungry but high quality form of transmission based on *frequency modulation*. The carrier has a constant amplitude but its frequency is made to vary in sympathy with the intensity of the audio signal. Again, ordinary detectors won't work but the solution is less expensive than for single-sideband (s.s.b.) modulation.

INVISIBLE COMPONENTS

There is a mystery about your receiver. Since it can be made to oscillate, positive feedback must be occurring. But how? Why should varying VR1 cause signals to be fed back from output to input?

Only TR1 is involved. The feedback is at radio frequencies. It is not from collector to base but from emitter to base. How? Through an invisible connection, formed by the internal impedance of the transistor between emitter and base.

Voltages across VR1 and C2 are fed back through this impedance to the tuned circuit. They get increased by a sort of transformer step-up property of the tuned circuit, which is just as well since the voltage at the emitter is less than the voltage at the base. This sustains the oscillation.

If the inductance of L1 is too large oscillation may only be obtained at the high-frequency end of the tuning range. The remedy is to reduce the number of turns or to reduce C1 (to, say, 150pF).

To be continued

COUNTER INTELLIGENCE

By PAUL YOUNG

The Future . . .

This is the time of year when Old Moore Young attempts to see the future. The delightful thing about forecasting the future is that you can go as far ahead as you wish.

I can imagine that no-one goes to work and we all sit at home and tap out instructions on our computer, with all the manual work being carried out by robots. A start has even been made in the manufacture of cars.

Would the home constructor be able to tap out his requirements on his computer, and would we ever reach the stage where it could all be beamed down and land immediately on his bench, a la "Star Trek"? Then again with the progress of Physco-kinetics he would not even have to press the buttons, only to think of the items he required. In time his arms and legs would atrophy, and he would move around in a programmed wheelchair, finally becoming a blob of jelly.

There are a few simple souls that worry about the computer taking us over completely, but just imagine the scientist programming his computer to carry out some original thinking, like discovering penicillin or cracking the D.N.A. code, the double helix, or the composer commanding it to compose a fugue that will excell all J. S. Bach's famous 48.

I will conclude by quoting a few words by Christopher Booker in a recent edition of the *Daily Mail*, talking about a friend. "Until a few years ago he was a brilliant computer expert. Financially, and in terms of job prospects he had the world of electronics at his feet. But he has thrown it all up to spend his time as a builder, as a potter—and looking after his children—for no other reason that he eventually found the glittering world of electronics utterly dead and boring."

Now I don't subscribe to his view and neither, I am sure, do our readers but I do agree with the Irishman who said, "All predictions are unreliable, particularly those dealing with the future," but in case I have depressed our reader's, I decided I would cheer them up by looking backwards instead of forward.

. . . The Past

Looking for a "spark" from the past with an electronics connection that might interest readers is very difficult. But suddenly I have an inspiration, Russian Ambassador I. M. Maisky.

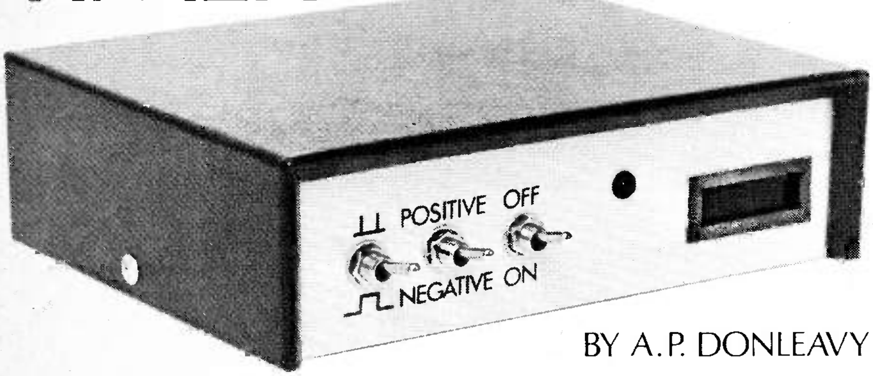
He is particularly appropriate if only for the following reason. Ask any British schoolboy who invented radio and the answer will come back, "Marconi". Ask a Russian schoolboy the same question and he will answer with equal speed, "Popoff".

Now although the Russians may claim to have invented the aeroplane, the internal combustion engine and the telephone, their claim to the invention of radio has considerable substance. Alexander Stepanovich Popoff was transmitting radio messages up to 30 miles in 1898, and it was used by the Russian navy for communications between ships, and ship to shore. The Marchese Guglielmo Marconi established radio communication between France and England in 1899 and in 1901 succeeded in spanning the Atlantic.

In 1936 my father worked for a short time as a humble clerk in the Russian Trading Mission at Bush House, London. Perhaps the O.G.P.U. had a file on him, and noted that he had a son who was a radio technician at Philips. Now their ambassador in London his Excellency Ivan Mikhailovich Maisky had a Philips radio at the embassy and was getting bad interference on his reception from electrical apparatus in the vicinity. I was asked to provide a cure.

So one afternoon in the autumn of 1936 saw me clambering on the embassy roof in Kensington Palace Gardens armed with a long coil of screened cable. Fortunately I was able to greatly improve reception by cutting out the noise and I was asked to demonstrate this to his Excellency who thanked me warmly for my trouble.

SHORT INTERVAL TIMER



BY A.P. DONLEAVY

THIS INSTRUMENT has been designed to measure time intervals of up to one second with a resolution of 0·0001 seconds, and with an accuracy of better than one per cent.

The stop/start can be activated by mechanical, electronic, or photoelectronic means, enabling the instrument to measure pulse widths, the time between two pulses of either polarity (the period), passage times of moving objects, and so on. The display is a 4-digit calculator type l.e.d. display.

CIRCUIT DESCRIPTION

A block diagram of the system is shown in Fig. 1. The incoming pulses are gated to produce the required polarity. Where the interval between two pulses is to be measured, the pulses are fed through a flip-flop. The resulting waveform is shown.

The rising edge of this pulse triggers a reset pulse which zeros the counter. The falling edge of the pulse (the end of the period to be timed) sends a pulse to the latch which then transfers the information in the counter to the display.

The clock oscillator, nominally at 9,999Hz, continuously feeds timing pulses to the counter. Thus the display at the end of the period shows the number of clock pulses counted during the timing pulse. For a 4-digit display, this will be a direct reading of the time in microseconds. The decimal point is to be before the most significant digit.

The reset and latch pulses are of microseconds duration, and therefore do not encroach significantly into the period to be timed.

POLARITY

Fig. 2 gives the circuit diagram. IC1 is a CMOS quad 2-input Schmitt trigger NAND gate. The input is fed in via IC1d and any effect of switch bounce or input signal jitter will be minimised by the switching characteristics of this type of gate. S1 is set for the appropriate signal polarity, this switch brings in an additional Schmitt gate, IC1c, for the NEGATIVE input pulse position.

The signal is then fed either through IC2 or direct to IC3 depending on the position of S2. IC2 is a dual D-type flip-flop, only one of which is used in this circuit. This flip-flop changes output state every time a rising edge signal is applied to pin 3. So if the time interval between two successive pulses is to be measured, the first pulse will switch the output to high, and the second pulse will switch it to low again, thereby activating the RESET and LATCH pulses in sequence.

RESET

The circuitry associated with S2a (C1 and R2) is designed to put the flip-flop into the right state when initially switched into this mode, by applying a momentary positive pulse to the RESET input pin 4.

The leading edge of the timing pulse is coupled via C3 and R3 to pin 12 of IC4 to produce a momentary RESET pulse. The trailing edge is fed to pins 11 and 5 of IC3, a CMOS dual monostable multivibrator, to produce the LATCH pulse from one of the monostables.

The other monostable has an l.e.d. connected to the output which illuminates when a new reading is made. The l.e.d. remains alight for a period determined by the values of R4 and C4, which for the given values is a few tenths of a second.

IC1a and IC1b form the clock oscillator to provide the timing pulses. The frequency is set by VR1 and should be 9,999Hz.

The counting, latch and display drive functions are all done by IC4, a 74C925. IC5 contains five individual transistors, four of which are used as current sources for the digits of the display. The display is a dual-in-line (d.i.l.) 4-digit common cathode display for a calculator. The decimal points are not used, since extra circuitry would be required to drive them.

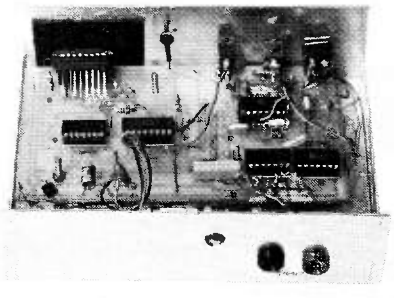
Finally, a stablised power supply of 5V is obtained using a voltage regulator, IC6. This is necessary to stablise the frequency of the oscillator and for IC4, which requires a +5V supply. The instrument is driven using a 9V PP3 battery. It can also be driven using a 9V mains adaptor via a suitable socket. The power supply circuit diagram is shown in Fig. 3.

COMPONENTS

IC5 may be replaced by an LM3086, a pin-for-pin equivalent of the CA3046. VR1 should be a multiturn preset potentiometer.

The display used on the prototype is a DL-340M common cathode calculator display. This is a d.i.l. display with four digits, all of which were used in this project. Other displays may be used, the best being d.i.l. for easy mounting. The p.c.b. layout may need to be modified to accommodate different pin configurations. Individual common cathode displays may also be used.

With the exception of C2, the values of the resistors and capacitors used are not at all critical, and the other values may be used. R7 to R13 affect the brightness of the display. Increasing the value will decrease the brightness by reducing the current, but will increase the battery life.



Rear view with top cover removed.

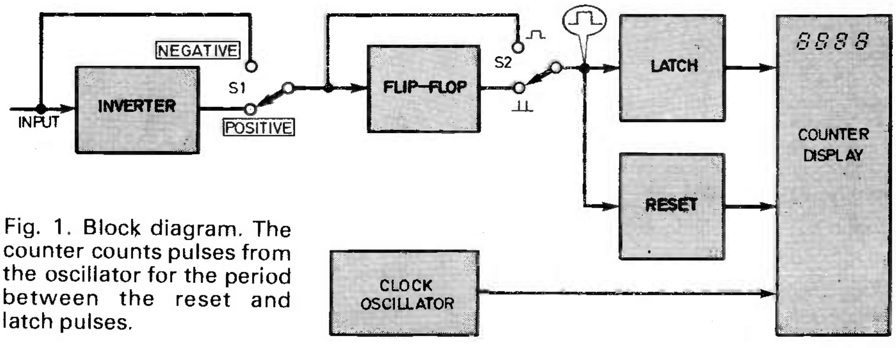


Fig. 1. Block diagram. The counter counts pulses from the oscillator for the period between the reset and latch pulses.

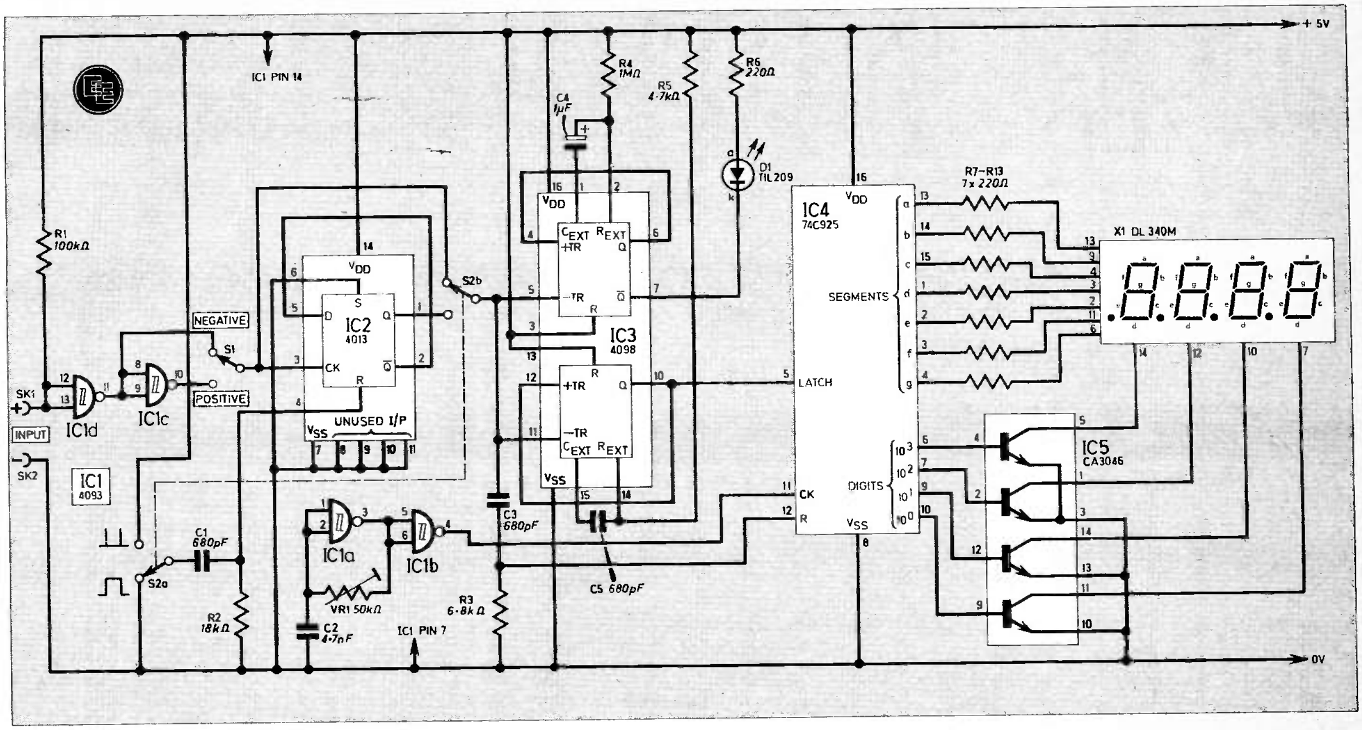


Fig. 2. Main circuit diagram of the Short Interval Timer.

CONSTRUCTION starts here

CIRCUIT BOARD

The unit is built on a single sided p.c.b. 138 × 75mm, the layout of which is shown in Fig. 4. Holders are used for the i.c.s as this prevents any soldering damage and facilitates any necessary debugging.

The display is mounted using a special 14-pin d.i.l. holder with both sets of pins bent at 90 degrees to allow the socket to sit at right angles to the board. As previously mentioned, if a different display is used, the p.c.b. connections may need to be altered. This should not be beyond the capabilities of the constructor.

If a multi-digit display is used, for example, from a calculator, this can be mounted behind the front panel of the instrument case and hard wired to the p.c.b. This type of display can have anything up to ten digits of which only four will be used.

CASE

The unit is housed in an aluminium instrument case, 45 × 105 × 150mm, with a vinyl covered lid, a type readily available. The p.c.b. is mounted using three spacers approximately 13mm long. Holes for the three switches and l.e.d. are drilled on the front panel, and a window for the display approximately 13 × 34mm must also be cut. Ensure that the position of this window is such that the display appears to be central.

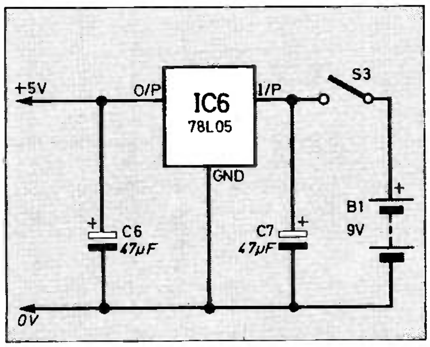


Fig. 3. Power supply circuit diagram. Optional external power socket not shown.

The input terminals are two 4mm banana sockets located at the rear of the instrument. If the instrument is also to be powered using a 9V calculator adaptor, a hole for a 2·5mm jack socket will also be required.

The battery is secured to the box by a double-sided adhesive tab. D1 is mounted with the standard black bezel clip.

A red filter is glued to the inside of the front panel to increase the display contrast. The switches are labelled using "Letraset" or similar dry print transfers and secured with a clear varnish to make them more durable.

If a mains adaptor jack socket is used, ensure that the terminals are wired so that the battery is disconnected when the jack plug is in place and that the polarity is correct.

A diagram showing all interwiring is given in Fig. 4.

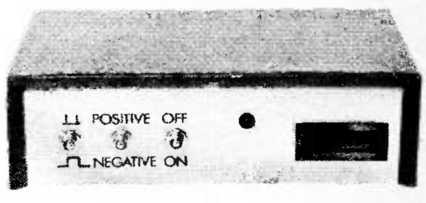
CALIBRATION

If a calibrated frequency source is available, with an 0–10Hz range, then this can be used for calibrating the instrument. With S2 set to measure the time between two pulses, the period is measured. This period is the reciprocal of the input frequency.

So, for example, a known 2Hz signal is applied to the input and VR1 is adjusted until the display reads 5000 (0·5 seconds).

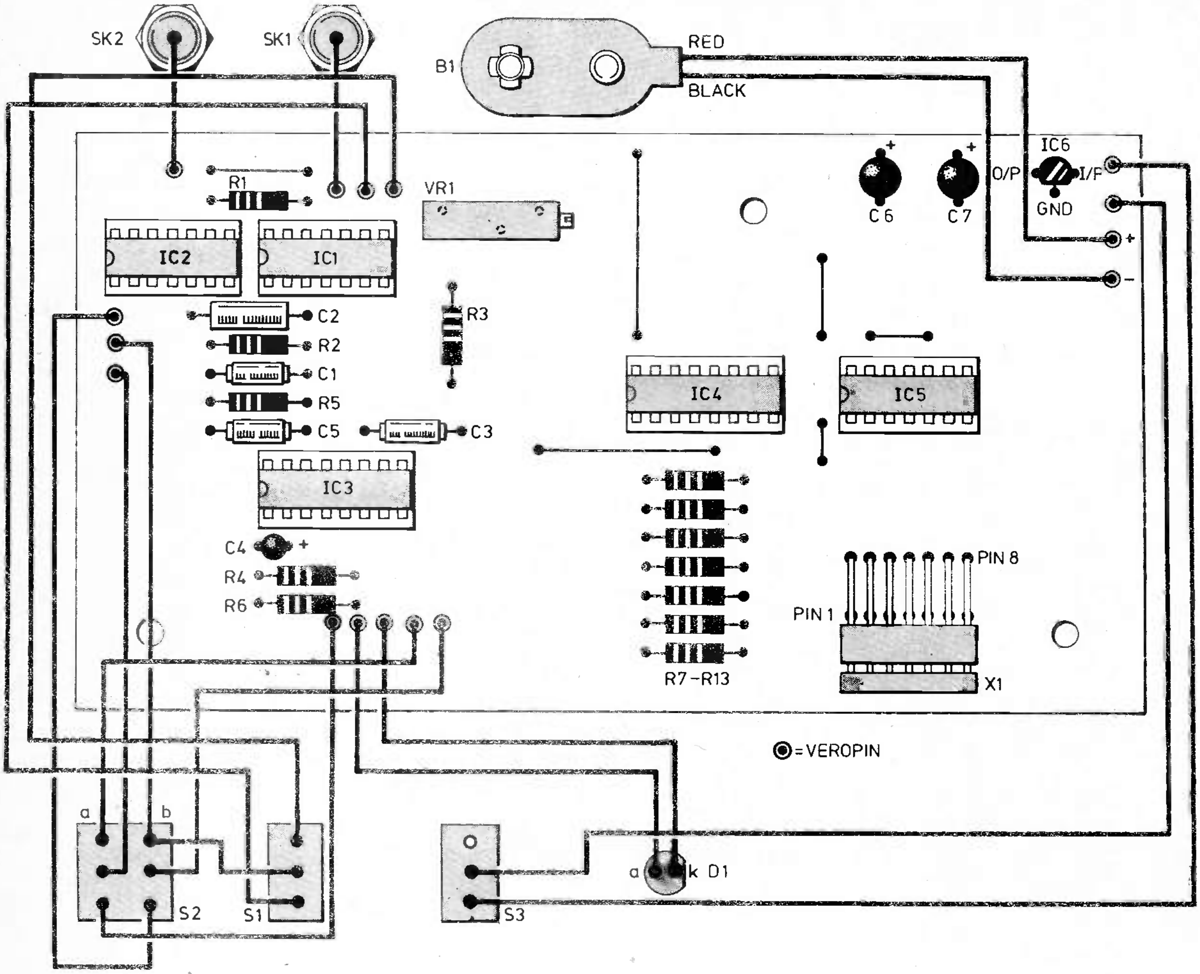
In the absence of a calibrated source, it is possible to use the 50Hz mains frequency. Using the unrectified secondary output of a low voltage mains transformer in the range 5 to 12V fed into the input via a 10 kilohm resistor, adjust VR1 until the display reads 0200 (0·02 seconds).

