PRACTICAL
ELECTRONICS

JULY 1976

35p

PE DIGISCOPE...

ALSO IN THIS ISSUE...

- FLUORESCENT LIGHT INVERTER
- AUTOSTOP for Model Railways
- RADIO CONTROL SYSTEM 2... Receiver and Decoder

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ALL PRICES INCLUDE VAT

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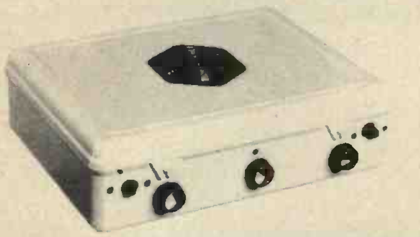
COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT
BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER



- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN —PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loud-speaker Radio MW/LW.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- Batteryless Crystal Radio
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier.

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Total building costs £9·00 P.P. and Ins. 65p (Overseas Seamail P. & P. £3·50)

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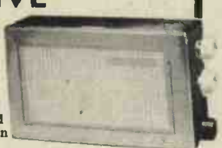
Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the long wave band and operating as shown in the instructions supplied free with all parts.

Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc.

All parts including case and plans

£3·95 P.P. & Ins. 40p

POCKET FIVE



Now with 3in Loudspeaker 3 tunable wavebands. MW, LW and trawler band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5½in × 1¾in 3½ in approx.

Complete kit of parts including construction plans.

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NEW Everyday Series

Build this exciting new series of designs.

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in. loudspeaker. Attractive case with red speaker grille. Size 9in. × 5½in. × 2½in. approx. All parts including Case and Plans.

Total Building costs **£4·30** P. & P + Ins. 50p

E.V.6. Case and looks as above. 6 Transistors 3 diodes. Powered by 9V battery. Ferrite rod aerial, 3in. loudspeaker, etc. MW/LW coverage. Push/Pull output.
All parts including Case and Plans.

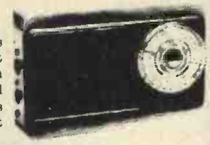
Total Building costs **£4·95** P. & P. + Ins. 55p

E.V.7. Case and looks as above, 7 Transistors and 3 diodes. Six wavebands, MW/LW, Trawler Band SW1, SW2, SW3, powered by 9V battery. Push pull output. Telescopic aerial for short waves. 3in. Loudspeaker. All parts including Case and Plans.

Total Building Costs **£6·35** P. & P. + Ins. 55p

TRANSONA FIVE

NOW WITH 3" LOUDSPEAKER



Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List free with parts.

Total Building Costs **£4·05** P.P. and Ins. 50p

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Build Radios, Amplifiers, etc., from easy stage diagrams

Five unit including master unit to construct

Components include: Tuning condenser, 2 volume controls, 2 slider switches, fine tone 3in moving coil speaker, terminal strip, ferrite rod aerial, battery clips, 4 tag boards, 10 transistors, 4 diodes, resistors, capacitors, 3 ¼in knobs. Units once constructed are detachable from master unit, enabling them to be stored for future use. Ideal for schools, educational authorities and all those interested in radio construction.

All parts including case and plans. **£6·30** P.P. and Ins. 55p

ELECTRONIC CONSTRUCTION KITS

E.C.K. 2 Self Contained Multi-Band V.H.F. Receiver Kit.

8 transistors and 3 diodes. Push pull output. 3in loudspeaker, gain control, superb 9 section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit).

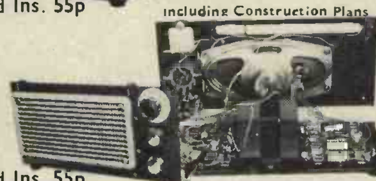
Complete kit of parts **£7·15** P.P. and Ins. 55p

Including Construction Plans

E.C.K. 4

7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band. 3 Short Wave Bands. Receiver Kit.

With 5in × 3in loudspeaker. Push pull output stage, gain control, and rotary switch. 7 transistors and 4 diodes. 6 section chrome-plated telescopic aerial. 8 in sensitive ready wound ferrite rod aerial, tuning capacitor, resistors, capacitors, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit).



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Including Construction Plans

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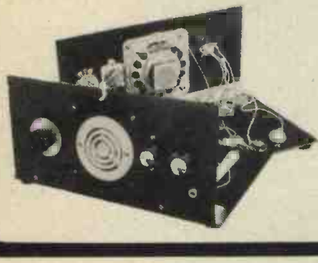
EDU-KIT JUNIOR



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- ★ 2 Transistor Regenerative Radio
- ★ 3 Transistor Earpiece Radio Medium Wave Coverage
- ★ 4 Transistor Medium Wave Loudspeaker Radio
- ★ Electronic Noise Generator
- ★ Electronic Metronome
- ★ 4 Transistor Push/Pull Amplifier

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PRACTICAL
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VOLUME 12 No. 7 JULY 1976

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Sounds the horn intermittently if doors, boot or bonnet are opened **548**

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A hand held, 1MHz low voltage oscilloscope with an l.e.d. display **553**

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Our August issue will be published on Friday, July 9, 1976
(for details of contents, see page 573)

It's here!

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Hold Isolator MS/2-7	3·24
Voltage Controlled Filter MS/2-8	7·54
Ring Modulator MS/2-9	3·75
Noise Generator MS/2-10	2·00
Output Amplifiers MS/2-11	8·93
Control Envelope Inverter MS/2-12	0·91
Stabilised Power Supply MS/2-13	9·00

CONVERSION KITS	
Ancillary Functions Kit MS/2-14C	11·67
Oscillator Conversion Kit MS/2-15C	11·04
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Power Supply EAO15	1·80
Dual Transistor MD8001	1·20
Operational Amplifier LM318N	2·00
Field Effect transistor 2N5459	0·48
Multi-Turn Preset Pots 1K, 10K, 20K	0·96

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MC1306P	0·53
MFC4000B	0·45
ZN424E	3·00
741	0·22
741 SCP	1·10

PANELS & PCBS	
PE Minisonic EA008	2·50

	£
Minisonic PSU EA011	1·60
Minimix—6 Composite	2·00
Minimix—6 front panel	4·18

CAPACITORS	
Axial Lead—Electrolytic	
22µF 10V	2 for 25p
1500µ 16V	2 for 25p
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End Angles (PR) HWV1F	0·55
8in Module K8V1F	2·40
4in Module K4V1F	1·80
2in Panel F2V1F	0·85
1in Panel F1V1F	0·80
Plug 19124/SS31	0·60
Socket 19125/SF31	0·70
Card Handles (10 off)	0·60
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Module M26/19012	0·70

Send S.A.E. for further details

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- C. & G. Electrical Engineering Practise ☐
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2N930	0·26
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2N2369	0·20
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2N2646	0·55
2N2647	0·98
2N2904	0·40
2N2904A	0·45
2N2905	0·47
2N2905A	0·50
2N2906	0·33
2N2906A	0·42
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2N2925	0·20
2N2926	
Green	0·12

Yellow	0·12
Orange	0·12
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2N4061	0·15
2N4062	0·15
2N4126	0·21
2N4289	0·34
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2N4920	1·10
2N4921	0·83
2N4922	1·00
2N4923	1·00

2N5190	0·92
2N5191	0·96
2N5192	1·24
2N5195	1·46
2N5245	0·29
2N5294	0·48
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2N5298	0·50
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3N140	1·00
3N141	0·81
3N200	2·49
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40362	0·45
40363	0·88
40389	0·46
40394	0·56
40395	0·65
40406	0·44
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40408	0·50
40409	0·52
40410	0·52
40411	2·00
40594	0·74
40595	0·84
40601	0·67
40602	0·61
40603	0·58
40604	0·56
40636	1·10
40669	1·00
40673	0·73
AC126	0·20
AC127	0·40
AC128	0·35
AC151V	0·27
AC152V	0·49
AC153	0·35
AC153K	0·40
AC154	0·25
AC176	0·41
AC176K	0·40
AC187K	0·35
AC188K	0·40
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AC188 }	0·95
AD142	0·57
AD143	0·68
AD149V	0·74
AD150	1·15
AD161	0·69
AD162	0·69
AD161 }	PR
AD162 }	1·58
AF106	0·40

AF106R	0·40
AF114	0·35
AF115	0·35
AF116	0·35
AF117	0·35
AF118	0·35
AF124	0·30
AF125	0·30
AF126	0·28
AF127	0·28
AF139	0·65
AF186	0·46
AF200	0·65
AF239	0·65
AF240	0·90
AF279	0·70
AF280	0·79
AL102	1·00
AL103	1·00
BC107	0·14
BC108	0·14
BC109	0·15
BC113	0·15
BC115	0·17
BC116	0·17
BC116A	0·18
BC117	0·21
BC118	0·14
BC119	0·29
BC121	0·35
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BC147	0·10
BC148	0·09
BC149	0·13
BC153	0·18
BC154	0·18
BC157	0·16
BC158	0·16
BC160	0·78
BC167B	0·15
BC168B	0·15
BC168C	0·15
BC169B	0·15
BC169C	0·15
BC170A	0·15
BC171	0·16
BC172	0·12
BC177	0·19
BC178	0·18
BC179	0·21
BC182	0·12
BY182L	0·12
BC183	0·12
BC183L	0·12
BC184	0·13
BC184L	0·13

BC207	0·12
BC208	0·11
BC212	0·16
BC212L	0·16
BC214L	0·18
BC237	0·16
BC238	0·15
BC239	0·15
BC251	0·25
BC253	0·25
BC257	0·18
BC258	0·16
BC259	0·17
BC261	0·25
BC262	0·22
BC263	0·25
BC300	0·38
BC301	0·34
BC302	0·29
BC303	0·54
BC307	0·17
BC308A	0·15
BC309C	0·20
BC317	0·12
BC318	0·12
BC337	0·20
BC338	0·20
BCY30	1·03
BCY31	1·06
BCY32	1·18
BCY33	0·96
BCY34	1·00
BCY38	1·00
BCY39	1·50
BCY40	0·97
BCY42	0·28
BCY58	0·30
BCY59	0·32
BCY70	0·17
BCY71	0·22
BCY72	0·18
BD115	0·75
BD116	0·75
BD121	1·00
BD123	0·82
BD124	1·20
BD131	0·40
BD132	0·50
BD135	0·21
BD136	0·22
BD137	0·24
BD138	0·26
BD139	0·71
BD140	0·87
BD529	0·80
BD530	0·80
BDY20	1·05
BF115	0·29
BF117	0·55
BF121	0·35
BF123	0·35
BF125	0·35
BF152	0·20
BF153	0·25
BF154	0·20
BF159	0·27

BF160	0·23
BF163	0·32
BF166	0·40
BF167	0·25
BF173	0·27
BF177	0·29
BF178	0·35
BF179	0·43
BF180	0·35
BF181	0·36
BF182	0·35
BF183	0·35
BF184	0·30
BF185	0·30
BF194	0·12
BF195	0·12
BF196	0·13
BF197	0·15
BF198	0·18
BF200	0·40
BF225J	0·23
BF244	0·21
BF245	0·45
BF246	0·58
BF247	0·65
BF254	0·19
BF255	0·19
BF257	0·47
BF258	0·53
BF259	0·55
BFR39	0·24
BFR79	0·24
BFS21A	2·30
BFS28	1·36
BFS61	0·27
BFS98	0·25
BFX29	0·35
BFX30	0·34
BFX84	0·30
BFX85	0·35
BFX87	0·28
BFX88	0·30
BFX89	0·90
BFY50	0·30
BFY51	0·28
BFY52	0·30
BFY53	0·26
BFY90	1·27
BRY39	0·48
BSX20	0·28
BSX21	0·30
BU105	2·50
BU205	2·50
C106D	0·85
CA3020A	1·80
CA3028A	0·79
CA3035	1·37
CA3046	0·70
CA3048	2·11
CA3052	1·62
CA3080A	1·08
CA3089E	1·96
CA3090Q	4·23
LM301A	0·48
LM308	1·17
LM309K	1·88

LOO5T1	1·50
LM380	0·98
LM381	2·07
LM702C	0·75
LM709	
TO99	0·38
8DIL	0·45
14DIL	0·40
LM710	0·47
LM723C	0·66
LM741	
TO99	0·40
8DIL	0·40
14DIL	0·38
LM747	1·05
LM748	
8DIL	0·44
14DIL	0·41
LM3900	0·61
LM7805P	1·60
LM7812P	1·60
LM7815P	1·60
LM7824P	1·60
MC1303	1·50
MC1310	2·50
MC1330P	0·90
MC1351P	0·80
MC1352P	0·80
MC1466	3·50
MC1469	2·75
ME0402	0·20
ME0404	0·13
ME0412	0·18
ME4102	0·11
ME4104	0·11
MJ480	0·95
MJ481	1·20
MJ490	1·05
MJ491	1·45
MJ2955	1·00
MJE340	0·48
MJE2955	1·20
MJE3055	0·75
MJE370	0·65
MJE371	0·75
MJE520	0·60
MJE521	0·70
MP8111	0·32
MP8112	0·40
MP8113	0·47
MPF102	0·39
MPSA05	0·25
MPSA06	0·31
MPSA12	0·35
MPSA55	0·25
MPSA56	0·31
MPSU05	0·65
MPSU06	0·58
MPSU55	0·63
MPSU56	0·80
NE555V	0·70
NE556	1·30
NE560	4·48
NE561	4·48
NE565A	4·48
OC28	1·48
OC35	1·16

OC42	0·50
OC45	0·32
OC71	0·17
OC72	0·25
OC81	0·25
OC83	0·24
ORP12	0·60
R53	1·80
SL414A	2·35
SL610C	2·35
SL611C	2·35
SL612C	2·35
SL620C	3·50
SL621C	3·50
SL623	5·75
SL640C	4·00
SL641C	4·00
SN76003N	2·92
SN76013N	1·95
SN76023N	1·60
SN76033N	2·92
ST2	0·20
TAA263	1·20
TAA300	1·84
TAA350	1·96
TAA550	0·32
TAA611C	2·18
TAA621	2·03
TAA661B	1·32
TBA641B	2·25
TBA651	1·69
TBA800	0·89
TBA810	0·98
TBA820	0·80
TBA920	1·79
TIL209	0·35
TIP29A	0·49
TIP29C	0·80
TIP30A	0·58
TIP30C	0·85
TIP31A	0·62
TIP31C	1·00
TIP32A	0·74
TIP32C	1·25
TIP33A	1·01
TIP33C	1·45
TIP34A	1·51
TIP34C	2·60
TIP35A	2·90
TIP36A	3·70
TIP41A	0·79
TIP41C	1·40
TIP42A	0·90
TIP42C	1·60
TIP2955	0·98
TIP3055	0·50
TIS43	0·28
ZTX300	0·13
ZTX301	0·13
ZTX302	0·20
ZTX500	0·15
ZTX501	0·13
ZTX502	0·18
ZTX530	0·23
ZTX531	0·22

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Round nose box joint 4in long	£2·50
Diagonal cutters box joint 4in long	£2·80
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Snipe nose box joint 4in long	£2·40

P.C. MARKER PEN DALO 33PC, 87p.
ZENER DIODES 400MW **11p**, 1W **17p**, 2·5W 35p.
IC SOCKETS 8 DIL **12p**, 14 DIL **14p**, 16 DIL **16p**.
RESISTORS ¼W **2p** (100 per value 0·013p); ½W **3p** (100 per value 0·02p)
SCORPIO CAR IGNITION KIT £12·75.
JUMBO 7 SEGMENT DISPLAYS £2.
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MINITRON £1·50.
LEDs Red, green and yellow, 20 dia. 32p.

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CD4002	0·18	CD4020	0·98	CD4044	0·77
CD4006	0·99	CD4021	0·88	CD4045	1·30
CD4007	0·18	CD4022	0·85	CD4046	1·20
CD4008	0·82	CD4023	0·18	CD4047	0·85
CD4009	0·52	CD4024	0·72	CD4049	0·48
CD4010	0·52	CD4025	0·19	CD4050	0·45
CD4011	0·18	CD4027	0·43	CD4510	1·25
CD4012	0·18	CD4028	0·83	CD4511	1·84
CD4013	0·45	CD4029	1·06	CD4516	1·25
CD4014	0·89	CD4030	0·52	CD4518	1·87
CD4015	0·89	CD4031	1·98	CD4520	1·87
CD4016	0·45	CD4037	0·88		
CD4017	0·88	CD4041	0·70		

Veroboard

	Copper		Plain	
	0·1	0·15	0·1	0·15
2·5 × 3¾in	36p	26p	22p	17p
2·5 × 5in	40p	39p	—	19p
3¾ × 3¾in	40p	39p	—	—
3¾ × 5in	45p	47p	32p	32p
3¾ × 17in	£1·61	£1·26	£1·00	£1·92
PINS × 36	30p	30p		
× 200	£1·16	£1·16		

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SN7401	0·16
SN7402	0·16
SN7403	0·16
SN7404	0·19
SN7405	0·19
SN7406	0·36
SN7407	0·36
SN7408	0·19
SN7409	0·18

SN7410	0·16
SN7411	0·20
SN7412	0·22
SN7413	0·28
SN7416	0·28
SN7417	0·28
SN7420	0·16
SN7423	0·23
SN7425	0·23
SN7427	0·23
SN7430	0·15

SN7432	0·22
SN7437	0·28
SN7438	0·28
SN7440	0·16
SN7441AN	0·68
SN7442	0·65
SN7445	0·78
SN7446	0·84
SN7447	0·80

SN7448	0·90
SN7450	0·16
SN7451	0·16
SN7453	0·16
SN7454	0·16
SN7460	0·16
SN7470	0·29
SN7472	0·21
SN7473	0·31

SN7474	0·31
SN7475	0·45
SN7476	0·30
SN7480	0·42
SN7481	1·00
SN7482	0·65
SN7483	0·82
SN7484	0·95
SN7485	1·00
SN7486	0·29
SN7490	0·42
SN7491	0·75

SN7492	0·45
SN7493	0·45
SN7494	0·75
SN7495	0·68
SN7496	0·68
SN74100	1·10
SN74107	0·30
SN74118	0·85
SN74119	1·75
SN74121	0·32
SN74122	0·42
SN74123	0·65

SN74141	0·75
SN74145	0·72
SN74150	1·20
SN74151	0·68
SN74153	0·68
SN74154	1·20
SN74155	0·78
SN74157	0·76
SN74160	0·88
SN74161	0·88
SN74162	0·88
SN74163	0·88
SN74164	1·60
SN74165	1·60

SN74167	3·30
SN74174	0·99
SN74175	0·70
SN74176	1·14
SN74180	1·10
SN74181	1·95
SN74190	1·86
SN74191	1·86
SN74192	1·15
SN74193	1·15
SN74196	1·60
SN74197	1·58
SN74198	1·80
SN74199	1·80

15% DISCOUNT FOR 100 MIX

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Linear or Log	Single	Double
Rotary Pots	25p	75p
Rotary Switched	55p	—
Sliders	45p	75p

Full range of capacitors stocked. See catalogue for details

Presets—Horizontal or Vertical
0·1W **8p**   0·3W **10p**

DIN PLUGS—18p DIN CHASSIS SOCKETS—11p
3-pin, 4-pin, 5-pin 180°, 5-pin 240°, 6-pin spkr., 7-pin

FREE SOCKETS—18p each
3 pin, 5 pin 180° and spkr. plugs

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P73 standard—3 pin mains (male socket) 50p per pair
P360 miniature—3 pin mains (male socket) 40p per pair
P437 standard—3 pin mains output (male plug) 70p per pair

JACK PLUGS AND SOCKETS
¼in mono plastic plug **18p**
¼in mono chrome plug **22p**
¼in chrome line socket **25p**
¼in plastic switch socket (makes 2 circuits) **18p**
¼in stereo plastic plug **26p**
¼in stereo chrome plug **50p**
¼in stereo plastic line socket **40p**
¼in stereo chrome line socket **30p**
¼in stereo plastic switched socket (makes 3 circuits) **26p**
3·5mm plug **16p**; 3·5mm socket **8p**; 3·5mm line socket **16p**;
2·5mm plug **16p**; 2·5mm socket **8p**

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2P 2W 60p; 1P 2W 55p.

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1P 2W 55p; 2P 2W 60p; 2P 2W centre off 70p; 1P on-off 45p.

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High quality audio

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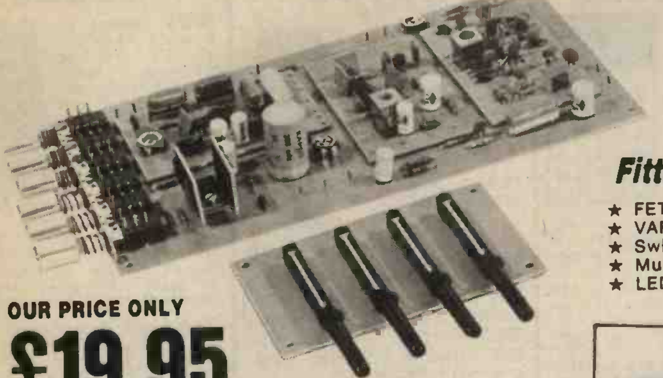
STEREO FM TUNER

Fitted with Phase Lock-loop Decoder



★ FET input Stage
★ VARI-CAP diode tuning
★ Switched AFC
★ Multi turn pre-sets
★ LED Stereo Indicator

Typical Specification:
Sensitivity 3μ volts
Stereo separation 30dB
Supply required 20–30V at 90 Ma max.

OUR PRICE ONLY

£19.95

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, by simply changing the settings of the pre-set controls.
Used with your existing audio equipment or with the BI-KITS STEREO 30 or the MK60 Kit etc. Alternatively the PS12 can be used if no suitable supply is available, together with the Transformer T461.
The S450 is supplied fully built, tested and aligned.
The unit is easily installed using the simple instructions supplied.

STEREO PRE-AMPLIFIER PA 100

A top quality stereo pre-amplifier and tone control unit. The six push-button selector switch provides a choice of inputs together with two really effective filters for high and low frequencies, plus tape output.

Frequency Response +1dB 20Hz–20kHz.
Sensitivity of inputs:
1. Tape input 100mV into 100k ohms
2. Radio Tuner 100mV into 100k ohms
3. Magnetic P.U. 3mV into 50k ohms

P.U. input equalises to R1AA curve within 1dB from 20Hz to 20kHz. Supply 20–35V at 20mA. Dimensions —299 × 89 × 35mm.

£13.50

P. & P. 45p

MK60 AUDIO KIT:
Comprising: 2 × AL60's. 1 × SPM80. 1 × BTM80. 1 × PA100. 1 front panel and knobs. 1 Kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklet. **COMPLETE PRICE £27·55** *plus 62p postage.*
TEAK 60 AUDIO KIT:
Comprising: Teak veneered cabinet size 16¾ × 11½ × 3¼in. other parts include aluminium chassis, heatsink and front panel bracket plus back panel and appropriate sockets etc. **KIT PRICE £9·20** *plus 62p postage.*

VAT ADD 12½%

AL 60

25 Watts (RMS)

● Max Heat Sink temp. 90°C. ● Frequency response 20Hz. ● Distortion better than 0·1 at 1kHz. ● Supply voltage 15–50V. ● Thermal Feedback. ● Latest Design Improvements. ● Load—3, 4, 5 or 16 ohms. ● Signal to noise ratio 80dB. ● Overall size 63 × 13mm.

Especially designed to a strict specification. Only the finest components have been used and the latest solid-state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

ONLY £3.95

Stabilised Power Supply Type SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watts (r.m.s.) per channel simultaneously. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5A at 35V. Size: 63 × 105 × 30mm. Incorporating short circuit protection.

INPUT VOLTAGE	33–40V A.C.
OUTPUT VOLTAGE	33V D.C. Nominal
OUTPUT CURRENT	10mA–1·5 amps
OVERLEAD CURRENT	1·7 amps approx.
DIMENSIONS	105 × 63 × 30mm
TRANSFORMER BMT80	£2·60 + 62p postage

£3.00

STEREO 30 COMPLETE AUDIO CHASSIS

7 + 7 WATTS R.M.S.
The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, mains switch, fuse and fuse holder and universal mounting brackets enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available. Ideal for the beginner or the advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty (can be installed in 30 mins.).

TRANSFORMER £2·45 plus 62p P. & P.
TEAK CASE £3·65 plus 62p P. & P.

£15.75

P. & P. 45p

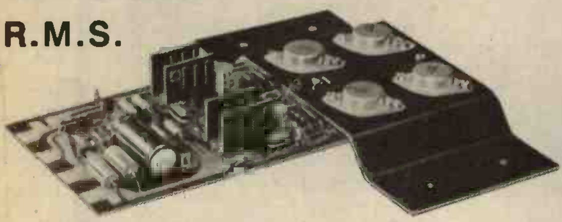
equipment mono and other modules for Stereo

IT'S NEW!

IT'S POWERFUL

IT'S THE AL250

125 watts R.M.S.



POWER AMPLIFIER

**Specially designed for use in—
Disco Units, P.A. Systems, high power Hi-Fi, Sound reinforcement systems**

The module has a sensitivity of 450mV and a frequency response extending from 25Hz to 20kHz whilst distortion levels are typically below 0·1%. The use of 4, 115W transistors in the output stage makes the unit extremely rugged while damage resulting from incorrect or short-circuit loads is prevented by a four transistor protection circuit.
The unit is intended for use in many applications such as disco units, sound reinforcement systems, background music players, etc.

SPECIFICATION:

Output Power: 125 watt RMS Continuous
Operating voltage: 50–80
Loads: 4–16 ohms
Frequency response: 25Hz–20kHz *Measured at 100 watts*
Sensitivity for 100 watts output at 1kHz: 450mV
Input impedance: 33k ohms
Total harmonic distortion
50 watts into 4 ohms: 0·1%
50 watts into 8 ohms: 0·06%
S/N ratio: better than 80dBs
Damping factor, 8 ohms: 65
Semiconductor complement: 13 transistors 5 diodes
Overall size: Heatsink width 190mm, length 205mm, height 40mm

ONLY £15.95 + 8% VAT

MPA 30

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the new Bi-Pak M.P.A. 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only. Used in conjunction are 4 low noise, high gain silicon transistors. It is provided with a standard DIN input socket for ease of connection. Supplied with full, easy-to-follow instructions.

£2.65

VAT ADD 12½%

POSTAGE & PACKING

Postage & Packing add 25p unless otherwise shown. Add extra for airmail. Min. £1·00

AL10-20-30

AUDIO AMPLIFIER MODULES

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S. The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the home. Harmonic Distortion Po = 3 watts f = 0·25% Load impedance 8–16 ohm

Frequency response ± 3dB Po = 2 watts 50Hz–25kHz Sensitivity for Rated O/P—Vs = 25V. RL = 80 ohm f = 1kHz 75mV. RMS. Size: 75 × 63 × 25mm.

AL10 3W R.M.S. **£2.30** AL2 5W R.M.S. **£2.65** AL30 10W R.M.S. **£2.95**

NEW

PA12 £6.50

NEW PA12 Stereo Pre-Amplifier completely redesigned for use with AL10 20 30 Amplifier Modules. Features include on/off volume. Balance, Bass and Treble controls. Complete with tape output.
Frequency Response 20Hz–20kHz (−3dB)
Bass and Treble range ±12dB
Input Impedence 1 meg ohm
Input Sensitivity 300mV
Supply requirements 24V, 5mA
Size 152 × 84 × 33mm

PS12

Power supply for AL10/20/30, PA12, S450 etc. Input voltage 15–20V a.c. Output voltage 22–30V d.c. Output Current 800mA Max. Size 60 × 43 × 26mm.

