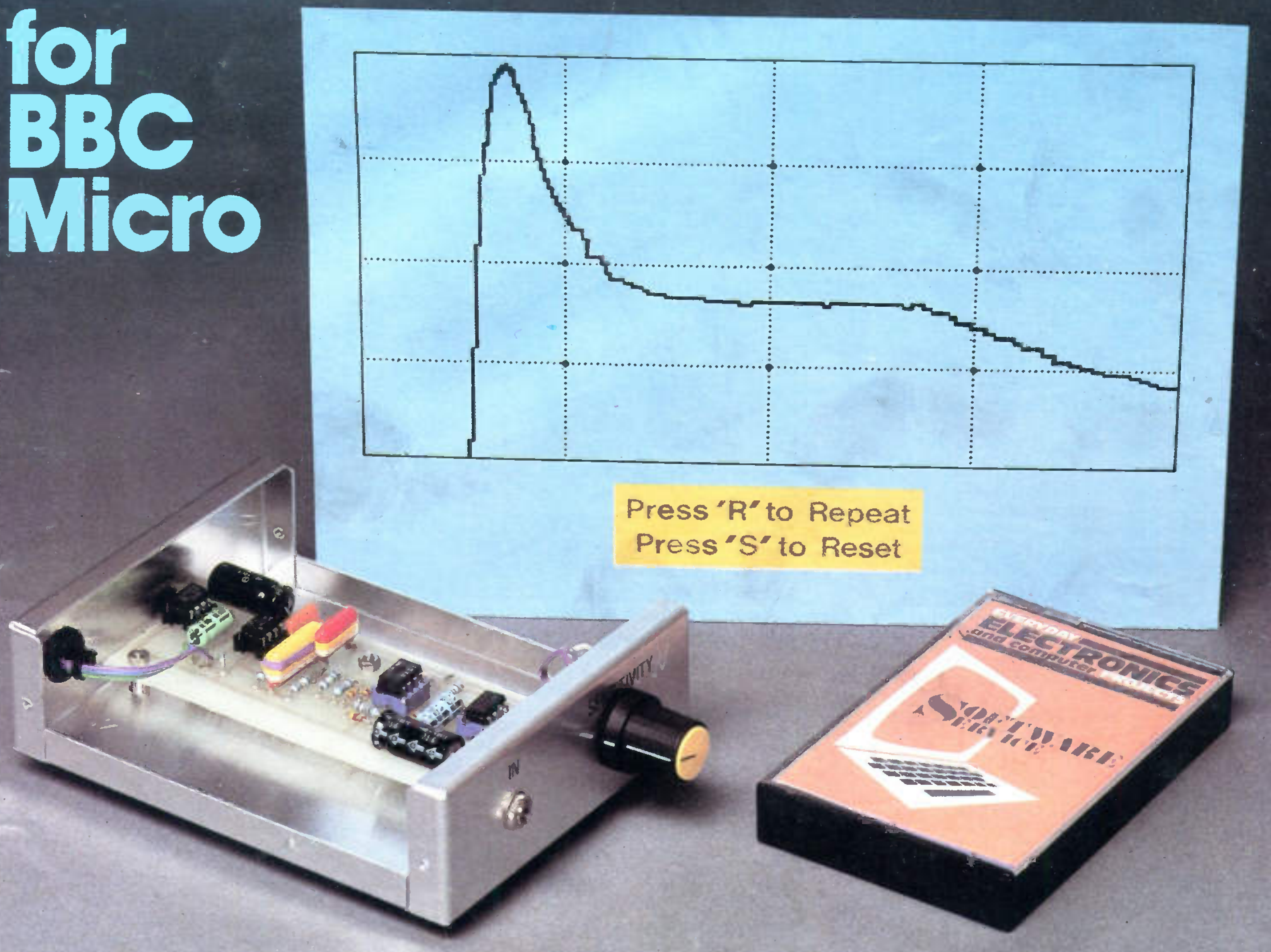
EVERYDAY ELECTRONICS and computer PROJECTS

AUGUST 1983

85p

STORAGE 'SCOPE INTERFACE for BBC Micro



CAR INTRUDER ALARM

1kW MAINS POWER CONTROLLER

HOME SYSTEMS MONITOR

Australia $1.50 New Zealand $1.60 Malaysia $4.95 IR £1.23 (inc V.A.T.)

SAVE ON THE PRICE OF YOUR COLOUR PRINTS!

with the Everyday Electronics Colour Print Service

While prices go up elsewhere, Everyday Electronics makes a bargain offer in its Colour Print Service. Now you can have as many films printed as you like, including Giant Superprints, at only 12p a print. There is no developing charge and just 25p towards postage and packing.

At this new price, the magazine Colour Print Service, already used by hundreds of thousands of readers, is as fast and efficient as ever. Here's all you have to do to enjoy its advantages.

Send any make of colour print film, including disc film, inside the envelope enclosed with this issue. Or fill in the coupon below and send with your colour print film in a strong envelope to: **Everyday Electronics Colour Print Service, FREEPOST, READING RG1 1BR. No stamp is required.**

SEND NO MONEY

We are so confident in the reliability of our service and the quality of our prints (each one date-stamped with the month and year of developing) that you don't pay until you've seen them.

LUXURY COLOUR PRINTS

You will be amazed at the beautiful colours and sheen finish of these prints. They have elegant rounded corners and are borderless to give you maximum picture area. And with the Giant Superprints, you get 30 per cent more picture area than the standard enprints *at no extra cost!*

UNBEATABLE VALUE

All you pay for the Colour Print Service is 12p for each good print received plus 25p towards postage and packing. The most you would pay us for processing and printing a 24-exposure film for example is £3.13. Compare that with the price you would pay in the shops.

FREE ALBUM PAGES

With each film we process, you receive an album page voucher. Collect and return three vouchers, and you receive a set of FREE album pages to fit into our specially designed album for any size of print up to 4in. by 6in.

HOW YOU BENEFIT

You benefit in three ways. Firstly, you pay nothing for the actual processing—only for prints and postage and packing. Secondly, you enjoy a personal service with every care taken over each individual order. And thirdly, you pay only for what you get—with no credit vouchers as with many other companies. An invoice comes with your prints, so it is a straight business transaction.

48 HOURS IN-LAB SERVICE

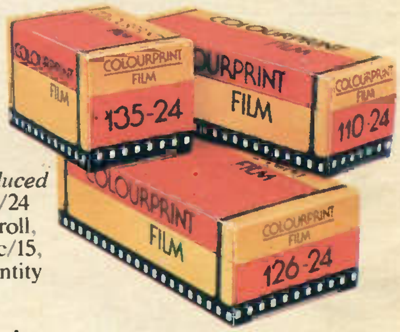
Your films will be processed within 48 hours* of receipt, but please allow for postal delays.

The price of this offer is limited to the U.K.

*C41 Process cassette and cartridge film only.

FILMS AT REDUCED PRICES

Always keep your camera action-ready. Order replacement films *at our specially reduced prices:* 110/24, 126/24 or 35/24 at £1.20 a roll, or three for £3; disc/15, £1.30 each (no quantity discount).



Offer excludes Black & White, transparency, sub-miniature. C22 & Agfa CNS film.
Superprints can only be produced from Kodacolour II, C41 cassette, cartridge and disc film not half frame. Prices correct at time of going to press.

If you have any queries, contact our Customer Service on Reading (0734) 597332.

Use this label if you have no envelope, or pass it to a friend. It is used to pack your prints.

To: Everyday Electronics Colour Print Service
FREEPOST, Reading RG1 1BR

● Please print my film Superprint size ☐
Standard Enprint size ☐

If film is being ordered ● Please send me ______
of 110/24 ☐ of 126/24 ☐ of 35/24 ☐ of disc/15 ☐

● Tick box(es) as required.