When using this latter method, the instrument is taking 50 readings per second, and the last digit may appear to change rapidly.



Front view clearly showing the labelling of the three switches.

SHORT INTERVAL TIMER



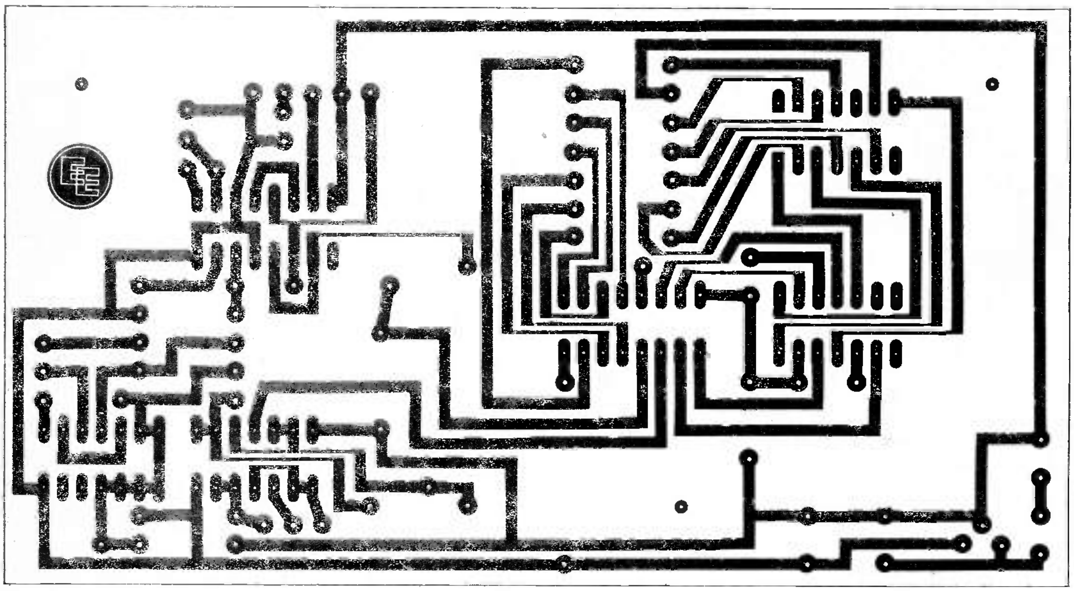


Fig. 4. Full size printed circuit board artwork and component layout. Topside also shows interwiring details. Note that switches are shown as if the front panel had been folded flat.

COMPONENTS

See Shop Talk page 85

Resistors

R1	100kΩ
R2	18kΩ
R3	6·8kΩ
R4	1MΩ
R5	4·7kΩ
R6–13	220Ω (8 off)

All ¼W carbon ±5%

Capacitors

C1,3,5	680pF polystyrene (3 off)
C2	4·7nF polyester
C4	1μF 6·3V tantalum
C6,7	47μF 10V tantalum or electrolytic (2 off)

Semiconductors

D1	TIL209 red l.e.d.
IC1	4093B CMOS quad 2-input Schmitt triggered NAND gate
IC2	4013B CMOS dual D-type flip-flop
IC3	4098B CMOS dual monostable
IC4	74C925 CMOS 4-decade counter/driver with multiplexed 7-segment outputs
IC5	CA3046 or LM3085 silicon *npn* transistor array
IC6	78L05 +5V, 100mA regulator
X1	DL-340M 4-digit common cathode multiplexed display in d.i.l. package (see text)

Miscellaneous

S1,3	s.p.d.t. miniature toggle (2 off)
S2	d.p.d.t. miniature toggle
VR1	50kΩ multiturn preset
SK1	4mm banana socket red
SK2	4mm banana socket black
B1	9V PP3 battery

Aluminium instrument case, 150 x 105 x 45mm; single sided p.c.b. 140 x 76mm; red display filter approx. 50 x 30mm; battery clip; 16-pin d.i.l. holder (2 off); 14-pin d.i.l. holder (3 off); vertical mounting 14-pin d.i.l. holder (for X1); 7/0·2mm wire; rubber feet (4 off); mounting hardware.

Approx. cost Guidance only £18

CIRCUIT OPTIONS

The constructor may wish to extend the time range, for example, 0 to 10 seconds. This can be achieved by either changing VR1 or C2. The oscillator frequency is inversely proportional to the resistance and capacitance, so to have a maximum period of 9·999 seconds, C1 would have to be 0·047 microfarads or VR1 would have to be 500 kilohms.

Should more than one range be required, the appropriate number of preset potentiometers will need to be added, and another switch to select the range.

TROUBLE SHOOTING

The following should be of use to identify any problems which may occur when the instrument is first switched on.

The four digits should light, or possibly a random number appear, when first switched on. Any missing digit or segment will be either a wiring error or a fault in IC4 or IC5.

A momentary short of the input terminals should cause D1 to flash (S1 in NEGATIVE position, S2 in PULSE WIDTH position). The new display reading should coincide with this flash. If this does not occur and the oscillator is known to be working, the function of IC4 may be checked by putting pin 5 (LATCH input) of IC4 to V_{DD}.

However it will be necessary to disconnect pins 10 and 12 of IC3. Do this by putting IC4 in another d.i.l. holder and bend pin 5 of this holder out so that it protrudes from the side, and plug into the board socket.

When the new protruding pin 5 is connected to V_{DD} the display will count continuously. If it does not, and assuming the RESET pin 12 of IC4 is at 0V, the i.c. may be considered faulty.

If the timer gives completely wrong readings, then it is likely that there is a wiring error to one or both of S1 and S2.

USING THE TIMER

The polarity of the pulse to be measured must be known before the measurement is taken.

The switches can now be set to the appropriate mode. These are as follows:

To measure the duration (pulse width) of a positive pulse, S1 is in the POSITIVE position (up) and S2 must be down, pointing to the pulse symbol.

To measure the duration (pulse width) of a negative pulse, S1 is switched to the NEGATIVE position (down). S2 is unchanged.

To measure the interval between two positive pulses (the period), S1 is set to the POSITIVE position (up) and S2 is switched to the up position, pointing to the symbol representing two pulses.

To measure the interval between two negative pulses (the period), S1 is simply switched to the NEGATIVE position (down) and S2 is unchanged.

SOURCE IMPEDANCE

If a measurement is being taken from a circuit or piece of equipment with an output impedance of greater than 33 kilohms, then R1 will have to be substituted with a higher value, for example one megohm.

The Short Interval Timer has been designed for pulses of 5V peak and signals of greater amplitude require an additional resistor in series with the input. A 10 kilohm resistor is sufficient, and the reason that it is required is that the input protection diodes on IC1d will start to conduct at voltages greater than the positive supply rail.

PHOTOCELL

If a phototransistor is to be used to trigger the timer, for example a TIL81, then all that is required is to connect the collector to the positive input terminal (SK1) and the emitter to the negative input terminal (SK2). R1 acts as the load resistor for this device and may need adjustment to suit the transistor used.

If the time interval to be measured is the interruption of incident light falling on the phototransistor then the Timer must be set up for the measurement of a positive pulse width.

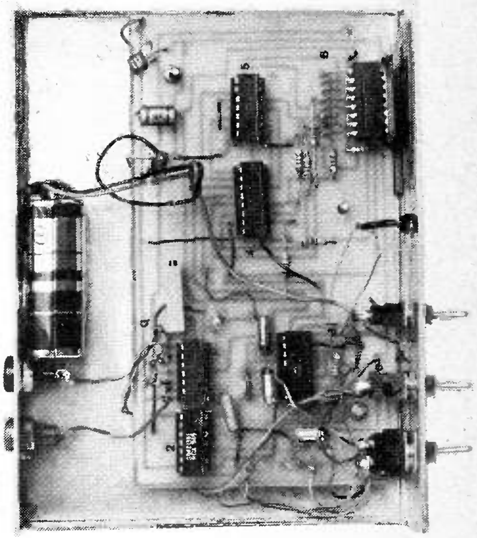
To measure the time interval of light actually falling on the phototransistor, the Timer is set to measure a negative pulse width.

A microswitch can also be used to trigger the timer. In this case the Timer would be measuring the interval of a mechanically moving object which activates the switch. Using the normally open contacts, put in the NEGATIVE position; and for the normally closed contacts, in the POSITIVE position.

APPLICATIONS

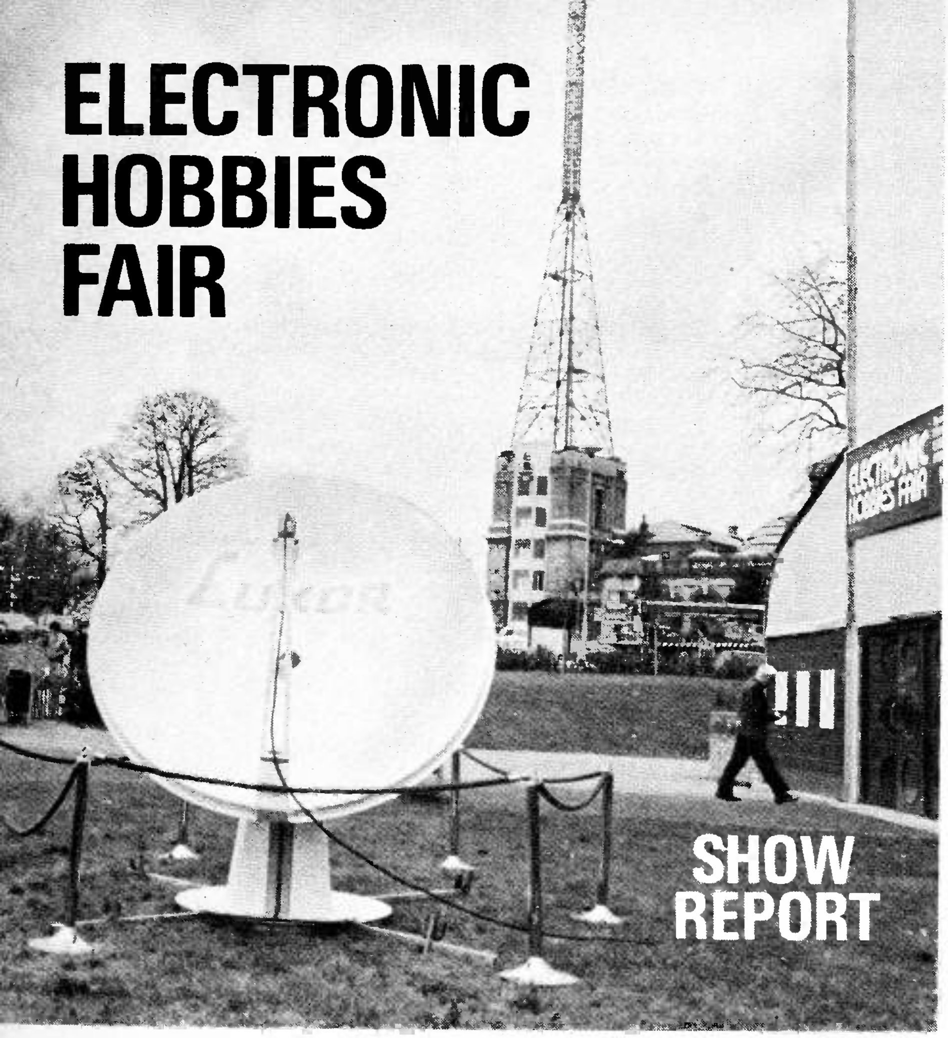
An example is to use a phototransistor to measure the shutter speed of a non-automatic camera. With a light in front of the lens and the phototransistor behind the lens, the shutter speed can be checked for accuracy. The waveform seen by the input would correspond to measuring a negative pulse width.

The Timer can also be used to measure the r.p.m. of a rotating object. For example, a white strip painted or stuck on the rotating object will reflect light to the photocell (held in close proximity) with every revolution, and thus giving a continuously up-dated display of the time between each revolution, which for a constant speed can be converted to r.p.m. by dividing 60 by the time displayed. □



The finished prototype p.c.b. assembly mounted in the case. This layout differs slightly from that given in Fig. 4.

ELECTRONIC HOBBIES FAIR



SHOW REPORT

FROM the opening of the doors on Thursday, 18th November, the Alexandra Pavilion in North London became a bustling scene with visitors of all ages circulating among the stands which offered a wide range of products from components of all descriptions to complete units and instruments representative of all branches of electronic technology.

SPECIAL ATTRACTIONS

The crowds swelled appreciably on the Saturday and Sunday when the family presence was particularly noticeable. Non-technical members of visiting families soon discovered plenty to amuse and interest themselves amongst the special attractions. Handel's Water Music, Bach's Toccata and Fugue and Jeremiah Clarke's Trumpet Voluntary issued forth at regular intervals from the mighty four manual electronic organ built by a member of the Electronic Organ Constructors' Society. There was no dearth of volunteer players hence the nearly continual flow of music from this example of the king of instruments.

Ham radio and holography may seem poles apart but they occupied adjoining stands as if to demonstrate how wide and divergent are the activities to be found within the sphere of electronics. Holographic Developments demonstrated 3D holograms and offered for sale products related to this the very latest field for the hobbyist to explore.

Radio is as old as electronics, and the Radio Society of Great Britain carried the banner for this most popular hobby, aided and abetted by two other satellite organisations, the British Amateur Radio Teleprinter Group and the North London Raynet Association. The latter participated actively in guiding fellow hams to the Fair via VHF and UHF links.

Nearby the Army had a display of its own very special kind of radio equipment and this was demonstrated by young members of the Royal Signals from the Army Apprentice College. Exhibits included an operational radio station, teleprinter and a "rolling road" on which visitors were invited to ride a bicycle and try their luck at beating the speed record.

Just across the way in a railed off arena, radio was being put to another use by Model Land. Model cars, buggies, helicopters and planes were put through their paces and demonstrated their manoeuvrability at high speed when under the control of a skilful operator.

On the first day Leonard Bliss of Model Land, reported a near disaster when his radio-controlled helicopter went out of control and "crash landed", by providence, on his stand. Damage to the stand was minimal and fortunately they had a standby helicopter to hand.

ROBOTS

Not far away stood a family of life size robots belonging to Advanced Robotics. Now and again the father of the quartet felt the urge to take a wander around the neighbouring area of the Pavilion, and in one instance even ventured outside to greet visitors to the show. During the course of these perambulations he chatted up visitors much to their amazement.

These robots were featured in the ITV programme, "The Six O'clock Show" on the Friday evening. The activities of the outside broadcast unit supplied an added attraction to visitors who stayed on to watch this live telecast from the Fair.

Over on "the other channel" the BBC's important role in education was illustrated by displays of the BBC Computer, electronic teaching modules and other items featured in BBC sound and TV programmes. The stand was crowded most of the time with visitors glued to the demonstration video film monitors.

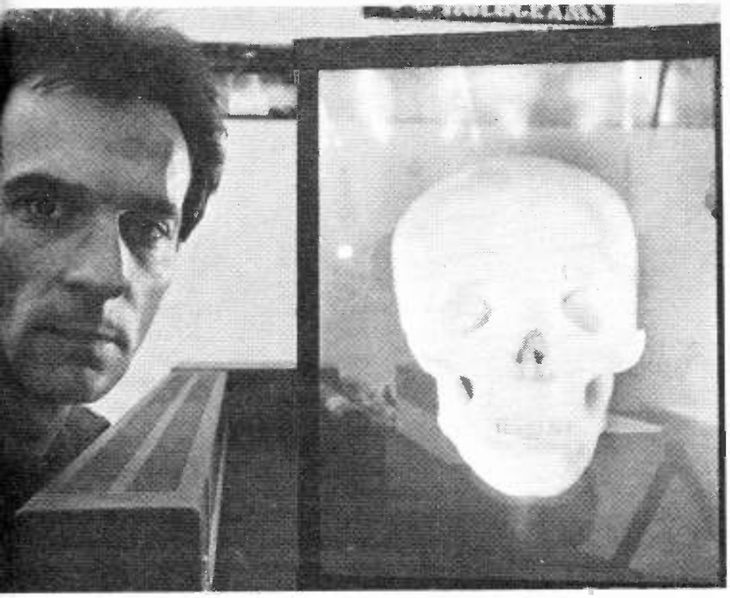
BBC representative Robin Gwyn said the numbers of visitors and the interesting enquiries concerning the BBC's activities in education was, in his experience, unprecedented. Many parents wanted guidance about computers, often because they felt the need to keep up with their children. Others involved in teacher/parent associations wanted advice regarding suitable computers for schools.

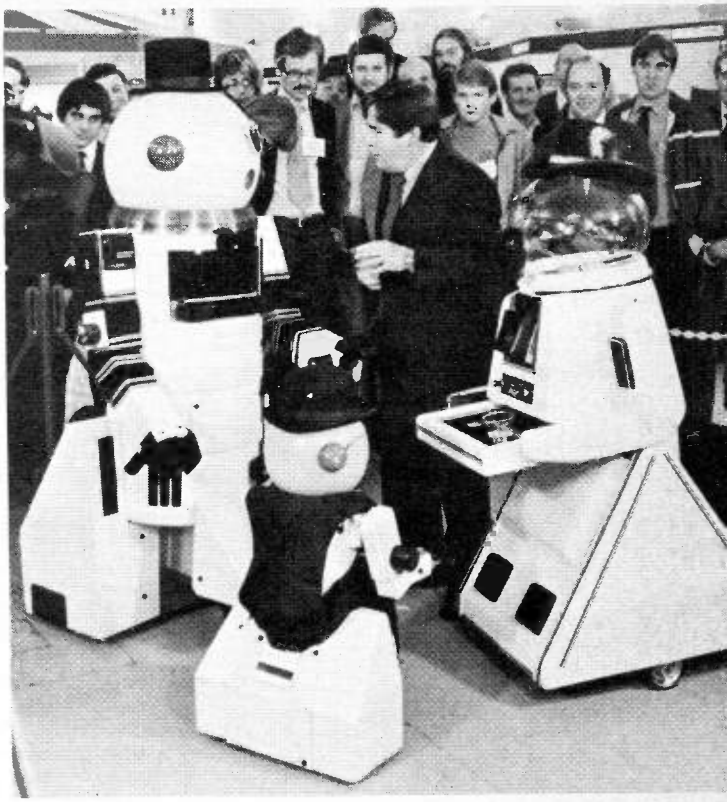
This general view of a thronged aisle indicates the popular appeal of the Fair.