Transformer T538 £2·30

£1·20

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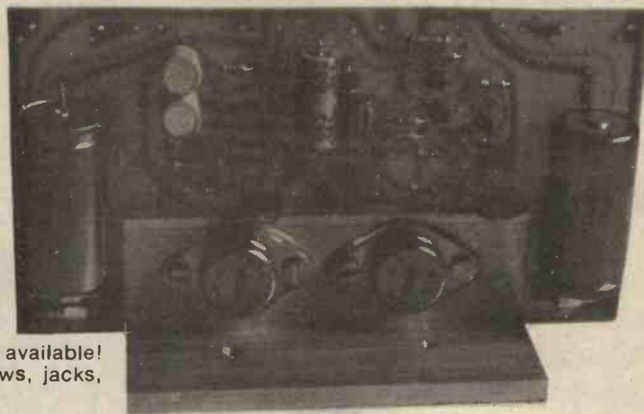

PA110 (as illustrated): 110W 4Ω with 45–0–45V d.c. 3A P.S.U. All you need is Amp Card and Transformer! Hi-power, hi-fidelity and low noise! Hundreds of satisfied users! Kit **£19·50**; Built **£24·50**; Trans. **£9·90**

PA50: 50W 4Ω with 45V d.c. 2A P.S.U. 150W output transistors and 5 diode protection circuit. Fuses and capacitors on P.S.U. Built **£7·95**; P.S.U. Card Built **£5·95**; Transformer **£4·95**

IC2/4: Input Microchip Pre-amp to suit either amp unit. Factory set at 14mV 50KΩ. Linear adjustable to 3mV 47kΩ. Riaa mag. equalised or any magnetic crystal or ceramic device. High or low Imp.! Up to 2·5V output available! Cadmium-plated chassis kit with knobs, screws, jacks, etc., **£9·95** (screen printed and drilled). Package deal PA110 **£61·95**; PA50 **£49·95**.

Chunky ¾in thick metal-cornered Wooden Cabinet with heavy-duty feet and handles, really professional finish, **£8·95**. Mono Disco Pre-amp: Kit **£49**; Built **£69**. Stereo Discomix: Kit **£79**; Built **£119**. Fuzz Lights: red, blue, amber, green, **£19·50**. Super Teak Cabinets: 7 × 4in **£3·90**; 8 × 5in **£4·90**; 8in **£5·90**; 10in **£7·90**; 12in **£8·90**; TW **£9·90**. Heavy Duty Black Cabinets: 12in **£12·90**; 2 × 12in **£16·90**; 15in **£19·90**; 15in Bin **£36·90**; 4 × 12in Tall **£24·90**.

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ALL COMPONENT PARTS ARE AVAILABLE SEPARATELY S.A.E. FOR LISTS, OR FOR PRICING.

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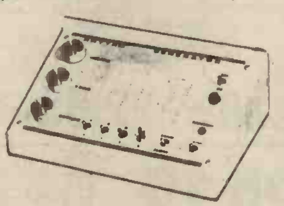

FULL KIT: £37·50 + £1·00 (includes V.A.T.)

KIT INCLUDES NEW UPDATED P.C.B.'s

With Printed layout for easy assembly, all components "nice" switches and knobs, case, in fact everything you need to complete this very exciting Project.

P.C.B.'s ARE AVAILABLE SEPARATELY

Set of NEW UPDATED P.C.B.'s with a printed layout, made in first class quality fibre-glass, by a well known national company.

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ALWAYS SHELVES FULL OF ODD UNITS, CHASSIS, etc. Many bargains for callers. Lists also available S.A.E.

12in LONG PERSISTENCE CRT. New. boxed. Last few 100 to clear at £1 each, or Carr. at £2·50 each.

MIN. TRANSFORMER. 240V input. 3V 1A output. Brand new. Now only 25p each, P. & P. 50p.

WIDE RANGE WOBBULATOR. 5MHz to 150MHz up to 15MHz sweep width. Only 3 controls, preset RF level, sweep width and frequency. Ideal for 10·7 or TV IF alignment, filters, receivers. Can be used with any general purpose scope. Full instructions supplied. Connect 6·3V a. c. and use within minutes of receiving. All this for ONLY £6·75, P. & P. 35p. (Not cased, not calibrated.)

20Hz to 200kHz WB, SINE and SQUARE GENERATOR. Four ranges. Independent amplitude controls, thermistor stabilised. Ready to use. 9V supply required. £8·85 each. SINE WAVE only £6·85 each. P. & P. 35p. (Not cased, not calibrated.)

GRATICULES 12cm x 14cm high quality plastic 15p each. P. & P. 8p.

NEW—UPGRADED CONTENTS—FOR LESS MONEY. * 3lb electronic goodies, £1·60 post paid. * High value printed board pack—hundreds of components, transistors, etc.—no flat to the board transistors. £1·65 post paid.

GRATICULES 12 x 14cm high quality plastic 15p each. P. & P. 10p. * 1000pF feed thru capacitors 10 for 30p, P. & P. 15p. * **CAPACITOR** pack 50 brand new components only 50p, P. & P. 48p.

FIBREGLASS BOARD PACK. More board —less money. Larger pieces. Not less than 2·5 sq. ft for 95p, P. & P. 65p. Double or single sided cut to any size. New lower price 1p per sq.in, P. & P. extra.

***METER PACKS**—3 different meters £2, P. & P. £1.

SOME OSCILLOSCOPES ALWAYS AVAILABLE. S.A.E. stating specification and price range.

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74L03	18p	74L71	21p	74L93	97p
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74L10	18p	74L74	44p	74L164	1-69p
74L20	18p	74L78	49p	74L165	1-69p
74L30	18p	74L85	96p		
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74LS02	26p	74LS40	35p	74LS107	40p
74LS04	26p	74LS42	92p	74LS164	1-38
74LS08	29p	74LS74	46p	74LS193	1-50
74LS10	26p	74LS90	92p	74LS197	1-38p
74LS20	26p	74LS93	92p		

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74H00	18p	74H22	21p	74H61	29p
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74H08	18p	74H50	18p	74H101	40p
74H10	18p	74H52	21p	74H102	40p
74H11	18p	74H53	23p	74H103	46p
74H20	18p	74H55	23p	74H106	46p
74H21	18p	74H60	24p	74H108	46p

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74S00	26p	74S08	35p	74S22	26p
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8263	3-79	8267	1-79

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9002	24	9309	56	9601	62
9301	72	9312	56	9602	56

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932	12	944	12	962	12
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MM5314	6 digit multiplexed 12-24 Hr, 50-60Hz 24 pin	3-07
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4001A	21	4020A	1-22	4068A	36
4002A	21	4021A	1-13	4069A	36
4006A	1-10	4022A	90	4071A	22
4007A	22	4023A	21	4072A	29
4008A	1-46	4024A	72	4073A	32
4009A	47	4025A	21	4075A	32
4010A	44	4027A	48	4078A	32
4011A	22	4028A	81	4082A	29
4012A	21	4030A	37	4518A	1-69
4013A	37	4035A	1-04	4528A	1-31
4014A	1-22	4040A	99	4585A	1-71
4015A	1-22	4042A	1-21	4901A	31
4016A	46	4049A	48		
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74C02	35	74C76	1-07	74C163	2-05
74C04	47	74C107	94	74C164	2-21
74C08	47	74C151	1-83	74C173	1-83
74C10	41	74C154	2-21	74C195	1-90
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MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation 24 pin	2-78
MM5739	9 digit, 4 function, 9V battery operation 22 pin	2-78

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1103	1024 bit RAM MOS 18 pin	1-97
1702A	2048 bit static PROM elect. prog. - UV eras. 24 pin	10-50
2102 (2602)	1024 bit static RAM DTL/TTL comp. 1 ms 16 pin	2-00
2101-1	Same as 2101 except 500ns	2-25
5203	2048 bit static PROM elect prog. - UV eras. 24 pin	7-55
5260	1024 bit dynamic RAM MOS 16 pin	1-35
5261	1024 bit dynamic RAM MOS 16 pin	1-35
5262	2048 bit dynamic RAM MOS 22 pin	1-55
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5262	"	10/ 9-59	100/ 84
5002	Calc Chip	10/ 8-20	100/ 72
5005	" "	10/ 9-59	100/ 84
5738	" "	10/ 13-80	100/ 121
309K	5V Reg	10/ 6-90	100/ 61
741	Op Amp mDIP	10/ 1-45	100/ 13
3900	Quad Amp DIP	10/ 1-76	100/ 16
MAN 1	Display	10/ 8-20	100/ 72
74123	Dual Monostable multivibrator	10/ 3-86	100/ 34

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MV5020	Jumbo clear	12p
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MAN5	Green .27" CA	2-03
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DL10A	Red .26" CA	2-08
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305	Pos V Reg TO-5	60
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308	Micro Pwr Op Amp mDIP TO-5	69
309K	5V 1A regulator TO-3	1-25
310	V Follower Op Amp mDIP	75
311	Hi perf V Comp mDIP TO-5	67
319	Hi Speed Dual Comp DIP	82
320T	Neg Reg 5, 12, 15 TO-220	1-12
320K	Neg Reg 5.2, 12 TO-3	1-32
322	Precision Timer DIP	69
324	Quad Op Amp DIP	1-23
339	Quad Comparator DIP	1-06
340K	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3	1-48
340T	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220	1-23
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373	AM/FM/SSB Strip TO-5	35
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207	500, 500	0-8-9, 0-8-9	2·73
208	1A, 1A	0-8-9, 0-8-9	3·94
236	200, 200	0-15, 0-15	1·95
214	300, 300	0-20, 0-20	2·82
221	700 (DC)	20-12-0-12-20	4·28
206	1A, 1A	0-15-20, 0-15-20	4·70
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COMPONENTS SETS include all necessary resistors, capacitors, semi-conductors, potentiometers and transformers. Hardware such as cases, sockets, knobs, etc. are not included but most of these may be bought separately. Fuller details of kits, PCBs and parts are shown in our lists.

CIRCUIT AND LAYOUT DIAGRAMS are supplied free with all PCBs designed by Phonosonics.

PHOTOCOPIES of the P.E. texts for most of the kits are available—prices in our lists.

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THE MAIN SYNTHESISER
Stabilised power supply £12·05
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PCB for both Envelope Shapers £1·55
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GUITAR EFFECTS PEDAL (P.E. July 75)
Will modify an audio signal not only from a guitar but from any audio source, producing 8 different switchable effects that can be further modified by manual controls. Possibly the most interesting of all the low-priced sound effects units in our range.
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Alternative component set with panel mounting switches £4·60
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SOUND BENDER (P.E. May 74)
A multi-purpose sound controller, the functions of which include envelope shaper, tremolo, voice-operated fader, automatic fader and frequency-doubler.
Component Set for above functions (excl. 5Ws) £6·58
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Optional extra—additional Audio Modulator, the use of which, in conjunction with the above component set, can produce "jungle-drum" rhythms.
Component Set (incl. PCB) £2·55

PHASING UNIT (P.E. Sept. 73)
A simple but effective manually controlled unit for introducing the "phasing" sound into live or recorded music.
Component Set (incl. PCB) £2·50

PHASING CONTROL UNIT (P.E. Oct. 74)
For use with the above Phasing Unit to automatically control the rate of phasing.
Component Set (incl. PCB) £3·75

WAH-WAH UNIT (P.E. Apr. 76)
The Wah-wah effect produced by this unit can be controlled manually or by the integral automatic controller.
Component Set incl. PCB £2·99

P.E. JOANNA (P.E. May/Sept. 75)
A five-octave electronic piano that has switchable alternative voicing of Honky-Tonk piano, ordinary piano, harpsichord, or a mixture of any of the three, together with facilities including fast and slow tremolo, loud and soft pedal switching, and sustain pedal switching. The power amplifier typically delivers 24 watts into 8 ohms. The PCBs have been redesigned by ourselves making improved use of the space available.

Main Power Supply £9·41
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PCB for Main PSU, Tone Gen & Top C E.S. £2·10
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PCB for Voicing and Pre-amp £2·64
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PCB for Power Amp and PSU 95p

RHYTHM GENERATOR (P.E. Mar./Apr. 74)
Programmable for 64,000 rhythm patterns from 8 effects circuits (high and low bongos, bass and snare drums, long and short brushes, blocks and soft cymbal), and with variable time signatures and rhythm rates. Really fascinating and useful.
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Power Supply for T, T and L, and Effects, incl. PCB £6·42
(See our list for Power Supplies for Mixers)

REVERBERATION UNIT (P.W. Nov./Dec. 72)
A high quality unit having microphone and line input pre-amps, and providing full control over reverberation level.
Component Set (excl. spring unit) £7·55
Printed Circuit Board £1·76
9 in. Spring Unit £4·95
Panel Meter (50μA) (optional) £3·75

WIND AND RAIN UNIT
A manually controlled unit for producing the above-named sounds.
Component set incl. PCB £2·83

P.E. MINIMIX 6 (P.E. Nov./Dec. 75)
Each of the 6 input channels has its own gain, volume and panning controls. The volume of the twin channel outputs are fully manually controllable, as are the headphone and pre-fade monitoring facilities. Twin VU meters provide visual display of channel audio levels. Ideal for use with effects and synthesiser kits.
For details see our list.

8-INPUT MIXER
A simple mixer having 8 inputs each of which has a preset level control and which are combined into one output channel having a preset over-all level control and a master output volume control. Designed for inter-coupling our various sound effects and synthesiser kits.
Component set incl. PCB £3·70

25 WATT MONO AMPLIFIER (P.E. Sept. 75)
A good general purpose integrated circuit power amplifier typically delivering 25 watts into 8 ohms. Power bandwidth 20Hz to 20kHz, 3dB, Input impedance 20k m. Distortion 0·2%. Suitable for use with any of our sound producing kits.
Component Set incl. power supply £14·50
Printed Circuit Board 95p
For stereo use two sets and PCBs are required.

TREBLE BOOST UNIT (P.E. Apr. 76)
Gives a much shriller quality to audio signals fed through it. The depth of boost is manually adjustable.
Component Set incl. PCB £2·15

P.E. MINISONIC MK 1
(P.E. Nov. 1974 to March 1975)
A portable, battery or mains operated, miniature sound synthesiser, with keyboard circuits. Although having slightly fewer facilities than the large P.E. Synthesiser, the functions offered by this design give it great scope and versatility. Like the large Synthesiser it too may be advantageously used with other circuits in our lists.

Two Voltage Controlled Oscillators £5·22
Voltage Controlled Filter and Voltage Reference Circuit £3·41
Two Envelope Shapers and Two Voltage Controlled Amplifiers £7·25
Keyboard Controller and Hold Circuits £2·66
Keyboard Divider Resistors (select type to suit keyboard used) (all are 2% tolerance): 2 Octave £1; 3 Octave £1·48; 4 Octave £1·96; 5 Octave £2·44.
H.F. Oscillator and Detector £1·66
Ring Modulator, Noise Generator and Envelope Inverter £5·45
Two Power Amplifiers and Two Mixers £3·55
Battery Eliminator £5·88
Temperature Stabiliser £1·47
PCB to hold 2 VCOs, VCF and V-Ref £2·02
PCB to hold 2 ESs, 2 VCAs, 2 Mixers, Ring Mod, Keyboard Control and Hold £2·20
PCB to hold 2 Power Amps., Noise Gen., Envelope-Inverter, H.F. Osc and Detector £1·45
PCB to hold Battery Eliminator and Temperature Stabiliser £1·35

P.E. MINISONIC MK 2
Conversion kits and PCBs for updating the MK 1 version are now available. Details in our list.

ENVELOPE SHAPERS
Both of the kits below have manual control over their Attack, Decay, Sustain and Release functions. Both kits include PCB.(VCA means Voltage Controlled Amplifier)
Envelope Shaper and VCA (P.E. Apr. 76) £5·43
Envelope Shaper (without VCA) (P.E. Oct. 75) £4·16

VOICE OPERATED FADER (P.E. Dec. 73)
For automatically reducing music volume during "talk-over"—particularly useful for Disco work or for home-movie shows.
Component Set incl. PCB £3·05

VOLTAGE CONTROLLED FILTER (P.E. Oct. 74)
An independently designed VCF that can be used with the P.E. Synthesiser.
Component Set £3·41
Printed Circuit Board £1·25

P.E. TUNING FORK (P.E. Nov. 75)
Produces 84 switch-selected frequency-accurate tones. An LED monitor clearly displays all beat note adjustments. Ideal for tuning acoustic and electronic musical instruments alike.
Main Component Set incl. PCB £14·22
Power Supply set incl. PCB £6·57

P.E. SYNCHRONOME (P.E. Mar. 76)
An accented-beat electronic metronome, providing duple, triple and quadruple times with full control over the beat rate. Can also be used as a simple drum-beat rhythm generator. Includes power supply.
Component Set incl. loudspeaker £10·20
Printed Circuit Board £1·70

PEAK LEVEL INDICATOR (P.E. Mar. 76)
A twin-channel visual display unit for monitoring the peak level of audio signals. Well suited for use when inter-coupling our many sound producing kits to help avoid signal over-loading.
Component Set incl. PCB (as published) £3·26

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EXPORT ORDERS are welcome, though we advise that a current copy of our list should be obtained before ordering as it also shows Export postage rates. All payments must be cash-with-order, in Sterling and preferably by International Money Order or through an English Bank. To obtain list for Europe send 20p, for other countries send 40p.

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OTHER PROJECTS

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

LIST—Send Stamped Addressed Envelope with all U.K. requests for free list giving fuller details of PCBs, kits, and other components.

OVERSEAS enquiries for list: Europe—send 20p; Other Countries—send 40p.

KEYBOARDS AND CONTACTS

Kimber-Allen Keyboards as required for many published circuits, including the P.E. Joanna, P.E. Minisonic, and P.E. Synthesiser. The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C. The keys are plastic, spring-loaded and mounted on a robust aluminium frame.
3 Octave (37 notes) £20·50. 4 Oct (49 notes) £23·50. 5 Oct (61 notes) £27.

Contact Assemblies for use with above keyboards: Single-pole change-over (type SP) as for P.E. Joanna and P.E. Minisonic. Two-pole normally open-make-break (type DP) as for P.E. Synthesiser. Special contact assembly (type 4PS) having 4 poles, 3 of which are normally-open make-break contacts and the fourth is a change-over contact—this special assembly enables THE SAME KEYBOARD to be used with the P.E. Synthesiser, P.E. Minisonic and the P.E. Joanna simultaneously thus avoiding the cost of more than one keyboard.

Contact	*Each*	*3 Octave Set*	*4 Octave Set*	*5 Octave Set*
SP	20p	£7·40	£9·80	21·20
2P	24p	£8·88	£11·76	£14·64
4PS	48p	£17·76	£23·52	£29·28

PRINTED CIRCUIT BOARDS for use with the above contacts and thus eliminating most of the inter-wiring required, are available. Details in our lists.

SOUND-TO-LIGHT (P.E. Apr./Aug. 71)
The ever-popular **Aurora**—4 or 8 channels each responding to a different sound frequency and controlling its own light. Can be used with most audio systems and lamp intensities. A MUST for any Disco, and a fascinating visual display for the home.

4 Channel Component Set (excl. thyristors)	£13·05
8 Channel Component Set (excl. thyristors)	£22·56
Power Supply Component Set	£4·96
PCB for 4 frequency channels	£3·32
PCB for power supply and 8 lamp drivers	£1·56
1A 400V thyristors (1 per chan. req.) each	75p
Panel meter (1μA) (optional)	£3·75

3-CHANNEL SOUND-TO-LIGHT (P.E. Apr. 76)
A simple but effective sound-to-light controller capable of operating 3 lamps each of approximately 700 watts. Includes power supply, thyristors, and by-pass switches.

Component Set incl. PCB	£11·36

BIOLOGICAL AMPLIFIER (P.E. Jan./Feb. 73)
Multi-function circuits that, with the use of other external equipment, can serve as lie-detector, alphaphone, cardiophone etc.

Pre-Amp Module Component Set incl. PCB	£3·71
Basic Output Circuits—combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lamp-driver circuits	£5·38
Audio Amplifier Module Type PC7	£6·75

TAPE NOISE LIMITER
Very effective circuit for reducing the hiss found in most tape recordings. All kits include PCBs.

Standard Tolerance Set of Components	£2·60
Superior Tolerance Set of Components	£3·22
Regulated Power Supply (will drive 2 sets)	£3·98

SINE AND SQUARE WAVE GENERATOR (P.E. July 75)
Suitable for audio, digital, or general purpose. Controllable through 4 decade ranges 10Hz to 100kHz. switched attenuation through 10 ranges from 10V to 1mV peak-to-peak.

Component Set	£8·88
PCB for above components	£1·60
Power Supply	£5·70
PCB for Power Supply	96p

HARMONIC DISTORTION FILTER (P.E. Mar. 76)
A simple to operate filter for use in measuring the total harmonic distortion in amplifiers.

Component set incl. PCB	£2·45

SEMI CONDUCTOR TESTER (P.E. Oct. 73)
Essential test equipment for the enterprising home constructor. While stocks last.

Set of resistors, capacitors, semiconductors, potentiometers, makaswitches and PCB	£8·44
Panel meter (500μA)	£3·75

PHOTOPRINT PROCESS CONTROL (P.E. Jan./Feb. 72)
For colour and B & W, and indispensible dark-room unit for finding exposure, controlling enlarger timing, and stabilising mains voltage. While stocks last.

Component Set (excl. meter)	£10·72
Printed Circuit Board	£1·74
Panel Meter (1mA)	£3·75

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Fuzz unit inc. P.C.B.	£1·80

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BC478	28p
BCY71	22p
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BD132	54p
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BFY51	22p
BFY52	24p
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Celestion C03K	£4·46
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Decca CO/1/8 crossover (DK30)	£4·50
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EMI 13 × 8in 20W bass 8 ohm	£9·00
EMI 14 × 9in bass 8 ohms, 14A770	£11·92
EMI 8 × 5in, 10W, d/cone, roll surr.	£3·56
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EMI 8in roll surr. bass	£5·73
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Elac 59RM 109 (15 ohm), 59RM114 (8 ohm)	£3·38
Elac 6½in d/cone, roll surr., 8 ohm	£3·83
Elac 10in 10RM239, 8 ohm	£3·83
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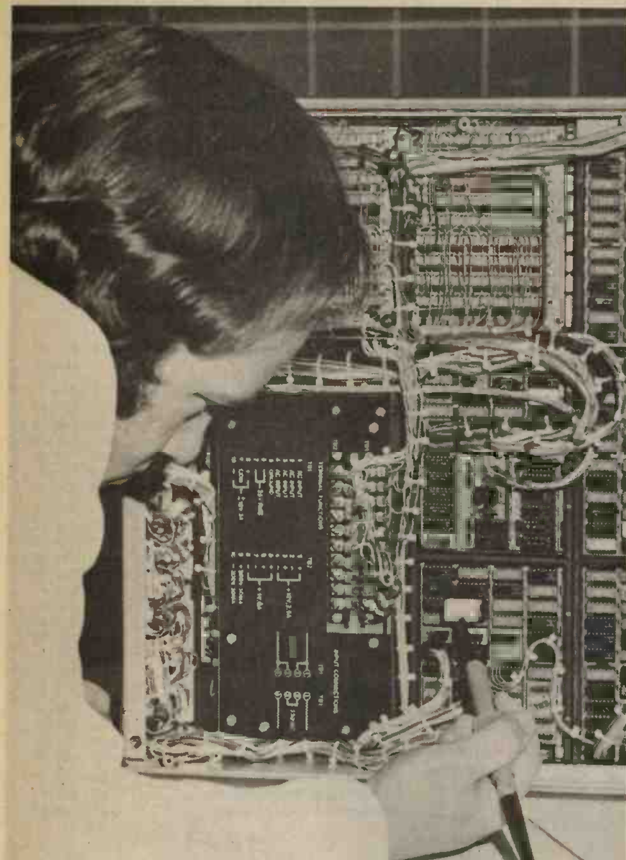

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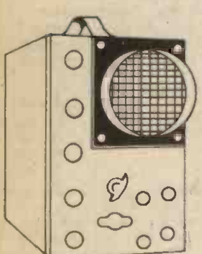

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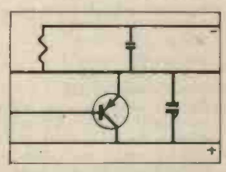

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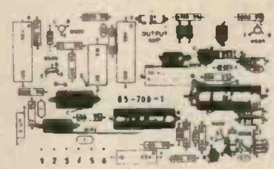

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A POWERFUL COMBINATION

Britain's new National Exhibition Centre at Birmingham was the setting for this year's International Electrical, Electronic and Instrument Exhibition. This new and spacious venue was most appropriate for the marriage of the IEA and Electrex. appearing together for the first time in one combined exhibition. A report will appear next month. Meanwhile the significance of the event deserves comment.

The close relationship between electronics and electrical engineering is self-evident. But as technologies advance this relationship grows ever closer and today the electricity supply services rely upon electronic instruments and circuits for control and monitoring purposes at all stages, from the power generating station through the varied distribution networks to the ultimate consumer. Conversely, electronic equipment requires electrical power to operate, though electronics is not entirely dependent upon the normal electricity supply. A real measure of independence is enjoyed by electronics because so much equipment can operate from other sources of electrical energy. But since battery manufacture, like all industry, is finally dependent upon mains supplies it would be unwise to make too much of such an argument. Devolution may be fashionable in political circles, but that's not the road for the electronics and electrical industries. Future needs and circumstances can only bring the two even closer together. In such an amalgamation of forces much of our future prosperity, if not existence, depends.

Energy resources has become a commonplace topic, and with very good reason. Indigenous fossil fuels will not last for ever, and there is an undeniable need to start looking for alternative sources of energy from which to produce electricity. For electricity remains the most convenient and flexible form of power, although not the most economical to generate using traditional methods and fuels.

Much work is currently being performed in exploring possible ways of harnessing and using solar radiated energy. But the self-sufficient home is still a dream, despite valiant efforts being made by various individuals and groups. One interesting idea recently mooted is for a two-way system whereby houses could feed current collected from roof top batteries of solar cells into the national grid in times of low domestic demand. Energy so contributed by countless homes could be used to pump water to high level reservoirs where it would be stored for eventual use to drive generators at time of heavy demand. The ambitious scheme envisaged poses mammoth problems, and clearly electronic control would play a vital role in any practical realisation of such a two-way exchange scheme.

No Government is likely to allocate millions of pounds to finance this or any other revolutionary scheme—however ideal and desirable—so long as it is not immediately imperative to do so. Thanks to North Sea oil, the present day fuel situation seems good and adequate. But we may be living in a fool's paradise. The situation will be very different in 25 years time.

Common sense cries out for a National Energy Policy and a bold plan to organise research and engineering resources to concentrate on new alternative methods for electricity generation. May the coming together at Birmingham of the electronic and electrical industries be an augury of some determined and positive efforts in this direction.

F.E.B.

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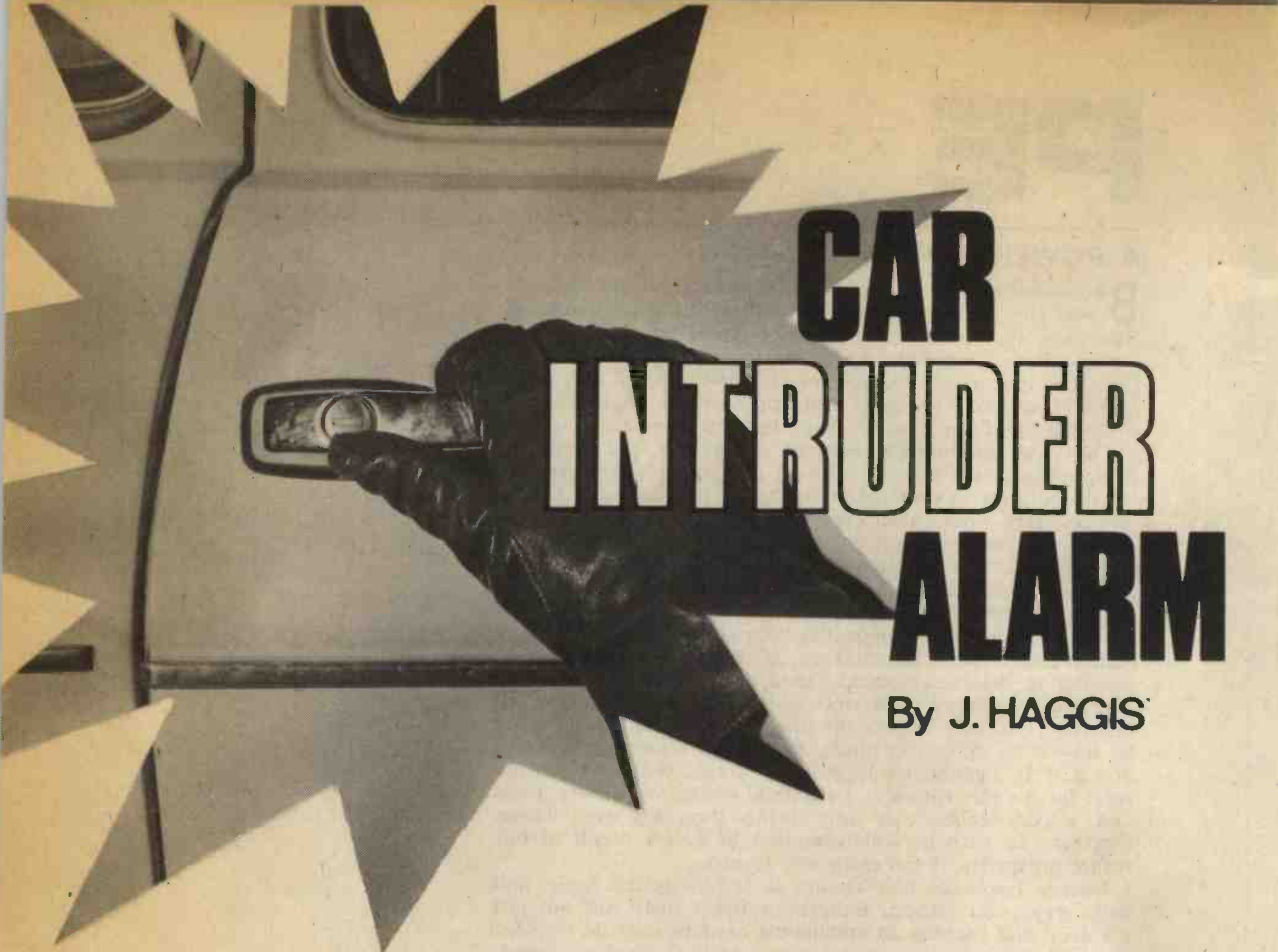


CAR INTRUDER ALARM

By J. HAGGIS

THIS article describes the design and construction of a circuit that can be made to give warning of an intruder opening any of your car doors, boot or bonnet. The circuit is made to operate a relay which repeatedly switches on for three seconds and off for one second. This relay can in turn be made to operate the vehicle horn or any other audible warning device.