From: Everyday Electronics Colour Print Service
FREEPOST, READING RG1 1BR

Mr/Ms ______

Address ______

______

______ Postcode ______

EVERYDAY ELECTRONICS and computer PROJECTS

VOL. 12 NO. 8 AUGUST 1983

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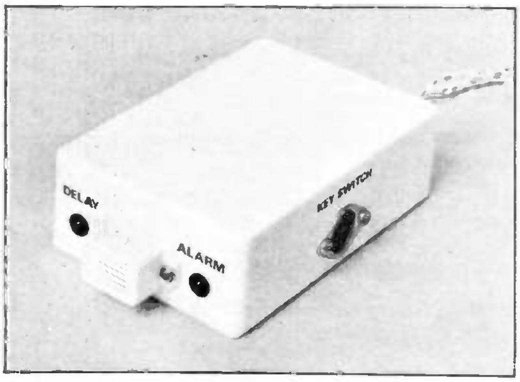
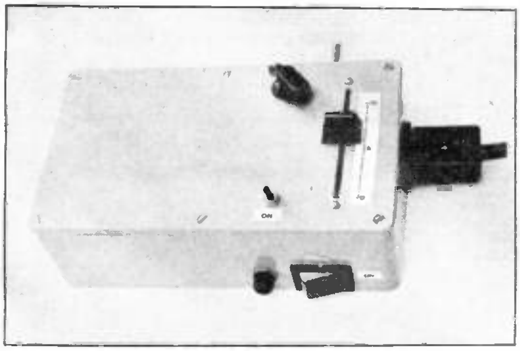
COMMENT . . . POPULAR FEATURES . . .





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electronize

AUTO-ELECTRONIC PRODUCTS

KITS OR READY BUILT

TOTAL ENERGY DISCHARGE ELECTRONIC IGNITION

IS YOUR CAR AS GOOD AS IT COULD BE?

SPECIAL OFFER

- ★ Is it **EASY TO START** in the cold and the damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.
- ★ Is it **ECONOMICAL** of does it "go off" between services as the ignition performance deteriorates? Total Energy Discharge gives much more output and maintains it from service to service.
- ★ Has it **PEAK PERFORMANCE** or is it flat at high and low revs. where the ignition output is marginal? Total Energy Discharge gives a more powerful spark from idle to the engines maximum (even with 8 cylinders).
- ★ Is the **PERFORMANCE SMOOTH.** The more powerful spark of Total Energy Discharge eliminates the "near misfires" whilst an electronic filter smoothes out the effects of contact bounce etc.
- ★ Do the **PLUGS and POINTS** always need changing to bring the engine back to its best? Total Energy Discharge eliminates contact arcing and erosion by removing the heavy electrical load. The timing stays "spot on" and the contact condition doesn't affect the performance either. Larger plug gaps can be used, even wet or badly fouled plugs can be fired with this system.
- ★ **TOTAL ENERGY DISCHARGE** is a unique system and the most powerful on the market - 3½ times the power of inductive systems - 3½ times the energy and 3 times the duration of ordinary capacitive systems. These are the facts:

Performance at only 6 volts (max. supply 16 volts)

SPARK POWER	140W	SPARK ENERGY	36mJ
SPARK DURATION	500µS	STORED ENERGY	135mJ
LOADED OUTPUT VOLTAGE			
50pF load	38kV	50pF + 500k	26kV

We challenge any manufacturer to publish better performance figures. Before you buy any other make, ask for the facts, its probably only an inductive system. But if an inductive system is what you really want, we'll still give you a good deal.

- ★ **All ELECTRONIZE electronic ignitions feature: EASY FITTING, STANDARD/ELECTRONIC CHANGEOVER SWITCH, STATIC TIMING LIGHT and DESIGNED IN RELIABILITY (14 years experience and a 3 year guarantee).**
- ★ **IN KIT FORM** it provides a top performance system at less than half the price of comparable ready built units. The kit includes: pre-drilled fibreglass PCB, pre-wound and varnished ferrite transformer, high quality 2µF discharge capacitor, case, easy to follow instructions, solder and everything needed to build and fit to your car. All you need is a soldering iron and a few basic tools.

Most **NEW CARS** already have electronic ignition. Update **YOUR CAR**

PROTECT YOUR CAR WITH AN ELECTRONIZE ELECTRONIC ALARM

- ★ **2000 COMBINATIONS** provided by an electronic key - a miniature jack plug containing components which must match each individual alarm system. (Not limited to a few hundred keys or a four bit code).
- ★ **60 SECOND ALARM PERIOD** flashes headlights and sounds horn, then resets ready to operate again if needed.
- ★ **10 SECOND ENTRY DELAY** allows owner to dis-arm the system, by inserting the key plug into a dashboard mounted socket, before the alarm sounds. (No holes in external bodywork, fiddly code systems or hidden switches). Re-closing the door will not cancel the alarm, before or after it sounds, the key plug must be used.
- ★ **INSTANT ALARM OPERATION** triggered by accessories or bonnet/boot opening.
- ★ **30 SECOND DELAY** when system is armed allows owner to lock doors etc.
- ★ **DISABLES IGNITION SYSTEM** when alarm is armed.
- ★ **IN KIT FORM** it provides a high level of protection at a really low cost. The kit includes everything needed, the case, fibreglass PCB, CMOS IC's, random selection resistors to set the combination, in fact everything down to the last nut and washer plus easy to follow instructions.

FITS ALL 12 VOLT NEGATIVE EARTH VEHICLES. SUPPLIED COMPLETE WITH ALL NECESSARY LEADS AND CONNECTORS PLUS TWO KEY PLUGS

Don't Wait Until Its too Late ~ Fit one NOW!

fill in the coupon and send to:

ELECTRONIZE DESIGN Dept C · Magnus Rd · Wilnecote · Tamworth · B77 5BY · tel 0827 281000

TOTAL ENERGY DISCHARGE (6 or 12 volt negative earth)

- ☐ Assembled ready to fit ~~£26.70~~ £19.95
- ☐ D.I.Y. parts kit ~~£15.90~~ £14.95

TWIN OUTPUT for cars and motor cycles with dual ignition

- ☐ Twin, Assembled ready to fit ~~£36.45~~ £29.95
- ☐ Twin, D.I.Y. parts kit ~~£24.55~~ £22.95

INDUCTIVE DISCHARGE (12 volt only)

- ☐ Assembled ready to fit ~~£15.95~~ £12.75

Goods normally despatched within 7 days.

Prices Include VAT. P+P £1-00 (UK)

C

CAR ALARM

- ☐ Assembled ready to fit £37.95
- ☐ D.I.Y. parts kit £24.95

I enclose cheque/postal order OR debit my Access/Visa card

VISA

Name ____________________

Address ____________________

____________________ Code ________

Rapid Electronics

MAIL ORDERS:
Unit 3, Hill Farm Industrial Estate,
Boxted, Colchester, Essex CO4 5RD.
TELEPHONE ORDERS:
Colchester (0206) 36412.