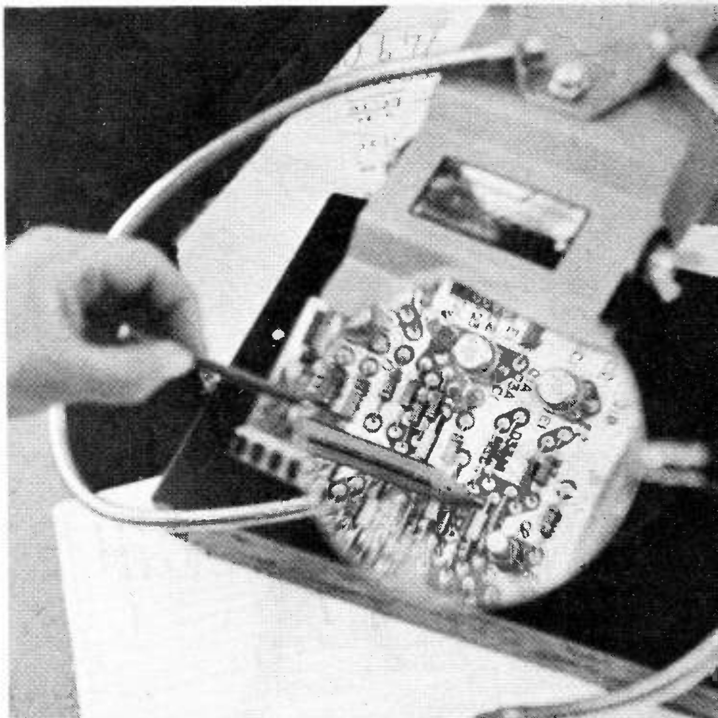
ELECTRONIC MILESTONES

Approaching the entrance to the Alexandra Pavilion visitors passed between two metallic objects each highly significant in technology terms. On the left, rising from the East Tower of the old Alexandra Palace, is the mast that radiated the world's first TV service. On the right, on the ground just before the entrance to the Pavilion, stands a 2-metre diameter dish aerial designed to receive Russian national TV programmes from a satellite hovering over the USSR.

Forty-four years of electronic history neatly symbolised by two aerials standing less than 100 yards apart in the grounds of Alexandra Palace, North London.





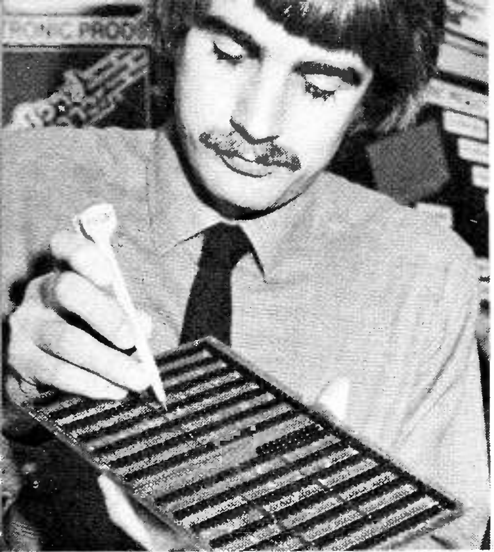


(Top left). Skulduggery by Holographic Developments. Holographer Ken Harris is pictured beside a dramatically realistic 3-D hologram.

(Top right). The family of robots being interviewed during the ITV telecast from the Fair.

(Left). An Army P.E. instructor advises a visitor before she attempts to break the speed record! This racing cycle was linked to a microprocessor to record the rider's speed.

(Above). All is perfectly clear through this magnifier, one of the attachments available for the Absoglen Minibench.



Bargains galore! Brisk business in the market place area.

(Left). The Roadrunner wiring system being demonstrated.

COMPUTERS

Talking of computers, the visitor could scarcely step in any direction without soon encountering the screen of a VDU alive with readout from one of the well-known personal computers.

There was no shortage of eager fingers to manipulate the keyboards, whether a game or a more professional problem was being tackled. It was not uncommon to see a youngster clutching his own hand written program eagerly awaiting the chance to try it out.

Maplin had a particularly impressive array of computers, including Atari, Vic and Dragon modules, and these attracted crowds. Roger Allen of Maplin reported a brisk trade in computers, software and publications.

Amongst other exhibitors featuring personal computers were Electrovalue, Chromasonic Electronics, Midwich, Kansas City Systems, SEDAC and Army Apprentice College, with some selling software and computer accessories.

COMPONENTS AND KITS

The constructor and practising designer or engineer alike had much to feast their eyes on. The whole gamut of electronic components was on display, as well as tools and instruments, materials and cases. If it was a new soldering iron you were after then a visit to the Light Soldering Developments stand was the place to call.

Bargain packs were offered by many components firms.

Calling in on the Bi Pak stand, Bill Baines informed us that apart from component packs, cases and their new ZON X-81 Sound Unit were in big demand.

The ZON X-81 is a sound effects box that plugs directly into the back of the ZX81 home computer. This allows the user to produce such sounds as: helicopters, lasers, explosions, space invaders, and so on.

Electronic kits provide a convenient alternative for the constructor in a hurry as well as for the less experienced to assemble. Some fine collections of kits were on display covering electronic gadgets such as musical doorbells to hi fi equipment. Vellerman, for example, offered a good selection of kits and furthermore had a working model of each on display so that the intending purchaser could see and try for himself the operation of a completed assembly.

Electronic ignition is still extremely popular judging by the sales reported by Peter Biddle of Sparkrite. Apart from an ignition system, they also market a comprehensive anti-theft device.

CATALOGUES

Apart from cash sales, most retailers disposed of considerable numbers of their catalogues. Taken away by visitors, these will be consulted time and time again in the coming months and many an order will be placed by this means. Indeed, some firms have already reported a large amount of business subsequent to the Fair that must be directly attributed to the selling power of the catalogue.

Maplin inform us they sold a few thousand copies of their mammoth opus. Another household name, Vero Electronics, gave away several thousand copies of their catalogue. Mrs Mary Pearce, who was in charge of their stand, told us they have high hopes of extending the uses of their well-known products as a result.

Talking of follow-ups, Global Specialities were delighted with the large proportion of professional enquiries and business buyers amongst visitors to the Fair. Managing director Tina Knight told us they are confident that large amounts of business will materialise from the nature of the enquiries at their stand.

Global's breadboard system, for one, attracted the attention of the professional and looks like being introduced into more than one industrial R&D department as a result. Global also report lively business in their educational kits. Dads were much in evidence buying these kits for their sons (a likely story!).

Global seized the opportunity (and challenge) offered by their commanding site at the front of the house: a warm introduction to the Fair was induced by the carefully arranged and festively decorated stand.

MARKET PLACE

One corner of the Pavilion was reserved for "small holders" of the electronic retail trade. Trestle tables laden with component goodies of all shapes and forms, and enticing bargain bags of capacitors and the like, attracted crowds.

Everyone likes a rummage, it seems! Except perhaps certain component retailers who felt that business on their stands had suffered as a consequence of the market trading area. The more typical view, however, was that the market area added a desirable touch to the whole scene, and since no-one can obtain *all* his requirements from these less orthodox trading pitches, the retailer with a wide selection of first class components will always be sought out.

WE THREE

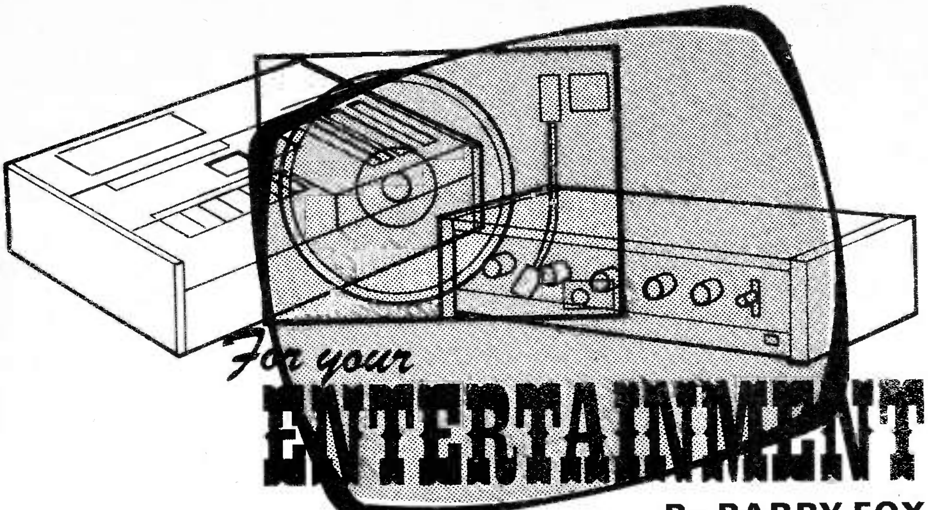
The centre piece in the Pavilion was a large circular stand shared by the three sponsoring magazines, PE, PW and EE. The EE stand featured the *Introducing Electronics* series for the beginner using solderless techniques, and this attracted considerable attention.

Another focal point was a small lathe under the control of the BBC Computer. Here visitors could see a length of plain wooden dowel being machined to a complex shape—the pattern being displayed on the VDU.

The five-digit combination lock provided a source of frustration to countless visitors as they strived to "crack the safe". However, we must congratulate Miss R. Mitchell of Gidea Park, Essex on showing her brother, and others on how it is done.

A new collection of test instruments for the hobbyist, musical effects units, computer add-ons and a variety of miscellaneous pieces of equipment were also on show.

Winning projects were demonstrated on the SEDAC stand by students from the successful schools in last year's competition. Considerable interest was aroused in this national competition for secondary schools sponsored by Mullard Ltd and Everyday Electronics, and requests for entry forms for the 1983 contest were frequent. □



By BARRY FOX

Mysteries Of Hi Fi

A fascinating gadget is being demonstrated by Sony at hi fi shows and trade exhibitions around Europe.

A transparent plastic case stands on a tape-recorder. Inside the case an ordinary audio cassette hangs suspended by a couple of thin black threads.

There's no visible drive for the suspended cassette, no playback heads and no electronic circuitry. But as you operate the controls of the tape-recorder underneath, the floating cassette runs, re-winds, fast winds and produces music through an unseen amplifier and loudspeaker. It's all very eerie.

In fact the demonstration is intended to show off the extraordinary small size of the tape drive mechanism used in a Walkman portable stereo. The two black threads suspending the cassette are electric wires which feed power to a Walkman drive motor attached to the underside of the suspended cassette. You can just see it if you peer underneath and up at the right angle.

The controls of the recorder underneath operate not only the main recorder drive, but also (via the threads) the unseen motor underneath the suspended cassette. So, as the main recorder re-winds, so does the suspended cassette, and so on.

The sound you hear is actually coming from the recorder, not the suspended cassette. So in some respects the demonstration is a phoney. But it's an interesting talking point, and it does prove the point that tape drive mechanisms are now incredibly small.

Jargon Generator

A few years ago I wrote about a computer jargon generator. Now there's a hi fi jargon generator. It's published, but so far only for the benefit of the trade, by Celestion Loudspeakers.

Like all jargon generators it's simple to use. There are three columns of technical terms, each with a number. At random you take one phrase from each column and drop it casually into a sentence.

Celestion reckon that any one of the 9000 permutations of hi fi expertise offered by their generator is enough to silence a hi fi salesman, confuse a friend, or serve as a basis for an impressive letter to a hi fi magazine. Here are a few examples:

"I am having trouble with my (1) transient (2) mosfet (3) bucket brigade". If that doesn't work you could try. "I've now got doubts about (12) digitally processed (16) comb filtered (7) linear interpolation.

Hot Shot

Pooled information will often solve problems you hadn't yet recognised.

Recently a chance remark by a studio engineer raised an interesting question. The studio had built a digital timer and clock from a package of chips. One day one of the junior engineers was idly playing with an anti-static pistol that's kept in the studio to clear the static from gramophone records after they have been wiped clean. He was "playing guns" with the pistol, pointing it close to the clock and squeezing the trigger. Soon afterwards the studio found that the clock wasn't working. All the chips had blown.

No-one will ever know for sure whether it was the ion stream from the pistol that blew the chips or whether there was some quite unrelated fault, like, for instance, a power supply failure. Since then I've tried gunning an old calculator with an anti-static pistol and it's done no damage. But there's a lingering doubt.

Have any readers ever encountered blown chips after using an anti-static pistol near them? If so, let's hear about it and pool information.

It's obviously important because more and more gramophone turntables now incorporate integrated circuits and microprocessors, and many people use anti-static pistols to clear the charge from a disc while it is sitting on a turntable.

Shopping In Tokyo

Digital Audio

I spent a few hours shopping in Tokyo recently, which is always an interesting experience.

Digital audio Compact Discs and players went on sale in early October. It's too early yet to say whether any are actually being bought. The price is low compared to that expected in Britain when Compact Discs go on sale in March 1983.

In Japan the price of a player is under £400 and discs around £7 each. It's likely that players will cost between £500 and £600 in Britain and the discs £10 each.

This is why many people feel that Compact Discs will take longer to take off here than the trade originally expected. It will be too expensive for all but the most dedicated hi fi enthusiast.

Video Disc

The Philips LaserVision video disc system has been on sale in Japan since October 1982. But it is backed over there only by Pioneer and it's very hard for any one company to do anything alone in Japan.

As a result LaserVision hasn't been selling well. This is also one reason why the rival VHD system, developed by JVC and backed by twelve Japanese companies, hasn't yet been launched.

Although many hi fi and video shops in Japan still have Pioneer LaserVision players on working demonstration, they don't seem to attract much interest. Neither, incidentally, did the Compact Disc demonstrations I saw. But this is probably because many customers in department stores and record shops where Compact Disc is being demonstrated, didn't really recognise the significance of what they were seeing and hearing.

Solar Power

The most interesting gadget I saw was a solar power pack, costing around £25. It's a panel of solar cells, with rechargeable Nickel Cadmium batteries, and in sunshine it delivers enough power to drive a portable radio or cassette player.

One shop was demonstrating it with one of the new portable Sony flat screen televisions. These cost a little over £100 and use a flat, squashed cathode ray tube similar to the type originally proposed by Sinclair of Britain. The rechargeable Ni-Cads keep the set running while the sun goes behind a cloud.

In-Car TV

Probably the daftest new development in Japan, is the craze for in-car television. I saw several electronics shops showing in-car TV systems. One even had a mock-up of a car with a hi-fi stereo and TV installed alongside the driver's seat.

I've always thought that pocket-portable TV's were a pointless extravagance. After, all who wants to watch TV while they are walking down a road. But the idea of anyone watching TV while they drive is really ridiculous.

RADIO WORLD

By Pat Hawker, G3VA

Exit The Pirates?

In *Radio World*—November 1982, in discussing the complex legal maze surrounding so much of our use of modern electronics technology, I observed that the Wireless Telegraphy Acts had fallen into disarray although new legislation was threatened.

Over recent years "pirate" (unlicensed) use of radio transmitters has multiplied many times over. Although there have been a number of successful prosecutions brought by the authorities, these have been rendered very difficult by what amounts to the need to catch offenders "microphone-handed" so to speak.

The 1967 Act, for example, made it illegal to import certain types of 27MHz CB equipment, but there proved to be glaring loopholes in the legislation and there was nothing to prevent the open sale and advertising of equipment that would have been illegal to import in working order or manufacture. Then again the fines imposed on "pirates" have often made it hardly worth the bother of bringing prosecutions.

Piracy

Apart from the continued sale and use of amplitude-modulated CB equipment, and equipment capable of operating outside the 40 UK 27MHz CB channels, there are many other forms of "piracy" including illegal operation that causes interference to broadcast services or other licensed users of radio frequencies.

These include the many "broadcast" stations on both medium-wave and v.h.f./f.m. that can be heard most weekends and evenings in many cities. In London some have been active for many years despite occasional prosecutions and seizure of equipment, often using tapes which are produced openly.

There are also a number of so-called "international CBers" using modern h.f. s.s.b. transceivers on frequencies between 6600–6700kHz. Then again there are the pirate or "bootlegger" stations who operate inside the amateur bands using the callsigns of licensed radio amateurs. (I have had the experience of listening to someone calling CQ de G3VA in execrable morse!)

There are the CBers who have been infesting the 28 to 29·7MHz amateur band using equipment designed originally for both amateur and CB use, or else modified for this band. There are also a number of misguided individuals who for some five years or so have taken a delight in interfering with and abusing the use of amateur 144MHz "repeaters".

All such pirates may soon be confronted with altogether tougher opposition.

Telecommunications Bill

In November 1982, terms of a new "Telecommunications Bill" were published. This is an extremely long and complex Parliamentary Bill aimed primarily at preparing the way for the "privatisation" of British Telecommunications, abolishing many of its monopoly powers and setting up a Director General of Telecommunications to license firms wishing to provide telecommunications services. But one part of this Bill—Part V, which runs to 150 pages—is concerned with amendments to the Wireless Telegraphy Acts 1949 to 1967 "and to make further provision for facilitating enforcement of these Acts".

While, of course, the Act may be modified during its passage through Parliament, the Bill as published promises to be very tough indeed on pirates and those causing interference to other services. In particular it proposes that the restrictions on specified apparatus should be extended to cover not only use and importation but also:

> Manufacture (whether or not for sale). Manufacture is defined as including "construction by any method and the assembly of component parts".
>
> Selling or offering for sale, letting on hire or offering to let on hire, or indicating (whether by display of the apparatus or by any form of advertisement) one's willingness to sell or let on hire.
>
> Having in one's custody or control. This is thus far more wide ranging than Section 7 of the existing 1967 Act and creates entirely new offences.

It is clearly aimed not only at stopping the sale of equipment which it would be illegal to use—but also at making "possession" of such equipment a breach of the law. It will also be possible to specify equipment by the use to which it is put, rather than the frequencies on which it can operate.

There are clauses relating to seizure and disposal of equipment; arrest without warrant; a clause making it an offence to obstruct intentionally the seizure of equipment.

There is little doubt that if Part V of the Telecommunications Bill becomes law in a few months time it will immensely strengthen the power of the authorities to clamp down on radio pirates and the use of unauthorised frequencies. This is long overdue, although in giving the State so much more power it does, or should, impose on the authorities an equal obligation that the licensing process should be reasonable and fair.

It also strengthens the case for amateur radio "novice" licences and legal low-cost "community" radio broadcasting.

Simple Radio—Costly TV

The advent of video cassette machines combined with rental of tapes (whether "pirated" or genuine) has tended to make viewers forget the very high cost of producing high-quality TV programmes. With VCR it may appear to cost only one or two pounds an hour to have your own programme.

In the talk about 30-channel cable TV networks, and whether these should be based on co-axial cable or optical fibres, most of the debate has been concerned with the cost of the network. Less attention has been given to the cost of worth while programmes and how much greater these would be than, for example, the making of radio programmes for local stations or national networks.

Production costs for cinema films can amount to millions of pounds for each hour of material; network television drama is costing £100,000 to £200,000 per hour or even more, while production costs of some TV commercials can reach £100,000 for 30-seconds, not including the cost of air-time. By comparison programme budgets for radio are usually modest in the extreme.

One reason is that radio programmes are produced much faster with far smaller production teams and far less hassle.

Recently I had personal experience of this while taking part in various TV and radio programmes. In each case what was required was a brief one-or-two minute session of off-the-cuff replies to questions.

The prime-time TV current affairs programme took up two mornings, including one morning with the full film production crew of eight people. The network radio spot, on the other hand, required a ten-minute visit to my office from a presenter/researcher with his own portable recorder. The local radio recording was a matter of an interview conducted over a noisy telephone line.

With the arrival of the integrated TV camera/recorders such as the RCA "Hawkeye" and the Sony "Betacam" it would in theory be possible to produce TV news and current affairs almost as simply as with radio's portable audio recorder. But there are many reasons why, even with such equipment, production costs are likely to remain far, far higher for TV than radio.

This is one reason why truly local TV is never likely to be possible to full broadcast-quality standards—even a tightly-budgeted TV national programme channel represents £100-million-plus per year in programme costs.

Everyday ELECTRONICS

MARCH 1983 ISSUE ON SALE FRIDAY, FEBRUARY 18

MARCH ISSUE

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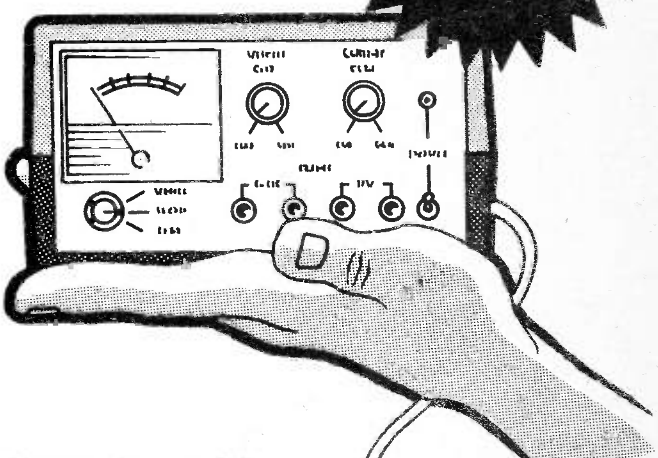

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THE ELECTRONICS OF IT INFORMATION TECHNOLOGY

PART FOUR

BY T.E. IVALL C.Eng., M.I.E.R.E.