The circuit is arranged such that the horn will silence after a chosen interval only if the car door, boot or bonnet are properly closed again. If, however, the door, etc. are not closed the horn will continue to sound.

It was thought that if the horn was made to sound intermittently it would attract more attention and save the battery and horn. With this interrupted sound, an intruder could not claim he had his horn stuck on.

DOOR SWITCHES

The first requirement is to fit the vehicle doors, boot and bonnet with switches. These switches should be installed such that when the door, etc. is closed the contacts are open, and closed when the door is open. Reed relays and magnets could be usefully employed if desired, instead of push-buttons.

CIRCUIT DESCRIPTION

The circuit is required to operate a relay if any of the door switch contacts are made, and to operate that relay at approximately a three second on, one second off ratio. It must also keep doing this for approximately one minute 15 seconds after the door switch has been made, even if the door is closed immediately.

If, however, the door remains open, the circuit must ensure that the relay will continue to operate at the above on/off ratio indefinitely.

To achieve these two requirements, two of the now well-known 555 timers are used. Timer IC1 (Fig. 1) is wired in the monostable mode and provides a positive supply to timer IC2 for approximately one minute 15 seconds.

Timer IC2 is wired in the astable mode and provides the on/off pulse to drive the relay RLA.

It is worth noting at this stage that the diode across the relay coil *must* be a germanium gold bonded type. Other types were tried but did not fully suppress the back e.m.f., causing the timer to be re-triggered.

The values of R5 and C2 determine the length of time the circuit remains operative. With the values shown it will operate for approximately 75 seconds. This is a long time for a car horn to be blowing,

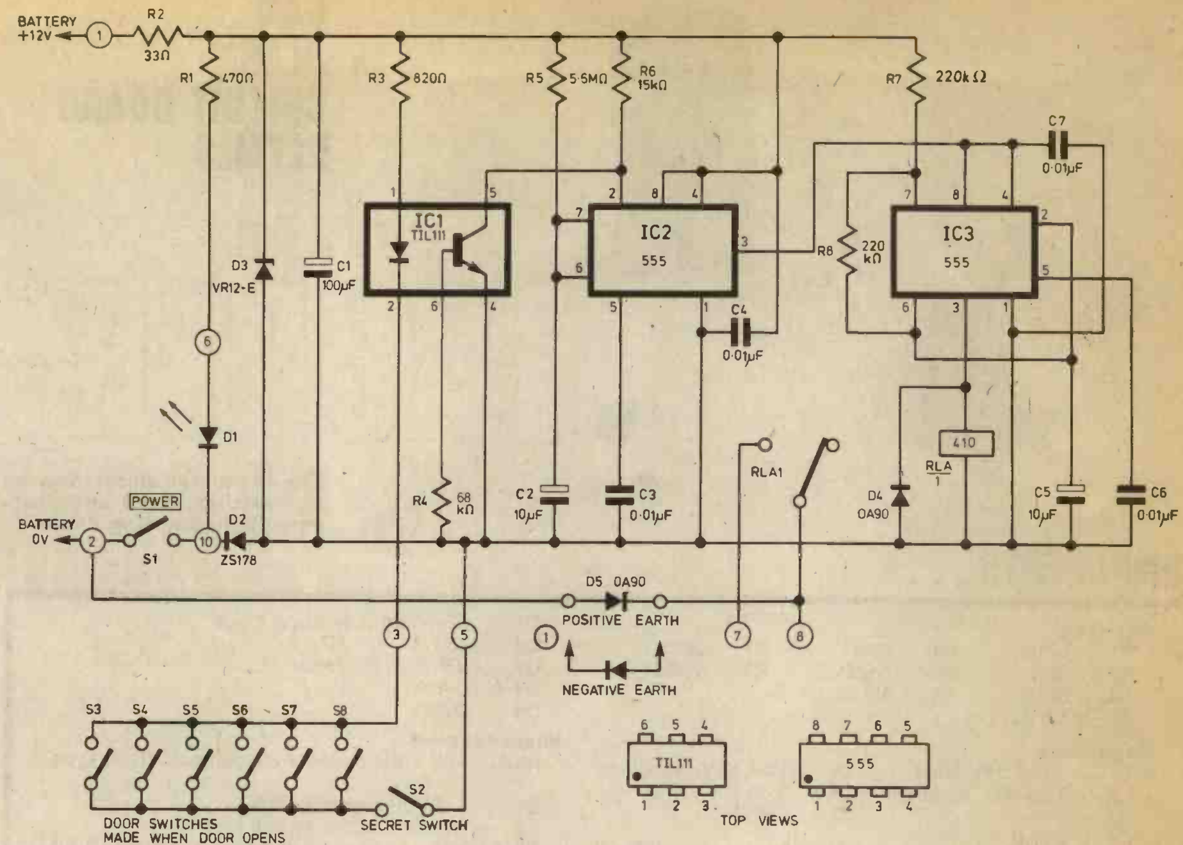


Fig. 1. Complete circuit diagram of the Car Intruder Alarm

but if any constructor thinks it should be longer, he can increase the time by increasing the value of R5 or C2. The data sheet for the timer states that the maximum value of R5 for reliable operation is determined by the value of the threshold current (I_T) into pin 6 which is 0·25µA (max).

$$R5\ (\text{max}) < \frac{V_{CC}}{3 \times 0{\cdot}25}\ \text{M}\Omega$$

$$R5\ (\text{min}) = 1\text{k}\Omega$$

i.e. for 12V operation R5 (max) = 16MΩ.

Ideally R5 should be kept as small as possible. C2 is determined from the formula for the time delay. For t = 3 mins with a value of R5 = 8MΩ

$$C2 = \frac{180}{1{\cdot}1 \times 8 \times 10^6}\ \text{farads} = 20\mu\text{F}.$$

It is worth noting that individual tolerances of capacitors can make a mockery of calculations. Allow plenty of time for the capacitor to cool before its timing is checked.

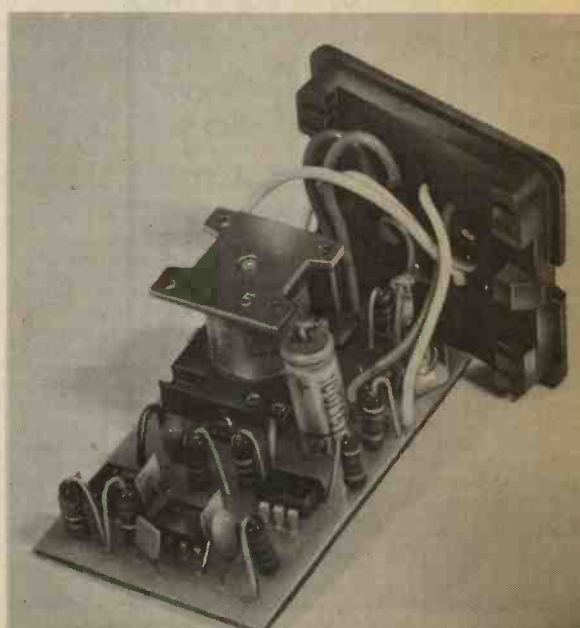
Again, if desired, timer IC2 on/off ratio can be altered.

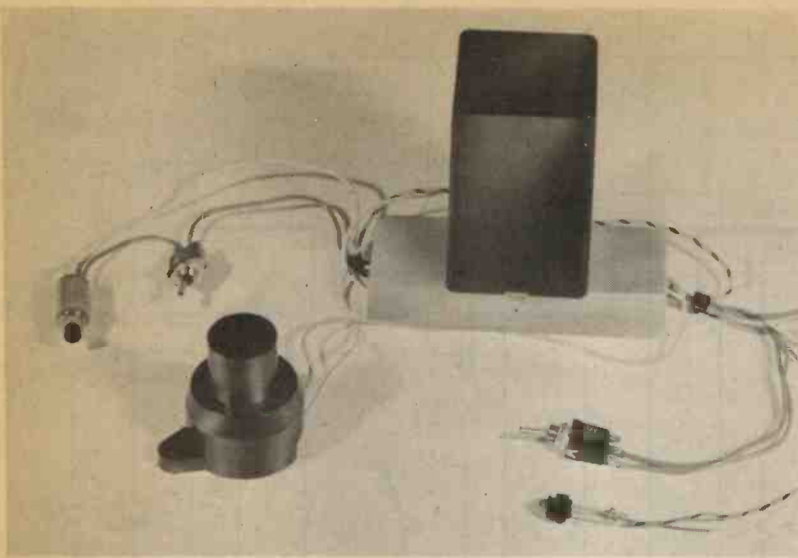
$$t_{ON} = 0{\cdot}685\ (R7 + R8) \times C5$$

$$t_{OFF} = 0{\cdot}685\ R8 \times C5$$

where t_{ON} and t_{OFF} are in seconds when R7 and R8 are in ohms and C5 is in farads. Total period $t = t_{ON} + t_{OFF}$. The same constraints on the choice of values of R7, R8 and C5 apply as given for the monostable mode.

The intruder alarm circuit wired to the 11-pin base





CAR ALARM CIRCUIT BOARD DETAILS

The completed alarm showing all switches, siren and dash-board light emitting diode

COMPONENTS . . .

Resistors

R1	470Ω	R4	68kΩ	R7	220kΩ
R2	33Ω	R5	5·6MΩ	R8	220kΩ
R3	820Ω	R6	15kΩ		

All ± 5% ½W

Capacitors

C1	100μF 15V elect	C5	10μF 35V tantalum
C2	10μF 35V tantalum	C6	0·01μF
C3	0·01μF	C7	0·01μF
C4	0·01μF		

Semiconductors

IC1 TIL111 optically coupled isolator
IC2 555 timer i.c.
IC3 555 timer i.c.
D1 Green light emitting diode
D2 ZS178
D3 VR12-E 12V Zener
D4 OA90
D5 OA90

Miscellaneous

RLA 6V 410Ω changeover contacts (R.S. Type 912)
S1 On/off toggle switch
S2 On/off toggle switch (see text)
S3–S8 Miniature push-to-break switches (R.S.) or reed switches and magnets (see text)
11-pin module case, 11-pin screw base, screw base cover (all R.S.)

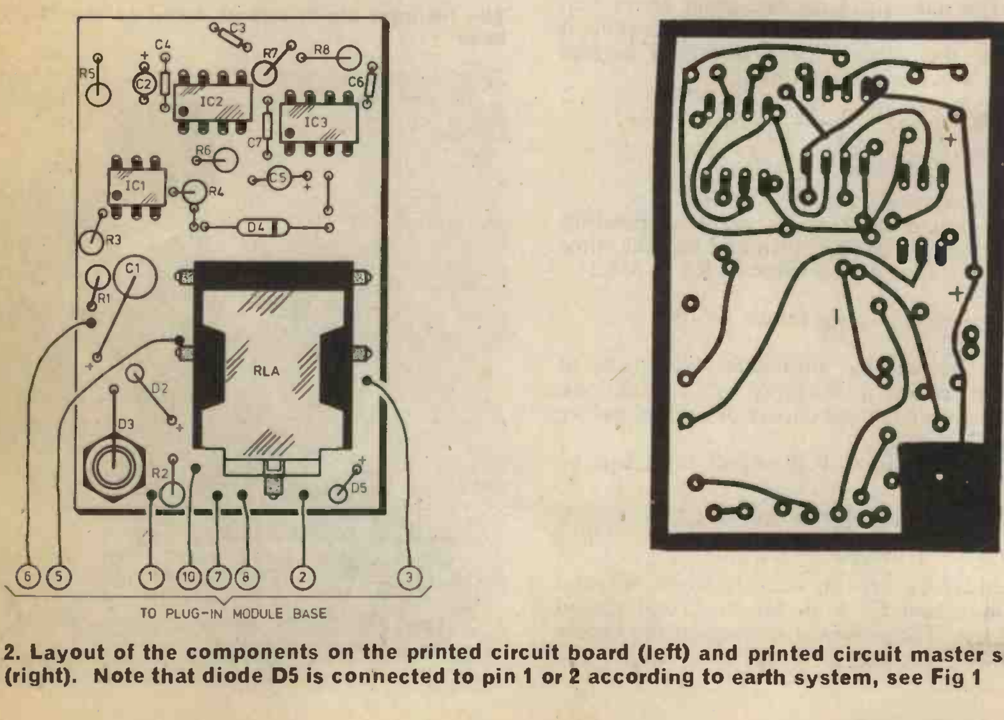


Fig. 2. Layout of the components on the printed circuit board (left) and printed circuit master shown full size (right). Note that diode D5 is connected to pin 1 or 2 according to earth system, see Fig 1

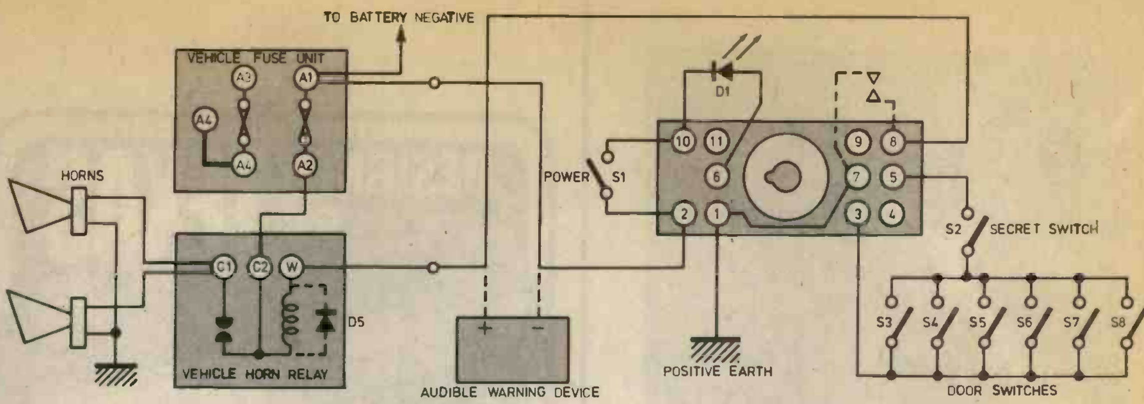


Fig. 3. Wiring the unit into a car with a positive earth system. The green l.e.d. (D1) can be mounted inside the car to show that the system is in operation. The audible warning device can be used if it is preferred not to use the car horns

The trigger input, pin 2, of the 555 is very sensitive and it was found that even the shortest length of wire on this point gave trouble, the main difficulty being that the timer would be re-triggered after the time interval.

To avoid any trouble from the long length of wire required to reach the door switches, it was decided to isolate them from the timer by using a TIL111. This is an optically coupled isolator which consists of a light emitting diode (l.e.d.) and photo-transistor in one 6-pin dual-in-line package.

The current through the l.e.d. must be limited to 60mA maximum. The transistor is an *npn* type. The base resistor (R4) is chosen to ensure that the transistor is turned fully on when full light is emitted from the l.e.d.

It is arranged that when any door is opened 0V is applied to the l.e.d. cathode causing it to illuminate, turning on the phototransistor.

The negative going edge at the collector triggers the timer IC1. Once triggered, the output (pin 3) goes to +9V.

If the door is then closed timer IC1 will remain in that state, providing supply voltage to IC2, until its time interval is ended, pin 3 then falling to 0V.

If the door were to remain open, holding the door contact closed, the l.e.d. would remain illuminated, the phototransistor collector and pin 2 remaining at 0V. In this condition (pin 2 at 0V) the time interval does not terminate, i.e. the output pin 3 remains at +9 volts until such time as pin 2 is returned to its high state.

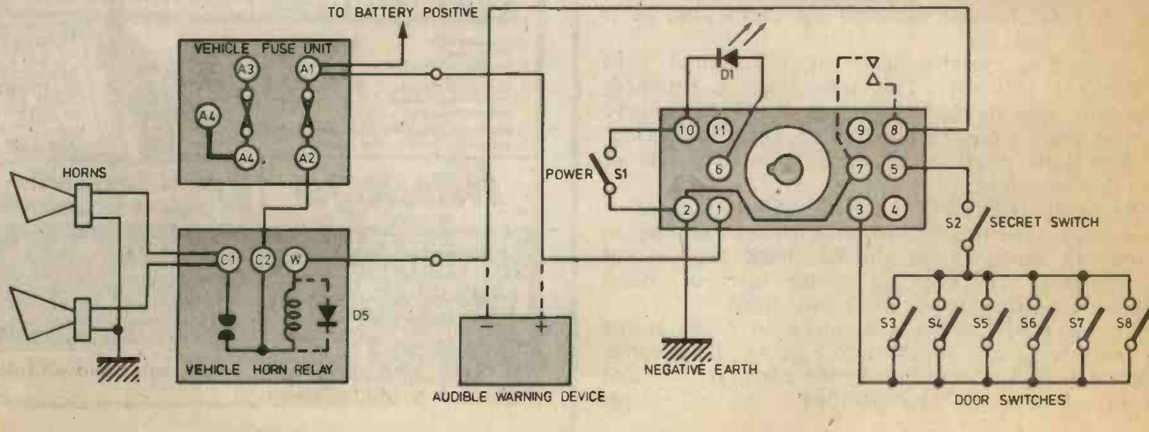
The voltage from a car 12V battery can rise to as much as 15 volts so a 12V Zener D3 has been used to stabilise the voltage.

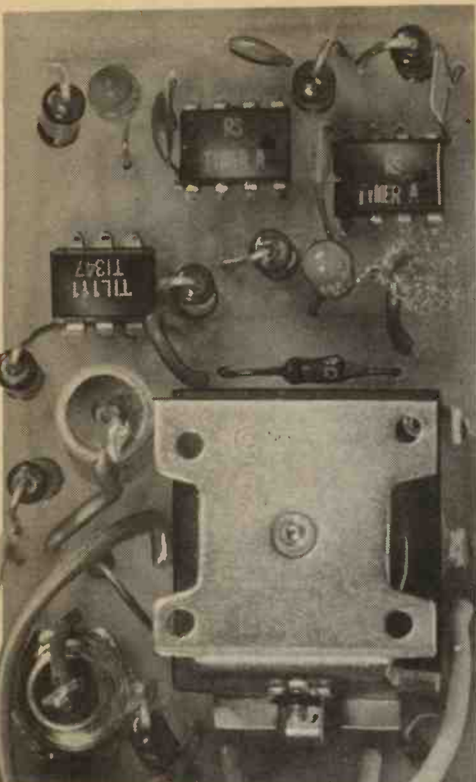
The switch to provide power to the circuit is best situated well out of sight and reach. To indicate that the circuit is on a green l.e.d. (D1) is used. This gives very long life.

ARMING THE SYSTEM

In order that the owner can set the system and get out of his car the secret switch (S2) must be installed. This is a switch that has to be actuated once the owner is out of his car with all doors closed. It is not much use going into detail in this article about this switch. There is plenty of scope here for the ingenious.

Fig. 4. Wiring the unit into a car with a negative earth system





Completed printed circuit board showing component layout

CONSTRUCTION

The circuit board is housed in an 11-pin plug-in module case, which can then be used with a screw terminal, 11-pin relay base and cover.

The circuit board measures 6·5cm × 4·1cm and the layout is not critical. A full size layout is given in Fig. 2.

The system can be used with either positive or negative earth systems. Some cars employ a horn relay and others switch the horn directly. In either case, whether it be a positive or negative earth system, all cars checked switched the earth side, be it positive or negative.

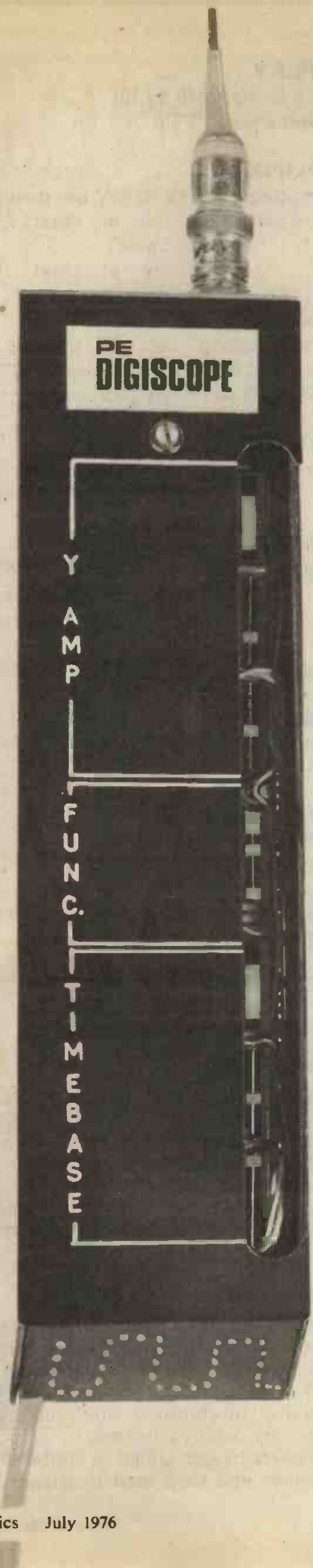
For positive earth systems strap Terminal 7 to Terminal 1 (Fig. 3). This puts positive (earthed) volts onto one of the relay contacts. For negative earth systems strap Terminal 7 to Terminal 2 (Fig. 4). This puts negative (earthed) volts onto one of the relay contacts.

The sysem described has only been used on a horn relay system and any constructor wishing to switch the horns direct should check the current requirements. The contacts of the relay described in this article are rated at five amps, 150W.

It is essential to have a suppression diode across the horn relay coil (diode D5, Fig. 1). Its polarity must be changed according to the earth system, and again must be of the type specified. ★

PE DIGISCOPE

By R. W. Coles and B. Cullen



THIS is the first of a series of articles describing an experimental oscilloscope not much bigger in size than a logic probe with an l.e.d. display substituting for the c.r.t. Although it lacks the capability of the conventional instrument in both bandwidth and resolution of waveshapes, it presents a different approach in design by replacing the usual high voltage analogue circuitry with TTL logic and interfacing with an 8 × 10 l.e.d. matrix.

Of course, with an X and Y scan of a matrix of this density it can sometimes be difficult to identify the shape of wave, this applies particularly to those with a slow rate of change. However, familiarity with the instrument in handling the controls can do much to lessen this problem. Pulses, step functions, etc. are relatively easy to identify and measure. An excellent triggered timebase generator contributes a great deal in really positive locking.

FRESH APPROACH

It occurred to the writers that with modern l.e.d. and integrated circuit techniques, it might be possible to design an entirely new breed of scope which would be small and handy for portable use, but which would operate from low voltages, even batteries.

The display device itself was the crucial factor, and it was recognised from the start that it would not be possible to match the high definition of a c.r.t. Nevertheless, by using an l.e.d. matrix it seeemed possible that one would be able to see the shape of waveforms, and be able to measure their amplitude and frequency to a reasonable degree of accuracy.

Furthermore, since a matrix display consists of a series of discrete points, it seemed that low cost TTL logic could be used extensively to replace the expensive high voltage analogue circuitry used in conventional scopes.

NEW GROUND

As finally defined, Digiscope breaks new ground in the oscilloscope hierarchy since it is not much bigger than a logic-probe, and is suitable for hand-held operation and the more traditional bench use with a probe attached. The major compromise made when choosing an l.e.d. display was in the definition possible with only 80 data points against the several thousand equivalent points on a similar sized c.r.t. Once this compromise has been accepted, however, the rest of the circuitry becomes much simpler than that of a conventional scope, and the performance in most other areas is equal to or better than that of its predecessors. Most important of all, the eradication of high voltages from the design makes the circuit easy to build using the minimum of hardware.

CIRCUIT

A block diagram of Digiscope is shown in Fig. 1.1. and it can be seen that at this level there are more boxes in this design than in a traditional instrument! This is not as bad as it at first appears, since most of the boxes can be easily produced with cheap integrated circuits.

The display is built up from a matrix of l.e.d.s wired as eight rows by ten columns, so the drive circuits are required to produce eight separate Y drives, and ten separate X drives. When the scope is triggered the timebase circuitry causes each column to be enabled in turn from left to right, the duration of each "column enable" being determined by the timebase speed setting. At the end of a sweep the display is blanked and the timebase rests to await another trigger pulse.

The output of the Y Amplifier is compared with a series of reference thresholds and the result of this comparison decides which of the eight rows should be enabled at any given time. The interaction of this X and Y scan results in a waveshape trace being plotted on the screen. At slow speeds, individual points of the plot can be observed, but at higher timebase rates the eye integrates the display and observes what appears to be a static plot of the waveform.

Y AMPLIFIER

The Y Amplifier itself is of traditional form, being simply a linear amplifier with variable gain and a high input impedance, preceded by a switched attenuator.

The output from the Y Amplifier is fed in parallel to nine comparator circuits which have as their other inputs, one of a series of nine reference voltages from the Reference Generator circuit. The Reference Generator is simply a chain of forward biased diodes so that each reference voltage differs from its neighbours by about 700mV.

A typical voltage output from the Y Amplifier will be above some comparator thresholds, and below others, so that some comparators will give a logic 1 out, others a 0. The display requires a single row drive whose position in the column can be interpolated from the transition between 1s and 0s in the nine comparator outputs, and this interpolation is achieved by a bank of eight EXCLUSIVE-OR gates, forming the Row Decoder.

• • SPECIFICATION • • •

DISPLAY

80 l.e.d. matrix (8 by 10)
Display area 1·5in by 1·1in

AMPLIFIER

Sensitivity	10mV to 80V per division
Bandwidth	d.c. to at least 1MHz (d.c. coupled)
	5Hz to at least 1MHz (a.c. coupled)
Input impedance	1 Megohm
Input coupling	d.c., a.c., ground
Maximum input voltage	(see text)
Y Shift	8 switched positions

TIMEBASE

Time/division	100ns to 10s per division in 25 calibrated steps

TRIGGERING

Trigger modes	*AUTO* or *NORM* (*AUTO* provides a reference trace in the absence of a trigger)
Trigger slope	positive or negative selectable
Trigger level	seven switched steps
External trigger	requires TTL type square edge

POWER SUPPLIES

+12 volts at 60 milliamps
−12 volts at 60 milliamps
+5 volts at 350 milliamps
from external mains power unit or batteries (3·5W maximum consumption)

ROW DRIVERS

The appropriate row is driven by one of eight Row Drivers which consist of open collector gates and *pnp* transistors which take the required row line up to plus 5V. The second inputs to each of eight open collector gates are commoned together and used as an overriding blanking input so that the display can be disabled between each sweep.

TRIGGER CIRCUIT

The sharp transition generated when a particular comparator switches, is ideal as a triggering signal for the timebase, and since each comparator switches at a different threshold voltage it is a simple matter to choose a single comparator output as a trigger by means of a switch.