ACCESS AND BARCLAYCARD WELCOME

LINEAR

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

TRANSISTORS

				BC517	40	BF337	40	MPSU56	60	ZTX108	8	2N3055	50
				BC547	7	BFR40	23	TIP29A	30	ZTX109	12	2N3442	120
				BC548	10	BFR80	23	TIP29B	55	ZTX300	14	▶2N3702	6
AC125	35	BC149	9	BC549	10	▶BFR81	20	TIP29C	37	ZTX301	16	2N3703	9
AC126	25	BC157	8	BC558	10	BFX29	25	TIP30A	35	ZTX302	15	▶2N3704	6
AC127	25	BC158	10	BCY70	18	BFX84	25	TIP30B	50	ZTX304	17	2N3705	9
▶AC128	20	BC159	8	BCY71	18	BFX85	25	TIP30C	37	ZTX341	30	2N3706	9
AC176	25	BC160	45	BCY72	18	BFX86	28	TIP31A	35	ZTX500	15	2N3707	10
AC187	22	BC168C	10	BD115	55	BFX87	25	TIP31C	37	ZTX501	15	2N3708	10
AC188	22	BC169C	10	BD131	35	BFX88	25	TIP32A	35	ZTX502	15	2N3709	10
AD142	120	BC170	8	BD132	35	BFY50	23	TIP32C	37	ZTX503	18	2N3772	170
AD149	80	BC171	10	BD133	50	BFY51	20	TIP33A	50	ZTX504	25	▶2N3773	195
AD161	40	BC172	8	BD135	40	BFY52	23	TIP33C	75	2N697	20	▶2N3819	18
AD162	40	BC177	18	BD136	30	BFY53	32	TIP34A	60	2N698	40	2N3820	40
AF124	60	BC178	18	BD137	30	BFY55	32	TIP34C	85	2N706A	20	2N3823	65
AF126	50	BC179	18	BD138	30	BFY56	32	TIP35A	105	2N708	20	2N3866	90
AF139	40	BC182	10	▶BD139	35	BRY39	40	TIP35C	125	2N918	35	2N3903	10
AF186	70	▶BC182L	8	▶BD140	35	BSX20	20	TIP36A	125	2N1132	22	2N3904	10
AF239	75	BC183	10	BD204	110	BSX29	35	TIP36C	135	2N1613	30	2N3905	6
BC107	10	BC183L	10	BD206	110	BSY95A	25	TIP41A	45	2N2218A	45	2N3906	10
BC107B	12	BC184	10	BD222	85	BU205	160	TIP42A	45	2N2219A	25	2N4037	45
▶BC108	10	BC184L	7	BF180	35	BU206	180	TIP120	90	2N2221A	25	2N4058	10
BC108B	12	BC212	10	BF182	35	BU208	170	TIP121	90	2N2222A	20	2N4060	10
BC108C	12	BC212L	10	BF184	25	MJ2955	99	TIP122	98	2N2368	25	2N4061	10
▶BC109	10	BC213	10	BF185	25	MJE340	50	TIP141	98	2N2369	16	2N4082	10
BC109C	12	BC213L	10	BF194	12	MJE520	65	TIP142	98	2N2484	25	2N5457	36
BC114	18	BC214	10	BF195	12	MJE521	95	TIP147	110	2N2646	45	2N5458	36
BC115	22	▶BC214L	8	BF196	12	MJE3055	70	TIP2955	60	2N2904	20	2N5459	30
BC117	18	BC237	8	BF197	12	MPF102	40	TIP3055	55	2N2904A	20	2N5485	36
BC119	35	BC238	14	BF198	10	MPF104	40	TIS43	40	2N2905	22	2N5777	45
BC137	40	BC308	12	BF199	18	MPSA05	22	TIS44	45	2N2905A	22	2N6027	30
BC139	40	BC327	14	BF200	30	MPSA06	25	TIS90	30	2N2906	25	40360	40
BC140	28	BC328	14	▶BF244B	22	MPSA12	30	TIS91	30	2N2906A	25	40361	50
BC141	30	BC337	14	BF245	30	MPSA55	30	VN10KM	45	2N2907	25	40362	50
BC142	25	BC338	14	BF256B	45	MPSA56	30	VN46AF	75	2N2907A	25	40408	70
BC143	25	BC477	30	BF257	32	MPSU05	55	VN66AF	85	2N2926	9		
BC147	8	BC478	30	BF258	25	MPSU06	55	VN88AF	95	▶2N3053	23		
BC148	8	BC479	30	BF259	35	MPSU55	60	ZTX107	8	2N3054	55		

CABLES

20 metre pack single core connecting cable ten different colours.	65p
Speaker cable	10p/m
Standard screened	16p/m
Twin screened	24p/m
2.5A 3 core mains	23p/m
10 way rainbow ribbon	65p/m
20 way rainbow ribbon	120p/m
10 way gery ribbon	38p/m
20 way grey ribbon	80p/m

REGULATORS

78L05	30	79L05	65
78L12	30	79L12	65
78L15	30	79L15	65
7805	35	7905	40
7812	35	7912	40
7815	35	7915	40
LM309K	130	LM723	35
LM317K	270	SPECIAL OFFER!	
LM317T	120	78P05 10A +5V	
LM323K	350	only 390p each.	

DIODES

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

OPTO

▶3mm red	7	▶5mm red	7
▶3mm green	10	▶5mm green	10
▶3mm yellow	10	▶5mm yellow	10

Clips to suit - 3p each.

Rectangular		TIL32	40
▶red	12	TIL78	40
green	17	▶TIL111	60
yellow	17	ORP12	85
▶TIL38	40	TIL100	90
2N5777	45	Dual colour	60

Seven segment displays:

Com cathode		Com anode	
DL704 0.3"	95	DL707 0.3"	95
▶FND500		FND507	
0.5"	100	0.5"	100
TIL313 0.3"	115	TIL312 0.3"	115
TIL322 0.5"	115	TIL321 0.5"	115

LCD: 3½ digit 580p. 4 digit 620p.

HARDWARE

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

POTENTIOMETERS

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

TRIACS

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

MULTIMETERS

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

CAPACITORS

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

BRIDGE RECTIFIERS

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

EPSON PRINTERS

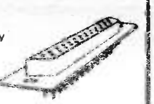
Latest generation printers from Epson. Logic seeking, bi-directional, bit image printing, 9 x 9 Matrix, Auto underline, Centonix 8 Bit Parallel Interface as standard.

RX80 100 CPS 80 column Tractor feed £288.00

FX80 160 CPS 80 column Tractor Feed £398.00

Carriage £7 per printer.

MIN. D CONNECTORS



	9 way	15 way	25 way	37 way
Plugs solder lugs	60p	85p	125p	170p
Right angle	120p	180p	240p	350p
Sockets lugs	90p	130p	195p	290p
Right angle	160p	210p	290p	440p
Covers	100p	90p	100p	110p

SOLDERING IRONS

Antex CS 17W Soldering iron	460
2.3 and 4.7mm bits to suit	85
CS 17W iron. 450, element:	210
Antex XS 25W	480
3.3 and 4.7mm bits to suit	85
Solder pump desoldering tool	480
Spare nozzle for above	70
10 metres 22swg solder	100

RESISTORS

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

PCB MATERIALS

Alfac transfer sheets – please state type (e.g. DIL pads etc.)	45
Dalo etch resistant pen	100
Fibre glass board 3.75 x 8"	80
Fibre glass board 8 x 12"	200
Ferric Chloride crystals	100

BOXES

		Aluminium	
		3 x 2 x 1"	65
Plastic with lid & screws		4 x 2¾ x 1½"	95
		4 x 2½ x 2"	95
3 x 2 x 1"	55	6 x 4 x 2"	120
4½ x 3 x 1½"	88	7 x 5 x 2½"	165
7 x 4 x 2"	160	8 x 6 x 3"	205

CONNECTORS

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

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

SCRs

▶C106D	30
400V 8A	70
400V 12A	95

TOOLS

Small trimming tool	22
Small pocket screwdriver	16
Large pocket screwdriver	13
6 piece precision screwdriver set in plastic case	170
Low cost side cutters	160
High quality side cutters	650
Low cost pliers	160
High quality pliers	650
Wire strippers	120
Expo reliant drill	695
Expo Titan drill	1025
Drill stand	1200

VERO

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

SWITCHES

Submin toggle:
SPST 55p. SPDT 60p. DPDT 65p.
Miniature toggle:
SPDT 80p. SPDT centre off 90p.
DPDT 90p. DPDT centre off 100p.
Standard toggle:
SPST 35p. DPDT48p
Miniature DPDT slide 12p.
Push to make 14p.
Push to break 22p.
Rotary type adjustable stop.
1P12W, 2P6W, 3P4W all 55p each.
DIL switches:
4SPST 80p 6 SPST 80p. 8SPST 100p.