ONE method of sending a number of different signals through a single common medium without mixing them up was described in last month's article on carriers. **Frequency division multiplex (f.d.m.)** makes use of the time of occurrence of electrical events (Part 1), as manifested in the different periods of the various oscillation frequencies.

Another technique for achieving the same result—putting byways on to highways, so to speak—uses time intervals more directly. Called **time division multiplex (t.d.m.),** it is now taking over from f.d.m. in trunk telecommunications and becoming increasingly important in local data transmission.

The whole purpose of multiplexing is to keep line and cable installations fully loaded with information so that they are utilised economically. In this way we save space, materials and money. But first a small digression on the subject of timing.

IMPORTANCE OF TIMING

In your bank account the presence or absence of a mere "0" at a particular position on paper can make a lot of difference to the size of your balance or your overdraft. All digitally represented information is sensitive in this way. When such information is electrically transmitted from place to place, what then becomes significant is the occurrence or non-occurrence of an electrical symbol (for example, voltage or current value) at a particular *time*. Small variations in the value of the electrical quantity itself make no difference at all to the situation: what matters is whether the symbol is there or not there.

So in the digital electronics of **IT** systems the timing of electrical events is all-important. Indeed it is only through the relative timing of the electrical events that digital signals carry any meaning at all. Some of these relationships are internal to a given item of information. For example, in transmitting sequentially the group of binary digits 1101, the whole meaning of the group could depend on whether you start with the least significant digit or with the most significant digit.

The timing of the electrical events can also be in relation to some outside time reference such as an electronic clock.

The electronic clock is, in fact, a prominent feature of many digital **IT** systems. Often in the form of a crystal controlled pulse generator, it measures out the precise intervals of time in which the electrical values representing digits are permitted to occur. It's rather like an orchestral conductor—or more prosaically a metronome—defining the beat of a piece of music and hence the duration of its bars. Into the intervals so defined the performers insert notes and rests (the information) to produce sounds with a formal rhythmical structure and therefore a meaning as music.

Multiplexer for data communications made by Racal-Milgo. This is a statistical multiplexer (see text) which takes data from up to 32 sources and issues the interleaved information sequentially on a single line at speeds up to 19,200 binary digits per second.

TIME SLOTS

A t.d.m. transmission system, as sketched in Fig. 4.1, makes use of these "time slots". It assigns the common path successively to the different signals by allocating different time slots to pieces of these signals. You have a simple mechanical analogy right in front of you. Spread out the fingers of your two hands. The left-hand fingers represent time slots available for signal L (imagine a line across the base of the fingers as the time scale) and similarly the right-hand fingers represent time slots for signal R.

Place your two hands together so that the fingers of one hand are positioned between the fingers of the other. The finger time slots are now interleaved and so provide the timing conditions for multiplexing signals L and R.

INTERLEAVING

A rather more advanced analogy will show the interleaving of more than just two signals. Imagine the heads of several garden rakes laid on a table with the prongs pointing upwards. Line them up one behind the other so that the sets of prongs are staggered with respect to each other, as shown in Fig. 4.2(a). If you now view all the prongs from the side at table level they will appear interleaved as shown in (b).

What emerges clearly from (b) is that the time slots available for each individual signal are spaced some distance apart on the analogue of the time scale. How, then, can they be used to convey the information in the signal?

If we want to send an analogue signal like a speech waveform, it can be sampled at intervals corresponding to the occurrence of the time slots for that signal (see discussion on pulse code modulation in Part 2). But the t.d.m. system must be designed so that for each signal the intervals between time slots, and hence the sampling rate, will convey all the information we require (see relevant footnote in Part 2).

If, however, the signal consists of discrete binary digits, as in data transmission, this digital data can be generated at a rate that fits into the time slots available in the t.d.m. system (for example, eight digits per slot).

Figure 4.2 is only a rough analogy. In using the rake prongs to represent the time slots it suggests, wrongly, that there are gaps between the t.d.m. time slots. In reality the time slots follow directly after each other. In Fig. 4.2 you could convey this continuity by imagining the gaps to

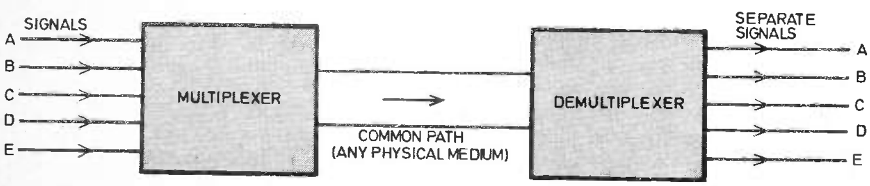

Fig. 4.1. Outline of a multiplex transmission system, for sending a group of separate signals (A to E) along a common path without mixing them up. In time division multiplex, portions of the separate signals are taken in turn, interleaved and transmitted in a continuous sequence along the common path.

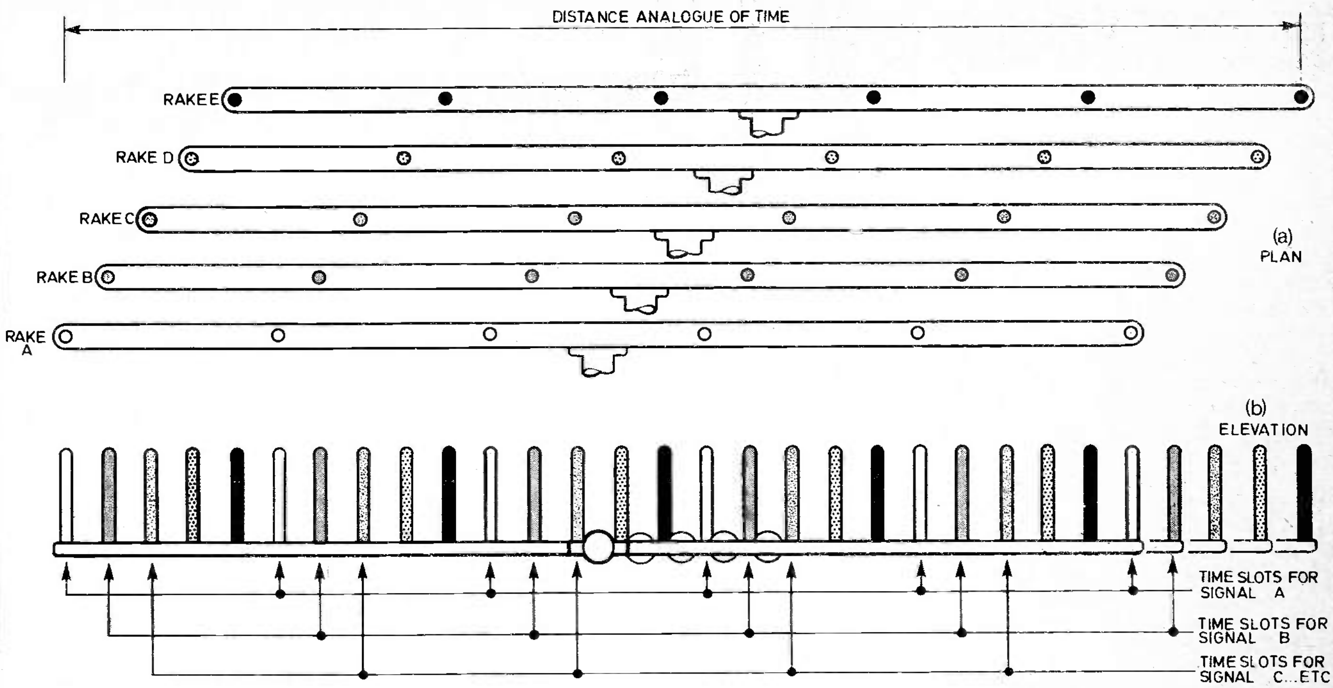

Fig. 4.2. Mechanical analogy of interleaved time slots: (a) a view looking down on a group of five garden rake heads with the prongs pointing upwards; (b) a side view through all the rakes showing the interleaving of the five sets of prongs. Distance along the rakes is an analogue of time. Each set of prongs represents a sequence of time slots for conveying one signal.

be completely closed up by fatter prongs—or more rakes. The actual electrical conditions on the common path of a t.d.m. transmission system are something like Fig. 4.3—though the voltage steps will not be so sharp, for reasons to be explained later in the series.

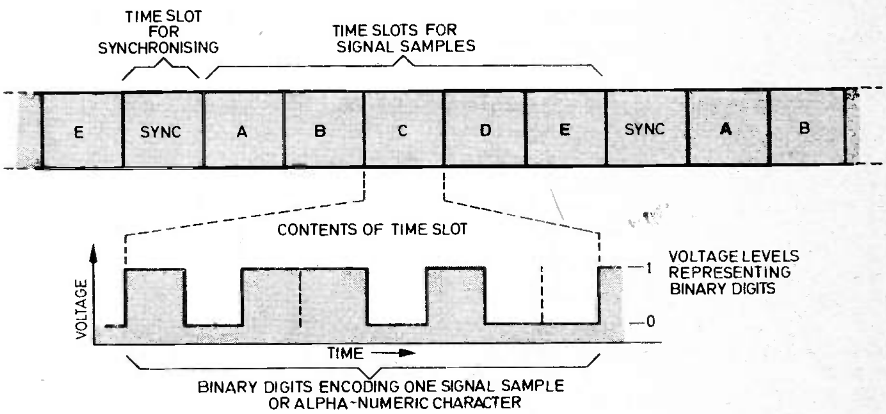

Fig. 4.3. Successive time slots for portions of the five signals A to E in Fig. 4.1, with one extra slot per group to carry synchronising information. Each signal's time slot contains a group of binary digits formed from two voltage levels. These groups are binary coded samples of analogue signals (for example voice) or codes for alpha-numeric characters (for example data transmission).

ELECTRONIC HARDWARE

But how are the time slots shown in Fig. 4.3 actually established in the electronic hardware? It is simply a matter of switching the common path in Fig. 4.1—whether twin-wire circuit, coaxial cable or optical fibre—to carry a piece of each signal in turn. The highway scans the byways, accepting their offerings one by one.

The principle can be illustrated by the analogy of a railway with a single-track section which takes trains coming from the "up" and "down" pairs of lines. This is operated by points, shown as selector switches in Fig. 4.4. Imagine, however, that the arrangement is not being used normally for trains going in opposite directions (trains *P* and *X*) but for trains going in the same direction (trains *P* and *Q*).

For the time that the points are switched to line 1 as shown, train *P*, representing an encoded signal sample, can travel from one end of line 1 to the other. This is one time slot. When train *P* has completed the single track part of its journey, both sets of points are switched over to line 2. For the time they are in this position, train *Q*—representing a piece of another signal—can travel along the common track in a similar way. This is another time slot.

And this imaginary railway could of course be extended to allow the common single track to take trains from further lines, as indicated by the chain lines in the diagram. The right-hand set of points acts like the de-multiplexer in Fig. 4.1.

So the time slots are defined by the actions of the points at each end of the single-track section. In the real t.d.m. system the time slots are similarly defined by electronic switches at both ends of the common highway in Fig. 4.1. But to make sure that all the pieces of signals go to their right destinations (for example, that train *P* goes back on to line 1 and is not switched to line 2) the two electronic switches must work in exact synchronism.

SYNCHRONISING

In Fig. 4.4 the two sets of points could be automatically operated together, at regular intervals, by a common electrical equipment controlled by a clock, as shown at the bottom of the diagram. The t.d.m. system in fact uses its electronic

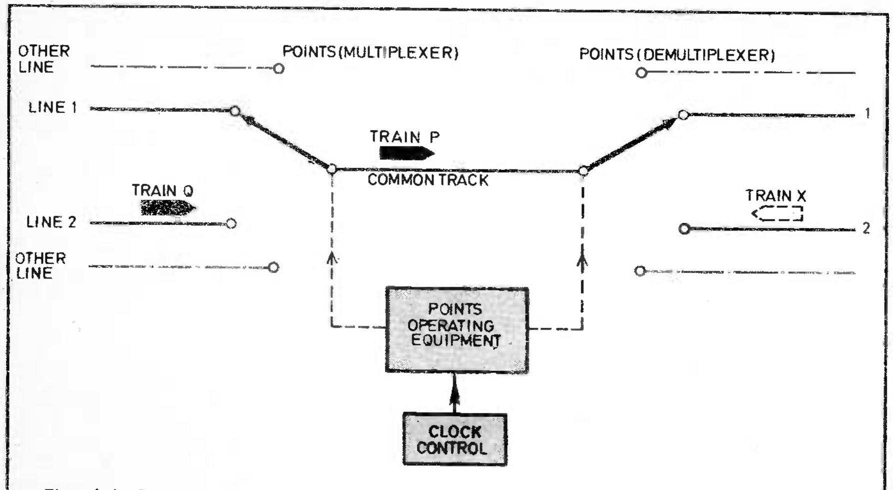

Fig. 4.4. Railway analogue showing how coded samples from several different signals are interleaved into successive time slots by electronic switching. The left-hand set of points corresponds to the multiplexer in Fig. 4.1 while the right-hand set corresponds to the demultiplexer.

clock to synchronise the switches. This process takes the form of synchronising pulses sent along the common path by time division multiplexing just as if they were portions of actual signals, as shown in Fig. 4.3.

In telecommunications this t.d.m. principle is employed throughout the world for pulse code modulation trunk transmission systems (see Part 2). More locally it is being used to allow a number of terminals to work into a remote computer via a single telephone line. A "statistical multiplexer" is one that takes advantage of any inactivity in signals to fill up the otherwise empty time slots with information from other, active signals, thereby increasing the number of signals that can be multiplexed for a given rate of transmission along the common path.

BUSES AND INTERFACES

To transmit information between electronic units we must make sure that what comes from the output of one unit is effective as an input for another unit. It is not only a matter of getting the wires, plugs and sockets right but ensuring that the electrical representation of the information on these conductors is compatible with the functioning of the units connected. If communication is to be achieved the "talker" must first make himself heard to the "listener". Then he must use a language that the listener can understand.

If a single manufacturer designed and produced all the units concerned he could make sure of these requirements himself. But because **IT** equipment is introduced by different firms at different times in the development of the technology there is a real problem to deal with. For example, we might need to connect together a computer, modems (Part 3), a multiplexer and several terminals of different kinds—all of which could come from different makers.

STANDARD INTERFACE AND BUS

A sensible way of dealing with this problem is to have a standardised method of connection and information transmission that will cover all eventualities. This is the reason for the emergence of the standard interface, as it is called, for connecting separate units, and the standard bus*, for connecting internally the different parts of a single equipment.

Typically, the interface is used for connecting terminals to a computer, while the bus is used inside a computer to transfer information between its central processor, its memory and its input and output devices. (The distinction between them is not rigid, however. One widely used connecting system, for example, is called the General Purpose Interface Bus.)

But because technology develops as an historical process influenced by commercial pressures, there is no single standardised interface and no single standardised bus. Instead we have a *number* of "standard" interfaces and buses, most of them originated by manufacturers or their trade associations. Nevertheless a few of them have been accepted world-wide and ratified by international bodies—which helps to avoid the utter confusion that would otherwise occur.

Although buses and interfaces can be very complicated in their electrical and mechanical detail they are simple in principle. They all depend on the three aspects of an electrical quantity—magnitude, position and time of occurrence—that are used throughout **IT** to represent and convey information (see Part 1). The position of the electrical quantity is, of course, the particular conductor on which it occurs; the magnitude is, typically, a voltage or current; and the time of occurrence is when that voltage or current acts as an electrical symbol.

In this article we are mainly concerned with digital information. For analogue signals it certainly helps to standardise your system of connection between units, but the magnitude and time aspects of the electrical quantity are not so critical. One need only specify ranges of, say, amplitude and frequency to transmit information successfully between units.

SERIAL AND PARALLEL SYSTEMS

So in digital systems, magnitude, position and time are manipulated by engineers to produce different kinds of "standard" buses and interfaces. For practical and economic reasons two main groups have emerged: serial and parallel. In serial systems the different magnitudes of the electrical quantity are sent one after the other. In parallel systems the different magnitudes are sent simultaneously.

As an analogy, consider the process of reading this magazine. The individual words (or perhaps small groups of words) forming a sentence enter the eye and brain serially. When one looks at a diagram, however, the component parts of its two-dimensional pattern are perceived simultaneously—in "parallel".

Videotex systems (formerly called Viewdata in the UK) send digitally-encoded information along telephone lines using the serial method shown in Fig. 4.5(a). This videotex business terminal made by Pye TMC can be used with the public Prestel service or in private information retrieval systems. (In Prestel, digital information is sent from the computer data base to the terminal at a rate of 1200 binary digits per second; from terminal to data base at 75 binary digits per second.)

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* The term "bus" is of course an abbreviated form of the Latin *omnibus*, meaning "for all" (cf. "busbar" in electrical engineering).

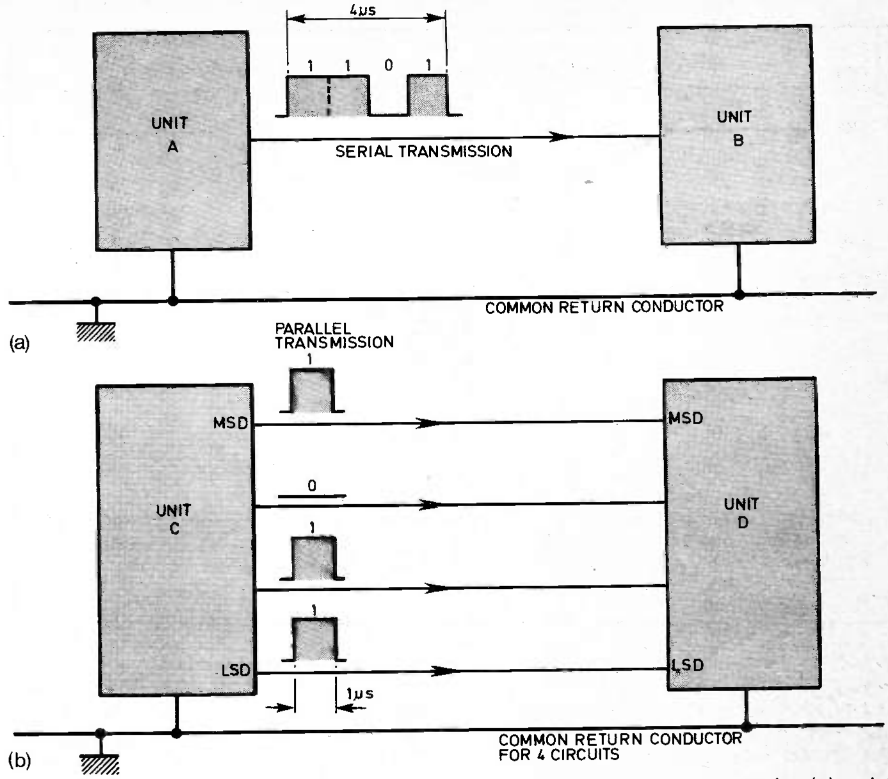


Fig. 4.5. Two ways of transmitting the group of binary digits 1011 between units: (a) serial transmission on a single circuit, the electrical values representing digits following one after the other; (b) parallel transmission, with the four electrical values sent simultaneously on four separate circuits. Assuming equal durations of digit signals, (b) is much faster than (a). Note in (a) that the least significant digit (l.s.d.) is sent first and the most significant digit (m.s.d.) last.