The chosen trigger signal is buffered by the Trigger Amplifier and then used to trigger a monostable

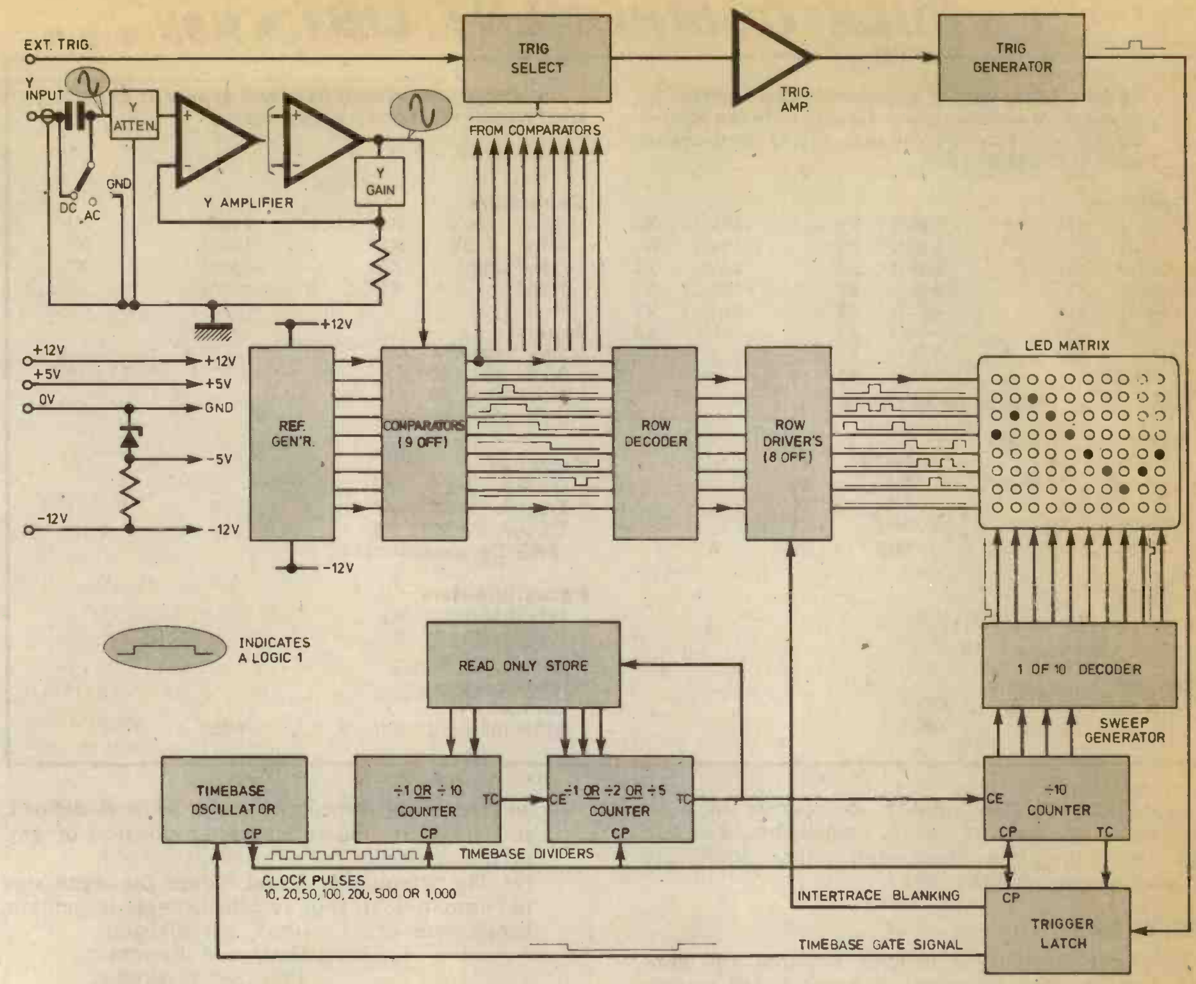


Fig. 1.1. Block diagram of the Digiscope

in the Trigger Generator circuit. If the Trigger Latch is primed then the pulse from the monostable will reset it. The output of the Trigger Latch is used to enable the Timebase Oscillator which then starts to generate pulses at the selected rate.

TIMEBASE

In all, there are 24 possible timebase speeds, and to select all these directly, at the Timebase Oscillator would require the switching of lots of bulky C/R networks. To overcome this problem, the Timebase Oscillator itself is restricted to only four switched speeds, and thus four C/R networks. Each of these basic frequencies is then divided down in a ROM programmed, two decade, BCD counter to arrive at one of four switch selectable rates. This Timebase Divider circuit divides the selected Timebase Oscillator frequency by 1, 2, 5, 10, 20, 50, or 100, to give a total range of speeds which are more than adequate for the job.

The final timebase frequency is fed to a further BCD counter which forms part of the Sweep Generator to step the matrix columns in sequence. The outputs of this counter drive a four-line-to-ten-line decoder the purpose of which is to connect each of the column lines to ground in turn as the counter counts from 0 to 9. At the end of a single count from 0 to 9 the Sweep Generator sets the Trigger Latch which in turn shuts off the Timebase Oscillator and blanks the display while awaiting a further trigger.

POWER SUPPLIES

The power supplies required by Digiscope are plus 5V at 350mA, plus 12V at 60mA, and minus 12V at 60mA, a total of about 3·25W. The prototype is at present operating with a small mains power unit which will be described later, but there is no reason why existing supplies or batteries should not be used if desired, providing adequate regulation is maintained.

CONSTRUCTION

From the outset Digiscope was planned as a miniature instrument and a probe like shape was considered essential to the design. The main circuitry is mounted on two strip board decks, one above the other, each measuring 7½in by 2in and spaced only ½in apart. Because of this dense constructional layout any intending constructors should

•• BULK COMPONENT LIST •••

To take advantage of any concessions offered by retailers for bulk purchases we include the following list which covers the majority of components used in the Digiscope.

Individual component lists will appear as usual with circuit diagrams as they occur.

Resistors

100Ω	X10	1·8kΩ	X1	10kΩ	X3
150Ω	X1	2·2kΩ	X2	15kΩ	X1
330Ω	X1	2·7kΩ	X1	39kΩ	X1
560Ω	X2	3·9kΩ	X2	100kΩ	X1
620Ω	X18	4·7kΩ	X3	910kΩ	X1
820Ω	X8	5·6kΩ	X1	1MΩ	X3
1kΩ	X17	6·8kΩ	X1		
1·5kΩ	X1	9·1kΩ	X1		

All ⅛W 5% metal oxide miniature

Integrated Circuits

CA3100	X1	74145	X1
μA710C	X9 (8 pin)	7486	X2
DTL935	X1	7474	X1
74123	X2	7410	X1
74160	X3	7401	X2

Transistors

2N3819 X2
Any silicon *npn* X11
Any silicon *pnp* X8

Diodes

Silicon small signal X23
RL50-01 (l.e.d.s) X80

Capacitors

0·1μF 400V	X1	24pF	X1
0·1μF 250V	X1	100pF	X1
0·1μF≥20V	X8	330pF	X1
6·8pF	X1		

Zeners

5·6V 400mW X2
3·3V 400mW X1
9·1V 400mW X1
5·1V 400mW X1

Switches

DS16A 2–4 X2
DS16A 1–8 X4
DS16A VAR24 X1
(ERG Components Ltd.)

Potentiometers

1kΩ (helical) X1
10kΩ (helical) X1

Miscellaneous

Formica
0·15in matrix Veroboard, b.n.c. socket

be confident of their ability to operate in such miniature environments, and of course should ensure that their soldering irons and other tools are "mouse" enough for the job!

CONTROLS

The large number of selector switches and controls required on any practical scope raised serious problems which were solved by using d.i.l. switches made by ERG Components. These clever little switches are the same size as a 16 pin d.i.l. integrated circuit, and since they can be soldered directly onto a printed circuit they avoid the bulk and tangle of panel mounted rotary switches.

In all, 23 integrated circuits are used in the design, 13 logic types, and 10 analogue types, all except the op. amp being in dual-in-line packs.

MATRIX

The display matrix is built up with the cheapest kind of discrete l.e.d.s on a piece of specially modified 0·15in matrix Veroboard, and when constructed it forms a compact and durable sub-assembly. The display matrix is mounted at the rear of the case and viewed through a red filter.

The case is built up from Formica sheet joined with Araldite, and this material proved ideal because of its strength combined with a thinness which made it possible to build a "tight" protective cladding.

Y-AMPLIFIER EXAMINED

The basic circuit of the Y Amplifier is shown in Fig. 1.2. There are three parts to the circuit, an input attenuator, a source follower, and a high gain operational amplifier. The performance conditions required from this circuit are as follows.

(a) The input impedance must be well defined at 1 megohm, regardless of the position of any of the controls.

(b) The attenuator should reduce the input signal amplitude in four switched ranges to achieve sensitivities of: 10mV per division
100mV per division
1V per division
10V per division
with other controls in the CAL position.

(c) The output of the amplifier must produce a 5·6V peak-to-peak swing in order to completely fill the screen vertically. (The figure of 5·6V is arrived at by multiplying the threshold difference, 800mV, by the number of thresholds to cover a column, 7.)

(d) The gain of the amplifier must be variable in eight switched steps of 1:2:3:4:5:6:7:8 to provide a fine sensitivity control over the total range of 10mV to 80V/division.

(e) The amplifier must have a good d.c. performance and a negligible output offset voltage so that output signals are accurately referred to 0V.

(f) The a.c. performance of the amplifier should be as good as possible, i.e. the bandwidth should extend to at least 1MHz at all gain settings.

(g) The inputs to the active devices must be protected against accidental application of overvoltages.

ATTENUATOR

The attenuator is basically a switched potential divider giving a constant 1 megohm resistance to ground at the Y input, but a variable resistance to ground as far as the amplifier itself is concerned.

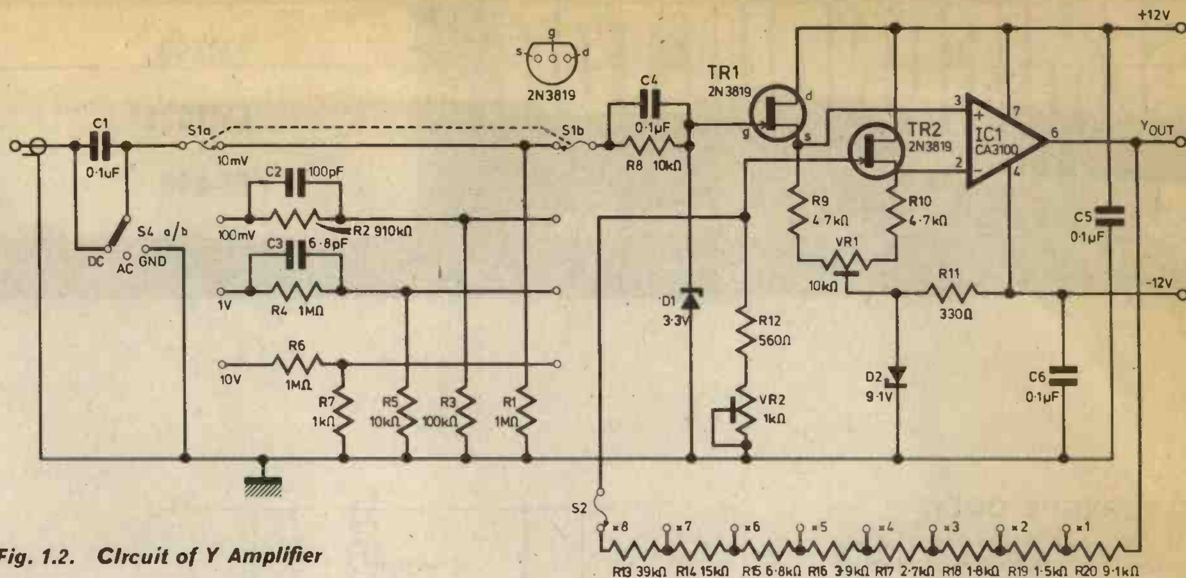


Fig. 1.2. Circuit of Y Amplifier

The fact that the resistance to ground seen by the non-inverting terminal of the amplifier changes with the attenuator setting, makes it impossible to feed the attenuator directly into an op amp since the bias current drawn by the chip would produce a varying input offset voltage across the attenuator resistance and cause drastic shifts in the base level of the trace. Therefore, despite the fact that an op amp in the non-inverting configuration has an input impedance quite high enough to meet condition (a), the bias current problem makes it necessary to install an f.e.t. source follower as a buffer.

SOURCE FOLLOWER

The f.e.t.s have the well-known advantage of requiring a negligible gate current for biasing, and in fact have most of the properties of a "cathode follower" valve circuit. The source loads of the f.e.t.s provide a similar and constant resistance to ground for the bias currents of the two op amp inputs and therefore resolve the level shifting problem.

The operational amplifier chosen is the RCA CA3100S, because it gives an excellent bandwidth at very low cost. This choice is certainly not the last word, however, and it is possible to use most op amps with similar specifications, including the inferior 741 and NE531, both of which were used in the development of the Y Amplifier without component changes. It is to be expected that future op amps with a bandwidth better than the CA3100S will become available and could be substituted to improve the overall performance of the instrument.

VOLTAGE GAIN

The maximum voltage gain required from the amplifier can be deduced from the maximum sensitivity required (10mV/div) and the full screen output swing (5·6V).

$$\text{Gain} = \frac{5{\cdot}6\text{V}}{7 \times 10\text{mV}} = 80$$

The minimum gain required is 10 (from condition (d)).

Switch S4 is provided to allow selection between a.c. or d.c. coupling and a reference ground connection, and C2 and C3 in the attenuator ensure that this circuit is compensated for a flat response at higher frequencies. R8 and D1 prevent the gate of TR1 being driven into a breakdown condition by an out of range input voltage while set to the more sensitive ranges. VR1 makes it possible to use a non-matched pair of f.e.t.s for TR1 and TR2 by facilitating the balancing-out of offsets due to differences in the f.e.t.s characteristics. VR2 makes it possible to set the gain precisely.

Next month: the Timebase and Trigger Amplifier will be described

COMPONENTS . . .

Y AMPLIFIER

Resistors

R1	1MΩ	R8	10kΩ	R15	6·8kΩ
R2	910kΩ	R9	4·7kΩ	R16	3·9kΩ
R3	100kΩ	R10	4·7kΩ	R17	2·7kΩ
R4	1MΩ	R11	330Ω	R18	1·8kΩ
R5	10kΩ	R12	560Ω	R19	1·5kΩ
R6	1MΩ	R13	39kΩ	R20	9·1kΩ
R7	1kΩ	R14	15kΩ		

All ⅛W miniature 5% metal oxide

Potentiometers

VR1 10kΩ   VR2 1kΩ   Helical presets

Capacitors

C1	0·1µF 400V	C4	0·1µF 250V
C2	100pF	C5, 6	0·1µF ≥ 20V
C3	6·8pF		

Semiconductors

IC1 CA3100   TR1/2 2N3819

D1 3·3V 400mW Zener   D2 9·1V 400mW Zener

Switches

S1a, b DS16A 2-pole 4-way

S2 DS16A 1-pole 8-way

S4 DS16A VAR 24

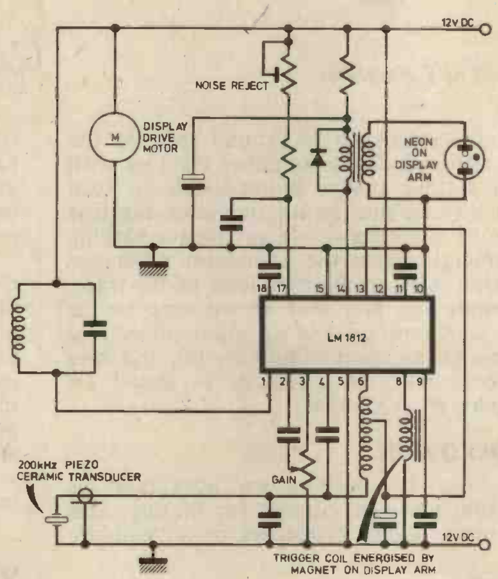
SEMICONDUCTOR UPDATE

□ □ □ By R.W. COLES

LM399

LM1812

DI-445



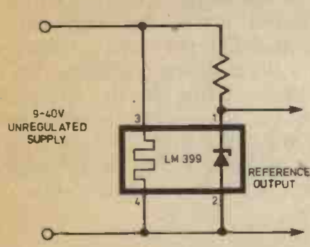
REFERENCE ONLY

If you need to develop a stable reference voltage, then a Zener diode is the simple solution, but unfortunately not always a completely satisfactory one, because a standard Zener suffers from several problems which often require the use of extra components before the required reference can be relied upon.

The most obvious characteristic of a Zener is its slope resistance (i.e. how much does the voltage change with change in current?) and it's true that modern silicon devices have fairly low slope resistances, but where large line and load variations are encountered it is often still necessary to add an external Op-Amp voltage follower to the reference circuit.

Zeners are noisy too . . . making them useful as "white-noise" generators but doubtful candidates for use in precision voltage regulators where output noise can be an unwanted embarrassment. These problems are, however, small beer compared to their fundamental vice which is their shift of reference voltage with change in temperature. There isn't a lot you can do about this one other than putting the reference circuit in a temperature controlled oven, and of course we couldn't normally contemplate *that*, or *could* we?

Well, yes, now we can, because of a clever new "Zener" integrated circuit from National, the **LM399**. The LM399 contains a single monolithic chip incorporating a Zener, an amplifier, and a temperature stabilised oven circuit all in a tiddly four lead TO46 can. Although on a single chip, the circuit breaks logically into two sections, the reference section and the temperature stabiliser, each with two leads, Fig. 1.



The reference section behaves just like a conventional Zener (only better!) and can be substituted into any circuit in which a Zener is normally used. The temperature stabiliser will operate from any supply between 9 and 40V and keeps the chip temperature at a very stable 90°C, regardless of ambient temperature fluctuations, giving the reference section a temperature co-efficient of 0·002%/°C maximum!

This "Super-Zener" also has a low slope resistance of 0·5 ohms, a wide operating current range, and a very low noise figure into the bargain. What more could you ask?

FISH WITH CHIPS?

Summer is with us again, and no doubt many readers will be turning their thoughts away from electronics and towards some nautical pursuit such as sea-fishing or cruising. If these readers have any pangs of remorse about neglecting their soldering irons for the season, perhaps the National **LM1812** integrated circuit might persuade them to *share* those summer evenings between their two hobbies without conflict!

The LM1812 looks good even to a land-lubber like me because it contains in a single 18-pin d.i.l. all the necessary electronics to build an ultrasonic sonar transceiver with a 12W transmitter output and a versatile display drive facility. An ultrasonic system like this can be used in a boat as a fish-finding sonar or as a depth echo-sounder but with a few extra components the LM1812 can also be used for amplitude modulated diver communications links, and can even be used in air at lower frequencies in, for example, intruder or burglar alarms.

In a typical role, as an echo-sounder (Fig. 2), the chip generates a single transmit pulse as the display driver motor passes a zero reference point, the display then indicates any return signals received during the ensuing 360° rotation, showing the depth to the sea-bottom or any obstruction.

The output from the transmitter drives a piezo-ceramic transducer (which is also used for reception) via a simple auto transformer, the resonant frequency of the transducer and the transformer being chosen to suit the application, 150 to 200kHz being typical for echo sounding work. A single parallel tuned circuit sets the exact frequency of operation of the acoustic receiver and transmitter, keeping external components to a minimum.

The display driver stage would traditionally operate a "peanut-neon" on the end of the motor driven display arm, via a step up transformer, but alternative displays such as l.e.d.s or even c.r.t.s can be catered for if desired.

Applications for the LM1812 are almost endless; this is a thoroughly useful and intriguing new device, with a versatile collection of control and signal inputs too numerous to mention, a terrible temptation to all those who intend to give up chips while they fish!

DRIVE POWER

If a t.t.l. or MOS logic circuit has to talk to the outside world, it often finds the conditions a bit overpowering out there. Nasty big mains-switching relays and thirsty filament bulbs make your average logic gate tremble at the knees at the thought of those high collector voltages, inductive spikes, and all those *dreadful* milliamps. It is necessary under these conditions to use a discrete component circuit to carry out the dirty business, leaving the delicate and well brought up logic gate at a proper distance from the distasteful conditions which BFY50s and hairy-chested 2N3055s can easily take in their stride!

If it were just a case of slapping a power transistor on the gate output, then this type of interface wouldn't be too much of a headache, but of course power driver circuits tend to grow like "Topsy", requiring resistors, diodes, capacitors and perhaps even a second transistor for level shifting and extra current gain.

With problems like these, wouldn't it be nice if someone were to produce a gate-compatible power driver integrated circuit which tackled these difficult loads and didn't need a bevy of other components in support? Well, someone has, a firm called Dionics Inc. has taken a long look at the problem and has produced a device called the **DI-445** which offers mailed-fist performance in a velvet-glove 8-pin mini-d.i.p. package.

Dionics really did their homework well, because the DI-445 will switch up to 125mA at 80V and can be driven from a wide range of logic levels including the CMOS and t.t.l. variety. Not only that but it isn't even necessary to get the "load-ON" logic level right because the DI-445 will operate from *either* positive *or* negative true input levels. A fully isolated power diode is provided in the package for use as a "catching diode" when driving inductive loads such as solenoids or relays, making it unlikely that any ancillary components would be required even with the most unfriendly of loads. In short, the new Dionics device could take a load off your mind!

NEWS BRIEFS

Sea Call

WITH more than half of all 'phone calls into and out of Britain handled by undersea cable the speedy repair of cable breakdowns becomes even more important as even bigger complexes are brought into service every year.

To help tackle this problem the first of two specially designed cable ships commissioned by the Post Office has just started service. Claimed as the World's most advanced cable repair ship, the Post Office cable ship *Monarch* is now fully operational and its sister ship. *CS Iris*, will be operational in the Autumn.

As part of an exercise to gain further sea experience. a Royal Navy Wasp helicopter was, for the first time, landed on her helicopter deck whilst on the move. This manœuvre was to test and calibrate *Monarch's* glide path indicator equipment, a device used to give the helicopter pilots a correct approach reading.

Microprocessor Tutor

TO help fill the need for a form of microprocessor "teach-in", RCA have introduced a COSMAC Microtutor kit which is based on the CDP18000 series of microprocessors with 256 bytes of random access memory. Outputs are registered on a 2-digit hexadecimal display and a set of eight switches is provided for manual inputs.

The Microtutor is intended as an experimental/educational system and is accompanied by a manual written in a language designed for people with only a basic electronics background.

Microcomputer concepts are demonstrated by sample programmes, which are claimed to be simple to load and run on the tutor. All system signals can be directly observed, and an external option socket allows users to add their own circuits, typical examples being suggested in the manual.

The tutor may also be used for prototyping COSMAC systems in applications which do not justify the use of more sophisticated programming aids.

Further information on the CDP COSMAC Microtutor and further systems can be obtained from RCA Solid State—Europe, Dept P.E. Sunbury-on-Thames, Middlesex, TW16 7HW.

BY FRANK W. HYDE

SOLAR ENERGY

The United States are as ambitious in their harnessing of the energy of the Sun as they were with other space programmes. The project known as *Powersat* has a programme to launch up to thirty stations in orbit. The source of the scheme as reported earlier in *Spacewatch* is the Boeing Company. Each of the Powersats will give 10,000 MW at *ground level*, about equal to two of the present maximum output stations. The ground aerial would be about 8km in diameter.

With these plans go the methods of launching the materials for the giant structures that need to be built in space to provide the microwave energy. The heavy lift vehicle needed for the task is provisionally scaled to be some 158ft in diameter and 189ft high. The power required for this vehicle would be provided by 22 oxygen-hydrogen engines.

SATCOM LAUNCHES

The RCA *Satcom* system began in 1973 and has been a highly beneficial and successful system. This was the first of the United States own domestic systems and used capacity leased from Canada using the *Anik* satellites. Since then there have been cost improvements and tariffs have been reduced so that voice grade circuits can now be rented for rather less than the normal terrestrial links.

The second RCA *Satcom 2* was launched on March 26th and was to be finally in its appointed place at the end of June. This will be a geostationary position at 135 degrees west and will complement *Satcom 1* which is at 119 degrees west. Together the satellites will provide 48 channels, each one capable of one colour transmission, 1,000 two way voice circuits or 64 million bits of data per second. *Satcom 2* will provide facilities to Alaska, Hawaii and the 48 states. Each of the four dish aerials will be oriented to cover a particular section of the territory.

The satellite weighs 2,000lb and when the solar panels are open the span is 37ft. The main body measures 5ft 4in × 4ft 2in × 4ft 3in. It is a three axis stabilised vehicle and has the power for a life of eight years with all operations continuous.

The satellite was launched by a three stage *Delta* launch vehicle. The first stage was a modified Douglas *Thor* booster using nine strap on solid fuel motors. The booster itself utilised liquid oxygen and liquid hydrocarbon propellant. The second stage was powered by a liquid fuel engine which was gimbal mounted to suit control during the second stage burn. The third stage was spin stabilised. The satellite first went to 140 miles height and then three days later with the aid of an "apogee kick" motor was transferred to its geostationary position.

FEED HORNS

The fixed assembly of four reflector aerials are offset for direction by the use of feed horns. This system makes for stable operation. There are a number of special RCA products employed. One of these is the graphite fibre epoxy material for the microwave filters, the waveguide sections and the antenna feeds.

Frequency and polarisation interleaving is achieved with the separate channels, 24 of them, by use of the transponder and the four antennas. Each channel has a 34MHz usable bandwidth within a 500MHz allocation. The dielectric reflectors use embedded wires in conducting grids to provide cross polarisation isolation. This is how the 24 channels are achieved.

CONTROL SYSTEM

The satellite control system is very comprehensive. The attitude section employs a sealed high speed wheel at 4,000 rpm, with a separate earth sensor and closed loop magnetic roll control. The RCA stabilised attitude control system provides three axis control by virtue of its gyroscopic rigidity provided by the wheel and the servo exchange of angular momentum with the craft main body. The inertial stability permits attitude determination by a single roll/pitch sensor of the earth's horizon. Magnetic torque is used and there is no need for moving parts. The system maintains orientation during the normal orbital operation, adjustment of orbit and the injection of manoeuvres. The pointing capability is ±0·21 degrees about roll ±0·30 degrees about yaw and ±0·19 degrees about pitch.

For orientation the satellite uses 12 hydrazine thrusters in a closed loop for north/south. east/west rotation keeping. During a period of 7 minutes every three weeks this loop with its rate gyro will be energised to modulate the north/south station keeping thrusters and compensate for residual thruster misalignment or mismatch to maintain attitude control.

For thermal control of heat absorption and heat rejection in order that the components and equipment stay within their operating limits (10 to 30 degrees Centigrade). space type mirrors and thermal insulation is employed to give passive control.

POWER AND PROPULSION

The power system consists of two folded solar array panels and three nickel cadmium batteries. The maximum output of the power supplies is 740 watts regulated at 35 volts. This falls to 550 watts at 35 volts after eight years. The batteries supply the power during the two eclipse periods each year. The Sun oriented solar arrays and direct arrays balance the efficiency and weight ratio. With the main body of the spacecraft always aligned vertically, a single axis clock controlled drive shaft maintains the array toward the Sun. The area of the solar cells is 71·5 square feet. The use of distributed convertors through the system guards against power supply failure in toto. There is one in each of the 24 travelling wave tube amplifiers.

The propulsion system of the satellite is designed for the operational life of eight years. It carries 216lb of hydrazine propellant in four tanks. The thrusters can be controlled directly from the ground control station. Thrusters can be selectively fired to cover spin/axis control in the transfer orbit as well as velocity control in synchronous orbit. The hydrazine reacts with a catalyst to provide the energy thrust from 12 engine assemblies. Maintainance of the longitude position and equatorial orbit inclination of 0·1 degrees needs 21 minutes of thrusting every three weeks. The apogee kick motor has a solid propellant fuel and 2,000lb orbit transfer thrust.

The command and telemetry system uses two omni antennas and controls all functions. The frequencies for these are 6·424GHz, and for the beacons 3,701 to 4,199MHz. Logic level commands are distributed to the spacecraft by a demodulator.