MICRO

		6116P3	320	6852	240	8228	220
		6502CPU	325	6875	495	8251	250
		6522VIA	295	6880	100	8253	390
		6532	570	81LS95	85	8255	225
		6551 ACIA	650	81LS96	85	8259	390
2114L2	75	6800CPU	220	81LS97	85	MC1488	55
2716	205	6802CPU	250	8080A	220	MC1489	55
2532	290	6809CPU	620	8085AC	340	Z80ACPU	290
2732	290	6810RAM	115	8156	350	Z80APIO	260
2764	540	6821 PIA	110	8212	110	Z80ACTC	260
4116P20	70	6840	360	8216	100	Z80ASIO	900
5101L-1	220	6850	110	8224	120	Z80ADMA	1150

CMOS

		4016	20	4034	140	4054	78	4081	12	40193	65	4528	45
		4017	30	4036	249	4055	80	4082	12	4502	60	4529	150
		4018	45	4039	280	4059	430	4085	48	4503	32	4532	60
4000	10	4019	25	4040	40	4060	42	4086	50	4507	35	4534	400
4001	10	4020	42	4041	40	4063	80	4089	125	4508	110	4538	60
4002	12	4021	40	4042	38	4066	22	4093	18	4510	45	4543	50
4006	50	4022	45	4043	40	4067	225	4094	68	4511	40	4549	360
4007	14	4023	16	4044	40	4068	14	4095	65	4512	40	4553	215
4008	36	4024	33	4046	40	4069	13	4097	290	4514	115	4555	35
4009	24	4025	12	4047	35	4070	13	4098	70	4515	115	4556	35
4010	24	4026	75	4048	38	4071	13	4099	70	4516	55	4559	390
4011	10	4027	20	4049	21	4072	13	40106	40	4518	40	4560	140
4012	15	4028	40	4050	21	4073	13	40109	110	4520	50	4584	35
4013	20	4029	45	4051	42	4075	13	40163	60	4521	130	4585	60
4014	45	4030	14	4052	48	4076	45	40173	100	4526	60	4724	140
4015	40	4031	125	4053	48	4077	14	40175	75	4527	50		

LS TTL

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

SOCKETS

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

Soldercon pins 60P/100

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An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. ¼W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 650 resistors) 530
Ceramic Cap. kit. 5 of each value - 22p to 0.01u (135 caps) 370
Polyester Cap. kit. 5 of each value from 0.01 to 1uF (65 caps) 575
Preset kit. Contains 5 of each value from 100 ohms to 1M (total 65 presets 425
Nut and Bolt kit (total 300 items): 180p

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

TTL

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

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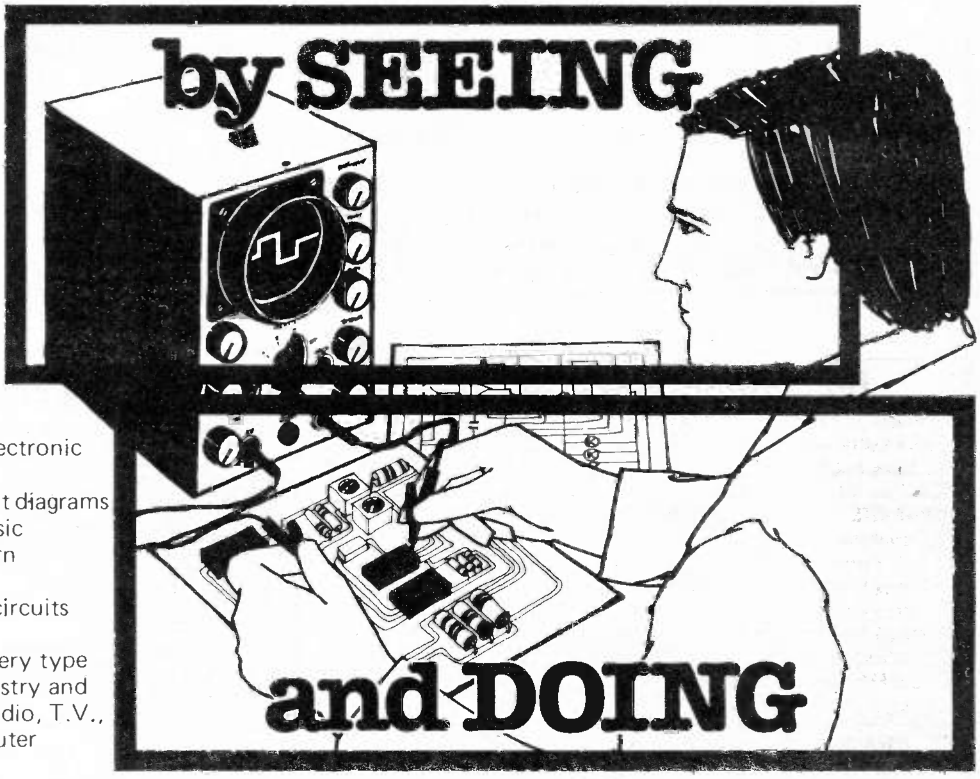

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EVERYDAY ELECTRONICS and computer PROJECTS

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SELF-INTEREST

EMPHASIS on computer projects in EVERYDAY ELECTRONICS has brought forth from correspondents commendation and complaint, in roughly equal proportions. Letters we have received on this subject represent just a very small sampling of our total readership, but as we all know only too well from recent happenings, the National Opinion Polls take small samples and from these can extrapolate with a fair degree of accuracy what the overall prevailing opinions are. What we are able to extrapolate (without difficulty) is that there exists a sharp division into two camps amongst our readers: those who use a computer and are pleased to explore all its possibilities and those who view computer activities as something alien to the electronic hobbyists' interest.

It is easy to understand the apprehension amongst some non-computer users that everything will eventually be subjugated to the computer; but so far as EE is concerned this will not happen. Even with the inclusion of computer orientated articles of substantial size, the number and variety of general interest (non-computer) projects has been maintained month by month in our pages.

But we all have to be realistic. Computers will continue their remorseless onward march and no area of human activity is or will be immune from their influence. So let us always be prepared to examine ways by which computing power can be directed to aid all constructors in the normal pursuit of their hobby. Looked at from a positive point of view, the electronic hobbyist has much to gain from the personal computer. It will be seen, in the near future, as a versatile instrument capable of offering useful service in the workshop or lab. The project featured on this month's cover indicates this kind of approach.

In this respect the *Storage Scope Interface* does have a significance—although it is itself quite modest in general circuitry terms. It allows the BBC Micro with its V.D.U. to be of direct use to the circuit designer and experimenter, by fulfilling a role similar to that of a low-frequency storage oscilloscope. This project can be seen as but the forerunner of many add-on's tailored for the constructors own use.

There is a certain justice in this kind of development in the application of personal computers. The constructor often finds himself the provider of customised hardware to some friend or acquaintance who happens to be a computer buff. Now the way is opening up for the constructor to look after number one and harness the computer to his own purposes as an aid; for example, in the course of circuit development and when carrying out performance checks on completed equipment.