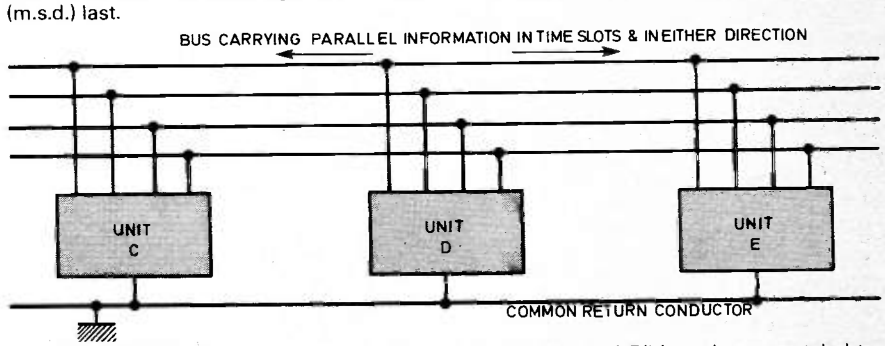


Fig. 4.6. Parallel connections between Units C and D in Fig. 4.5(b) are here extended to a further electronic unit, Unit E. The connections become a bus, or common highway, which, by suitable time-sharing arrangements, can carry parallel information in either direction between any of the units. More units could be connected to the bus on the same principle.

For serial transmission only one electrical circuit is needed to connect electronic units—the type of simple information path discussed in Part 3. For parallel transmission there have to be several such circuits between the units. Fig. 4.5 is a comparison between these serial and parallel methods of representing and conveying an item of information—here a number, or other character, encoded as the binary digits 1011.

In the serial case (a) the electrical magnitudes representing these four digits can only be sent one after the other through the single circuit connecting Units A and B. In the parallel case (b), however, all four electrical magnitudes representing the digits can be sent simultaneously on the four circuits (which share a common return conductor) between Units C and D.

So if each of the successive electrical symbols for the digits has a duration of 1 microsecond, the serial system (a) will take 4 microseconds to send the whole character while the parallel system (b) will take only 1 microsecond to send it.

This illustrates the general point that serial systems are slower in transmitting information than parallel systems. But in practice the single circuits of serial systems are extremely useful as interfaces because our existing telephone networks, both public and private, usually end up in simple pairs of wires running to individual instruments in homes, offices and factories. These single pairs are used in **IT**, for example, to connect terminals to distant computers or to connect facsimile machines to each other.

SHORT DISTANCES

Where the distances between units are short and the cost of installing many parallel circuits is not very high, the system in (b) can be utilised, to take advantage of the high speed of information transmission it allows. In practice this means connections within a machine (for example, a computer) or within a room (example, test instruments working automatically together). The multiple conductors required are sometimes on printed circuit boards, sometimes in flat flexible cables.

Associated with these interfaces and buses one finds electronic devices which allow serial information to be converted to parallel information and vice-versa. An integrated circuit commonly used for this purpose is the **"universal asynchronous receiver-transmitter (u.a.r.t.)"**.

Figure 4.5(b) could be an elementary bus. Practical buses in **IT** are, however, extremely complicated devices. One commonly used in microcomputers, for example, has 100 conductors altogether. Some of its circuits carry encoded characters (data), some convey encoded information on the storage locations of characters (addresses) and others carry control signals.

A bus provides a means for several different units to be connected to a common highway, as shown in Fig. 4.6, allowing two-way transfers of parallel information (in Fig. 4.5(b) form) between the various units. But electrically only one transfer can take place at a time, so there have to be careful arrangements for time sharing using clock-defined "time slots" as described earlier.

MICROPROCESSORS

Within a microprocessor, for example, where parallel information is continually being transferred between storage registers, a bus is electronically switched, in each time slot, to connect the output of one register to the input of another register. Buses are essential to **IT** systems using microprocessors, partly because these devices are designed to work with parallel information and partly because the small physical size of integrated circuits limits the number of pins that can be put on them and so makes the time sharing of a common set of conductors absolutely necessary.

Even a standard interface based on the serial principle in Fig. 4.5(a) can be quite complicated in practice, as conductors for sending characters are not sufficient in themselves. Other circuits, carrying monitoring and control signals, are needed to ensure that the units at each end—say teleprinters—are in proper electrical contact and operating in synchronism (compare with time division multiplex). As an example, the V.24 international standard serial interface (known also as RS232C in the USA) provides 25 conductors to cope with all the functions that may be required.

To be continued

Everyday News

HEADACHE CURE

A unique new instrument from Canada promises to assist sufferers from tension headaches and is now being marketed in the UK.

Working on biofeedback principles, the Antache instrument has been developed for research, clinical and home use. It consists of a pair of headphones and electronic circuitry to which is attached an elasticised headband and electrodes.

In operation, the Antache continuously monitors and averages the wearer's electromyogram (EMG) and converts it into a pleasantly modulated tone. Using the pitch of this tone as a guide, it is claimed that the user soon learns how to relax the muscles in the scalp, face and neck which, when they become too tense, bring on the symptoms of tension headaches.

Providing the headache condition has first been diagnosed by a medical doctor and provided, too, that the doctor has approved the use of the device for the patient concerned, the Antache is quite safe for use in the home.

The major advantage of using biofeedback principles for the treatment of headaches is that, unlike drugs, there are no side effects and the user is not restricted in his activities immediately following treatment.

For more details of the Antache, readers should contact: Beam Components Ltd., Dept. EE, 108 High Street, Strood, Rochester, Kent ME2 4TR.

Video games Shock

Video games help kids co-ordinate manual and visual skills. No doubt. But games manufacturers in the USA are reeling after a shock attack by opponents who claim on psychiatric grounds that as most kids prefer violent rather than educational games, they breed acceptance of violence as the norm.

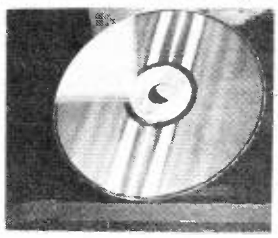
OVERTAKEN

Cars, until now the largest in money terms of Japanese imports into the UK, have been overtaken by video-cassette recorders. But discussions between the UK Department of Industry and Japan's Ministry of International Trade and Industry may result in establishment of manufacturing plants in the UK, possibly as joint ventures with UK companies, in the hope of stemming the import flood.

LASER-FI

Playing your favourite pop or classical disc takes on a new meaning with the announcement from Pioneer of the introduction of the Laser-Disc LD1100 player.

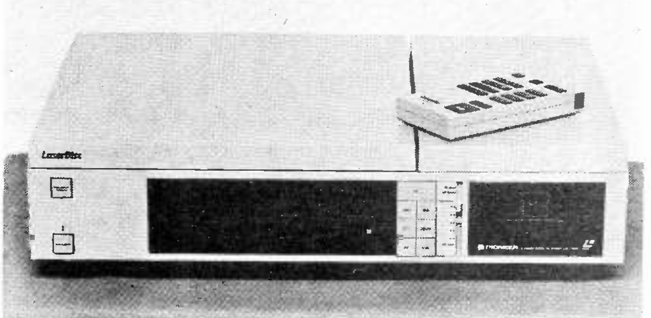
Launched just in time for Christmas, the new player uses a laser beam to read a special disc and reproduce both hi fi stereo sound and "action" video pictures. It is claimed that the sound reproduction is on par with, or better than, f.m. radio and that picture quality is equal to "off-air" broadcasts.



Over 54,000 individual video frames are contained on each side of the acrylic encased disc and a random access facility enables the user to locate and "freeze" any individual frame. Slow motion operation is also possible.

Unlike the audio stylus the optical laser system makes no physical contact with the disc so there is no deterioration in sound or visual quality, no matter how many times the disc is played.

Additional user benefits claimed for the player include a CX noise reduction system and the facility to link with teletex and interface with computers.



Cash Mountains

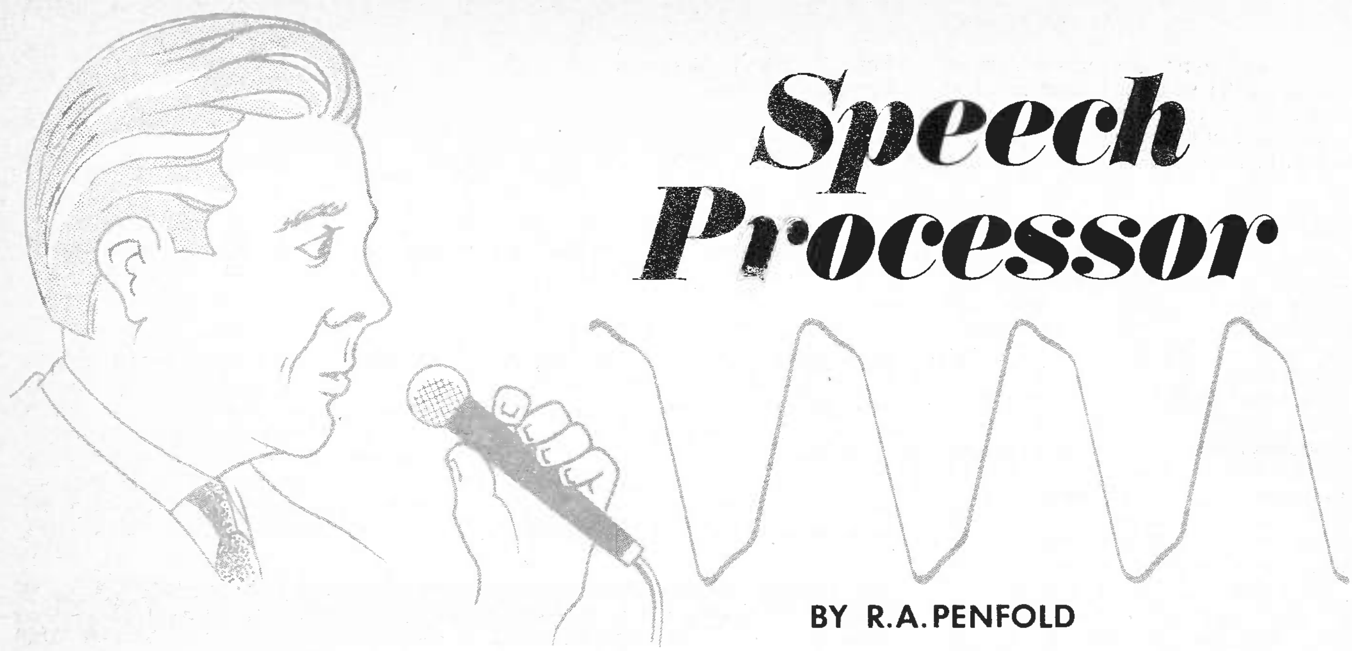
Leading British electronics manufacturers continue to beat the recession with growing order books and even money in the bank. Biggest cash mountain is at GEC with more than £1 billion. In comparison Plessey's liquidity is more like a molehill at £180 million following a 30 per cent rise in profits.

Cash in hand means takeover possibilities such as Plessey's recent acquisition of Stromberg Carlson in the USA.

Solar Flight

Lockheed Missiles and Space is reported to have developed an aircraft powered entirely by solar cells.

With a wing span of up to 300ft with the upper surface covered with solar cells it is claimed to fly non-stop for months at an altitude of 70,000ft. Payload is only 100lb, sufficient for a spy-in-the-sky camera and associated radio telemetry and control equipment.



Speech Processor

BY R.A.PENFOLD

BOOSTS AVERAGE LEVEL OF SOUND WITHOUT INCREASING PEAK LEVEL
SUITABLE FOR CONNECTION BETWEEN MICROPHONE AND AMPLIFIER

A SPEECH processor is a device which is used to process a speech signal in such a way that the strength of the signal is effectively boosted without any increase in the peak level of the signal.

Units of this type rely on the fact that a speech signal has a rather high peak level when compared to the average level, and the increase in "talk power" can be obtained by boosting the signal but clipping the peaks so that there is no increase in the peak level. Thus the peak level remains unchanged, but the average signal level is greatly boosted, and the volume of the signal is effectively boosted by a substantial amount.

Speech processors are mainly used in communications equipment; sometimes as an integral part of a transceiver, and sometimes as an add-on unit which connects between the microphone and the transceiver. Speech processors can also be used to good effect in other types of equipment, such as a public address system.

The unit described here is a reasonably simple but effective device which is battery powered, and is simply connected between the microphone and the transceiver or other equipment. It is intended for use with a high impedance dynamic microphone or an electret type, having a built-in step-up transformer, and this should present no problems since most communications and PA microphones are the high impedance dynamic type.

PROCESSOR SYSTEMS

There is more than one way of obtaining the limiting of signal peaks, and one method is to use a form of automatic gain control circuit. Here the processor adjusts the level of gain so that it is automatically reduced during periods of high dynamic level and increased during periods of low dynamic level.

This obviously gives the required narrowing of the difference between the peak and average signal amplitudes, but the circuit must be designed to respond very rapidly to changes in signal level if it is to be of real benefit. This can easily result in the signal waveform being seriously distorted with a lot of distortion being evident on the output signal.

Slower response times give reduced distortion, but also give a reduction in effectiveness. Of course, a certain amount of distortion is quite acceptable in this application, but more than several per cent distortion would impair the intelligibility of the processed signal and obviously reduce the benefit of the unit.

DISTORTION REDUCTION

A very simple method of speech processing is to use a clipping circuit which prevents the output signal voltage from exceeding a certain level. The circuit is adjusted so that most of the signal is below the clipping level and is unaffected by the unit, but so that the high signal peaks are held down and kept well below their normal level.

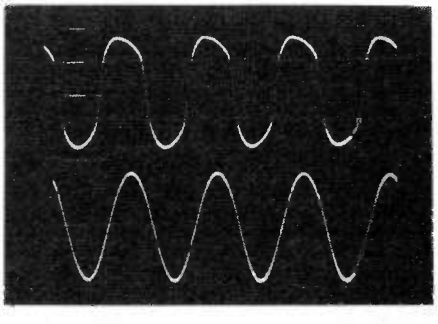
This system has the advantage of simplicity plus instant attack and decay times, but in this basic form it produces quite high levels of distortion. The distortion products produced consist mainly of harmonics, and harmonics are simply multiples of the frequencies in the clipped signals.

In order to obtain really good results from a clipping circuit it is necessary to include additional circuitry to minimise the distortion generated. The most sophisticated method of achieving this is to use an r.f. clipping circuit, and with this system the input signal is first processed to raise all the input frequencies by a substantial amount so that they are increased into the radio frequency (r.f.) range.

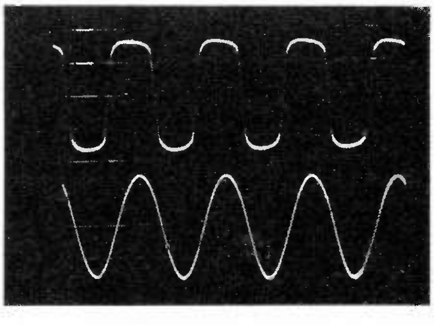
For example, the input frequencies could be raised by 100kHz, and then they would be at frequencies from just over 100kHz to about 120kHz. After clipping, harmonics would still be generated, but these would be at frequencies of about 200 to 240kHz, 300 to 360kHz, 400 to 480kHz, and so on. These are well clear of the input frequency range, and can be filtered from the output to leave a distortion-free signal which is then processed to restore the original audio frequencies.

The severe drawback of this system is

Upper Trace: Soft-limited sinewave. Lower Trace: 800Hz sinewave input signal.



Upper Trace: Hard-limited sinewave. Lower Trace: 800Hz sinewave input.



the cost and complexity, unless it is an internal part of an s.s.b. transmitter. For use with other types of equipment an add-on processor of this type could cost more than the main item of equipment!

SIMPLIFIED DESIGN

What is needed is a simpler method of obtaining a similar effect, and a system of this type is used in the processor described here. Fig. 1 shows the arrangement used in this processor in block diagram form.

The microphone signal is first amplified and then fed to a further stage of amplification by way of a variable gain control. This amplification is needed because the output of a microphone is at a fairly low amplitude, and it is not easy to produce a clipping circuit which operates at such low signal levels.

The signal is therefore boosted to a level where clipping can be achieved more readily. The gain control enables the unit to be adjusted to give the desired degree of clipping.

The next stage is a high pass filter, and this removes the lower frequencies in the signal. Frequencies below about 300 hertz contribute nothing to intelligibility, and can even impede it. These frequencies would be most troublesome if not removed as they would produce numerous harmonics right through the middle and upper audio range when the clipping was applied, and the removal of these frequencies substantially reduces the distortion level at the output.

SOFT CLIPPING

Distortion can be further reduced by using a soft clipping circuit rather than a normal hard clipping type, and so a soft limiter is used here.

The difference between the two is that a hard limiter permits no significant increase in the output level once the clipping level has been reached, no matter how large the input signal is made, whereas a soft limiter permits a slight increase in the output amplitude as the input is increased above the clipping threshold.

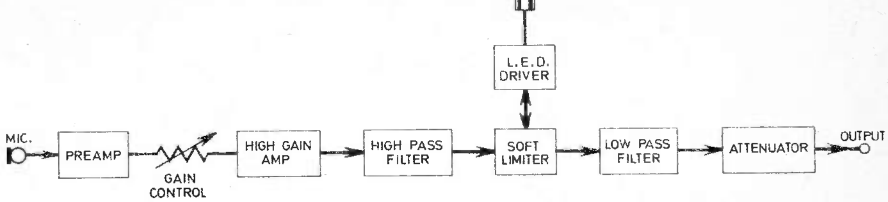
The use of soft limiting gives only a very marginal reduction in efficiency, and the fundamental signal is significantly stronger and the harmonics significantly weaker when compared to results using a hard limiter.

A l.e.d. indicator is switched on while the limiter is driven beyond the clipping threshold, and this makes it much easier to adjust the gain control correctly.

Most of the harmonics on the output signal will be at frequencies of about 3kHz and above, and frequencies in this range aid the intelligibility of a speech signal very little. A low-pass filter at the output of the unit is therefore used to severely attenuate signals at these frequencies, thereby greatly reducing the level of distortion on the output.

The final section of the unit is simply an attenuator which reduces the output level to one that is comparable to the

Fig. 1. Block diagram of Speech Processor.



input signal level. This enables the processor to be connected between the microphone and the main equipment without introducing any compatibility problems.