Paris Components Show '76

By D. Gibson

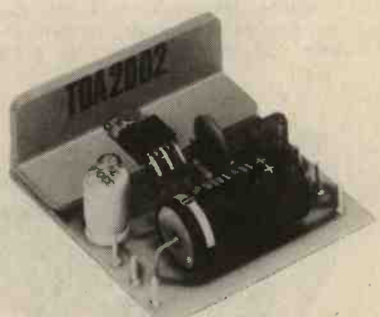
PARTICIPATION by exhibitors from 28 countries and well over 1,000 stands made this year's "Paris Components Show" a must for most people in the industry. Officially designated the Salon International des Composants Électroniques, it drew over 72,200 visitors.

POWER TRENDS

From such a galaxy of products displayed it is difficult to single out individual items. However, a number of the more interesting components and equipments do give useful food for thought. For example, the transistor sounding the death knell for valves did not sound so convincing a statement when examining a millimeter tube capable of delivering 1,000W at 40GHz. That power is for the c.w. mode; if pulsed, the tube gives 10,000W at 95GHz! It also has a life of many thousands of hours.

It would, of course, be foolish to "knock" transistors in terms of power since they have become established in many applications of lower dissipation. One such component shown, was housed in an innocent TO83 package and was rated at 350W at up to 50kHz. Not in the gigahertz range but still quite good enough to convert many a treasured hi fi speaker into an audio fuse.

Doubtless such devices will be a useful addition to the armoury of pop groups where such specifications will be loudly acclaimed—very loudly.



The TAD2002 8 watt amplifier

LACK OF SUPPORT

In the lower power audio range interest was aroused in the TDA2002. Basically a class-B audio amplifier it has been specifically designed for car radios and gives 8W into a 2Ω load. Perhaps the most striking thing about it is the marked lack of discrete supporting components required to form the complete amplifier; four capacitors and two resistors.

It would appear to be a useful component for simple record player amplifiers, modulators for amateur uses and many other applications.

SPOTLIGHT

Transistors with impressive power ratings were not the only items of interest. Indeed, a device described as an electro-optic timing switch proved to be positively intriguing. It incorporates an elapsed time indicator in which a drop of clear liquid moves through a mercury-filled capillary tube at a constant rate established by a fixed electric current through the tube.

This clear liquid "dot" is used as a lens to focus light from a built-in illuminator on to one or other of a pair of photo-sensitive sensors. The light is initially directed on one of the sensors, which is conductive, closing its associated load circuit. At the end of the cycle the control "dot" shifts the light to the other sensor, causing it to become conductive, and the first sensor to switch "open". Clearly a design which required a spot of pure genius.

FRENCH CONNECTION

With over 575 foreign exhibitors there was no shortage of ideas from overseas. But the French, too, offered a fair share of interesting exhibits. One such company showed a 24-position slide switch rated at 250V 0·1A 50Hz. They are suitable for direct insertion into p.c.bs and other switch combinations are also available.

Perhaps a switch-tuned radio offering instant selection of up to 24 stations without the need to fiddle about tuning would be a good application?

A switch with a difference describes a new relay system which really amounted to a do-it-yourself kit. The armature module is the basic element and this plugs into its allotted place in a rack. Around this one can add various time, contact and memory modules.

Each additional module is a snap-on unit and all modules butt together offering immediate automatic mechanical operation without any need for linkage assembly. Thus one starts with the basic armature assembly module and then adds such modules as are required for the system desired.

TRANSFORMATION

A transformer designed for television sets hardly seems an item to cause much interest, and yet one company from Belgium described

Jean Renaud multiway slide switches

just such an item as innovative. It has been designed for switched-mode power supplies and has the useful advantage of offering regulated secondary voltages. This means that many of the regulated voltages which were previously taken from the line scanning stage can now be derived from the switched-mode supply circuit.

An added benefit is that scanning stage power requirements are reduced and circuit reliability is improved. Apart from meeting scanning stage power requirements, this transformer also provides supplies to the set's h.f. and l.f. stages as well as for the picture tube's heater voltage.

This could be the start of a trend (certainly in Europe) to use switched-mode power supplies in entertainment-type equipment.

In this kind of supply, the mains is taken directly to rectifier(s) and used to power switching semiconductors which feed a smaller, usually ferrite transformer. The a.c. voltage, now at very much higher frequency, is rectified and smoothed and fed out as a source of d.c. voltage. The smoothing components can be very much smaller since the frequency is very much higher. A dramatic decrease in size is possible using this technique.

MULTI-HEAD

This year's show covered 28,000 square metres and would have been even bigger if the section dealing with measuring instruments had been included. However, this was left out because another exhibition in Paris was mainly devoted to this specific area. This did not mean that no instruments were present and many of these were included in the electronics production area.

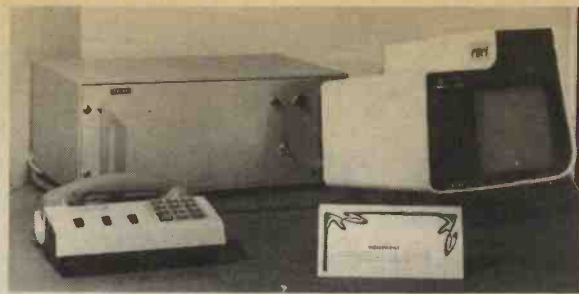
Here, such items as multi-head p.c.b. drilling machines were displayed. These were controlled by a paper tape which dictated where each head should drill a hole in the x and y axis. Many thousands of holes can be automatically drilled in this way with an accuracy of typically ±0·01mm. Some of these multi-head equipments also allow for an automatic change of drill.

A GOOD START

Very few areas of application escaped attention at this exhibition. The automotive market is one example where electronics manufacturers and designers are cultivating an increasing interest.

For one German exhibitor it was the contact breaker which was the focus of attention. The idea is to do away with nasty physical metal switching contacts which get dirty, pit and wear. This company is trying opto electronics as a possible solution. The second objective is to tie this in with transistorised ignition.

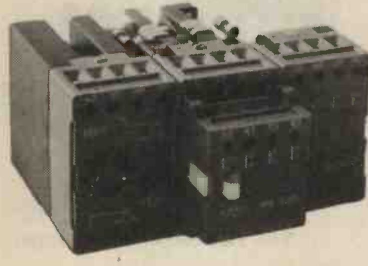
Some vision-phone (Visiophone) equipment on show. Quite clearly a Tele-phone!



The latter approach permits currents exceeding 8A which, together with reverse voltages of over 400V are superior to conventional systems.

The total system concept features a light barrier installed in the distributor comprising a l.e.d. functioning as a transmitter and a photosensitive transistor as a receiver. In the 3mm long infra red optical path a slotted cap rotates on the distributor shaft and allows a light beam to pass at the firing point. The make/break ratio determining the cut-in period of the primary circuit depends upon the slot width. The light from the phototransistor is amplified and directly acts upon the firing transistor (a power darlington type) into whose emitter-collector circuit the primary winding of the ignition coil is collected.

While development is still going on, figures and results to date show that this company is off to a good start!



"Do-it-yourself" relay system modules

REDS IN CONTROL

With ultrasonics making some headway in remote control for things like television receivers it would seem that such a system would develop from strength to strength. But no—there's a rival, and a serious one, too. It's our old friend infra red coming up fast off the rails with a challenge which just cannot be taken lightly.

Ultrasonic waves have a disadvantage that harmonics of the line time-base may lead to acoustic disturbances. The new remote control system offers up to 31 control functions and employs binary coding to keep peripheral outlay to a minimum.

Transmitted commands are selected by an 8 × 4 button matrix arranged on the transmitter. The receiver contains the interpreting circuit and three storages for analogue functions such as sound, colour saturation, brightness, with the associated analogue-to-digital converters.

ON THE LIGHT SIDE

An impressive sight on one stand was a lone battery. It has a shelf life of ten years and during that time can be relied upon to provide a minimum of 30 hours power. Useful for applications such as battery-powered burglar alarms or emergency torches it also featured elsewhere in a complete flashlight which was claimed to function happily from −53°C to +75°C.

Low level light tubes are always impressive but when one enters a completely dark room and still finds that the tube can resolve the scene there is something unnerving about it all—makes undressing in the dark a bit silly.

A French company displayed one such tube which has a sensitivity comparable to that of photographic film rated at 100,000 ASA. For the non-photographic reader this means that scenes with an illumination as low as one hundred thousandth of a lux can be televised at 25 images per second (a normal broadcast standard) with a resolution of over 700 t.v. lines per image.

Remember the early projection television tubes? Well, the military for one still uses them, or rather more sophisticated versions. One such beasty gives a very bright (10,000 foot candles), fine trace—2,000 t.v. lines.

It is employed to project dynamic images on to a screen of several metres square. Multi-coloured images are produced by superimposing the images from a number of tubes each with its own particular colour phosphor.

These are just a handful of the many items shown at the Paris show. Space available allows but brief mention of midget power supplies, valves which give 500,000W and tiny variable capacitors which measure only 1·9mm in diameter.

Perhaps the most staggering thought is that all these new things will be old by next year when, of course, there will be the 1977 Salon International des Composants Électroniques.

FROM BI-PRE-PAK

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UNIT 1—Pre-Amp/Control

Stereo Model

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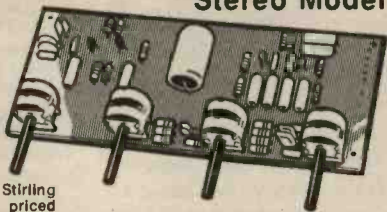

With active tone control circuitry

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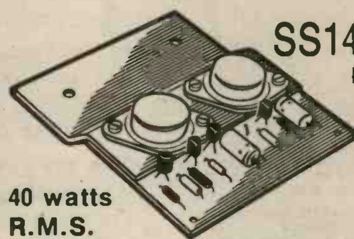
SS140 Mk. 3



Power Amp now with built-in output capacitor

Built for hard work

40 watts R.M.S. Into 4Ω

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Resulting from research and development, the Mk. 3 version of this most popular power amp. now includes built-in output capacitor with improved stability under severest working conditions. Greatly used for P.A., disco and similar work. SS140 offers fantastic value for the price.

Build and save with Stirling Sound

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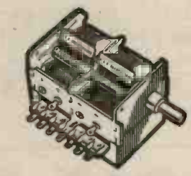
POWER AMPS

SS103	Simple I.C. module. 3W R.M.S. with current short-circuit and thermal protection.	£1·75
SS103-3	Stereo version of SS103 using two SL60745 I.C.s with data.	£3·25
SS105	5 watt amplifier to run from 12V.	£2·25
SS110 Mk. 3	Similar to SS105 but more powerful giving 10W into 4ohms. 24V operation	£2·75
SS120 Mk. 3	20 watt module when used with 34V into 4ohms (SS105, SS110, SS120, all 3½ × 2 × ¾in.)	£3·25
SS125	Deluxe high fidelity amp. with only 0·05% distortion at all levels. For 50V operation. 25W R.M.S out	£5·00



TUNING

SS201	Tuner front end. Geared variable tuning. 88–108MHz. A.F.C. facility	£5·00
SS202	I.F. amp A meter and/or A.F.C. can be connected (size 3in × 2in)	£2·65
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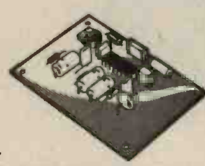
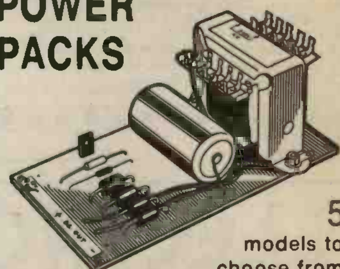
SS102	Stereo pre-amp with R.I.A.A. equalisation, mag., p.u., tape and radio in	£2·25



POWER STABILISER

SS300	Add this to your unstabilised supply to obtain a steady working voltage from 12 to 50V for your audio system, workbench, etc. Money saving and very reliable	£3·25*

Stirling Sound POWER PACKS



5 models to choose from

Not only do these excellent power packs stand up unflinchingly to hard work—inclusion of a take off point at around 13–15V adds to their usefulness and once again price and value are outstanding.

Made to serve for years

SS312	12V/1A	£3·75*
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20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0·01% 100Hz–10kHz. Frequency response ± 1dB 20 Hz to 20 kHz. Hum level virtually nil with volume full on.

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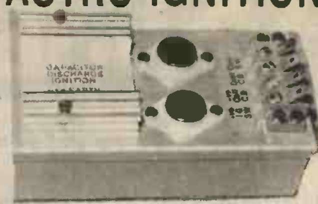
ASTRO IGNITION



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Size: 130mm × 90mm × 95mm. Weight: 10oz. Power supply: 110V a.c. ± 10% 60Hz; 230V a.c. ± 10% 50Hz.

Manufactured to high standards by a major American electronics corporation, this superbly styled solid-state timepiece is made available to all readers fully guaranteed.

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The All-Electronics Show

By G. Godbold

IT seems as if we can add another trade show to the Spring "walkabout" on the evidence of attendance at Park Lane's Grosvenor House where more than 160 companies had stands for the All-Electronics Show during the three days—13th to 15th April.

In the grand surroundings of the Great Room and Ballroom there was plenty to attract and interest particularly in the way of new items.

INSTRUMENTS

Not least in today's increasingly bewildering world of electronics is the mass of test and measuring equipment available. In this area, synonymous with technical excellence, but at a price, is Tektronix who also market under the Telequipment name.

On display was a couple of portable diagnostic aids to the TV serviceman; the Telequipment D32, a dual-trace 10MHz oscilloscope and the S22, a single trace 5MHz model. Both of these are extremely compact, weighing just 10lb with a relatively large screen area in relation to control fascia. Operation can be from mains or rechargeable batteries.

Prominently figured was the Tektronix TMS 500 series of test and measurement modules. These represent single function instruments which readily combine to form a console sharing a common power rail. Over 30 of these plug-in modules make up the series.

Other new scopes seen were the Dynamco 7500, a dual-trace portable instrument with a vertical sensitivity of 10mV/division over a 40MHz bandwidth and the OS4000 digital oscilloscope, the star of the Gould Advance range which combines a conventional 10MHz scope performance with a digital memory system capable of storing signals up to 450kHz. An output module is incorporated which processes the contents of the digital memory to provide a hard copy output for use with a chart recorder.

Other new Gould Advance products were the SG200 seven range signal generator covering 160kHz to 230MHz and the DMM7A, a $3\frac{1}{2}$ digit d.v.m. with a 10A measuring capability on both a.c. and d.c.

Claiming a world scoop B & K Labs showed their 2131 Digital Frequency Analyser designed to measure and display octave and third octave spectra in real time with outputs available to analogue or digital peripherals.

SEMICONDUCTORS

Last year the Philips giant absorbed Signetics and as a result of this it seemed rather strange to see the names Mullard and Signetics sharing stands.

Amongst the broad range of i.c.s and f.e.t.s on display was the MOSPOWER VMP-1. This rather remarkable f.e.t. has a power rating of 35W with maximum allowable current of 2A. The breakdown is 60V and the drive current is nanoamps. This growth area will represent a serious challenge to traditional bipolar devices particularly in high speed power switching. Signetics also displayed a 150μW triple op amp which draws only 50μA from a $1\frac{1}{2}$V supply.

Among the Mullard items were the new range of Locmos i.c.s, which now total 70, microprocessors and the recently introduced field programmable logic arrays.

Making its UK debut for Plessey was the SP750B high speed comparator which is claimed to be the world's fastest. Also on show by Plessey Traffic and Instrumentation was their VISTA scanning system designed to check p.c.b.s for defects after screen printing and plating.

CASES

About a decade ago lunch-boxes were a modish container for constructors' projects. With the enormous variety of metal and plastic cases both in colour and geometry there is no excuse for tatty containerisation. Lektrokit, a name familiar to all constructors, made a new contribution with their range of "Transistek" modular instrument cases. Totalling 25 models in eight different styles, colours and sizes, they are of low cost and professional standard. Support trays and aluminium are available for components and p.c.b.s.

The Imhof-Bedco display also included a new range of plastic boxes, called IMboxes, all of which had integral slots for accepting p.c.b.s.

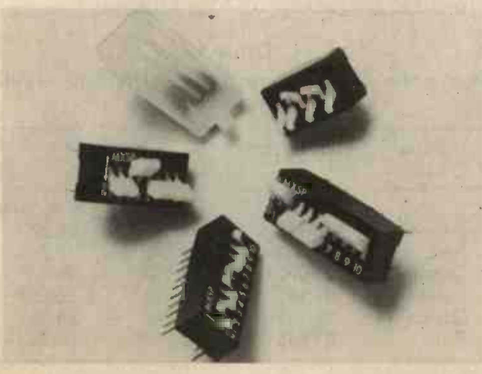
PASSIVE COMPONENTS

Departing from the traditional toroid shape and showing a significant cost-saving, Reading Windings introduced a "square toroid" range of transformers. Aimed at the audio and instrumentation market, the output power range extends through 5–120VA offering high efficiency with low radiation.

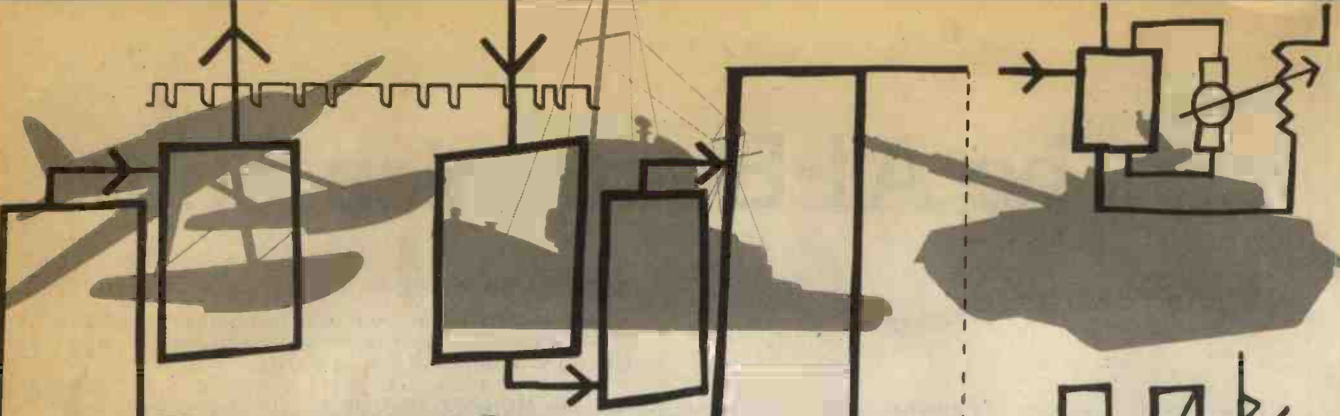
New from Molex Electronics was the 4130 series of multi-position d.i.l. binary option selection switches. Designed for mounting onto a p.c.b. they feature single and ganged lever action with up to ten discrete channels.

Practical Electronics also had a static display of projects past, present and future.

The Molex 4130 series of d.i.l. switches



Telequipment D32 dual-trace 10MHz battery/mains 'scope



Proportional RADIO CONTROL SYSTEM

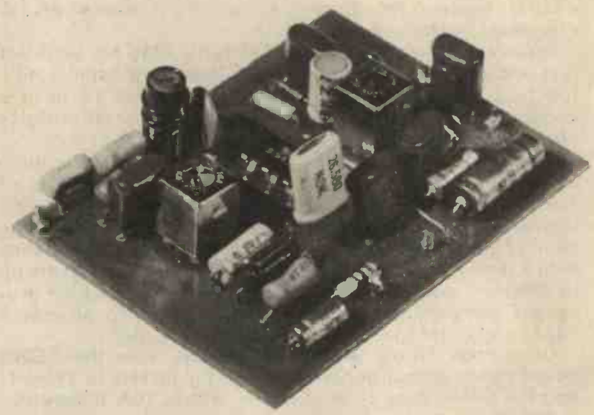
By J. D. WHITELEY

PART 2 Receiver, Interface & Decoder

THE receiver section of the system is both sensitive and selective and has been designed for use with the transmitter described last month, which operates at around 27MHz (dependent on crystal; see later).

It is a very stable crystal controlled superhet based on the TBA651 integrated circuit which is a complete radio including r.f. amplifier, oscillator, and i.f. amplifier. The package of the TBA651 is unusual since it is a 16-pin quad-in-line, sockets being difficult to obtain.

The manufacturer's data gives a maximum operating frequency of the oscillator of 30MHz and the receiver can be operated from a supply of 4·5–16V, although the author has found the best performance to be at 9V, using the crystal oscillator circuit as shown in Fig. 7.



CIRCUIT DESCRIPTION

From the circuit shown in Fig. 7, it will be seen that L1, C3 are a tuned circuit to the received r.f. signal, L2, C4 coupling the r.f. amp to pin 1. R1 is the untuned load of the r.f. amplifier with C5 coupling to the mixer stage at pin 4. The external components of the oscillator L3, L4, C7 and the crystal are connected to pins 6 and 7. The mixer output is coupled to the i.f. input pin 13 by C8 and T1. The second and final i.f.t. T2 connected to pin 10, has the detector D1, i.f. filter R3, C12, C13, and detector load R6, connected to the i.f. secondary. The a.g.c. reference voltage is connected to pin 15 by R4 whilst C14, C15 are a further i.f. filter. The delayed a.g.c. is controlled by R5, C11, both values being adjustable to suit the delay required. It is important that C16 is included, since R6 is above ground potential. An 'S meter' can be connected across R6 if required; for this purpose, pins have been included on the board.

CRYSTAL OSCILLATOR

For those not familiar with the channels used for radio control in the 27MHz band, a table has been included which may be of some use (Table 1).

The Toko transformers T1 and T2 are for an intermediate frequency of 455/470kHz.

Table 1
The colour codes used for different crystal frequencies

Channel Colour	Transmitter	Receiver	
	MHz	I.F. 455kHz	I.F. 465kHz
Brown	26·995	26·540	26·530
Red	27·045	26·590	26·580
Orange	27·095	26·640	26·630
Yellow	27·145	26·690	26·680
Green	27·195	26·740	26·730
Blue	27·245	26·790	26·780

RECEIVER

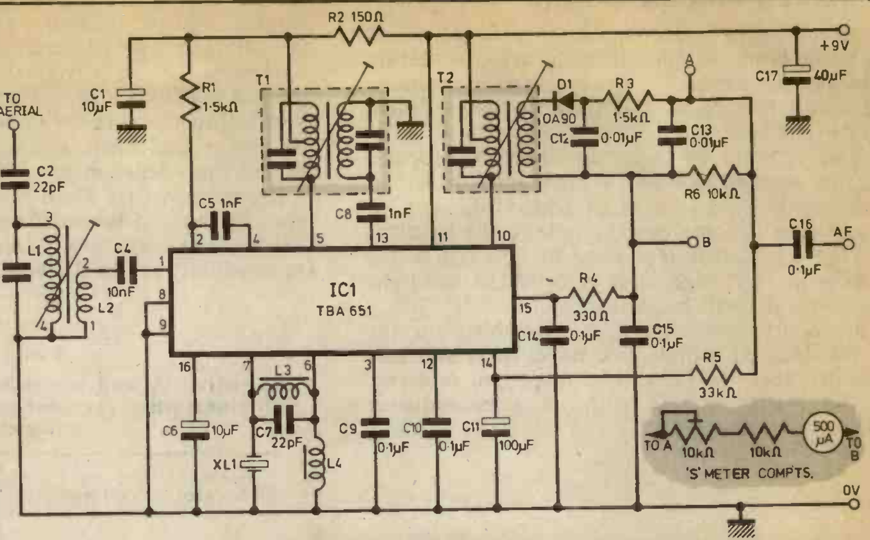


Fig. 7. Circuit diagram of the receiver section

COMPONENTS . . .

Resistors

R1	1·5kΩ	R3	1·5kΩ	R5	33kΩ
R2	150Ω	R4	330Ω	R6	10kΩ

All resistors $\frac{1}{8}$W 5% carbon

Capacitors

C1	10μF 25V elect.
C2	22pF ceramic
C3	22pF ceramic
C4	10nF ceramic
C5	1nF ceramic
C6	10μF 3V elect.
C7	47pF ceramic
C8	1nF ceramic
C9	0·1μF plastic or paper
C10	0·1μF plastic or paper
C11	100μF 6V elect.
C12	0·01μF plastic or paper
C13	0·01μF plastic or paper
C14	0·1μF plastic or paper
C15	0·1μF plastic or paper
C16	0·1μF plastic or paper
C17	40μF 25V elect.

Semiconductors

*IC1 TBA651 D1 OA 90

Inductors, transformers

L1	13 turns 5mm dia. former 28 s.w.g.
L2	4 turns 5mm dia. former 28 s.w.g.
L3	1·5μH r.f. choke
L4	80μH r.f. choke
*T1	Toko YRCS 11098 AC2 455kHz (1st i.f.)
*T2	Toko YHCS 11100 AC2 455kHz (3rd i.f.)

Miscellaneous

XL1 27MHz R/C band, selected to suit transmitter XL1
Aladdin 5 mm coil former
Printed circuit board (60×80mm) and p.c.b. pins
*The i.f. transformers and i.c. may be obtained from Ambit International, 37 High Street, Brentwood, Essex CM14 4RH

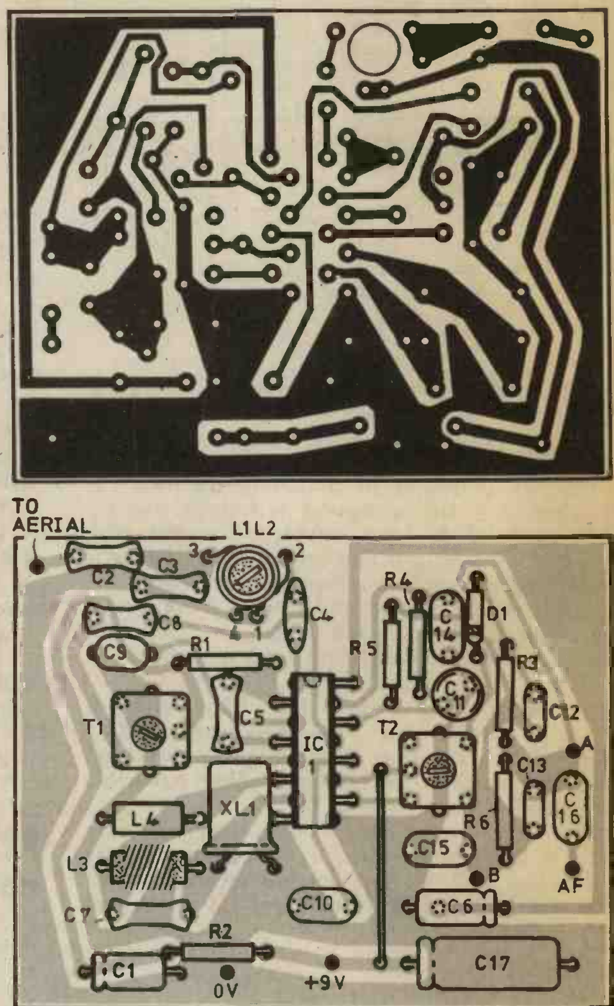


Fig. 8. P.C.B. master and component layout of the receiver

THE PRINTED CIRCUIT BOARD

The circuit is first drawn on a piece of single sided p.c.b. (60mm × 80mm) using a p.c.b. marker pen. The surplus copper is then removed by immersing the board in etchant and then the holes drilled using a No. 59 drill.

The base is removed from the 5mm coil former using a fine toothed saw and a 5mm hole drilled in the p.c.b. as in Fig. 8, a small round file will be found useful in opening out the hole to the required size so that the former is a good fit. Do not fit the coil former at this stage as it is better to wind the coils first—details will be shown later.

All the components are next assembled on the board and soldered using a fine tipped iron and thin gauge solder, then the i.c. can be fitted and soldered, taking the usual care as with all semiconductor devices.

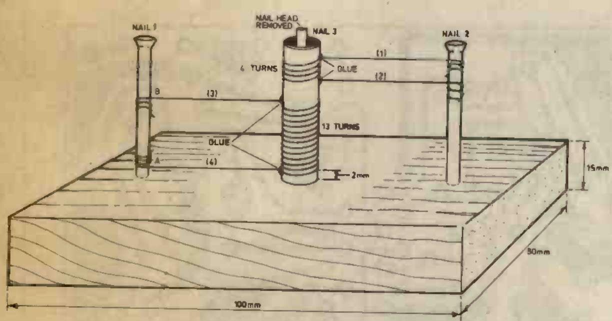


Fig. 9. Winding jig for L1 and L2

COIL WINDING DETAILS

If difficulty is found in obtaining the two r.f. chokes then they can be wound as follows: for L3 wind 30 turns of 40 s.w.g. enamelled copper wire on to a ¼W 100Ω resistor and for L4 wind 250 turns of the same gauge on to another 100Ω resistor.