Fred Bennett

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

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

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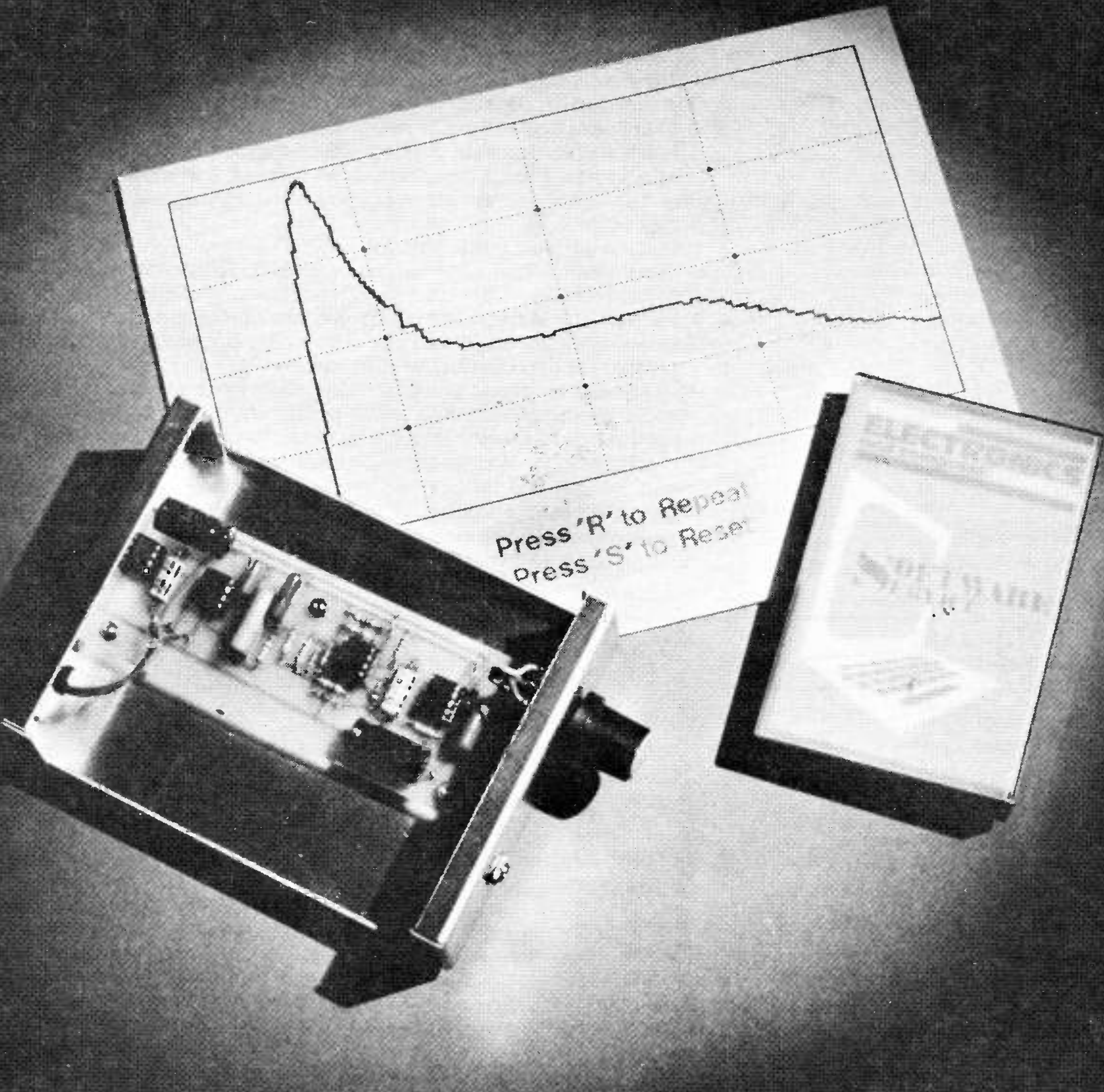
STORAGE 'SCOPE INTERFACE FOR BBC MICRO

BY R. A. PENFOLD

WHEN experimenting with sound effect circuits, synthesisers, and other sound generator circuits or instruments, it can be very useful to display the envelopes of signals on an oscilloscope. The display is in the form of a band across the screen which varies in height in sympathy with the amplitude of the input signal.

This system works well with short duration sounds, but problems often arise if the signal has a duration of about one second or more. Some oscilloscopes simply do not have a sweep rate of less than about one per second and are therefore unusable with long duration signals.

Most oscilloscopes have a medium or short persistence cathode ray tube which results in poor results at long sweep times as the beginning of the trace fades before the final section has been completed, and the trace as a whole is not seen unless photographic techniques are adopted.



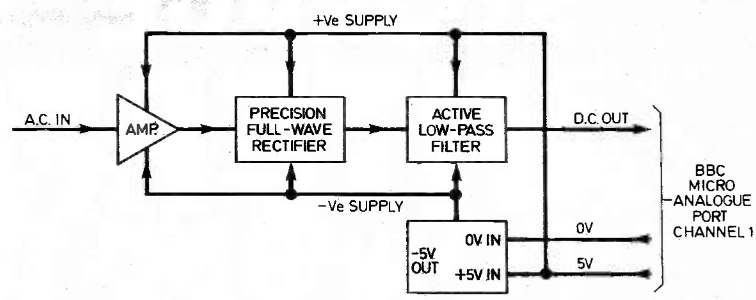


Fig. 1. The system in block diagram form.

There are a number of ways around this problem, such as using a storage oscilloscope or a type having a long persistence cathode ray tube. Another approach, and the one employed here, is to use a computer plus a television set or monitor as a sort of low frequency storage oscilloscope.

The unit to be described here is designed for use with the BBC Micro model B which has a built-in four channel analogue to digital converter. This has a sampling rate of about once every 40 milliseconds per channel, but only one channel is used in this application, and by switching off the three unused channels this increases the sampling rate to once every 10 milliseconds. This gives perfectly adequate resolution for sweep times of one second or more.

BLOCK DIAGRAM

Fig. 1 shows the system in block diagram form. The first stage is simply an amplifier which boosts the sensitivity of the unit to a more useful level. This gives an input sensitivity of about 150 millivolts r.m.s. into 220 kilohms for maximum deflection of the trace, and this is adequate for most purposes. However, an external preamplifier could obviously be added if the unit is to be used with a low level signal source such as a microphone.

It would be possible to feed the audio signal into the input of the computer together with a suitable bias voltage, but this would give a relatively crude display and might not be very accurate due to the limited sampling rate used. A better solution is to use a rectifier to feed a d.c. signal to the computer, the amplitude of this d.c. signal being proportional to the audio input level. The trace on the television is then in the form of a line which shows the envelope of the input signal in the conventional time/amplitude graph form. This gives a very clear and unambiguous display as can be seen from the accompanying photographs showing typical TV displays obtained using the unit.

PRECISION RECTIFIER

A precision fullwave rectifier is used so that accurate results are obtained and the unit responds to both positive and negative input half cycles. An active (18dB per octave) lowpass filter is used to smooth the output of the rectifier so that the circuit has reasonably fast attack and decay times, but ripple on the output due to low audio input frequencies is avoided.

The unit is powered from the 5 volt output at the analogue port of the computer, but the circuit requires dual 5 volt supplies. A voltage converter is therefore used to produce a 5 volt negative supply from the positive 5 volt supply obtained from the computer so that the required dual supplies are obtained.

It would be useful for the unit to have a logarithmic output and a logarithmic amplifier could be added at the output or the unit. However, this is not really necessary since the software can be used to give a logarithmic response where this would be more convenient, and this is the method finally used.

THE CIRCUIT

The complete circuit diagram of the adaptor appears in Fig. 2.

IC1 is used as the input amplifier, and this is a straightforward non-inverting operational amplifier circuit having a voltage gain of just over 20dB (ten times) set by negative feedback network R1 and R2. VR1 biases the non-inverting input of IC1 and this is also the sensitivity control.