This system does not completely eliminate distortion from the output since some input frequencies (those at about 300Hz to about 1·5kHz) will be fed to the limiter and will produce at least one distortion product that will not be removed by the low-pass filtering at the output. However, the distortion is kept down to acceptable levels provided an excessive amount of clipping is not employed, and the unit certainly seems to make a very

COMPONENTS

Resistors

R1	47kΩ	R12	560Ω
R2	15kΩ	R13	180kΩ
R3	15kΩ	R14	1kΩ
R4	270kΩ	R15	100kΩ
R5	2·7MΩ	R16	100kΩ
R6	6·8kΩ	R17	3·9kΩ
R7	22kΩ	R18	3·9kΩ
R8	220kΩ	R19	3·9kΩ
R9	220kΩ	R20	3·9kΩ
R10	4·7kΩ	R21	4·7kΩ
R11	4·7kΩ	R22	470kΩ

All $\frac{1}{3}$ watt carbon ±5%

Potentiometers

VR1	22kΩ log. carbon potentiometer
VR2	47kΩ 0·1 watt horizontal preset

See Shop Talk page 85

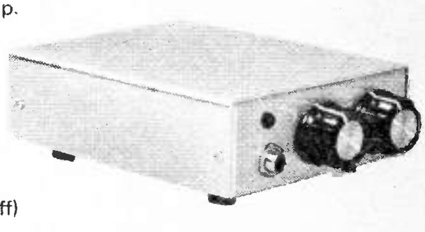
Capacitors

C1	100nF polyester (C280)
C2	47nF polyester (C280)
C3	330pF ceramic plate
C4	1μF 16V elect.
C5	0·47μF 10V elect. radial leads
C6	220nF polyester (C280)
C7	10nF polyester (C280)
C8	10nF polyester (C280)
C9	0·47μF 10V elect. radial leads
C10	47pF ceramic plate
C11	100nF polyester (C280)
C12	22nF polyester (C280)
C13	3·3nF ceramic plate
C14	10nF polyester (C280)
C15	2·2nF polystyrene
C16	120pF ceramic plate
C17	22nF polyester (C280)

COMPONENTS approximate cost £10

Semiconductors

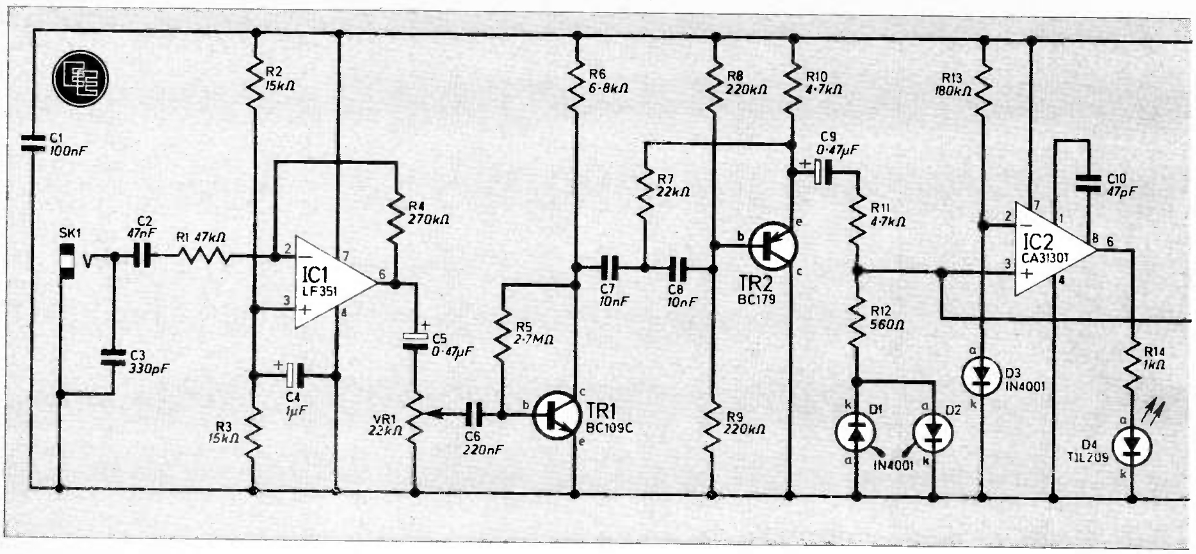
IC1	LF351 j.f.e.t. op. amp.
IC2	CA3130T MOS f.e.t. op. amp.
TR1	BC109C *npn* silicon
TR2	BC179 *pnp* silicon
TR3	BC109C *npn* silicon
D1,2,3	1N4001 (3 off)
D4	TIL209 3mm red l.e.d.

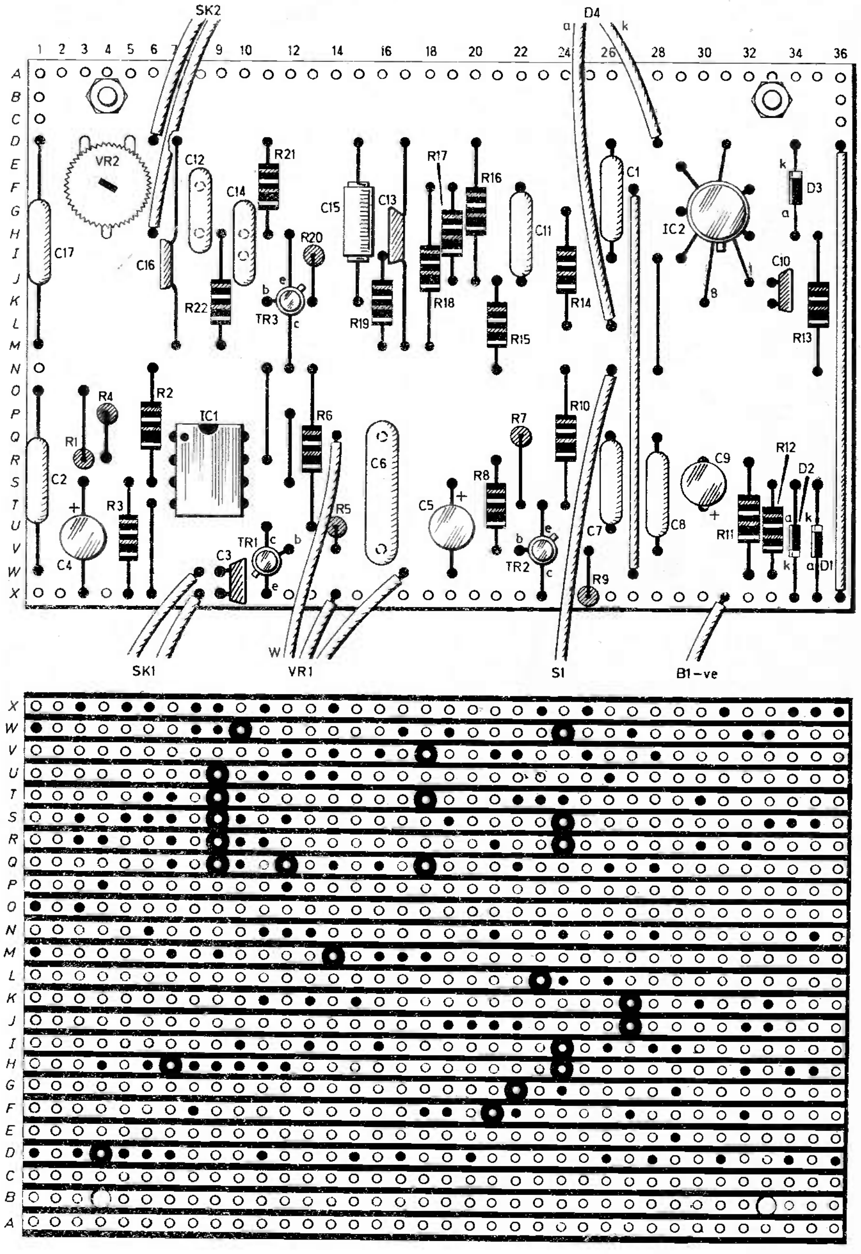


Miscellaneous

S1	Rotary on/off type
SK1,2	Standard jack sockets (2 off)
B1	9V PP3 battery

Aluminium case type AB10, 133 × 102 × 38mm; 0·1 inch matrix stripboard, 24 strips × 12 holes; two control knobs; panel holder for D4; battery connector; two 6BA fixings; two 6mm spacings; p.v.c. insulated connecting wire.





worthwhile improvement when used with communications equipment under adverse operating conditions.

Of course, if conditions are such that proper contact is easily achieved with no interference and good signal strengths, there is little room for improvement and a speech processor can be of little help. It is only when conditions are poor that the effect of a speech processor will become apparent.

THE CIRCUIT

Fig. 2 shows the complete circuit diagram of the Speech Processor.

IC1 is an operational amplifier used in the inverting mode and this acts as the microphone pre-amplifier. This stage has its voltage gain set at a modest level of about six times by R1 and R4, and R1 also sets the input impedance at a suitable level of about 47kΩ.

C3 is an r.f. filter capacitor and helps to prevent problems with r.f. breakthrough and consequent instability if the unit is used in a strong r.f. field.

IC1 is a low noise device having a j.f.e.t. input stage and this gives the unit a good signal-to-noise ratio.

VR1 is used to control the degree of clipping and the output from its wiper is fed to a high gain common emitter amplifier which uses TR1 in the standard configuration. The gain of IC1 together with the gain provided by TR1 enables the microphone signal to be readily boosted to a level of several volts peak-to-peak, and this is sufficient to drive the clipping circuit.

SIGNAL CONTROL

The high-pass filter is an active type which uses the Sallen and Key configuration and has a nominal attenuation rate of 12dB per octave below the 300Hz cut off frequency. There is unity gain through this stage at frequencies of 300Hz and above.

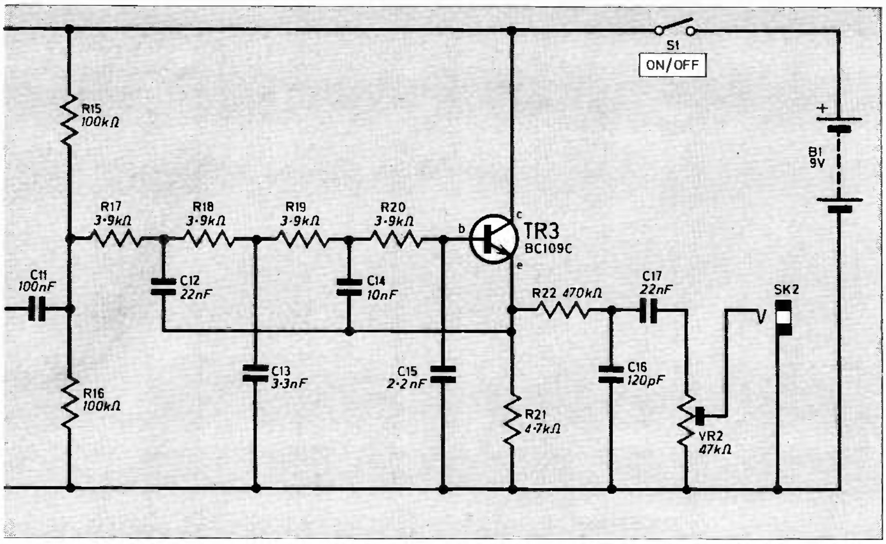


Fig. 2. Complete circuit diagram of Speech Processor.

D1 and D2 are used as the basis of the clipping circuit, D1 processing negative half-cycles and D2 processing positive ones. If the input signal level is less than about ±0·5 volts neither D1 or D2 will conduct and the signal can pass straight through R11 to the next stage of the unit.

If the signal level should exceed about 0·5 volts, either D1 or D2 (depending on the polarity of the signal) will be biased past its forward threshold voltage and will conduct heavily. This produces a voltage drop through R11 which tends to hold the signal voltage at little more than 0·5 volts even if the input level should be much more than this.

R12 introduces the softening of the clipping action since a current flowing through D1 or D2 must also flow through R12 as well, producing a small voltage across R12, which is proportional to the current flow. Thus the output signal at the junction of R11 and R12 can go slightly above the clipping threshold and the soft clipping is obtained.

◀ Fig. 3(a). Topside of stripboard showing component layout.

◀ Fig. 3(b). Underside of stripboard showing breaks in copper strips.

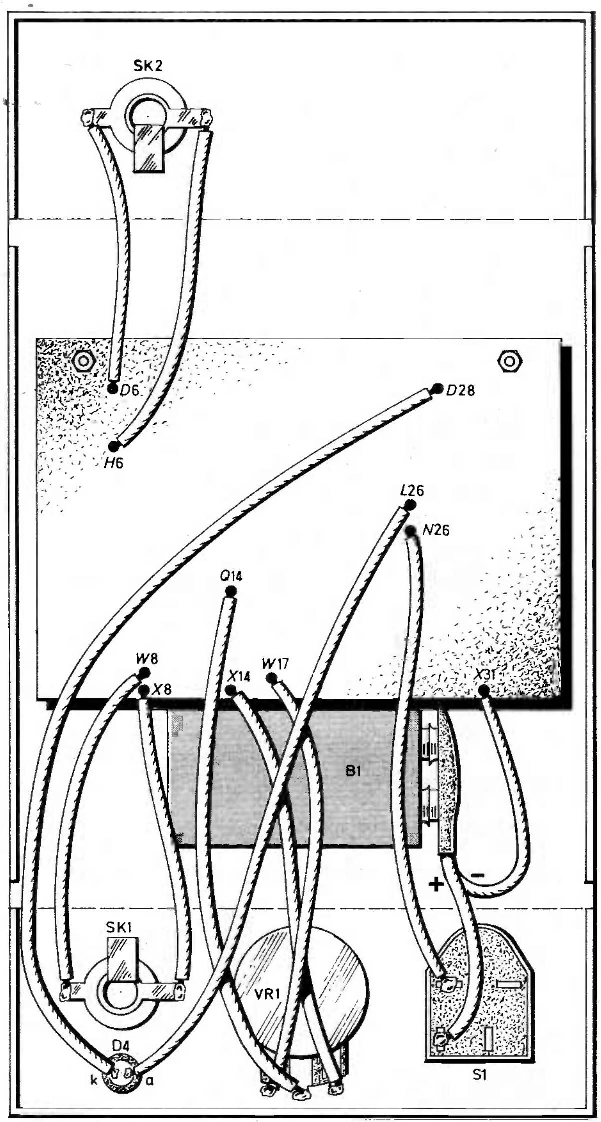


Fig. 4. Exploded view of unit showing interwiring for off-board components.

CLIPPING INDICATOR

IC2 is used as the l.e.d. driver, and in this application IC2 is a comparator rather than an operational amplifier. R13 and D3 form a simple voltage regulator circuit which biases the inverting input to about ±0·5 volts. The non-inverting input will normally be at a lower potential than this so that the output will be at zero volts and l.e.d. indicator D4 will be switched off.

During positive signal peaks if the clipping level is exceeded, the non-inverting input will be taken above 0·5 volts so that the output of IC2 switches to virtually the full positive supply voltage and D4 is pulsed on to indicate that clipping is occurring.

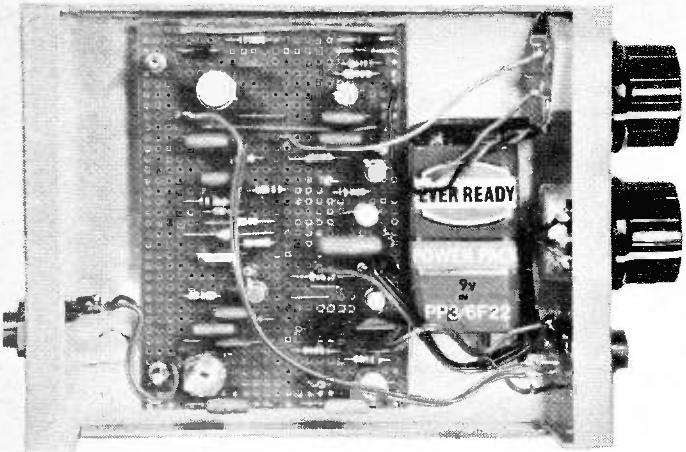
The output filter is another Sallen and Key active filter, but this time a four section circuit has been used so that a nominal attenuation rate of 24dB per octave is achieved. It is of course a low-pass filter that is used here, and the cut off frequency is about 3kHz. Further low-pass filtering is provided by R22 and C16.

C17 is the output d.c. blocking capacitor and VR2 is the pre-set output attenuator.

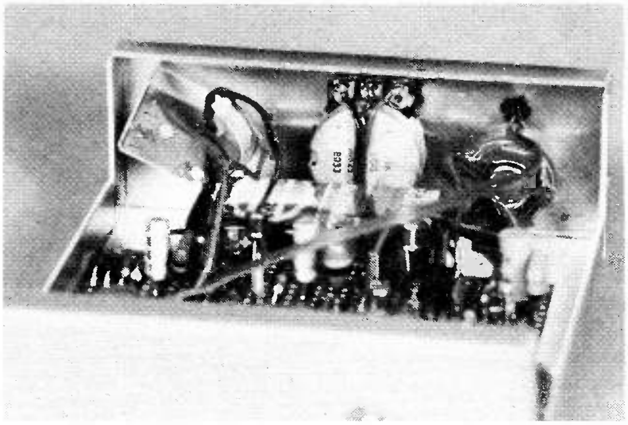
As the circuit has a current consumption of only about 4·5mA a small (PP3 size) 9-volt battery will give many hours of use before needing replacement.

CASE

An aluminium box having approximate outside dimensions of 133 × 102 × 38mm makes a suitable housing for the processor, and this is about the smallest case that will comfortably accommodate all the components. SK1, D4, VR1 and S1 are fitted on the front panel, and SK2 is mounted on the rear panel. SK1 and SK2 are both standard (¼ inch jack sockets).



Plan view showing component layout inside case.



Rear view showing front panel component wiring.

CIRCUIT BOARD

The component panel is a 0·1 inch matrix stripboard having 24 strips by 36 holes, and this can conveniently be a standard 37 holes by 24 strips board with one row of holes trimmed off or just ignored. Drill the two 3·3mm diameter mounting holes (which accept M3 or 6BA fixings) and make the numerous breaks in the copper strips before fitting the components on to the board. There are also six link wires to be soldered in place on the board. Use pins at the points where connections are to be made to the off-board components. Fig. 3 gives full details of the component board.

The completed component panel is mounted on the base panel of the case leaving sufficient space for the battery between the board and the components on the front panel. Use 6mm spacers over the mounting screws to keep the connections on the underside of the board well separated from the metal case. The remaining wiring is then completed using ordinary p.v.c. insulated connecting wire, and finally the battery clip is wired in place. All this wiring is illustrated in Fig. 4.

ADJUSTMENT

Only one internal adjustment is necessary before the unit is ready for use, and that is to set VR2 to give an output level which is comparable to the output of the microphone used with the unit.

If suitable measuring equipment to assist with this is not available, then it is really a matter of connecting the processor to the main unit using a suitable lead, plugging the microphone into the processor, and then adjusting VR2 by trial and error to a setting which gives results similar to those obtained without using the processor. While doing this VR1 should have a setting that is just high enough to cause clipping, which will be indicated by D4 just flashing briefly on signal peaks.

In normal use VR1 would be advanced somewhat further than this so that D4 lights up quite brightly whenever an input signal is present. It is probably best to monitor the output signal using an amplifier and headphones, or using a tape-recorder perhaps, when initially experimenting with various settings of VR1. This soon shows the benefit in apparent volume increase as VR1 is taken above the clipping threshold, and how excessive clipping simply gives increased distortion and no further increase in volume. Best results are obtained with VR1 advanced, just far enough to give a well clipped signal. □

BOOK REVIEWS

PRACTICAL ELECTRONICS FOR RAILWAY MODELLERS

Author Roger Amos
Price £7.95
Size 240 x 156mm. 160 pages. Hardback
Publisher Patrick Stephens Ltd
ISBN 0–85059–555–X

Anyone who has watched the operation of a modern model railway will realise that there is ample scope for using electronics in the control system. But as this excellent book shows, the railway modeller can make good use of electronic circuitry in many other ways. There is for example a chapter on Sound Effects, with circuits for simulating a steam whistle, the "chuffing" of steam engines, and so on.

The reader is assumed to be familiar with switches and volts but not with electronic devices. These are briefly explained as they are introduced in specific projects. A section of Practical Information near the end of the book gives more general information.

Topics covered include controllers, train detection systems, automatic signalling and points controls, and lighting systems, including high-frequency supplies. The only conspicuous lack is of detailed constructional information. G.S.

BEGINNER'S GUIDE TO BASIC PROGRAMMING

Author A. P. Stephenson
Price £3.95
Size 186 x 120mm. 192 pages
Publisher Newnes Technical Books
ISBN 0 408 01184 X

This paperback is an introduction to newcomers to computer programming. It is aimed at teaching the use of BASIC computer language as used on microcomputers, rather than large mainframe computers. It should therefore be of use to the newcomer who wants to take up computing as a hobby and to do more than just slavishly copy other people's programs.

The explanations are clear and no previous experience of programming or knowledge of BASIC is required. G.S.