The coil winding details for L1 and L2 are shown in Fig. 9. A piece of wood 15mm × 50mm × 100mm and three 50mm nails are assembled as shown.

The bottom coil L1 is first wound by putting a few turns of wire around nail 1 at A, then winding 13 turns on to the former in a clockwise direction, but leaving a space at the bottom of 2mm to enable the former to fit in the hole in the p.c.b.

When 13 turns have been wound, finish the wire on nail 1 at B. The other winding is done in a similar way, then the ends on the coil are secured with a suitable glue and when dry the wires cut at the nail ends.

TESTING AND ALIGNMENT

First examine the p.c.b. for any poor soldered connections and short circuits between the copper. Next connect a 9V battery via a multimeter and measure the current taken by the receiver; this should be about 10mA. Remove the multimeter and connect it to points A-B on the receiver with a low d.c. voltage range selected.

Remove the aerial from the transmitter and switch it on at a distance of a few feet from the receiver. Now adjust the core of T2 for maximum reading on the meter and then adjust T1 in a similar way. Repeat the operation to ensure maximum output.

The core in L1/L2 can now be adjusted for maximum reading on the multimeter.

If a signal generator is used, then typical figures for sensitivity are as shown in Table 2.

Table 2
Sensitivities and meter/'scope measurements obtained when receiver is tested with a signal generator

Signal Generator	Voltmeter	L.F. on 'scope
μV	V	(Modulation 80%) mV
10	0·2	65
18	0·5	
20	0·8	1,000
50	1·0	1,500
70	1·5	
carrier off	0·1	15 (noise)

TTL INTERFACE

The interface unit is necessary for two reasons; first it reshapes the pulses that have been distorted in the receiver due to L/C circuits and bandwidth limitation and secondly it presents to the TTL circuitry a pulse of the correct polarity and amplitude—both these features being important with any TTL equipment as it requires a fast rise time pulse for correct operation.

CIRCUIT DESCRIPTION

The circuit diagram is given in Fig. 10.

The signal from the receiver is fed to the base of TR1 which is unbiased and is held cut off by R7. A positive going pulse switches on TR1 which unlatches TR2 (being half a Schmitt trigger) while TR3 (the other half) switches on.

The emitter follower TR4 switches off due to TR3 collector falling to a low positive potential. When the signal pulse goes negative and the cut off point of TR1 is passed, the Schmitt resets quickly and TR4 is again switched on.

The net result of this fast switching is to produce an output very similar to that of the transmitted pulse train.

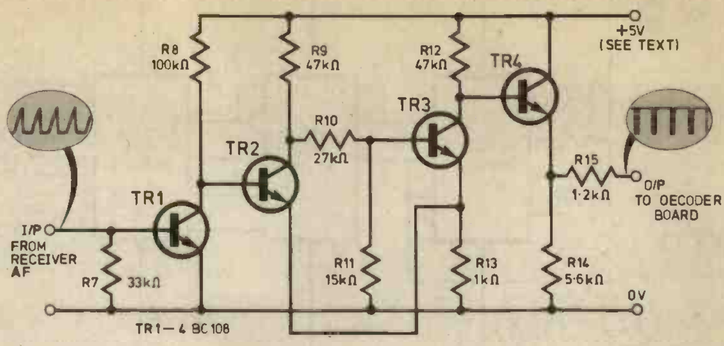
CONSTRUCTION

The p.c.b. design for the circuit described above requires a piece of board measuring 44mm × 42mm with all resistors ⅛ watt and BC108 transistors for TR1–TR4. Pins were used for wire take off points as soldering to the copper board with wire is seldom satisfactory.

The component layout and p.c.b. master are given in Fig. 11.

continued on pages 572 and 582

INTERFACE



COMPONENTS . . .

TTL INTERFACE

Resistors

R7	33kΩ
R8	100kΩ
R9	47kΩ
R10	27kΩ
R11	15kΩ
R12	47kΩ
R13	1kΩ
R14	5·6kΩ
R15	1·2kΩ

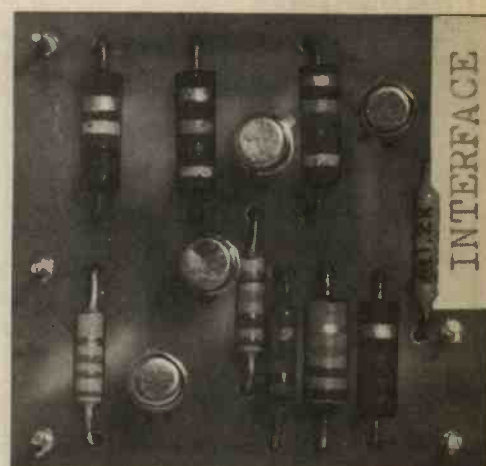
All resistors $\frac{1}{8}$W 5% carbon

Transistors

TR1–4 (4 off) BC108

Miscellaneous

Printed circuit board (44×42mm) and p.c.b. pins



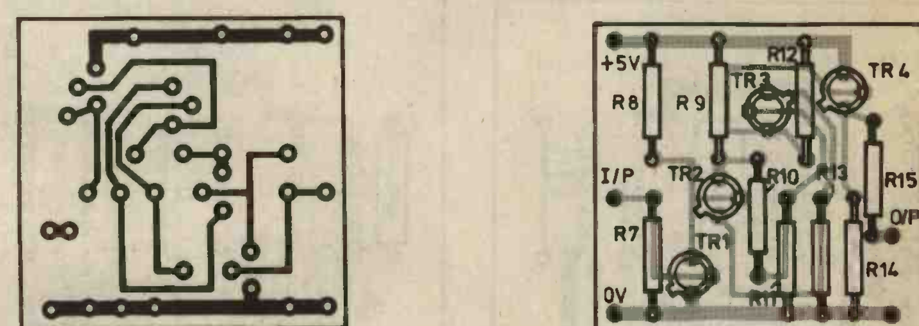


Fig. 11. Component layout and p.c.b. master for the interface section

DECODER

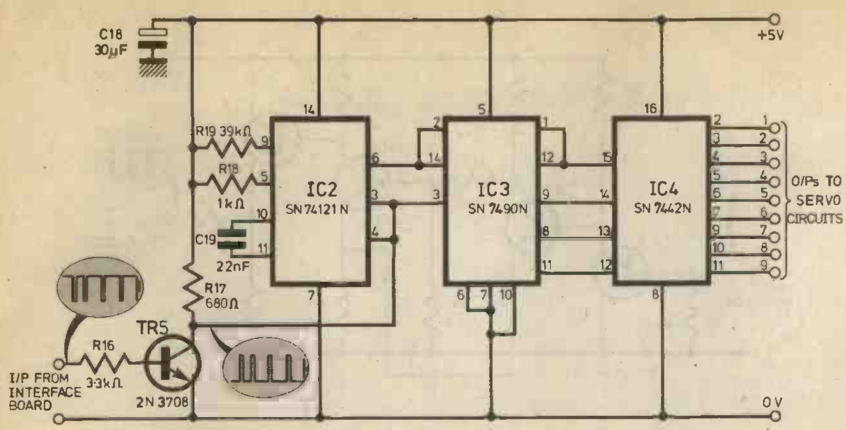


Fig. 12. Circuit diagram of the decoder

COMPONENTS . . .

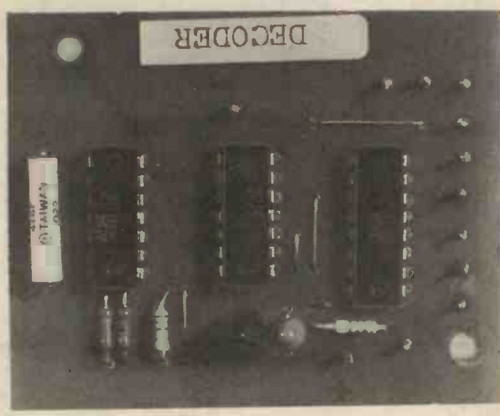
DECODER

Resistors
- R16 3·3kΩ
- R17 680Ω
- R18 1kΩ
- R19 39kΩ
- All resistors ⅛W 5%

Capacitors
- C18 30μF 10V tantalum
- C19 0·022μF plastic or paper

Semiconductors
- TR5 2N3708
- IC2 74121
- IC3 7490
- IC4 7442

Miscellaneous
Printed circuit board (70×55mm) and p.c.b. pins



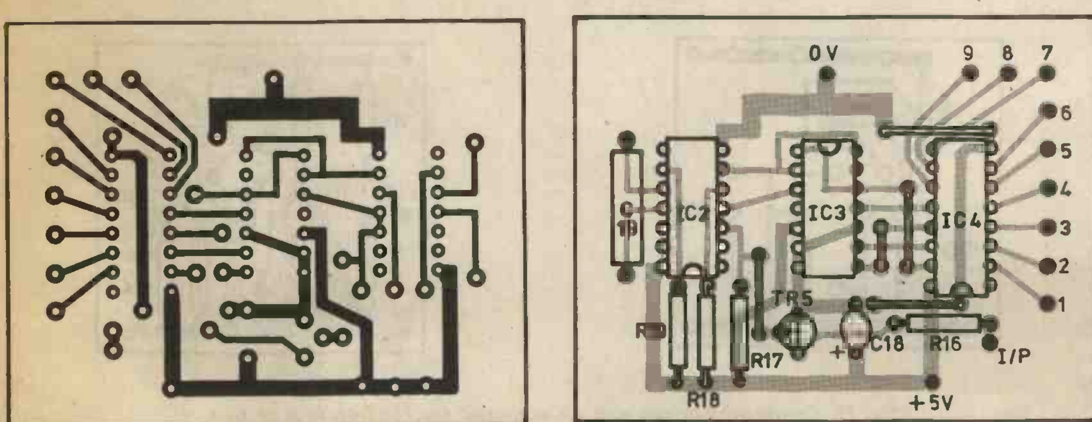


Fig. 14. Component layout and p.c.b. master for the decoder

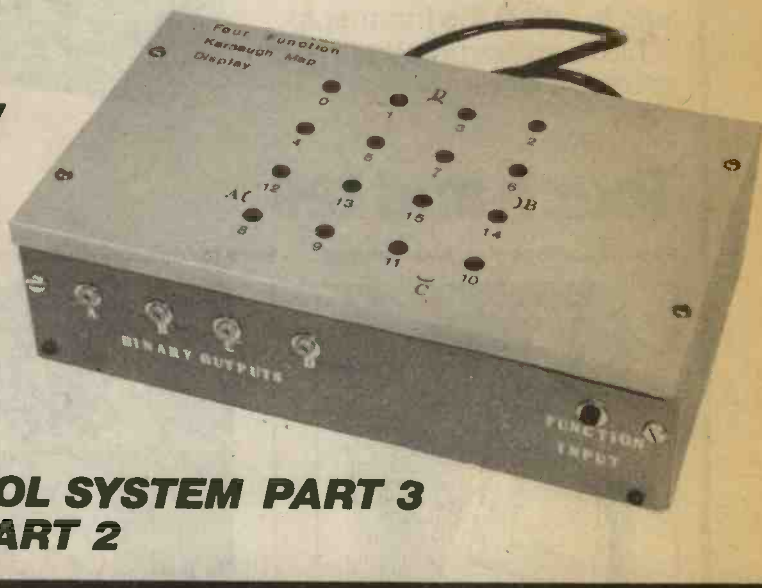
NEXT MONTH

GUITAR EFFECTS UNIT

Most Fuzz units tend to give a very harsh output, the original envelope of the guitar signal being completely lost due to the sustain effect which usually accompanies fuzz. The Guitar Overdrive Unit allows the user to produce many degrees of distortion, from the typical overdriven amplifier sound, through round 'shifting' tones, to the more common hard, spiky fuzz, the attack/decay characteristics in the first two cases being retained.

KARNAUGH MAP DISPLAY

A Karnaugh map is a simple visual representation of a number of two-state functions, and may be used to obtain a simplified Boolean expression from a truth table. The mapping is usually done with pencil and paper—this unit uses 16 l.e.d.s to portray the output function of a logic circuit having four input variables.



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RADIO CONTROL SYSTEM PART 3
DIGISCOPE...PART 2

PRACTICAL
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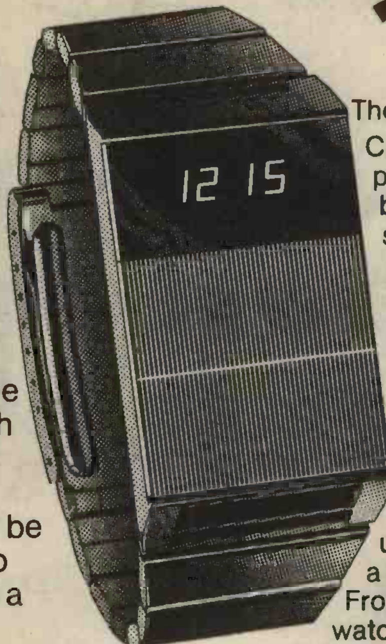
It is in *your* interest to place a firm order with your newsagent—in advance. Back numbers are not available, so make sure of your copy now!

OUR AUGUST ISSUE WILL BE PUBLISHED ON FRIDAY, JULY 9, 1976

The Black Watch kit £14.95!



★ **Practical**–easily built by anyone in an evening's straightforward assembly.

★ **Complete**–right down to strap and batteries.

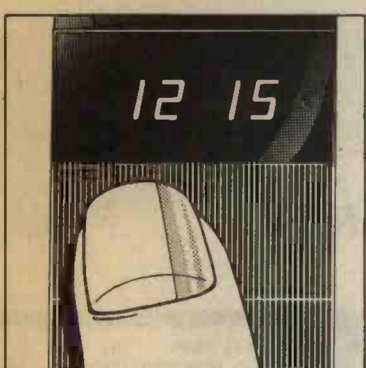
★ **Guaranteed.** A correctly-assembled watch is guaranteed for a year. It works as soon as you put the batteries in. On a built watch we guarantee an accuracy within a second a day–but building it yourself you may be able to adjust the trimmer to achieve an accuracy within a second a week.

The Black Watch by Sinclair is unique. Controlled by a quartz crystal, and powered by two hearing aid batteries, it uses bright red LEDs to show hours and minutes, and minutes and seconds. And it's styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash.

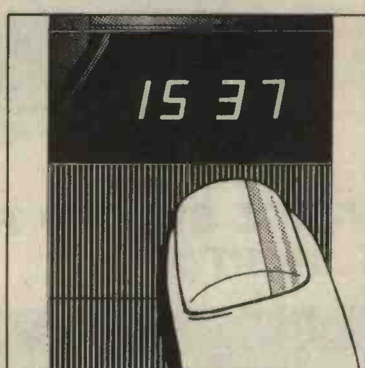
The Black Watch kit is unique, too. It's rational – Sinclair have reduced the separate components to just four–and it's simple: anybody who can use a soldering iron can assemble a Black Watch without difficulty. From opening the kit to wearing the watch is a couple of hours' work.

Touch and tell

Press here for bours and minutes...



here for minutes and seconds.



Batteries easily replaced at home.

The specialist features of the Black Watch

Smooth, chunky, matt-black case, with black strap. (Black stainless-steel bracelet available as extra–see order form.)

Large, bright, red display–easily read at night. Touch-and-see case–no unprofessional buttons.

Runs on two hearing-aid batteries (supplied). Easily re-set using special button–no expensive jeweller's service.

FLUORESCENT LIGHT INVERTER

Get new life out of your old tubes with this fluorescent tube economiser

By A. J. Bassett

THIS article describes a device which will readily light a large fluorescent tube from a 12V car battery without need of a choke or starter. The tube will start instantly without flickering, and may glow even more brightly than if it were used with 240V mains power. It is even possible to light an old tube which will no longer function at all on mains power, and when used for this purpose the device may truly be described as a tube-economiser, especially when one considers that it can quickly be built, mainly from scrap!

CIRCUIT OPERATION

The circuit of the device is shown in Fig. 1.

For the non-technical person this is simply a fluorescent lamp which can be switched on or off by means of a switch in the 12V supply from a car battery or other source capable of giving about 5 amps.

Technically it is a simple power oscillator which forms a push-pull inverter supplying power to the fluorescent lamp tube by way of a high voltage winding on the transformer.

The power transistors operate in a switching mode. Although in theory they should dissipate only a little heat, this is not realised in practice due to various sources of inefficiency in the circuit.

The more astute constructor will observe that there is no apparent bias on the transistor bases to cause them to conduct and initiate oscillations. The circuit in fact relies on the leakage present in the germanium transistors to generate a small impulse in the primary winding which "kicks" the circuit into oscillation at switch-on. If silicon devices were used, a bias arrangement would have to be incorporated due to their much lower leakage. After trying various germanium transistors, OC35s were finally chosen as they provided consistently high performance in this arrangement.

BASE DRIVE

The numbers of turns on the base drive windings (nominally only three turns each) may be easily altered if it is required to increase or decrease the base drive to the power transistors, and this may be done individually to compensate for one running hotter than the other.

By changing the values of R1, R2, the currents flowing in TR1, TR2 may be made to match yet more closely, and this results in greater efficiency.

By raising the value of R1, less current will flow in TR1 and likewise by raising the value of R2, less current will flow in TR2.

If the values of R1, R2 are lowered, a greater current will be taken and the fluorescent tube will glow more brightly. However, care must be taken not to exceed the maximum current rating of the transistors, which is 6 amps. A 7 amp fuse is used in the circuit.

FREQUENCY OF OSCILLATION

This is dependent upon a number of factors, principal ones being supply voltage, number of turns on the primary, and the nature and dimensions of the ferrite material of the core. If an annoying whistle is produced, the frequency may be raised by reducing the number of turns on the primary until it becomes inaudible. However, this results in an increase in current consumption, and this should be allowed for as described under the "Base Drive".

TUBE OPERATION

The tube operates in a somewhat different manner to that when 240-volt mains is used.

Because it is started by the action of high-voltage pulses from the oscillator on the gas in the tube, there is no need of heaters, choke or a starter and the tube will start from cold.

Although in theory this means that the cathodes will have a shorter life, the author has found that in practice tubes which will no longer operate from 240V mains will run quite happily from the oscillator for many extra months. So in these days of ecology-consciousness and material re-cycling, it makes a lot of sense to squeeze extra life out of your old fluorescent tubes by using such a tube economiser!

Because the frequency of operation is so much higher, the tube provides, when adjusted for ultra-

COMPONENTS . . .

Resistors
R1, 2 8.2Ω 2.5W

Transistors
TR1, 2 OC35

Transformer
Line output transformer obtained from a scrap t.v. and associated hardware

Miscellaneous
Silicone grease, 500sq.cm. of 16 s.w.g. aluminium sheet, 18 s.w.g. insulated copper wire, 30 s.w.g. insulated copper wire. FS1 7A

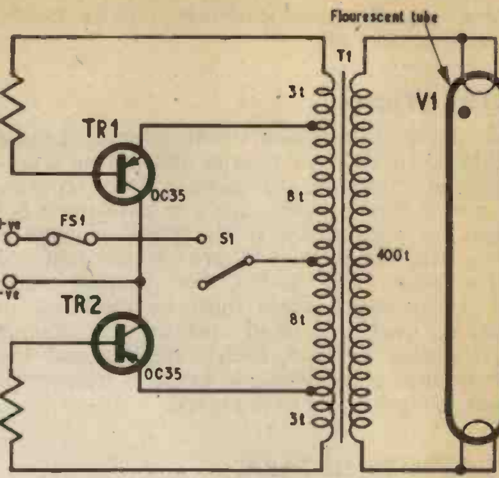


Fig. 1. The circuit diagram of the inverter

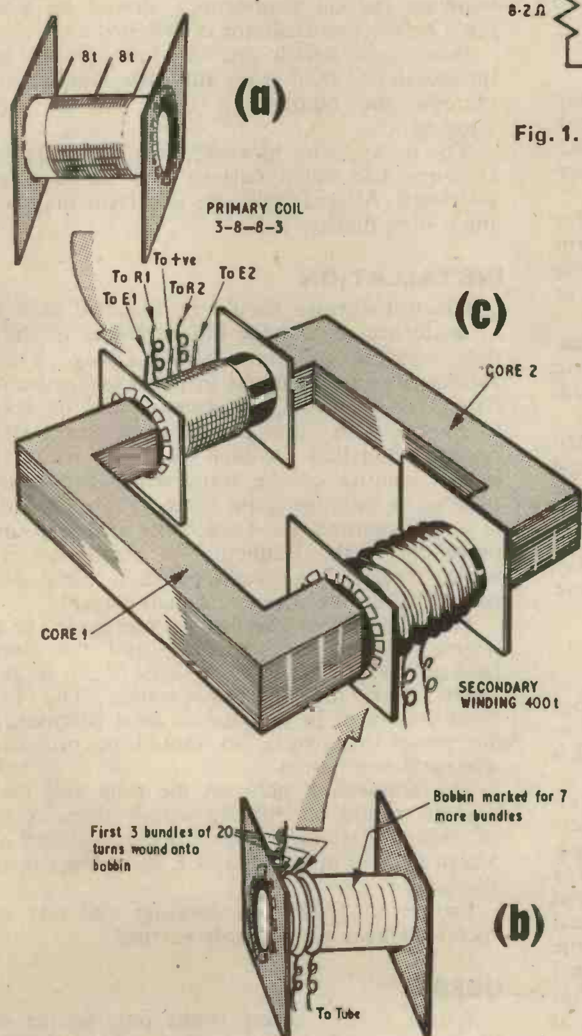


Fig. 3. Transformer winding details. (a) The primary winding. (b) The secondary winding shown during construction. (c) The completed windings assembled on the C-cores

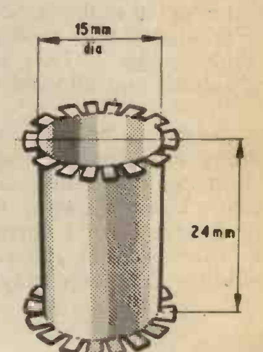


Fig. 2. Dimensions of a suitable bobbin. This size will fit most line-output transformers

sonic operation, about 40,000 pulses of light each second compared with only 100 pulses per second from 50Hz mains. This relies much less on our persistence of vision, and provides a more steady source of illumination.

CONSTRUCTION

Mount the OC35 transistors onto a piece of sheet aluminium of 16 s.w.g. or heavier and having a surface area of 500sq.cm. or more. (Two separate smaller pieces may be used, one per transistor.) No insulators are needed, as, if the power supply is negative earth, the metal will provide the required earth connection to chassis. For positive earth systems the transistor cases must be insulated, or *npn* devices used. A small quantity of silicone grease is placed between each transistor and the aluminium sheet or heat-sink to assist in transfer of heat from the transistors to the metal.

TRANSFORMER DETAILS

Obtain the line output transformer from a scrap t.v. set, and dismantle it, being careful not to break the ferrite core. Retain the ferrite core, which usually comes apart in two C-shaped parts. Keep also the core mounting components.

The next stage is to prepare new windings for the transformer. The primary consists of 16 turns of 18 s.w.g. insulated copper wire, centre tapped. At each end of the primary a further three turns of thinner wire are wound in the same direction.

Make two bobbins of thin cardboard or cartridge-paper according to Fig. 2. They may be dipped in quick-drying varnish and allowed to set in a warm dry place.

When the bobbins are dry, wind the 16-turn primary winding onto the stoutest one in a single even layer, bringing out a loop a few centimetres long at the centre tap as shown in Fig. 3a. Over each half of this winding, wind three more turns of thinner wire, which may be the same gauge as the secondary winding. The wire may be held in place with tape.

SECONDARY WINDING

The secondary is wound using a much thinner insulated wire, 30 s.w.g. being suitable. It is pile-wound in two layers. A method of winding which the author recommends is shown in Fig. 3b.

Leaving a few centimetres of wire at the beginning for connecting purposes, pile wind ten successive bundles of 20 turns each along the length of the bobbin. Obviously each bundle must occupy less than 2·4mm of the length of the bobbin, so it is a good idea to mark the bobbin into ten equal intervals before you start winding. This gives the first 200 turns. Cover with insulation, and repeat the winding back along the bobbin to give another 200 turns. Secure this with tape. After testing, it may be dipped in varnish.

Fit the C-cores into the windings so that the transformer has the appearance of Fig. 3c, and clamp firmly together. The clamps are not shown in the diagram as different transformers use clamps of a variety of shapes. When tightening the clamps be sure not to crack the C-cores as they are brittle, so only moderate pressure should be used.

TESTING

Connect the primary winding of the transformer to the two power transistors as shown in Figs. 1 and 3, by way of resistors R1, R2. If the 12V power is connected now, a high-pitched whine should be heard, and the unit should consume a current of about 3 amps. Whenever the unit is switched on, be careful that the secondary wires are kept out of contact with anything they should not touch, as a high voltage appears across them.

When the fluorescent tube is connected, the pitch should rise, and may become inaudible as it reaches the ultrasonic range of frequency.

Switch off the unit and disconnect the 12V supply. Now connect one end of the secondary winding to the two pins at one end of a fluorescent lighting tube. Similarly connect the other end of the secondary winding to both pins at the other end of the tube. As a high voltage will be present, this winding and all connections should be well insulated before the oscillator is switched on.

When you switch on, the tube should light up immediately. If it does not, try another tube, or increase the number of turns on the secondary winding.

Too many turns, however, may cause the device to consume too much current and the transistors to overheat. Alternatively, the oscillator may stall, giving a dim, flickery light.

INSTALLATION

The transformer should be installed in a cabinet or enclosure so that the high voltages of the secondary winding are out of harm's way. The transformer may be mounted in place using the original fixing arrangements, but care should be taken not to mount it in close proximity to sheet steel; the reason being that the high-frequency magnetic field in the vicinity of the transformer can cause steel objects to heat up quite considerably at a distance of a few centimetres. Indeed the author found that, especially if the frequency of oscillation is ultrasonic, temperature produced in a piece of metal placed within the core could melt solder!

Fortunately this effect is only apparent to a large degree with magnetic metals, and the aluminium heat-sink with the power transistors can be mounted fairly close to the transformer. The heat-sink becomes warm in use due to heat produced within the power transistors, so should be provided with adequate ventilation.

The connection between the tube and the transformer should be directly wired—there is no need of chokes, starters or capacitors, and if any of these are present in the lampholder, disconnect them from the tube.

Ensure that the tube housing and any exposed metal surfaces are correctly earthed.

USES

Where a 12V battery is the only source of electrical power for illumination, this steady light, coupled with the reduction of shadows when a long tube is used, make the tube economiser far preferable to the use of incandescent bulbs.

Obviously the same advantages hold for use in power-cuts together with the advantage that the economiser is cheap to build, and can be put together quite quickly. ★

INDUSTRY NOTEBOOK

By Nexus

TURBULENCE

Nobody would welcome, say, five years of absolute stability more than the semiconductor industry. Alas, the overall situation is as turbulent as usual but while the agony of the manufacturers is as intense as ever, the savage competition and struggle for market shares is, as I pointed out a couple of issues ago, beneficial to the consumer.

The two latest casualties are both Canadian-based. The brave hopes of Microsystems International Ltd., which started up in 1969 were never realised. The company, a subsidiary of Northern Electric, never became profitable and in 1974 is said to have lost £20 million.

Another Canadian company, Siltek, also in the CMOS trade and founded in 1972, might have put in a bid for MIL's assets but is now in receivership following the price-cutting battle between market leaders like RCA and Motorola.

Siltek couldn't stand the heat despite being largely funded by the Canadian government. So hopes of a rescue from Siltek have foundered and the latest news is that MIL's huge investment in the paraphernalia of semiconductor manufacturing, estimated at some £6 million, was scheduled for public auction in the first week of June.

Motorola has run into difficulties in fabricating I^2L microprocessors and is reported to be withdrawing from the technology and concentrating on *n*-channel MOS which has been outstandingly successful. Texas Instruments appears to be pressing on with I^2L but with a delayed launch date. The I^2L technology, if it can be realised successfully, gives a large increase in operating speed but pays a penalty in noise immunity and packaging density.