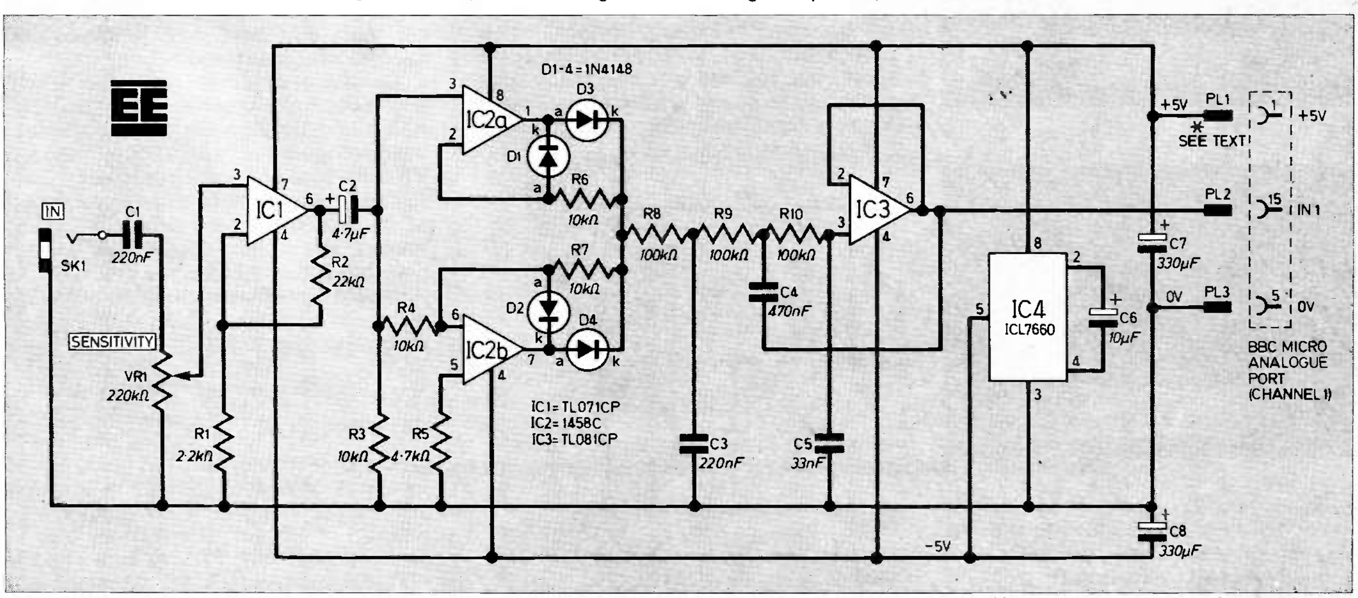
IC2 is used as the precision rectifier stage, and this really consists of two half-wave rectifier circuits connected in parallel. The one based on IC2a handles positive input half cycles while the one built around IC2b handles negative input half cycles. Thus the two circuits together provide full-wave rectification.

RECTIFIER EXPLAINED

Fig. 3 shows the two sections of the rectifier circuit in simplified form and helps to explain their operation. It is not possible to use a simple diode rectifier circuit due to the non-linearity of semiconductor diodes and the consequent poor performance that would result.

An ordinary silicon diode has a very high resistance at forward voltages of up

Fig. 2. The complete circuit diagram of the Storage 'Scope Interface for BBC Micro.



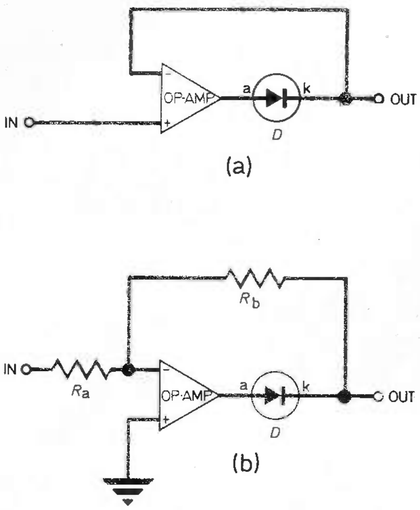


Fig. 3(a). Basic non-inverting precision rectifier, (b) basic inverting precision rectifier.

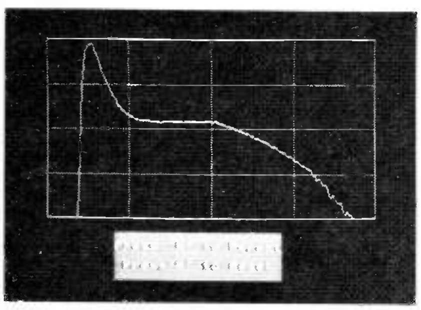
to about 0·5 volts, and its resistance then drops rapidly as the forward voltage is increased above this threshold level. This obviously gives severe distortion of the input signal, and actually gives no significant output at all until the input exceeds about 0·5 volts.

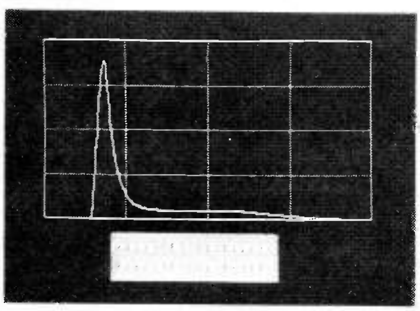
This problem is overcome by using the diode in the negative feedback circuit of an operational amplifier. If we consider the non-inverting circuit of Fig. 3(a) first, with a positive input signal and the diode conducting there is 100 per cent negative feedback over the amplifier and it therefore has unity voltage gain.

However, the action of the circuit is to balance the voltages at the inputs of the operational amplifier by a negative feedback action, and the output voltage from the operational amplifier is therefore equal to the input potential plus the voltage drop across the diode. In other words there is unity gain from the input to the output of the circuit rather than from the input to the output of the operational amplifier, and the feedback of the operational amplifier is used to compensate for the non-linearity of the diode.

The inverting circuit of Fig. 3(b) works in a similar manner, but it is when the input is negative going that a positive output is produced and the diode conducts. R_a and R_b set the voltage gain from the input to the output of the circuit at unity, and by balancing the input voltages to the operational amplifier, the negative feedback again compensates for the voltage drop across the diode.

A conventional 18dB per octave active lowpass filter based on IC3 is used to smooth the output from the precision rectifier circuit. This filter is essentially the same as the type used in scratch filters and similar applications, but it has a much lower cut-off frequency of only about 10Hz. This gives good attenuation over the entire audio band without limiting the attack and decay times of the circuit very much.





Typical screen display of result. The same signal "shape" (ASDR envelope) is used for both displays with the upper trace in LOG scaling mode and the lower in LIN scaling mode.

VOLTAGE CONVERTER

IC4 is the voltage converter, and this device has a high frequency audio oscillator driving a d.p.d.t. electronic switch connected as shown in Fig. 4. This first charges a capacitor across the positive input supply, and then discharges it into the negative output supply lines (with the appropriate polarity). This is done several thousand times per second and a smoothing capacitor across the negative supply rails gives a continuous and reasonably well smoothed supply here.

In theory the negative output voltage is equal to the positive input potential, but in practice there is a small reduction in the output voltage due to the resistance in the electronic switches. However, this is only about 0·07 volts per milliamp of supply current, and is not normally large enough to be of any practical significance where a negative supply current of only a few milliamps is required.

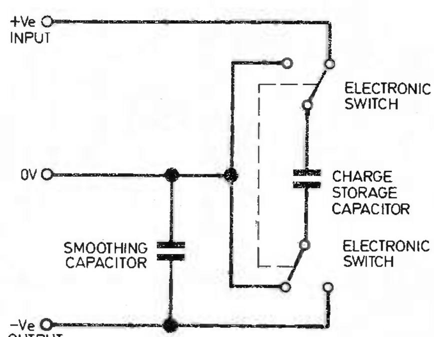
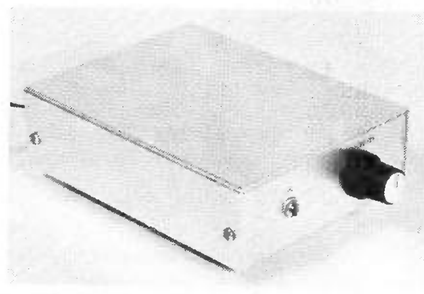


Fig. 4. Method of operation used by the ICL7660 (IC4).