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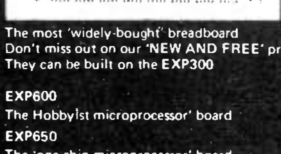

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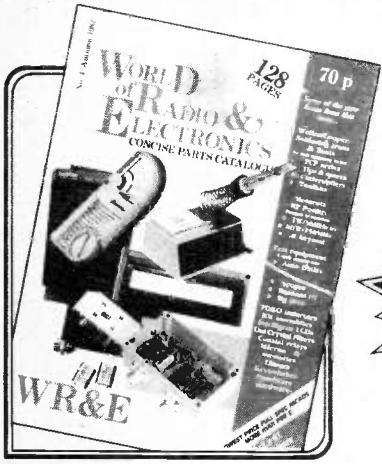

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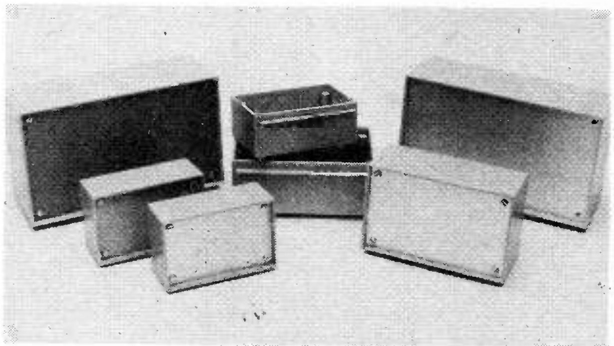

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EPROM PROGRAMMER FOR THE ACORN ATOM

BY D. C. GRINDROD

THE device to be described here will provide a simple, fast and relatively inexpensive method of programming and reading 2K and 4K byte single supply rail (+5V) EPROMS (Erasable and Programmable Read Only Memory) using the Acorn Atom computer.

It is able to program the following EPROMS (1) TMS2516, 2716 and other manufacturers' pin compatible types; (2) TMS2532 and other manufacturers' pin compatible types. It is not suitable for use with Intel 2732 type EPROMS or other manufacturers' compatible types.

Although specifically designed for use with the Acorn Atom (for which it was developed to overcome loading of frequently used long programs from cassette), it could also be used with other computers with modifications to connecting cables and suitably developed software.

The software controls all pulses and addressing, leaving the user to select only MODE (READ/PROG) and SIZE (2K/4K).

To be able to address up to 4096 bytes (4K) address lines A0 to A11 are required. A0 to A7 are provided by port A (£B801) of the VIA and A8 to A11 by the four lowest bits of port C (£B002) of the 8255. This break is not as awkward as would first be thought, as it occurs on a 255 byte boundary. The maximum number held in a single byte is 255, hence a carry procedure would be needed anyway.

Figure 1 and Table 1 show the pinning, programming and reading requirements of the two types of EPROMS catered for by this programmer from which we can see that they differ in the following respects:

(1) $\overline{CE}$/PGM is a different pin
(2) 2532 has an extra address line
(3) The pulse required for programming is –ve going for the 2532 and +ve going for the 2716

The first two differences are overcome by a d.p.d.t. switch, S1, while the third is dealt with by the software.

PROGRAMS

The original idea was to use EPROMS as a semi-permanent storage medium for long programs that were used often and hence reduce the time needed for loading from cassette.

Since each byte programmed needs a 50ms pulse the programming time is not greatly affected by the language used, thus, it was decided to use a Basic progam to control programming of the EPROM.

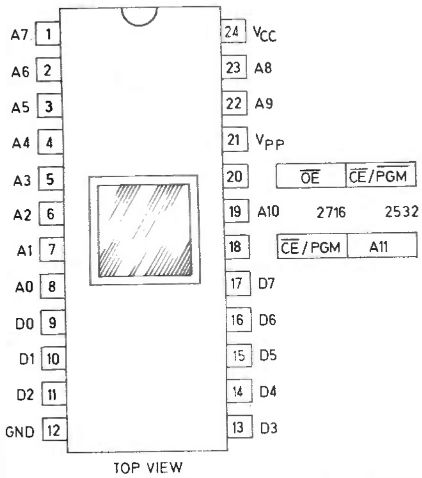
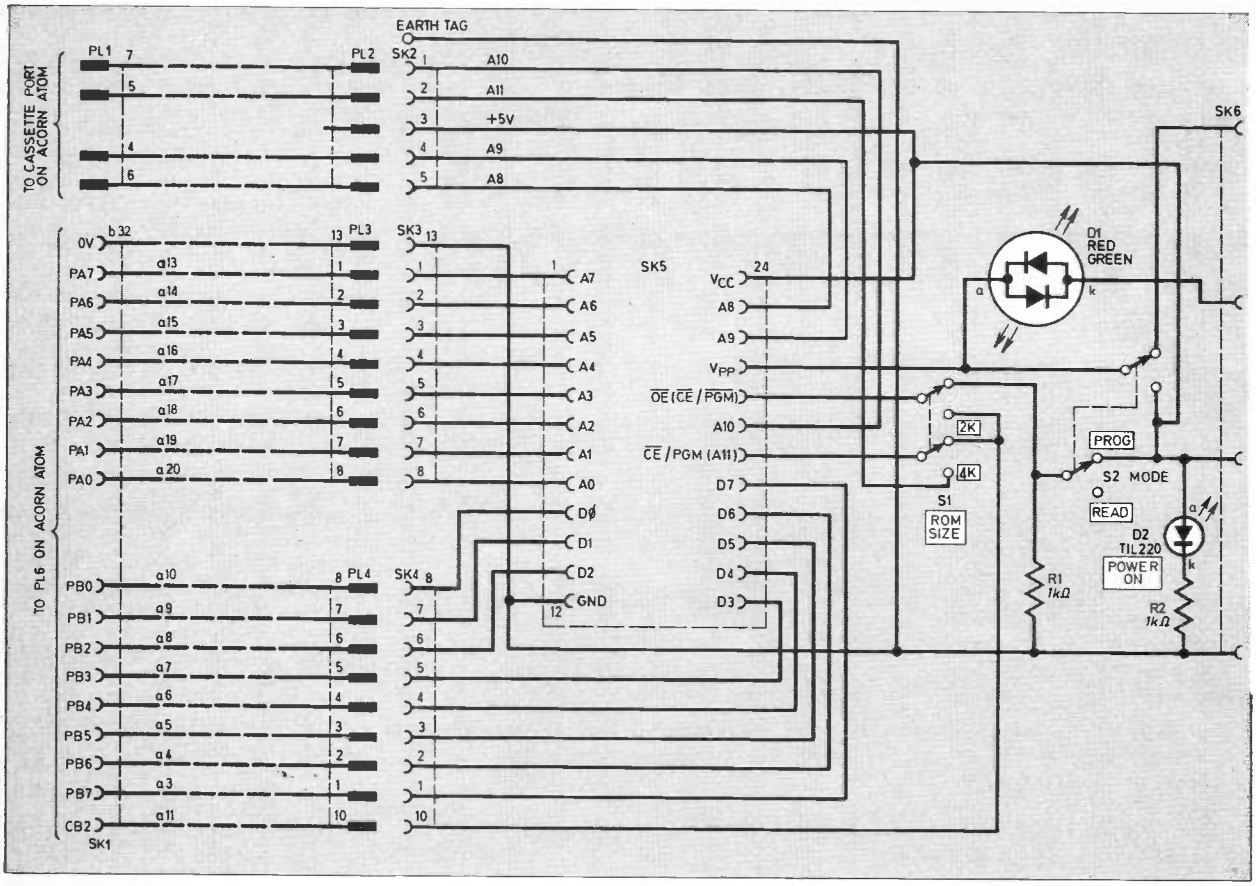


Fig. 1. Pin-out diagram for the 2716 and 2532 EPROMS. Note the different functions for pins 18 and 20 for the two types.

Table 1: Mode selection for the 2716 and 2532 Eproms

TYPE	2716 (2K)					2532 (4K)			
Mode \ Pin	$\overline{CE}$/PGM (18)	$\overline{OE}$ (20)	V_{PP} (21)	V_{CC} (24)	Outputs (9–11, 13–17)	$\overline{CE}$/PGM (20)	V_{PP} (21)	V_{CC} (24)	Outputs (9–11, 13–17)
Read	V_{IL}	V_{IL}	+5	+5	D_{OUT}	V_{IL}	+5V	+5	D_{OUT}
Standby	V_{IH}	Don't Care	+5	+5	High Z	V_{IH}	+5V	+5	High Z
Program	Pulsed V_{IL} to V_{IH}	V_{IH}	+25	+5	D_{IN}	Pulsed V_{IH} to V_{IL}	+25V	+5	D_{IN}
Program Venty	V_{IL}	V_{IL}	+25	+5	D_{OUT}	—	—	—	—
Program Inhibit	V_{IL}	V_{IH}	+25	+5	High Z	V_{IH}	+25V	+5	High Z

V_{IL} logic low, V_{IH} logic high



When reading the EPROM however, the time taken is determined by the language, therefore a fully re-locatable machine code program was developed which is small enough (79 bytes) to fit above the floating point variables at £2890. EPROM/RAM start and EPROM end addresses are stored in the two lowest bytes of the integer variables A, B and C, respectively.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Eprom Programmer is shown in Fig. 2. Nearly all the circuitry is for the generation from the mains supply of the +5 and +25 volt supply lines. We shall discuss this section first.

A.c. mains voltage enters the unit and reaches T1 primary winding via the on-off switch S3 and fuse FS1. T1 is a step-down transformer having two independent secondaries, each developing 20V a.c. across their windings.

The diode bridge D3–D6 provides full-wave rectification of the upper secondary voltage. The resulting pulsed d.c. is smoothed by C3 to reach the input of IC1. The latter is a monolithic voltage regulator i.c. which normally provides a stabilised 15V output. However, in this circuit the output voltage is stepped-up to 25V by the action of VR2 in series with the common connection.

COMPONENTS

See Shop Talk page 85

Resistors

R1	1kΩ
R2	390Ω
R3	4·7kΩ

All ¼W carbon ±5%

Capacitors

C1,4	0·047µF 35V tantalum (2 off)
C2,5	0·022µF 35V tantalum (2 off)
C3,6	100µF 35V elect. (2 off)

Semiconductors

D1	bi-coloured (red/green) l.e.d.
D2	TIL220 red l.e.d.
D3–6, D7–10	VM18 1A 50V bridge rectifier d.i.l. (2 off)
IC1	7815 15V 1A voltage regulator (TO–220)
IC2	7805 5V 1A voltage regulator (TO–220)

Miscellaneous

S1,2,3	d.p.d.t. miniature toggle (3 off)
SK1	64-way (a+b) in-line indirect connector
SK2	5-way 270° DIN
SK3,4	16-pin d.i.l. (2 off)
SK5	24-pin d.i.l. + 24-pin zero insertion force socket
SK6	4-way inter-p.c.b. connector
PL1	7-way DIN
PL2	5-way 270° DIN
PL3,4	16-pin d.i.l. header (2 off)
PL6	4-way inter-p.c.b. connector
VR1	5kΩ multiturn preset
VR2	1kΩ miniature horizontal skeleton preset
FS1	1A 20mm with panel mounting fuseholder
T1	mains primary/0–20V, 0–20V 6VA secondaries p.c.b. mounting—see text

Stripboard, 0·1 inch matrix; 17 strips × 51 holes, 25 strips × 25 holes; 6BA mounting hardware for circuit boards; Speedbloc cable or other; case, plastic, size 190 × 110 × 60mm (Tandy 270–224); 2-core mains cable; clips and bushes for l.e.d.s.; self-adhesive rubber feet for case (4 off); sleeving.

Guidance only. Appox. cost £30

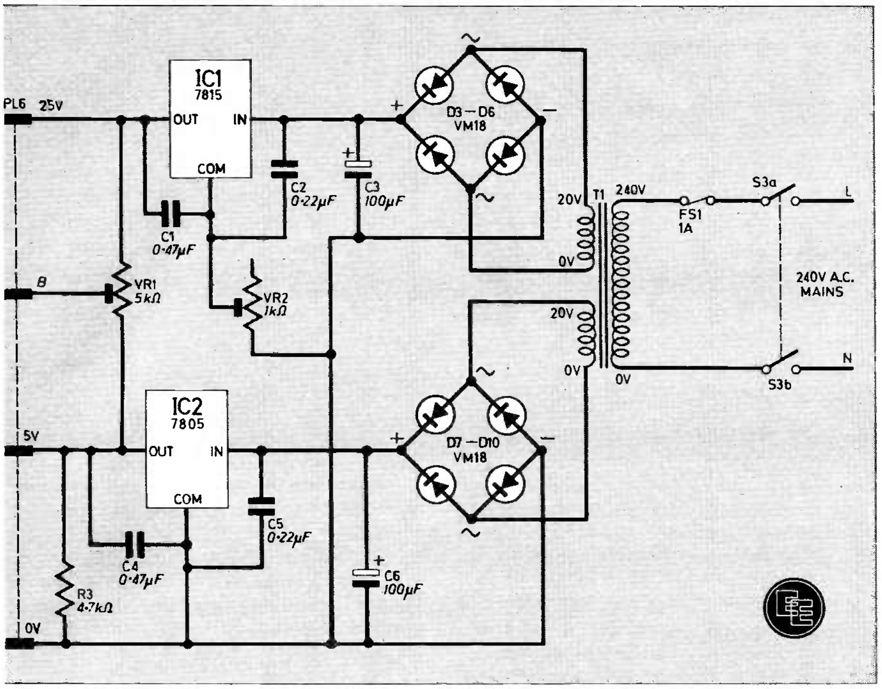


Fig. 2. Complete circuit diagram of the EPROM Programmer. The power supply section is shown above and the circuit (left) gives the interconnections from the 24-pin d.i.l. socket to the Acorn Atom computer.

C1 and C2 are included for reasons of stability. Similarly, a smooth voltage level of about 28V reaches the input of IC2 to provide a +5V output stabilised. C4 and C5 are included for reasons of stability. R3 acts as a bleed resistor for IC2.

The power supply is more than adequate, the maximum requirements being for the 4K EPROM: 5V at 150mA, 25V at 30mA.

The power supply is built on a circuit board separate from the remainder and connects to it by means of p.c.b. inter sockets/plugs (SK6/PL6).

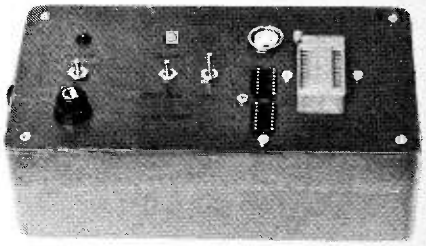
The +5V and 0V rails reach pins 24 and 12, respectively, of the EPROM socket SK5.

The bi-coloured l.e.d. D1 is an optional extra which was included to show the mode of operation. This was also marked around S2 on the top panel. In the prototype it was orientated so that it lights up red for PROGramming mode, and green in the READ mode. VR1 needs to be set to give equal brightness of the two colours, this will be described later.

The address and data for the EPROM are made available by the software at various pins on *PL6* on the Atom and the cassette port. These signals are under full software control.

The 25V supply is only needed for programming and therefore only reaches pin 21 of the EPROM when S2 is in the PROGramming mode. In the READ mode V_{pp} should be at +5V.

The only other control is S1, the ROM SIZE switch. This routes the program signal to the appropriate pin according to Fig. 1, and brings in A11 as required.



Next Month: Construction and Testing

CIRCUIT EXCHANGE

CHIRPING BIRD

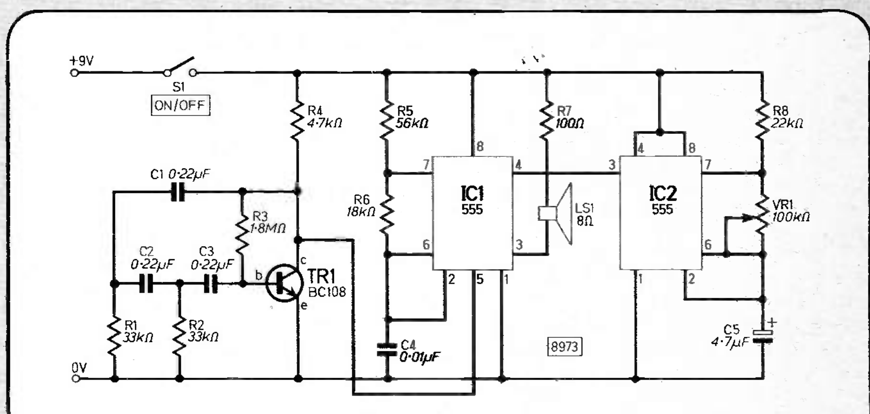
This circuit produces a sound similar to a chirping bird. TR1 and associated components form a sine-wave oscillator which runs fairly quickly. Increasing the values of C1, C2 and C3 would slow down the chirp rate, but they must all be the same value to produce the required phase shift.

The output of this oscillator is fed to the control pin (pin 5) of a 555 astable multivibrator IC1 which produces a high frequency square-wave at pin 3. R7 may be increased to lower the volume but the sum of R7 and the speaker resistance must not be less than 100 ohms, otherwise the current drawn by LS1 could damage IC1.

The output, therefore, is a square-wave modulated by the sine-wave which produces the characteristic "chirp" sound.

IC2 forms a slow-running astable multivibrator the output of which is fed to the reset pin of IC1. The chirping will be switched on and off because IC1 can only oscillate when pin 4 is positive. VR1 alters the time between each burst of "chirps". The component values are by no means critical and may be experimented with.

Mark Robinson,
Winsford,
Cheshire.



MORE ON PAGE 118

SQUARE one FOR BEGINNERS

THE trouble with earphones, headphones and allied devices is that it is only too easy to take them for granted. You make your miniature personal radio, say, and then you think: Ah, yes; it'll need an earphone. The chances are that you try some old earphone salvaged from a defunct radio and plug it in, hoping for the best.

IMPEDANCE

Quite often, it doesn't work, or at least doesn't work well. The most frequent explanation is that its impedance is too low or too high to suit the circuit to which you attach it. Most of the little plastic earphones which come with pocket radios have low impedance, often 8 ohms. This is fine if they are connected so as to replace an 8-ohm loudspeaker. But many home-built radios are designed to work into earphones of very much higher impedance.

In the old days of radio, the crystal set era, people listened on headphones whose two earphones were magnetic devices with an impedance of as much as 4000 ohms. In fact that was the d.c. resistance; the impedance to audio frequencies was very much higher.

A common arrangement was to have two earpieces each of whose impedances was 1000 or 2000 ohms. These could be connected in series to give 2000 or 4000 ohms or in parallel for 500 or 1000 ohms. They were extremely sensitive: they had to be to give any volume from a crystal set whose only power was what the aerial picked up. They were usually poor quality sound reproducers with a huge resonance at about 1kHz.

Today's two-earpiece headphones are usually very different. A typical pair of low-cost "stereo phones" contains in its rather large and comfortably padded earpieces a couple of small loudspeakers. These are usually of 8 ohms impedance and they are connected as shown in Fig. 1a. The connections are often brought out to a jack plug with three contact segments.

For stereo listening (b) the "live" sides of the two audio channels are connected to points 1 and 3; point 2 is the common or earthy connection.

For non-stereo use you have the option of using the two in series (c) to give an impedance of 16 ohms or in parallel (d) for 4 ohms. It is possible to obtain stereo phones of other impedances. Sound engineers may use 600-ohm phones for instance. But 2 × 8 ohms is by far the commonest impedance. Actually this too is really the d.c. resistance but the a.c. impedance at most audio frequencies is about the same.

CRYSTAL EARPHONES

For really high impedance nowadays you must use crystal earphones. The single type looks just like one of the low-impedance magnetic earphones, and beginners sometimes come to grief by mistaking one for the other. But inside they are totally different.

The low-impedance earphones contain a little coil of fine wire, a magnet, and some sort of diaphragm which is moved either by the magnetic field or by movement of the coil in the field.

The crystal types contain a thin piece of special material (an insulator) metallised on both sides to form a capacitor. The material bends under the influence of an audio voltage, to produce the sound. Being a capacitor, a crystal earphone does not pass d.c. Its resistance is infinite. But it offers an impedance to a.c. which falls as the frequency rises. This tends to make it accentuate treble notes.

In circuits like Fig. 2, where the audio is developed across a fairly high resistance (here 10kΩ) a crystal earphone is the natural choice. Since it passes no d.c. it may also be connected as shown dotted, no coupling capacitor being needed.