Meantime, the battle for supremacy in the market place continues and according to recent forecasts the market for microprocessors in Western Europe will top £300 million by 1984. Motorola claims to hold 15 per cent of the total world market this year and 35 per cent of the 8-bit market and, as I write, is threatening to slash prices for the small user (i.e. in quantities up to 100) by another 50 per cent. Mullard in the U.K. has already cut the small-quantity price of its Signetics 8-bit NMOS from £38 to £18 in 1–24 quantities. In 100–999 quantities the price drops dramatically to £12.

A speaker at the recent Seminex exhibition and conference in London suggested that the current commodity life for semiconductor devices was now only two years before obsolescence set in.

INSTRUMENT NEWS

After years of flat trading, electronic test and measuring instruments are perking up. Bright news is that the MRCA Tornado automatic test equipment (ATE) contract has now been finally firmed up in a European consortium led by Marconi-Elliott Avionic Systems as prime contractors and product managers.

The amount of the contract is not revealed either in test stations to be built or in cash, but it seems likely, taking into account the number of aircraft involved and the way they are expected to be deployed by Britain, Germany and Italy, that there won't be much change out of £50 million. MEAS's partners are Siemens in Germany and Selenia in Italy with British Aircraft Corporation and Rohde & Schwarz as sub-contractors.

Good progress was reported by Malden Electronics. This new company is virtually the old and well-established Venner Electronics, formerly a part of the multinational AMF Corporation. Former director of AMF, David Ollington, bought the electronics interests at the turn of the year and although the new company has a different name it is carrying on where Venner left off and is still making established products of the old firm like timer-counters, sine and square wave generators and test instruments for the Post Office, and will continue to support existing Venner instrument users with spares and service.

The new company reports six months work in hand and some potentially substantial orders in the pipeline. New instruments are also in development and these will be announced later in the year.

An export boost, through a marketing agreement with the Data Tech Division of the Penril Corporation located in Santa Ana, California, is expected by Racal Instruments. American engineers have already been to England to receive technical instruction on the Racal 99 Series of counter-timers and frequency meters, introduced last autumn, and on a number of communications test instruments.

The 99 Series of instruments are a complete family all built round a single LSI chip of considerable complexity designed by Racal and manufactured in the c.d.i. process by Ferranti. The instruments are said to have sold well in Europe since the original launch. In the United States they are to bear the Data Tech label but will all be custom-built by Racal for the U.S. market.

The largest of the wholly British instrument companies, Marconi Instruments, has just launched a new range of low-cost digital frequency meters using a custom built MOS-LSI chip. Large scale integration cuts down assembly costs and improves reliability. The TF2432 going up to 560MHz is priced at £380 but for the "low-frequency" engineer (how low is low?) who is content with 10Hz to 80MHz, the TF2430 comes at a bargain price of £165 with a standard crystal with a stability of 1·3 parts in 10^7 per deg C.

For long the slumbering giant in test gear, Philips has just introduced two new oscilloscopes, part of a programme to double the company's market share in the test gear market from its present five per cent during the next two or three years.

HAPPY RETIREMENT

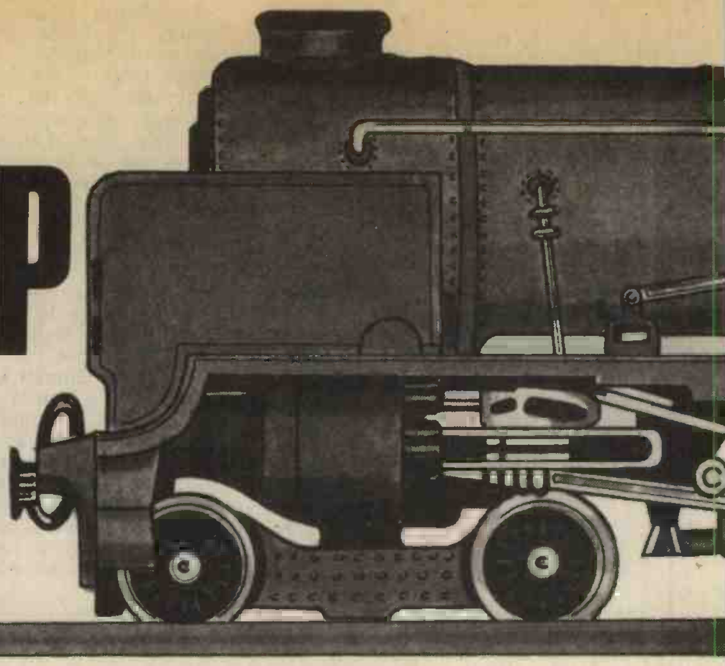
After more than thirty years of service with the Radio & Electronic Component Manufacturers' Federation (RECMF), Arnold C. Bentley retired as Director on May 6.

Affectionately known throughout the industry as Ben, he joined the RECMF as Assistant Secretary in 1945 when he retired from the Royal Air Force. In his later years, in addition to his other duties, Ben was deeply involved in the problems of component standardisation and international harmonisation. He was a founder-member of the Committee of European Passive Electronic Component Manufacturers' Associations (CEPEC) in 1965 and was President for the year 1969/70.

While wishing Ben a happy retirement we also extend a welcome to the new Director, William Barrett, who joins RECMF after five years as Director of the Scientific Instrument Manufacturers' Association (SIMA).

AUTO STOP for Model Railways

By E.A. PARR



THIS automatic stop circuit was designed to stop a model railway train for a pre-determined time at a station. It requires only two connections to the track and needs no external supplies.

The trains can approach the section from either direction and the delay will still operate.

CIRCUIT DESCRIPTION

The circuit diagram and track connections are shown on Fig. 1. As can be seen, there are only two connections to the track; these can be connected either way round.

With no engine on the track, all the voltages in the circuit will be zero, hence the transistors and the thyristor will not be conducting.

Suppose a train now appears. When it enters the station section it will stop as there is no current path by the bridge circuit.

The positive output from the bridge will now rise to the locomotive supply, and C1 will commence to charge via VR1. At this point in time TR1 base is negative with respect to its emitter, hence TR1, TR2 and the thyristor are still turned off.

When C1 charges to half the locomotive supply, TR1 will turn on, turning TR2 on, which in turn fires the thyristor.

There is now a through path via the bridge for the locomotive current and the train will start again.

DELAY TIME

The delay time that the train spends in the section is determined by VR1 and C1. R1 is included to prevent C1 being shorted to the positive output of the bridge.

Because the emitter of TR1 is held at half the locomotive supply, and C1 is being charged by the locomotive supply, the time at which TR1 turns on, and hence the delay time, is largely independent of the locomotive supply. The train can approach the section at speed or at a crawl and it will stop for the same time.

Diode D5 discharges C1 when the thyristor fires. This ensures that C1 starts charging from the same point each time, giving a consistent delay time.

COMPONENTS . . .

Resistors

R1–R3	1kΩ (3 off)
R4	10kΩ
R5	1kΩ
R6*	820Ω see text

All ½W 10% carbon

Capacitors

C1	250μF elect. 25V
C2	4,700μF see text
C3	250μF elect. 25V

Potentiometer

VR1	100kΩ miniature

Semiconductors

D1–D4	Silicon Bridge Rectifier REC 63 (R.S.)
D5, D6	1N4001
TR1	2N3704
TR2	2N3703
CSR1	Any 1A 50V thyristor (see text regarding holding current)

Miscellaneous

0·1in Veroboard 3·3in × 1·8in

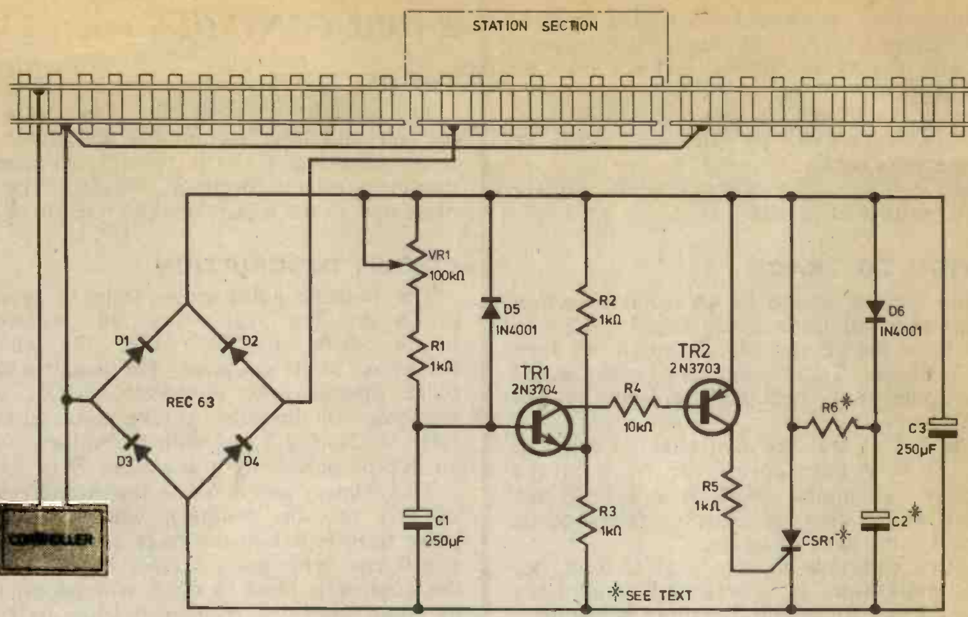


Fig. 1 Circuit of the Auto-stop unit

Once fired, a thyristor stays on as long as it is passing current. Unfortunately, a locomotive motor and the track itself causes the current to be intermittent. The circuit was built originally without R6, D6, C2 and it was found that the locomotive proceeded in short bursts. This could be caused with dirt on the commutator or the track breaking the locomotive supply. Here the thyristor would turn off, and the locomotive would have to wait for C1 to charge again.

TIME CONSTANT

C2 and R6 provide current for the thyristor to keep a small current flowing through the thyristor during the intermittent breaks in the locomotive current. The thyristor will stay on for a time determined by the time constant C2 and R6.

R6 is determined by the holding current of the thyristor (usually about 5mA) and the time required (and hence C2) by the length of the station section.

The author found 820 ohms and 4,700μF for R6 and C2 gave good results with the thyristor used and a section length of six inches.

If the time constant is made too long, the train following will not stop at the station as the thyristor will still be conducting.

Capacitor C2 is charged by the locomotive via D6, and this charging action softens the stop of the train, giving a somewhat fast ramp.

The start is unramped, but the circuit was designed for simplicity of design and connections rather than sophistication.

CONSTRUCTION

The circuit was built on standard 0·1in pitch Veroboard as shown in Fig. 2.

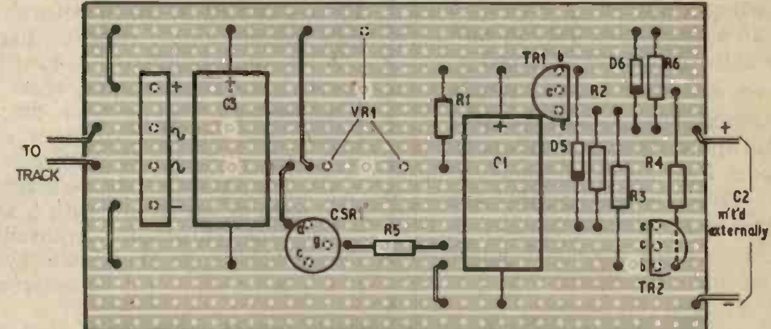


Fig. 2 Vero cutting details and component layout

The circuit is very uncritical with regard to transistors and thyristor types although some experimentation with the values of R6 and C2 may be required as explained above.

The value of VR1 and C1 give a delay time of up to 10 seconds. This can be increased further by increasing the value of C1.

Note that C2 is mounted external to the printed circuit board because of its size.

CONNECTION TO TRACK

The station section should be an isolated section with one common rail as shown in Fig. 1. The two track wires from the printed circuit board are then connected as shown. These wires can be connected either way round and the track polarity is not important.

To test the circuit, put the controller on full and connect a 12V 1W bulb across the track in the station section. It should shine at full brilliance then dim out as C2 charges. After a few seconds delay it should come back on again.

A locomotive can now be tried. If it does not restart or it pulls away in a series of small jerks the values of C2 and R6 probably require adjusting.

If it is required to have the auto-stop facility switchable, simply connect a switch across the a.c. inputs of the bridge to short the circuit out. The train will proceed through the section without stopping. ★

MAIL BAG

The on-going increase in postal and telephone charges does not seem to have made any difference to our post bag or our telephone bell. Enquiries continue to flood in.

We find that there are two points we are constantly mentioning. In the first place we just cannot afford to reply to any *readers' letters*, particularly those not associated with projects we have published, unless they are accompanied by a *stamped addressed envelope*. Were we to undertake to do so our post bill would become astronomic.

We cannot deal with *technical enquiries by telephone*. Readers should write in, giving details of symptoms and perhaps some test point readings, when requesting technical help so that we can at least give the relevant author some idea of the problems involved.

Finally, whilst we normally supply details as to source of components in each project we do assume that the constructor refers to advertisements and has an awareness of general sources. Thus, where goods are generally available we do not specify a source. You could save the cost of a letter by reading the advertisement pages first.

We regret that we are unable to supply any back copies of Practical Electronics

RADIO CONTROL *continued from page 572*

THE DECODER

The decoder receives the pulse train from the receiver and interface boards and detects the sync pulse allowing a b.c.d. count to commence for decoding in the decimal decoder. The output is presented to the inputs of the servo drive boards.

CIRCUIT DESCRIPTION

The positive going pulse train (a typical one is shown in Fig. 13) from the receiver is fed to the base of TR5 (Fig. 12) which inverts the pulses at its collector. The negative edge of the pulse operates the monostable (IC2) causing an expansion of the pulse to take place set by $t = C19 (R19 + 2k) \log_e 2$ and with the values selected gives an ouptut pulse length at output Q of 0·6ms.

This 0·6ms pulse is fed to the A and reset 1 inputs of IC3 (decade counter), whilst the unexpanded pulse train is fed to the reset 2 input of IC3. When the 0·5ms sync pulse arrives at the reset 2 input the counter is reset to 0000, whereupon it proceeds to count until the counter reaches 1001, when the internal 'b.c.d.' resets will occur.

The reset pulse is 0·1ms (this being the difference between the 0·6ms monostable output and the 0·5ms sync pulse). The b.c.d. output of IC3 is connected to the b.c.d. input to the decimal decoder IC4, which provides a decimal output of 1–9.

These are negative going outputs and each is repeated every 20ms or so, and offset from each other by 0·25ms, which is the pulse spacing in the train.

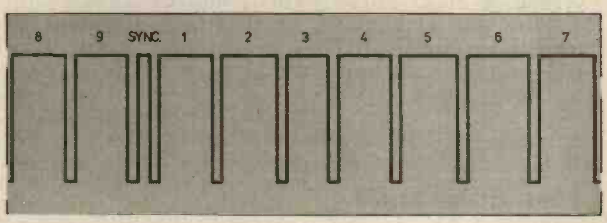


Fig. 13. Typical input waveform to TR5 with channel 3 operated

CONSTRUCTION

The layout of the printed circuit is shown in Fig. 14 and measures 70 × 55mm. The location of all i.c.s should be noted before they are soldered as they are difficult to remove afterwards if wrong.

A fine tipped soldering iron with small gauge solder prevents solder runs and short circuits. There are few discrete components on the board, but note the connections of TR5 which is of the form TO92a with the collector in the centre.

On completion of the soldering, the author found that washing the board with a small stiff brush and a drop of Turpentine removed all flux deposited during soldering. The result then, is a clean board that can be examined before connecting the supply.

Next month: The final part of this series will describe the servo amplifier, servo drive and relay drive sections.

PATENTS REVIEW...

EXTENDING PATENTS

It is interesting to note that patents are only very occasionally, and under very special circumstances, extended. The record for extension is held by BP 524 443, in the name of Georges Valensi. This patent, which dates back to January, 1939, expired, not after the normal 16 years' maximum life span of a British patent, but in June, 1971, after 32 years, having been extended several times.

The patent covered the original idea for using differential circuits to produce a series of comparisons of the various colour voltages in a colour TV system, thereby to produce a representative colour signal voltage which could be transmitted with relatively reduced band width. The extensions were granted to Valensi (and EMI) because the invention was obviously of dramatic significance and its exploitation was delayed first by the War and second by the late involvement of this country in colour TV.

Now that the patent has finally expired, its contents are, of course, free for any colour set manufacturer to use.

IMPROVED BASS

In BP 1 406 427, the Ferrograph Company of Slough, Bucks., suggests that the bass response of a reflex cabinet can be extended with less risk of undesirable resonance effects by extending the reflex aperture into the cabinet.

The conventional form of a bass reflex port is shown dotted in Fig. 1. The new idea is to make a port of much larger diameter and much greater length. To accommodate this greater length, the port is formed as an L-shaped pipe that extends first back into the cabinet and then upwards at right angles to behind the drive unit, Fig. 1.

The whole cabinet, including the L-shaped pipe, is filled with sound absorbent material such as long fibre wool or plastics fibre. In practice it is found that, with an enclosure of 2ft × 1ft 3ins × 1ft 6ins, the pipe should be between 1ft and 3ft long with an optimum length of 2ft.

WHY NOT A TRADEMARK?

We have previously reported on the continuing rise in official patent fees.

Individuals and firms active in the electronics field should not forget the other valuable source of commercial protection—Registered Trademarks. Many of the household names in electronics are registered trademarks, and although trademark fees are also continually rising, the cost of securing and maintaining a trademark may prove insignificant in comparison with the commercial benefits which accrue.

Anyone doubting the commercial benefit of a trademark need only recall the last time they asked for a branded electrical product by name and in consequence legally obliged the salesman to sell them only goods from the firm of origin denoted by the brand name.

Individuals or firms launching a new electronic product and seeking to establish whether the name of their choice is already owned by a competitor must currently either search for themselves in the Public Search Room of the Trademarks Registry or employ a searcher or trademark agent to do the job for them. Failure to carry out such a check before launching or importing and advertising a new product can prove to be an extremely expensive mistake if the chosen name subsequently proves to be someone else's property. It is, however, a common occurrence.

The Trademarks Registry (in the same building as the Patent Office, Southampton Buildings, Chancery Lane, London WC2) has on file a quarter of a million registered trademarks, but somewhat surprisingly a search through these marks must still be conducted by hand.

Although the simplicity of unambiguously classifying a trademark name or logo (as opposed to the difficulty of classifying the content of a lengthy patent document) should make trademarks ideal subjects for automated data storage and retrieval techniques, there is still no positive move in this country towards automation. This is partly because trademarks can give perpetual protection (Trademark No. 1, "Bass for Beer" is now 100 years old) and still in force, for there are now two quite different classification systems running alongside each other.

Although legislation dating back to 1938 provides for elimination of the older, obsolete classification, this has never been implemented, and there is currently even talk of attempting to devise a system for automating concurrent searches through both classifications. As this would, in some cases, involve searching through more than 20 separate classes for different filings of a single word used in a single situation (there are in all 50 classes in one classification and 34 in the other), the idea must surely be a non-starter.

BP 1 406 427

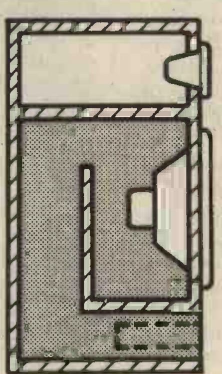


Fig. 1

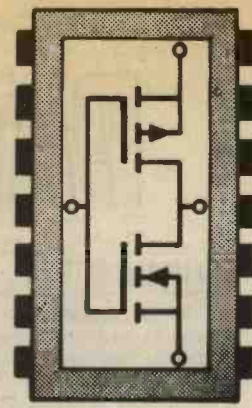
IN BRIEF

BP 1 426 962—Granada TV Rentals Ltd.: *Stereo Signal Generator.* A full circuit diagram, complete with values, is given for a clever system of locally producing multiplex stereo transmission signals (for instance for shop demonstration of a receiver) using a colour television chrominance chip.

BP 1 427 133—Smiths Industries Ltd.: *Vehicle Monitoring and/or Controlling Apparatus.* A very complex digital system for automatically monitoring virtually every performance parameter of a motor car, converting sensor signals into pulse trains and providing automatic control when necessary.

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent Price 75p each

Using CMOS *digital* I.Cs



By D.B. JOHNSON-DAVIES & A.M. MARSHALL B.A.

PART 7

THIS series has, so far, been restricted to a consideration of complementary MOS devices at the small-scale integration level. That is to say to the level of gate packages, monostables and Schmitt triggers. Many of the devices and circuits have been fairly routine conversions of popular TTL configurations into CMOS logic. The fact that it has been possible to do this in a comprehensive way with a new technology possessing very special properties of its own, is important. These special properties of CMOS logic—high noise immunity, low power dissipation and wide operating voltage range—achieve a greater relevance and clarity when presented in a setting already made familiar by the widespread use of TTL.

MSI CMOS

TTL gained its ascendancy over previous logic families more for its ability to provide a wide range of medium-scale integrated MSI functions than for its speed. This wide variety of MSI functions made it the standard choice even for users who did not require its speed but, nevertheless, had to pay the penalties that go with it.

Similarly what is really attracting users to CMOS is its ability to pack a much greater density of functions on to a chip. CMOS provides an even bigger range of MSI and LSI devices, some of which have the unique property of embracing both the digital and analogue worlds.

Table 7.1 gives a list of standard CMOS devices, above the gate level of complexity, for which there are no equivalent devices in any other logic family. These are, of course, additional to the dozens of other functions that go to make CMOS a comprehensive logic family.

What immediately becomes apparent from looking at the list is the number of high-density, complex sequential logic functions that CMOS technology has made possible. These are the MSI and LSI flip-flops, shift registers and counters that considerably simplify sequential logic design. They have, as will be shown, created new areas of application.

When the ability of CMOS to switch or multiplex analogue as well as digital signals is also taken into consideration, we find that CMOS provides the designer with entirely new and powerful methods of solving familiar problems.

D TYPE FLIP-FLOP

Before discussing these devices and associated circuits, it is worth taking a brief look at how CMOS technology achieves this high packing density in sequential logic functions.

The basic cell from which CMOS shift registers and counters are constructed is known as the "D" type latch flip-flop (Fig. 7.1). This consists simply of two inverters and two transmission gates. The transmission gate, described earlier in this series (Fig. 2.2)

Table 7.1—Standard CMOS devices

Part No.	Description
4006	18-stage static shift register
4016, 4066	Quad bilateral analogue switch
4017	Decade counter/divider
4020	14-stage binary counter/divider
4022	Divide-by-8 counter/divider
4024	7-stage binary counter/divider
4031	64-stage static shift register
4033	Decade counter/divider with 7-segment outputs
4034	8-stage static shift register
4040	12-stage binary counter/divider
4045	21-stage counter
4046	Digital phase-locked loop
4051, 2, 3	Bidirectional analogue multiplexers
4055, 56	Liquid crystal display drivers
4059	Programmable divide-by-"N" counter
4060	14-stage binary counter/divider and oscillator
4062	200-stage dynamic shift register
4067	16-channel multiplexer/demultiplexer
4511	BCD to 7-segment latch decoder driver
4517	Dual 64-bit static shift register
4521	24-stage binary frequency divider
4534	5-decade counter
4536	24-stage programmable timer
4549	Successive approximation A/D register
4553	3-digit counter
4557	Variable length (1 to 64 bit) shift register
4562	128-bit static shift register
4566	Time-base generator

is formed by connecting a *p*-channel and an *n*-channel MOS transistor in parallel. The result is an excellent single-pole, single-throw switch with no offset voltage.

The simplicity of the CMOS flip-flop comes from the fact that the two transmission gates literally switch the inverters into one of two states at each transition of the clock. To operate the transmission gates the clock (C) and its complement ($\bar{C}$) are required. When the clock is low, TG1 is on and TG2 is off. So Q follows the complement of the input D. When the clock is high, TG1 is off and TG2 is on. In this condition the data is memorised in the closed loop latch formed by the two inverters and TG2.

Cascading two of the flip-flops of Fig. 7.1 and using NOR gates instead of inverters to give SET and RESET facilities forms the standard CMOS master-slave "D" type flip-flop (Fig. 7.2). In operation the logic level at the input "D" is delayed before appearing at the Q output by half a clock cycle (hence the "D" meaning delayed).

The CMOS part number is 4013 and it consists of two "D" type flip-flops. The pin connections and truth table are shown in Fig. 7.3. A modified version of the "D" type flip-flop is formed by additional gating at the input to form two inputs, called J and K. This is the dual J-K flip-flop, 4027 (Fig. 7.4). The extra inputs make the 4027 especially useful in control logic, as well as in sequential counting.

DIVIDERS AND CLOCKS

The 4013 and 4027 are useful in simple dividers, where it is required to divide by two, three or four. For higher numbers it is more economical to use CMOS dividers from Table 7.1 such as the 4017 or 4022 which will be described later.

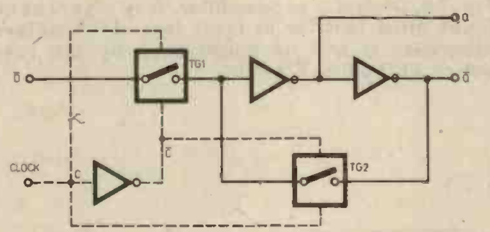
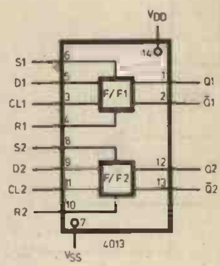


Fig. 7.1. Basic CMOS "D" flip-flop. The transmission gates switch in opposition at each clock transition. When TG1 is on, TG2 is off and the complement of the D input appears at the Q output. At the next clock transition, TG1 is off and TG2 is on and the data is memorised in the closed-loop latch formed by the two inverters and TG2.