CONSTRUCTION



CASE

An aluminium case having approximate outside dimensions of 133 × 102 × 38mm is suitable for this project, but any similar case should be satisfactory. A metal case is better than a plastic type in this application where the screening provided by a metal type is advantageous. VR1 is mounted on the right hand section of the front panel with SK1 on the left. A hole for the output lead to the computer is drilled in the rear panel of the case and this should be fitted with a grommet.

PRINTED CIRCUIT BOARD

A printed circuit board, single-sided, size 119 × 48mm, accommodates all the other components and the master pattern to be etched is shown actual size in Fig. 5. The black areas represent the copper tracks to remain after etching. This board is available through the *EE PCB Service,* Order code 8308-01.

The layout of the components on the topside is shown in Fig. 6 where relative positions of the case mounted components can be seen and the board wiring to them.

IC4 is a MOS device and should be fitted in an 8-pin d.i.l. i.c. socket, but it should not be plugged into circuit until the rest of the board has been completed. It should be left in its protective packaging until this time, and it should be handled as little as possible.

Do not overlook the three link wires which carry the negative supply to IC1, IC2, and IC3. Veropins are fitted to the board at the points where connections to VR1, SK1, and PL1 will be made.

The board is bolted to the base panel of the case using 6BA fixings including spacers about 6mm long which ensure that the connections on the underside of the board do not short circuit through the metal case. The final wiring is then completed, as shown in Fig. 6.

ANALOGUE PORT CONNECTOR

The connection to PL1 is made via a three way cable about 500mm or so long, and as the unit has a low output impedance it is not essential to use a screened cable here. PL1 can be a 15 way "D" connector which fits the analogue

COMPONENTS

Resistors

R1	2·2kΩ
R2	22kΩ
R3,4,6,7	10kΩ (4 off)
R5	4·7kΩ
R8,9,10	100kΩ (3 off)

All $\frac{1}{4}$W carbon ±5%

Capacitors

C1,3	220nF polyester (2 off)
C2	4·7μF 63V elect. axial
C4	470nF polyester
C5	33nF polyester
C6	10μF 25V elect. axial
C7,8	330μF 10V elect. axial (2 off)

Semiconductors

IC1	TL071CP b.i.f.e.t. op-amp
IC2	1458C dual op-amp
IC3	TL081CP b.i.f.e.t. op-amp
IC4	ICL7660 voltage converter
D1,2,3,4	1N4148 (4 off) silicon diode

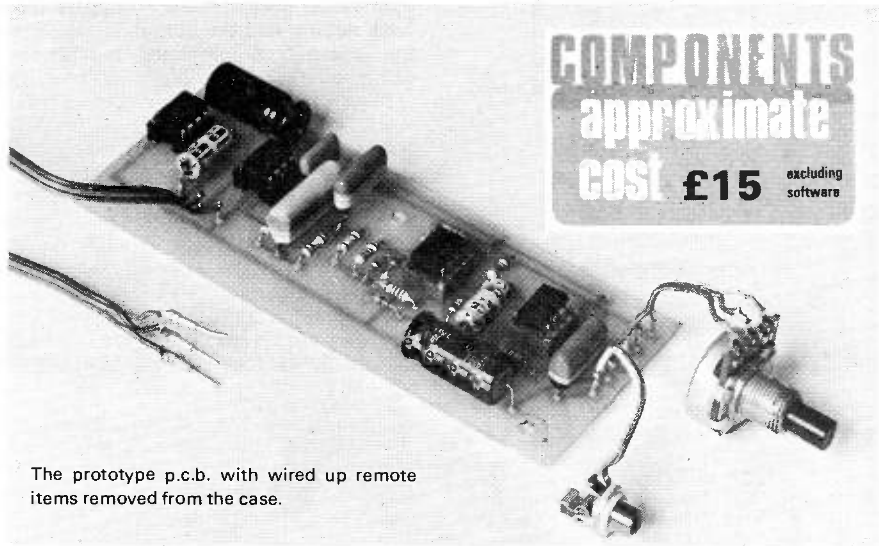
Miscellaneous

VR1	220kΩ log. carbon pot.
SK1	3·5mm jack socket
PL1/2/3	15-way "D" connector or 1mm plugs (3 off) see text

Printed circuit board: single-sided size 119 × 48mm, available from *EE PCB Service*, Order code 8308-01; aluminium case type AB10, size 133 × 102 × 38mm or similar; control knob, Veropins (8 off); 8-pin d.i.l. sockets (4 off), 6BA fixings and 6mm spacers (3 sets); connecting wire; self-adhesive rubber feet (4 off).

Software

T005 cassette: Storage 'Scope Interface, see page 499.



The prototype p.c.b. with wired up remote items removed from the case.

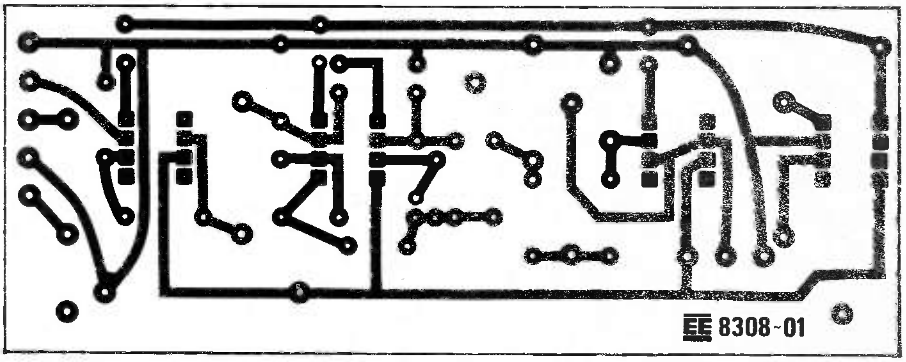


Fig. 5. The full size master p.c.b. pattern to be etched. This board is available from the *EE PCB Service*.