TRANSFORMER MATCHING

There are times when it is necessary to match a low impedance earphone to a high impedance audio source. This is a job for a transformer (Fig. 3).

Transformers need to be specified with care since many factors affect their performance. But when correctly designed and used they multiply the impedance of the earphone by the square of the ratio of turns on the primary to turns on the secondary. Thus a turns ratio of 10 multiplies 8 ohms to 800 ohms.

The current is multiplied by the same number which is why the use of a matching transformer can produce a big increase in volume, though only when conditions allow this. A transformer can't make energy, it can only enable you to make the best use of the available energy.

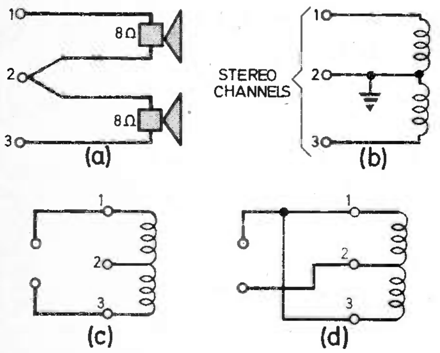


Fig. 1. The wiring configuration for stereo headphones is shown in (a) with the audio channels connected at points 1 and 3 (b) and earth at point 2. For mono use the headphones may be connected in series (c) or parallel (d).

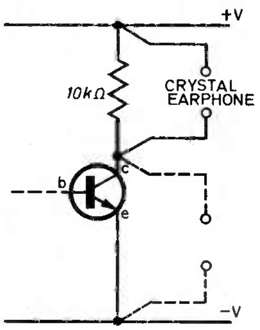


Fig. 2. In this circuit the audio is produced across a high resistance, so a crystal earphone is used since it passes no d.c.

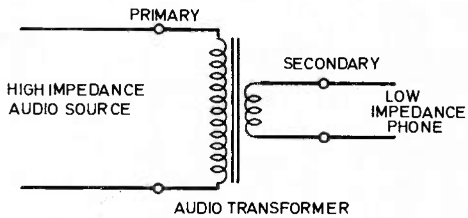


Fig. 3. When matching a low impedance phone to a high impedance audio source a transformer is used to multiply the impedance of the phone.

CIRCUIT EXCHANGE

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised.

Payment is made for all circuits published in this feature.

Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

JOGGER'S PACEMAKER

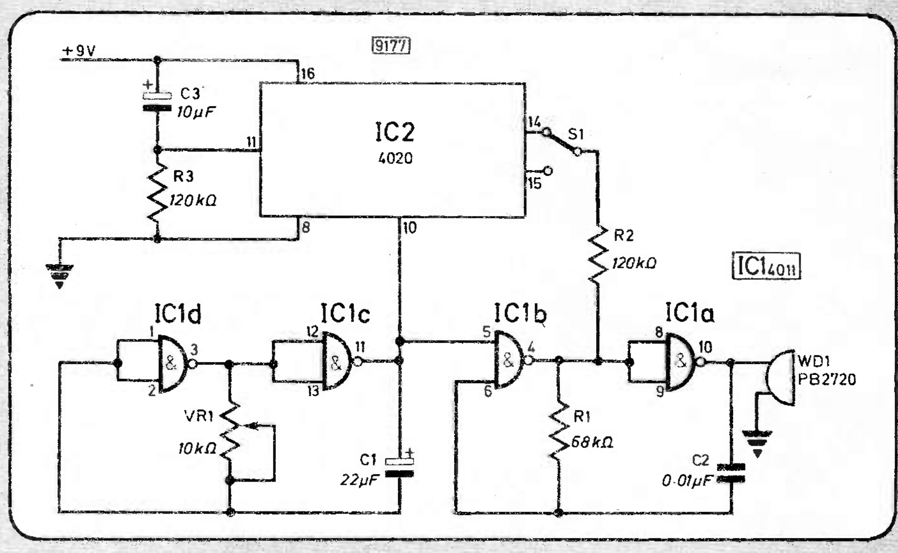
This circuit produces a pulsing tone that can be used to help joggers keep a constant pace and, by increasing the pulse rate, improve their running.

By counting the number of steps the jogger takes it is also possible to calculate the approximate distance that has been run. This is achieved by changing the frequency of the pulsing tone every 500 or 1000 steps.

IC1a and IC1b form an oscillator that generates a tone of about 1000Hz. A second oscillator is formed by IC1c and IC1d and this controls the running pace by switching the first oscillator on and off. The pulse rate is set by potentiometer VR1.

To count the steps, the pulses from the slower oscillator are fed into a 14-stage binary counter IC2. When approximately 500 (exactly 512) pulses have been counted by IC2, pin 14 goes high and changes the frequency of the tone produced by IC1a–IC1b. After a further 512 pulses pin 14 goes low again and the tone changes back to the first frequency. If the tone is to change every 1024 steps switch S1 should be set to pin 15 of IC2.

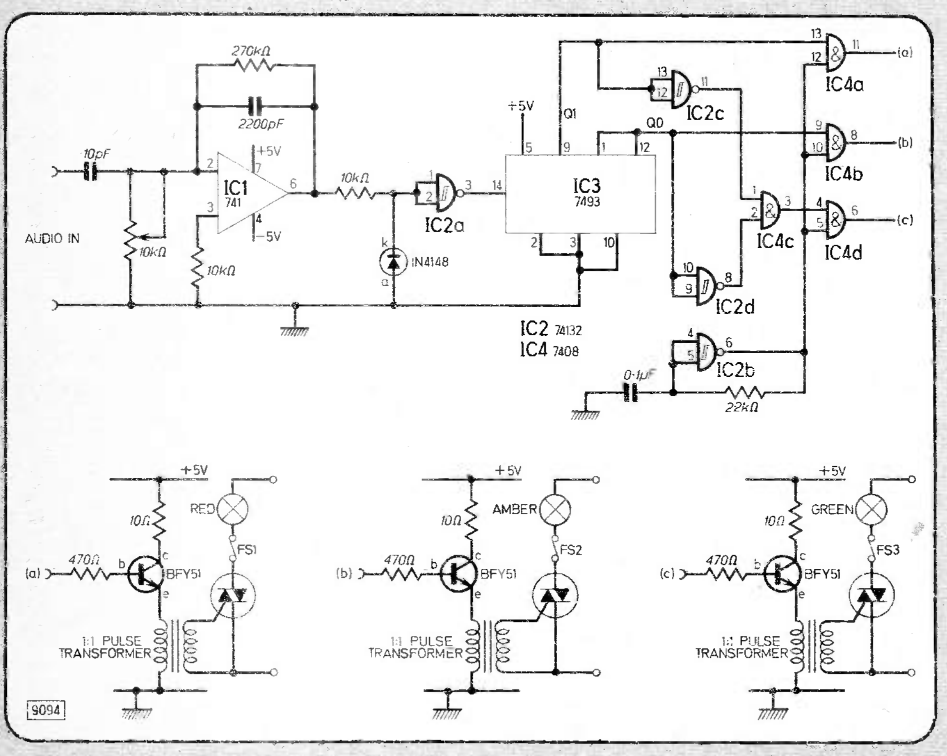
To calculate the distance you have run simply multiply the number of steps with the length of your steps. For example: 1500 × 1 metre = 1·5km.



Joachim Ramkull,
Lund, Sweden.

DISCO TRAFFIC LIGHTS

During the past few years many sound-to-light units have become available. A variation on the normal light sequencer is presented here, which provides a traffic light sequence. The operation of the circuit is as follows:



An audio input of greater than 200mV is amplified, and high frequency components of the signal are reduced by the inclusion of a low-pass filter. The signal then enters IC2a, a Schmitt trigger, which is included to reduce spurious pulses entering IC3. IC3 is a 4-bit binary counter, though this application utilises only two of its four outputs.

IC2b causes high level signals entering IC4a, IC4b and IC4d to be modulated at around 1kHz. This is required for the operation of the transformers. The triacs should be chosen to suit the power rating of the bulbs.

The sequence is as shown below:

Q0	Q1	Output
0	0	Green
1	0	Amber
0	1	Red
1	1	Red and Amber

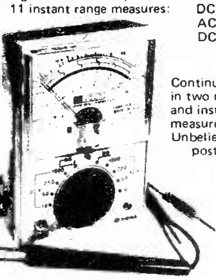
Since this cycle repeats, the standard traffic light sequence (Red, Red and Amber, Green, Amber and back to Red) is followed.

A. Marshall,
Old Basford,
Nottingham.

CIRCUIT EXCHANGE

MINI-MULTI TESTER

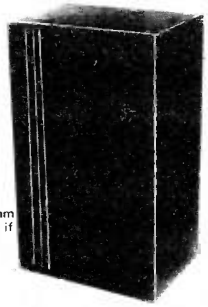
Deluxe pocket size precision moving coil instrument, Jewelled bearings - 2000 o.p.v. mirrored scale.
11 instant range measures: DC volts 10, 50, 250, 1000. AC volts 10, 50, 250, 1000. DC amps 0 — 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only **£6.75 + 60p** post and insurance.

FREE Amps range kit to enable you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but if you already own a Mini-Tester and would like one, send **£2.50.**

SUPER HI-FI SPEAKER CABINETS



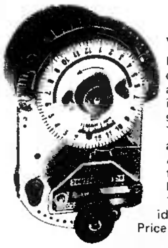
Made for an expensive Hi-Fi outfit – will suit any decor. Resonance free. Cut-outs for 6½" woofer and 2½" tweeter. The front material is Dacron. The completed unit is most pleasing. Supplied in pairs, price **£6.90** per pair (this is probably less than the original cost of one cabinet) carriage £3.00 the pair.

GOODMANS SPEAKERS

6½" 8 ohm 25 watt **£4.50.** 2½" 8 ohm tweeter. **£2.50.** No extra for postage if ordered with cabinets. Xover **£1.50.**

DITTO but for 8" speaker and 4" tweeter. **£7.50 + £3.50.**

VENNER TIME SWITCH



Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95.** These are without case but we can supply a plastic base **£1.75** or metal case **£2.95.** Also available is adaptor kit to convert this into a normal 24 hr. time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2.30.**

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses, appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 — 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 – however, you can have the parcel for **£2.50.**

50 THINGS YOU CAN MAKE

or do and still have hundreds of parts for future jobs. **LEARN** the practical way with our 10 kilo parcel of useful parts. Minimum 1,000 items includes panel meters, timers, thermal trips, relays, switches, motors, drills, taps and dies, tools, thermostats, coils, condensers, resistors, etc. etc. Parcel with data on 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post.

EXTRACTOR FAN

Mains operated – ex-computer

5" Woods extractor **£5.75, Post £1.25.**
5" Plannair extractor **£6.50. Post £1.25**
4" x 4" Muffin 115v. **£4.50. Post 75p.**
4" x 4" Muffin 230v. **£5.75. Post 75p.**

SEAT BELT REMINDER

Buzzer sounds when you switch on ignition – stops when you handle seat belt – Complete kit £3.00.

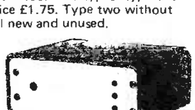
200 OHM EARPIECE

If you are a user of earphones then you really must try these, they do give far superior results to the usual 4 ohm model, this is due to very superior construction. Price 65p each.

RECHARGABLE NICAD BATTERY

By Deac, their reference number 150 DK, Made up as a battery of 4 cells with a nominal total voltage of 4.88. Two types: type one has pp3 battery clip at each end, price £1.75. Type two without the snap connectors price £1.50. All new and unused.

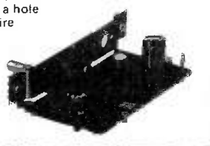
PROJECT CASE



All metal construction. Tubular body, Size approx 7 x 3 x 5" long with removable ends, blue hammer paint finish. **£1.75** each + 60p for postage.

MINI MONO AMP

on p.c.b., size 4"x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of **£1.15 each, or 10 for £10.00.**



THIS MONTH'S NEW KITS:

MULTI-CHANNEL or ROBOT CONTROLLER

This is two kits. The 8 channel transmitter kit and the 8 channel receiver kit. Each kit comes with diagrams and notes, but no circuit boards, the component layout being left to you. The data shows how to drive, reverse and steer two or more motors. With spare channels to perform other functions. Price **£9.50 for both kits.**

'BIG EAR'

As in December Hobby Electronics. Designed originally for listening to wildlife this could also be used to listen through walls or from long distances. Complete kit including the case at £9.50.

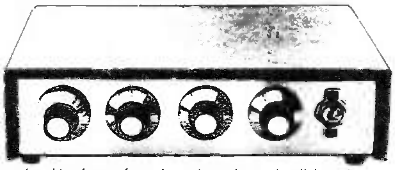
I.T.V. 4 PRE-AMP

Experiencing difficulties in getting a good picture on the new ITV Channel 4? An aerial pre-amp may be the answer. Uses 2 special transistors and has its own internal power supply. All you have to do is fit this into the TV down lead and plug into the mains. Complete kit including the case at £9.50.

THE HE MICROLOG

This is a biggish project but you build a complete computer! Full constructional details appear in December Hobby Electronics. We will supply the complete kit less the rather expensive case for £18.50. We feel sure you can make a case yourself just as efficiently and save most of the cost.

3 CHANNEL SOUND TO LIGHT KIT



Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special price is **£14.95** in kit form or **£25.00** assembled and tested.

TANGENTIAL BLOW HEATER

2.5 Kw quiet, efficient instant heating from 230/240 volt mains. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for **£4.95.** post £1.50.

CAR STARTER AND CHARGER KIT

In an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250 watt mains transformer, 40 amp bridge rectifier, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. **Price £12.50 + £3.00 post.**

TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox – all electronic parts and circuit. **£2.30.** (not licenceable in the U.K.)

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£6.90** comp. kit. (not licenceable in the U.K.)

FM RECEIVER

Made up and working, complete with scale and pointer needs only headphones, ideal for use with our surveillance transmitter or radio mike. **£5.85.** or kit of parts **£3.95.**

3 - 30v VARIABLE VOLTAGE POWER SUPPLY UNIT

With 1 amp DC output, for use on the bench, students, inventors, service engineers, etc. Automatic short circuit and overload protection. In case with a volt meter on the front panel. Complete kit **£13.80**

INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra red or ordinary light is broken. Main components – relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. **Price £2.30**

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder – complete mains operated kit, case included **£11.95** plus £2.00 post.

RADIO STETHOSCOPE

Easy to fault find start at the aerial and work towards the speaker – when signal stops you have found the fault. **Complete kit £4.95.**

INVISIBLE AND SILENT SENTINEL

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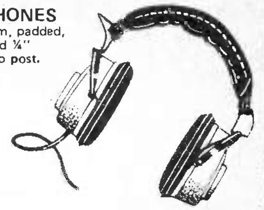

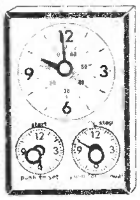

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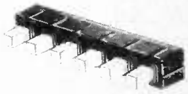

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(all different)

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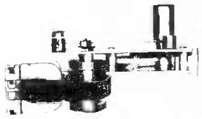

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7422	17p	74141	73p
7423	23p	74145	35p
7425	23p	74150	45p
7426	23p	74151	32p
7427	15p	74153	49p
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7432	15p	74157	49p
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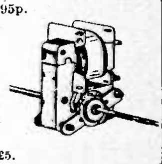

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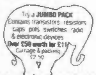

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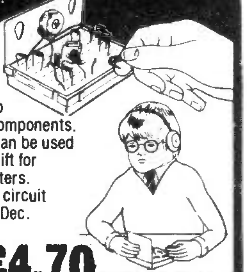

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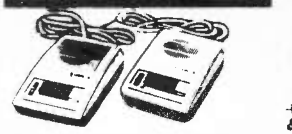

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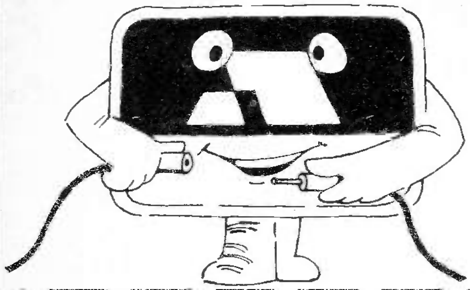

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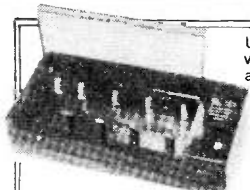

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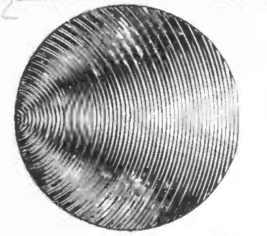

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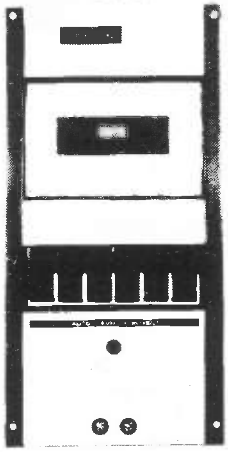

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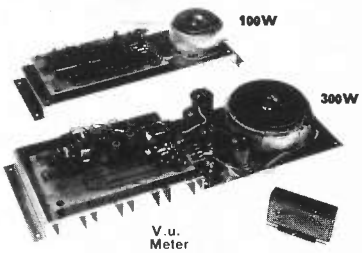
8" 50 watt R.M.S. Impedance 8 ohm. 20 oz magnet. 1½" aluminium voice coil, Resonant Frequency 40Hz, Frequency Response to 6KHz, Sensitivity 92dB. Also available with black cone fitted with black metal protective grill. **Price: White cone £8·90 each. Black cone/grill £9·50 each.** P. & P. £1·25.

B.S.R. P232 TURNTABLE
- P232 Turntable ★ 'S' shaped tone arm
- ★ Belt driven ★ Aluminium platter
- ★ Cueing lever ★ 240 volt AC operation (50Hz)
- ★ Cut-out template supplied
- ★ Used as standard by Hi-Fi and Disco manufacturers
- ★ Fitted with either a magnetic or ceramic cartridge, please state cartridge required

Price **£22·50** + £2·50 P & P.

OMP **POWER AMPLIFIER MODULES**



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Power Amplifier Modules with integral toroidal transformer power supply, and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. An LED Vu meter is available as an optional extra.
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Max Output Power:
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310 watts R.M.S. (OMP 300)
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Frequency Response: 20Hz—25KHz ±3dB.
Sensitivity for Max. Output:
500mV at 10K (OMP 100) 1V at 10K (OMP 300)
T.H.D.: Less than 0·1%
Supply: 240V 50Hz
Sizes: OMP 100 360 × 115 × 72mm
OMP 300 460 × 153 × 66mm
Prices: OMP 100 **£31·50** each + £2·00 P&P
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Vu Meter **£6·50** each + 50p P&P.

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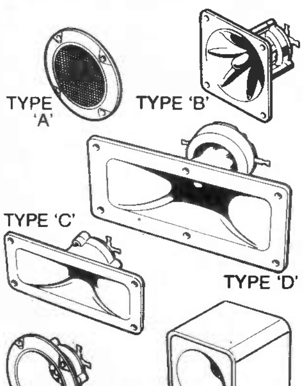

TYPE 'A' (KSN1036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-Fi speakers. Price **£3·45 each.**

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TYPE 'D' (KSN1025A) 2" × 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2,000 c/s). Suitable for Hi-Fi systems and quality discos. Price **£6·90 each.**

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems, etc. Price **£4·35 each.**

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price **£10·75 each.**

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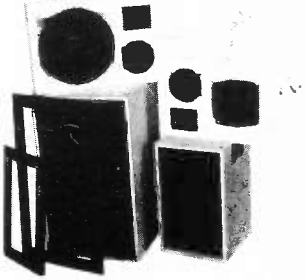

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12" 80 watt R.M.S. loudspeaker. A superb general purpose **twin cone** loudspeaker. 50 oz. magnet. 2" aluminium voice coil. Rolled surround. Resonant frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. **Attractive blue cone with aluminium centre dome.**
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