TRUTH TABLE

CL	D	R	S	Q	Q̄
/	0	0	0	0	1
/	1	0	0	1	0
\	X	0	0	NO CHANGE Q	NO CHANGE Q̄
X	X	1	0	0	1
X	X	0	1	1	0
X	X	1	1	1	1

X = ANY INPUT

Fig. 7.3. Truth table and package diagram of the 4013 dual "D" type flip-flop

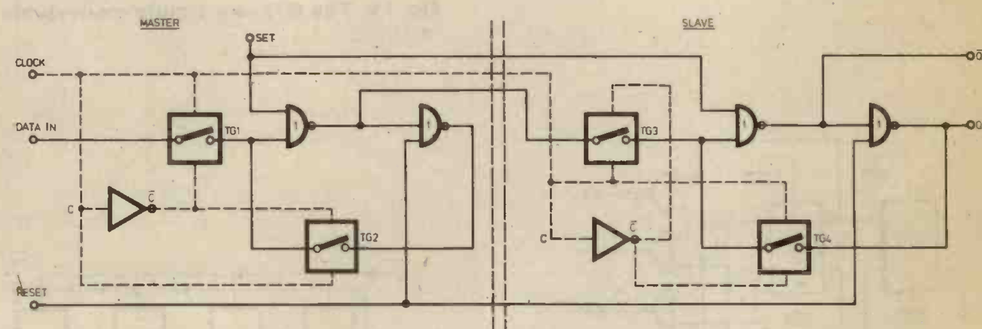
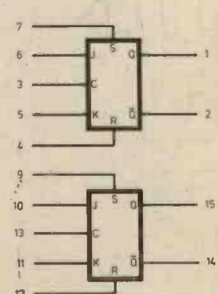


Fig. 7.2. The "D" type master/slave flip-flop. With SET and RESET at "0", the NOR gates are alternately cross-coupled to form latches by TG2 and TG4. When the clock is low, TG1 and TG4 are on and TG2 and TG3 are off. Thus the "Slave" is latched and the data is entered into the "Master". When the clock goes high, the transmission gates reverse their states. The "Master" latches the data which is directly applied, through TG3, to the output of the "Slave" (Q)



J	K	Qn	Qn+1
0	0	Qn	Qn
1	0	0	1
1	0	1	1
0	1	0	0
0	1	1	0
1	1	0	1
1	1	1	0

Fig. 7.4. Truth table and package diagram of the 4027 dual J-K flip-flop

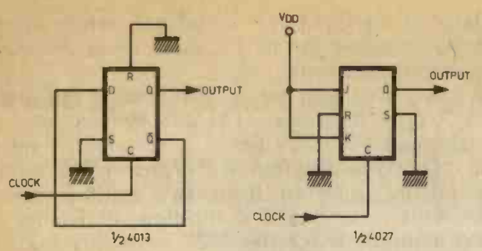


Fig. 7.5. Divide-by-2 circuits using the 4013 "D" type flip-flop and the 4027 J-K flip-flop

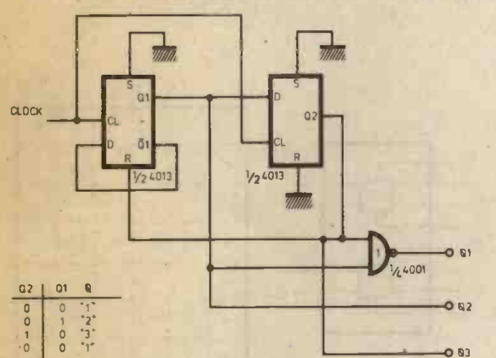


Fig. 7.6. Three-phase clock circuit using the 4013. The 4013 is connected to form a divide-by-3 circuit and the addition of a NOR gate provides three outputs of sequential non-overlapping pulses

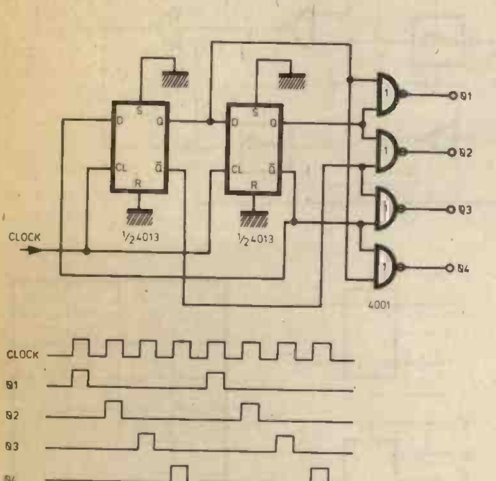


Fig. 7.7. Four-phase clock circuit. The divide-by-4 arrangement is decoded by a quad NOR gate to provide four sequential outputs

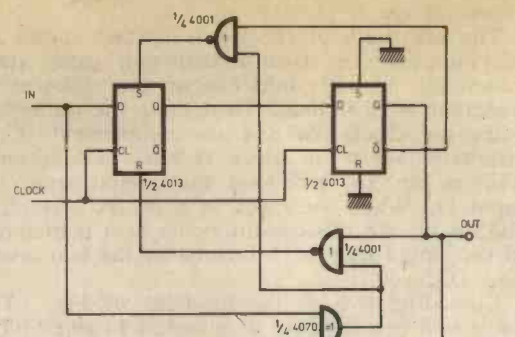


Fig. 7.8. Digital low-pass filter. Any signal at the input must last for at least two clock pulses, otherwise it will be suppressed by the reset action of the first flip-flop

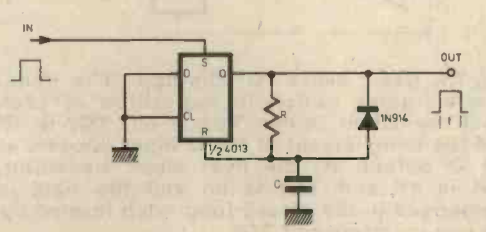


Fig. 7.9. The 4013 as a simple monostable

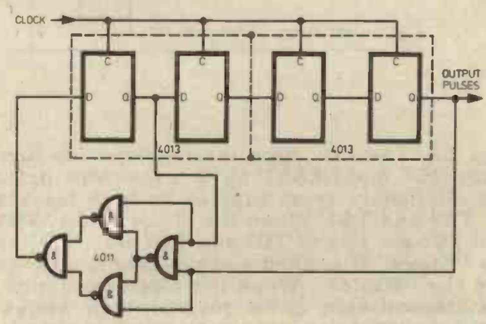


Fig. 7.10. Maximal-length pulse sequence generator. All possible combinations of 0s and 1s in the shift register (except the all-zero state) will appear at the output before repeating

Fig. 7.5 shows divide-by-2 arrangements using the 4013 or the 4027. Fig. 7.6 is a divide-by-3 circuit using 4013 dual "D" type flip-flop. The addition of a 2-input NOR gate ($\frac{1}{4}$ 4001) provides simple decoding to convert the divider into a 3-phase clock. The three outputs give sequential non-overlapping pulses.

Similarly in Fig. 7.7, a quad 2-input NOR gate (4001) decodes a divide-by-4 circuit to produce a four-phase clock. An application of these last two circuits would be to commutate the 4016 bilateral analogue switch, and thus produce a simple electronic equivalent of the electromechanical uniselector.

LOW-PASS FILTER

The S and R inputs, which are provided for asynchronous setting and resetting, can be used to convert the divide-by-4 circuit of Fig. 7.7 into a digital low-pass filter (Fig. 7.8).

This circuit is very useful for the suppression of spurious signals of high amplitude and long duration. It requires a simple adjustable oscillator connected to the CLOCK input to control the filter characteristics. The action of the filter is such that the input signal must endure for at least two clock pulses before it is transmitted to the output. Otherwise it is suppressed by reset action of the first flip-flop.

MONOSTABLE

Because of the very high input impedance and the high threshold voltage of CMOS, the 4013 flip-flop is useful in a variety of timing applications involving large time constants. Fig. 7.9 shows the 4013 connected to operate as a monostable or one-shot. The output pulse width (t) is approximately 0·66RC.

Because of the very high input impedance R can be as high as 10 megohms. Its minimum value is restricted to around 20 kilohms by the limited output current available from CMOS. However, this gives a ratio of 500 : 1 for the output pulse width by varying R alone.

The capacitor C discharges when its voltage reaches the threshold of the reset input of the flip-flop. The diode ensures that it discharges quickly. However, a lower limit of its value is determined by the flip-flop's requirement of a minimum reset pulse width of 125 nanoseconds. The minimum value of C would typically be 0·003μF.

With C and R both variable it is possible to adjust the output pulse width in the ratio of 10,000 : 1.

M-SEQUENCE GENERATOR

An economical noise generator can be constructed by cascading two 4013 flip-flops as a four-stage shift register, Fig. 7.10. When the outputs of the register are fed back to the input, as shown, via an EXCLUSIVE-OR gate and the clock is started, the output will cycle through all possible combinations of 0s and 1s in the register, except the all zero condition, before repeating. The all zero condition has to be avoided since it would latch-up the register.

In the circuit shown, the sequence will repeat after (2^4-1) bits i.e. 15 bits have been generated. This is the maximal-length pulse sequence (m-sequence) for a four-stage shift register. One application is the generation of noise where the harmonic spectrum is related to the clock frequency. ★

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7404	15p	7454	12p	74121	30p
7405	20p	7460	12p	74122	46p
7406	25p	7472	24p	74123	54p
7408	12p	7473	24p	74132	48p
7410	11p	7474	24p	74150	146p
7413	25p	7475	48p	74154	120p
7414	54p	7476	24p	74155	62p
7420	12p	7483	78p	74157	56p
7430	12p	7486	35p	74159	168p
7432	16p	7490	40p	74174	92p
7437	16p	7491	64p	74179	100p
7440	13p	7492	45p	74180	100p
7447	72p	7493	45p	74367	100p

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AC127	15p	BD132	40p
AC128	15p	BFY50	15p
AC176	16p	BFY51	15p
AC187	18p	BFY52	15p
AC188	18p	TIP41A	
AD161	35p	TIP42A	
AD162	35p	TIP2955	96p
BC107	10p	TIP3055	42p
BC108	10p	2N2219	26p
BC109	10p	2N2369	22p
BC109C	15p	2N2646	42p
BC147	10p	2N2926G	12p
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BC184	12p	2N3705	10p
BC212	14p	2N3708	10p
BC213	14p	2N3819	22p
BC214	14p	2N4059	10p
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50V 1A bridge 22p; 800V 1A 40p; 250V 2½A 40p
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Polystyrene 10pF to 1,000pF 4p; 1,200pF to 10,000pF 6p. All 2½%.
Electrolytics:
All 25V: 0·47, 1, 2·2, 4·7, 10, 22, 47mF 6p; 100mF 7p; 220mF 9p; 470mF 11p; 1,000mF 18p; 2,200mF 27p; 40V: 47mF 7p; 100mF 8p; 220mF 10p; 470mF 18p; 1,000mF 32p; 2,200mF 48p.
Tantalum bead, mF/V: 0·1/35; 0·22/35; 0·33/35; 0·47/35; 1/35; 2·2/16; 2·2/35; 3·3/35; 4·7/35; 6·8/35; 10/16; 10/25; 15/10; 22/6·3; 22/10; 22/16; 33/10; 47/6·3; 100/3. 11p each.

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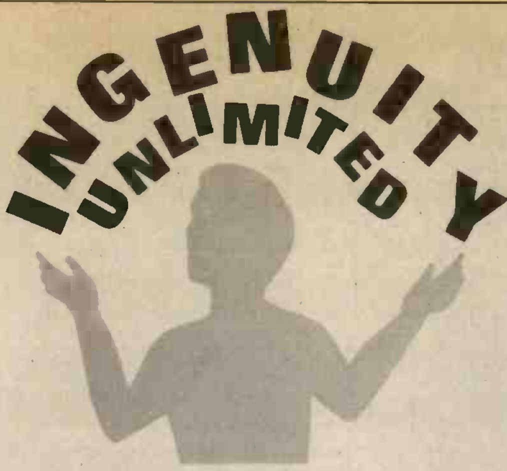

A selection of readers suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought. Any idea published will be awarded payment according to its merits. Why not submit YOUR IDEA?

Please Note

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

TACHO SLAVE

This circuit is designed to enable current impulse tachos to be used on cars fitted with electronic ignition.

Sometimes the pulsed coil lead can be looped through the tacho pickup coil, but in my case this was not possible because the loop is internal and the impulse lead permanently connected to the ignition feed. In any case this unit avoids very drastic rewiring.

The wire which used to feed the ignition coil (via the tacho loop) is now connected to the emitter of TR1. This is turned on by R2. TR2 is modulated by the contact breaker, R3 making the load minimal. TR2 thus modulates TR1 and causes current pulses to reach the tacho.

The coil lead on the original was of the resistance type (part of the car's ignition boost system). If the car to which the system is to be fitted does not have a resistance lead, some adjustments of R1 may be necessary. This may also be the case for tachos of different sensitivity.

The unit is so small that it can fit in the case of the C.D. ignition system.

F. C. Dunford.
London.

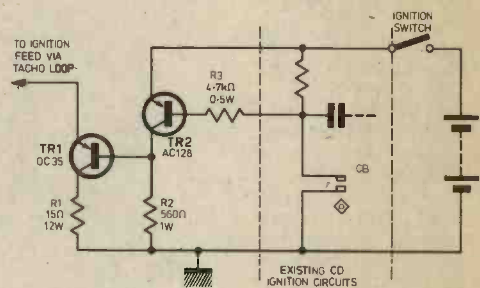

Fig. 1

SOUND TO LIGHT SYSTEM

The circuit operates on a nine volt supply, the gate of the s.c.r. or triac being connected to the positive rail via a 330 ohm resistor in parallel with a 100 microfarad capacitor. The cathode or MT1 in the case of a triac is taken to mains neutral.

Ths arrangement means that the s.c.r. or triac is normally turned on. The input from the sound source is put through an isolating transformer and the secondary is connected to the base and emitter of the transistor TR1. Thus when a sufficiently strong signal causes the transistor TR1 to turn on, an alternative current path is provided and this causes the s.c.r. or triac to turn off. The 50kΩ resistor VR1 is used to bias the transistor TR1 to alter the light/dark periods.

The circuit has been found to perform well in a Disco and if fairly low wattage lighting in suitable colours is used, can produce quite pleasing effects between records where the standard lighting is normally ultra-violet.

K. P. White.
Brighton.
Sussex.

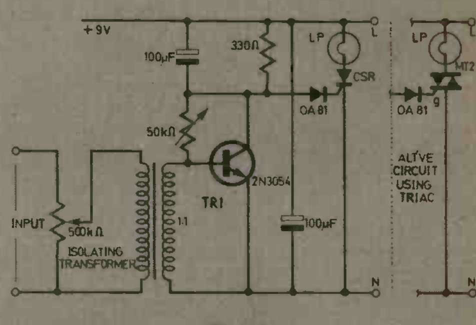

Fig. 1

A SIMPLE QUIZ BUZZER FOR TWO OR MORE CONTESTANTS

AFTER surveying the various designs for quiz buzzers, I did not find one that was simple enough to warrant construction of a buzzer system catering for six or more contestants. This prompted the development of the circuit shown below, Fig. 1.

The action of the lighting is simple. R2 holds CSR1 gate at ground potential until S1 is depressed. This connects R5 to the gate via R1, the gate "ON" voltage is gained and CSR1 switches on, lighting the lamp LP1. Resistor R1 limits the gate current when the gate is shorted to the anode by the switch S1.

If thyristors with particularly sensitive gates are used, then small capacitors. 10nF, may have to be connected across the gate resistor R2. This is to prevent the CSR from switching on due to noise, which can be picked up by the long cable connecting the contestant's pushbutton to the control box.

The inhibition circuit action is more complex, but only uses one steering diode per lamp circuit instead of several. When CSR1 is switched on, the p.d. across R2 (600mV with the resistance values as shown) is sufficient to switch the CSR on. As the gate currents and p.d.s required to turn the CSRs on varies from device to device, then R2 may have to be changed to suit.

Once CSR1 is switched on and lamp LP1 lit, point B is pulled down to near ground potential; it will be approximately 0·7V above 0 volts due to the p.d. across the current conducting CSR. Likewise point A will be at near ground potential, at 1·0 to 1·4 volts depending upon the diode D1. Thus if S2 is pushed the potential difference at point C will be the same (Fig. 2). So the p.d. across R4 will be 0·3V giving insufficient drive to the CSR gate to turn it on.

This circuit may be wired up to cater for any number of contestants just by adding more switching modules. Although TIC45s and IS120s were used in the prototype there is no reason why other types of thyristor and diode should not be used, bearing in mind that the correct functioning of the circuit is dependent upon the gate currents of the CSRs. and the diodes should be chosen for minimum voltage drop across their junctions. The resistances of R1 and R2 are determined by the current requirements of the CSR gates, and should be chosen to allow just enough current through to the gate to turn it on.

To give an audible indication as well as visual, a buzzer may be incorporated into the circuit. The circuit shown below in Fig. 3 is a simple transistor switch. When all the lights are out, then point A will be at the supply rail voltage, 10V; and the transistor base will be reverse biased, cutting TR1 off. Once a lamp has been lit, point A will be brought down to 1V above ground potential switching TR1 and the buzzer on.

Once the buzzer has been activated it will operate until the unit has been reset, thus indicating to the quiz master that the buzzer requires resetting before the next question is set.

The buzzer can be a 6V or 9V relay wired to buzz; these are more economical on current than bell buzzers, which may require a separate battery from the rest of the buzzer unit as they operate at different voltages, usually 4·5V (Fig. 3b).

All the cables used to wire up the contestants' switch buttons should be the same length (to ensure equal cable resistance), and if very long cable is used then the value of R5 may have to be reduced to compensate for the resistance of the wire.

Diodes D1-Dx should be germanium devices, as the voltage drop across the junction will be at a minimum.

P. Culverhouse,
Stevenage, Herts.

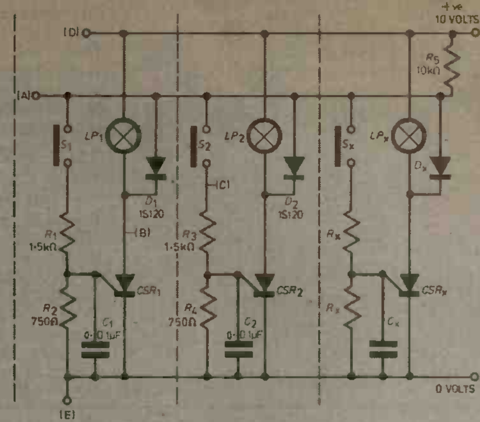

Fig. 1

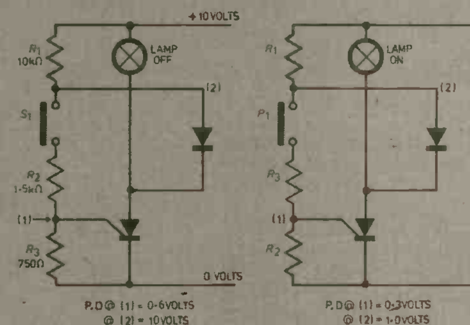

Fig. 2

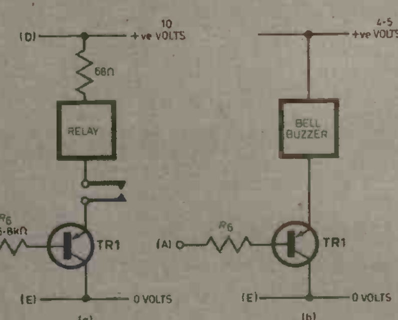

Fig. 3

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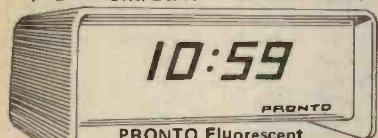

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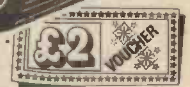

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AC188K	41p	BC169	15p	BD135	56p				
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FUSE FAILURE WARNING

The circuit in Fig. 1 gives a visual indication when the fuse fails.

The equation for calculating R1 is $R1 = 50VH_{FE}$ where V is the supply voltage and H_{FE} the current gain of the transistor.

If the supply exceeds 40 volts a transistor with larger V_{ce} should be used.

N. Ruiz.
London.

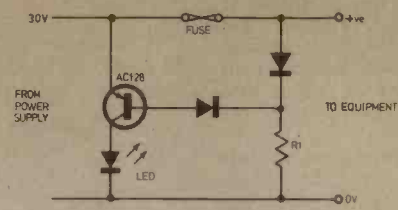


Fig. 1

ELECTRONIC DICE CIRCUIT

The normal method employed to generate random numbers for use in an electronic dice is to use a manual switch to control a high frequency oscillator that feeds pulses into a ÷ 6 counter whose outputs are displayed using a seven-segment display. The method described here follows the same idea but instead of a seven-segment display, a set of seven l.e.d.s is used giving all the possible patterns normally seen on a "manual" dice. This approach has the attraction of being economical in component requirement and in line with the games and other uses to which dice are normally put.

In this circuit, CMOS components were used to alleviate the problem of a power supply (the dice can be run from a PP3 9 volt battery taking less than 10mA) and other extra components.

From Fig. 1 it can be seen that if we want to have signals to drive the seven l.e.d.s of the die face, we only need four distinct signals: a, b, c, d, as there are three duplicated signals. Using the notation ABC for the output of the three-bit binary counter in Fig. 1, we can express the required secondary signals as follows:

$$a = 2 \text{ or } 3 \text{ or } 4 \text{ or } 5 \text{ or } 6 = \bar{A}B\bar{C}+ABC+A\overline{BC}+A\bar{B}C+AB\bar{C} = \bar{A}B + C$$

$$b = 6 \text{ only} = A\overline{BC}$$

$$c = 4 \text{ or } 5 \text{ or } 6 = A\overline{BC}+\bar{A}BC+AB\bar{C} = A.(\bar{C}+\bar{B})$$

$$d = 1 \text{ or } 3 \text{ or } 5 = \overline{AB}C+\bar{A}BC+A\bar{B}C = C.(\bar{A}+\bar{B})$$

Using the counter values 0 and 7 (ABC and ABC) as "don't care" signals, we can reduce these signal equations to:

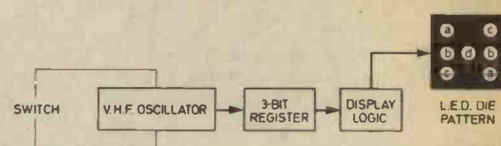
$$a = A+B;\ b = A.B;\ c = A;\ d = C;$$

Four dual-in-line package chips will suffice for the circuit—2×MC14207 and 2×MC14011 providing the decoding logic for the l.e.d. signals, the high frequency oscillator and the three-bit register made from J–K flip flops and NOR gates.

Using the normal convention for numbering the pins on a d.i.l. chip, the full circuit is shown in Fig. 2.

D. Relf,
Cranbrook

Fig. 1



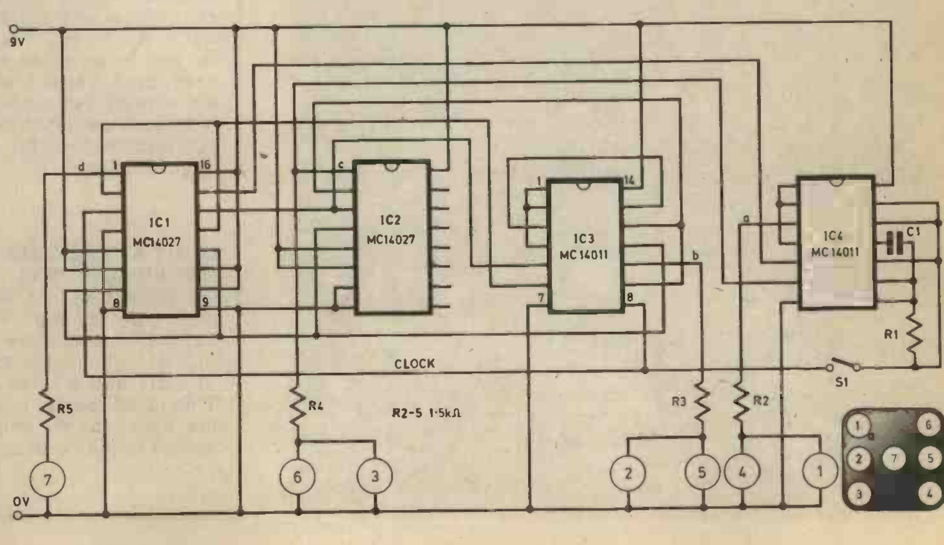


Fig. 2

DIGITAL MODEL CONTROL

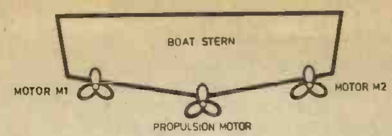
In this circuit an SN7493 four bit binary counter i.c. is used to switch motors on either side of a model boat so giving directional control by bringing about an imbalance in the forces propelling the boat and so turning it. Two motors are used, one on either side of the main propulsion unit (as far from it as possible).

Motor M_1 moves the boat to starboard; M_2 to port.

A pulse is received by the RC receiver in the boat and transmitted to TR1 base triggering the i.c. which counts one.

Only two outputs of the i.c. are used so the output codes obtainable are 00, used for half ahead, 01 to turn one way, 10 to turn the other and 11 for full ahead. The outputs of the i.c. are taken to TR2 and TR3 which operate relays controlling M_1 and M_2 so that they operate in sequence.

D. Osborne,
Carlisle.



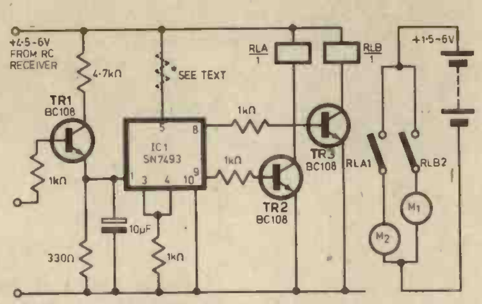


Fig. 2

NOVEL MEMORY

The circuit in Fig. 1 will be recognised by most of your readers as being a memory element. The usual method of operation is to have the inputs A and B at logic 1. The output Q_1 is $\overline{Q}_2$. If A goes to logic 0, Q_1 is set to logic 1 and Q_2 to logic 0. This state continues even when A returns to logic 1. Similarly, if B goes to logic 1, Q_2 is set at logic 1 and Q_1 at logic 0.

A novel method of operating this circuit is as follows. The input B is normally kept at logic 1. The output Q_1 is kept at logic 1 (assuming that A has been at logic 0 after B last returned to logic 1), no matter what input is seen at A. If a negative going pulse appears at the input B, the output Q_1 will be $\overline{A}$. If A is at logic 0, no change in the state of Q_1 is observed. If, however, A is at logic 1, the output Q_1 goes to logic 0 and will remain in this state until A goes to logic 0 and resets Q_1 to logic 1, irrespective of the condition of B. Typical waveforms are shown in Fig. 2.

P. N. Hobson,
Sheffield.

Fig. 1.

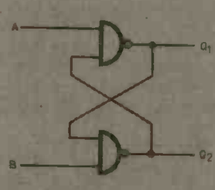
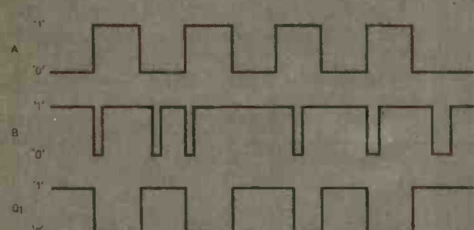


Fig. 2



POINTS ARISING

P.E. DIGI-PROBE (*April 1976*)
It has been brought to our attention that *DIGIPROBE* is the registered trade mark of Kane-May Ltd., of Welwyn Garden City, Herts. The instrument described in our April issue and entitled "PE Digi-Probe" has no connection with the above Firm nor its products. We apologise for any inconvenience that may have been caused because of the entirely coincidental choice of this almost identical name by our contributors for their own original design.

DIGITAL FREQUENCY METER (*June 1976*)
On page 505, the circuit diagram for the high impedance buffer (Fig. 13a) shows the base of TR14 connected to the gate of TR15 and also to "ground". This is, of course, incorrect and the base should *only* be connected to the "ground" line.

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Complete System with these speakers £65.00 + £6.50 p&p.

SYSTEM 2 £80.00

Viscount IV amplifier (As System 1a)
MP60 type deck (As System 1a)
Two Duo Type III matched speakers – Enclosure size approx. 27" x 13" x 11½". Finished in teak simulate. Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS. 8 ohms frequency range – 20 Hz to 18,000 Hz.
Complete System with these speakers £80.00 + £7.60 p & p.

PRICES: SYSTEM 1a

Viscount IV amplifier	£24.75 + £1.90 p & p.
2 Duo Type IIb speakers	£27.00 + £6.50 p & p.
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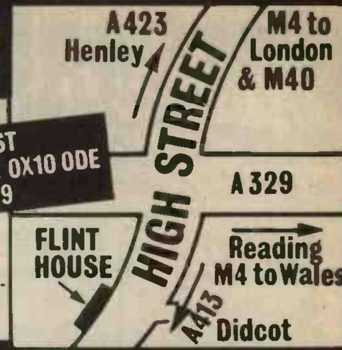

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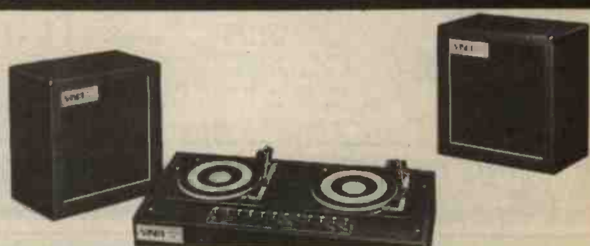

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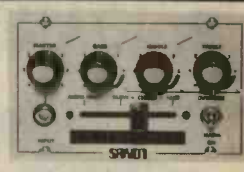

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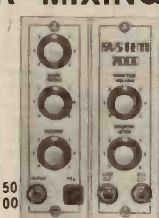

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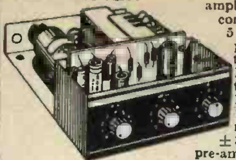

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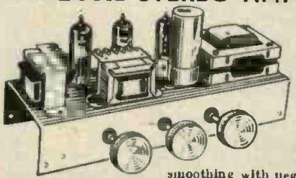

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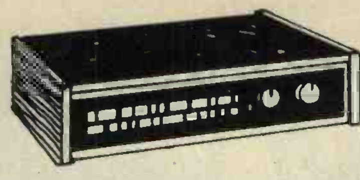

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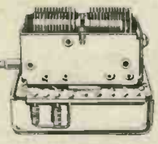

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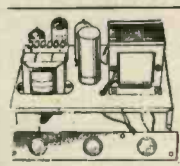

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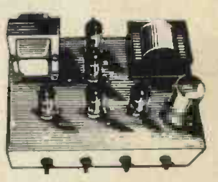

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