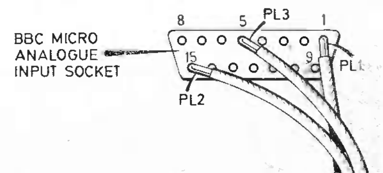
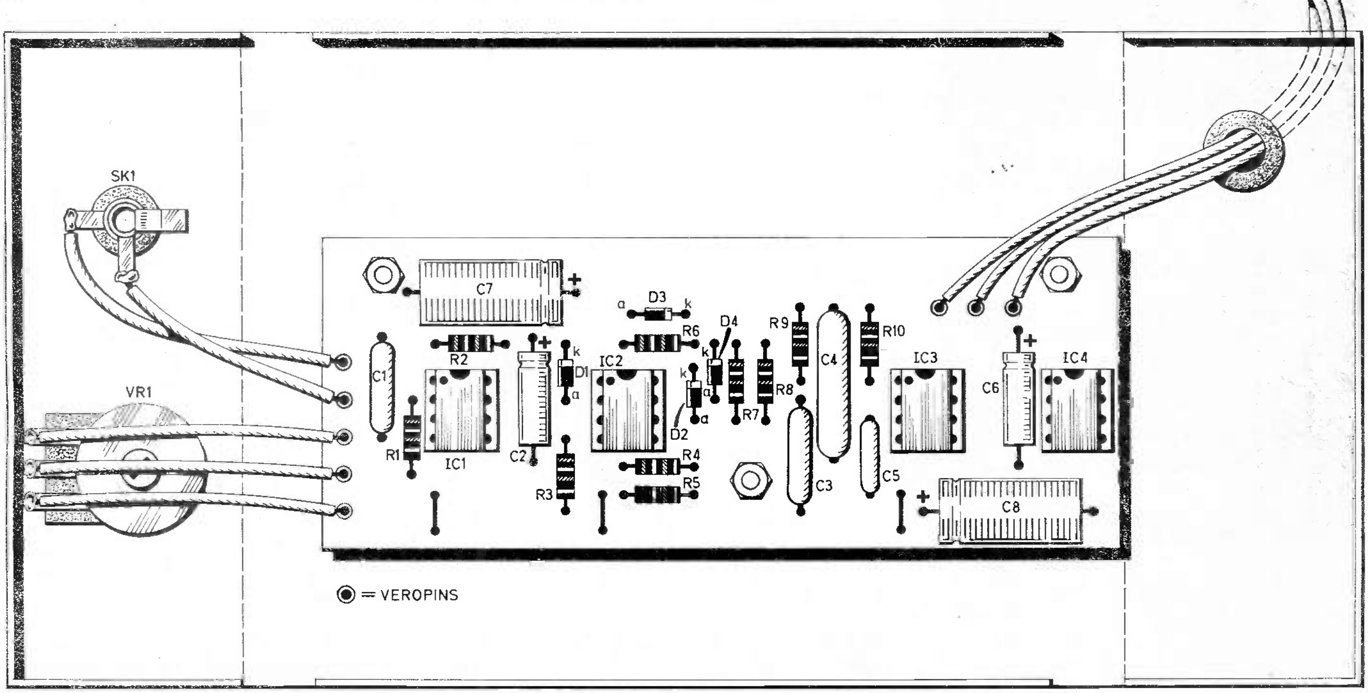
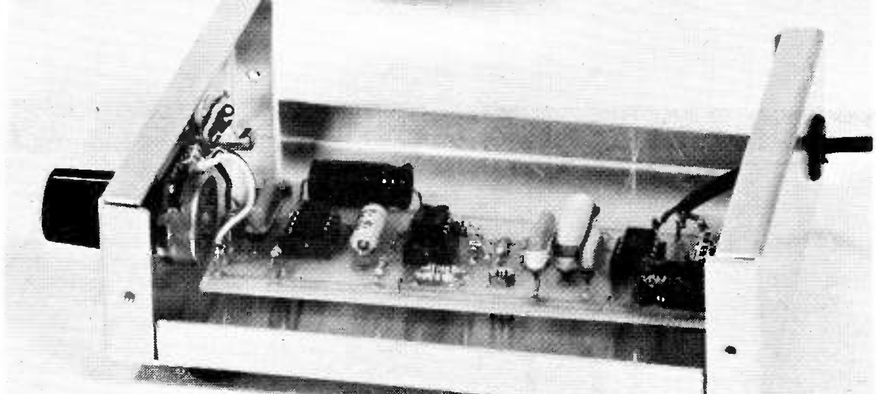


Fig. 6. Layout of components on the topside of the p.c.b. with interwiring details to case mounted components and the BBC Micro. Top right shows connection to the analogue port Channel 1 looking at the socket from the rear of the computer.





Completed prototype with lid removed.

Program for Storage 'Scope Interface

```
  10 REM Storage Scope Interface
  15 REM August 1983
  20 REM <c>Everyday Electronics 1983
  30 ON ERROR GOTO 3000
  40 MODE 1
  50 *FX 16,1
  60 PROCgrid
  70 PROCset
  80 END
 500 DEF PROCgrid
 505 VDU 19,1,4,0,0,0
 510 COLOUR 129:GCOL 0,2
 520 VDU 28,9,28,27,24,29,40;300;24,0;0;1200;600;
 530 CLS:CLG:MOVE 0,0
 540 DRAW 0,600:DRAW 1200,600:DRAW 1200,0:DRAW 0,0
 550 MOVE 0,150:PLOT 21,1200,150
 560 MOVE 1200,300:PLOT 21,0,300
 570 MOVE 0,450:PLOT 21,1200,450
 580 MOVE 900,600:PLOT 21,900,0
 590 MOVE 600,0:PLOT 21,600,600
 600 MOVE 300,600:PLOT 21,300,0
 610 MOVE 0,0
 620 ENDPROC
1000 DEF PROCset
1010 PRINT
1020 INPUT"LOG or LIN Scale"',A$
1030 IF A$<>"LOG" AND A$<>"LIN" THEN GOTO 1020
1040 INPUT "Sweep Speed"',S
1050 IF S>0 AND S<101 THEN PROCtrace ELSE GOTO 1040
1060 ENDPROC
1500 DEF PROCtrace
1510 PRINT" Press Space Bar"
1520 PRINT" to Start Trace"
1525 REPEAT UNTIL GET=32
1530 IF A$="LIN" THEN R=10
1535 IF A$="LOG" THEN R=30
1540 FOR X=1 TO 1200 STEP R/S
1550 IF A$="LOG" THEN Y=(LN(ADVAL(1)+100)-4.6)*92
1560 IF A$="LIN" THEN Y=ADVAL(1)/110
1570 DRAW X,Y
1580 NEXT X
1590 PROCnew
1600ENDPROC
2000 DEF PROCnew
2010 PRINT"Press 'R' to repeat"
2020 PRINT"Press 'S' to reset"
2030 K=GET
2040 IF K=82 THEN PROCgrid:PROCtrace
2050 IF K=83 THEN PROCgrid:PROCset ELSE GOTO 2010
2060 ENDPROC
3000 IF ERR=17 GOTO ERL
3010 IF ERR=32 THEN FOR X=X TO 1200 STEP R/S:GOTO 1550
3020 IF ERR=17 GOTO 1550
3030 MODE 7:REPORT:PRINT" at line ";ERL
```

port of the BBC model B, or an inexpensive alternative is to use three 1mm plugs as used on the prototype. Whichever method is used, make sure that the three leads are connected to the analogue port correctly. Fig. 6 shows the appropriate method of connection.

TESTING

The finished unit can be given an initial test by monitoring the voltage between the 0V and output terminals. Under quiescent conditions there should be no significant voltage present here, but with a suitable input signal it should be possible to obtain a potential of up to about 2 volts or so (at least 1·8 volts is needed to fully drive the analogue port of the BBC model B computer).

SOFTWARE

Constructors may wish to produce their own software, but the program listed here can be used by constructors who do not wish to do so. The program gives operating instructions, a choice of linear or logarithmic (amplitude) scaling, accepts sweep times under 100 seconds, and has error handling. This program on cassette tape is available from the *EE Software Service*, Order code T005. See elsewhere in this issue for further details.

PROGRAM NOTES

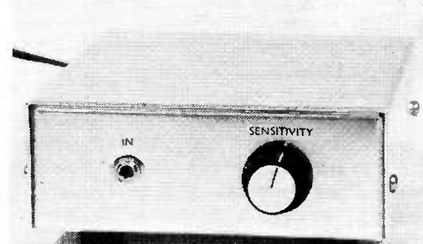
Line 5Ø enables one ADVAL channel only, thus ensuring the fastest sampling rate. See page 426 of the owner's manual.

Line 51Ø produces a yellow trace. Line 5Ø5 gives a blue background to the text.

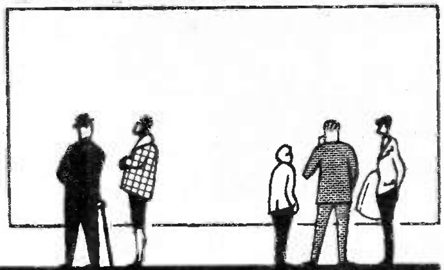
When selecting LOG or LIN the letters must be typed in capitals, without following spaces. Lines 1Ø3Ø and 1Ø5Ø ensure the program does not proceed until acceptable input is received.

The different values for the variable R in lines 153Ø and 1535 are to give the correct sweep speed. The higher the number, the faster the trace. The LOG setting needs a higher value to compensate for the time taken to perform the LOG calculation.

In line 155Ø, 1ØØ is added to the ADVAL value to limit noise effects. The '—4.6' compensates for this (approximately $\log_e(1ØØ)$). This provision is not necessary with the linear scale. □



SHOP TALK



BY DAVE BARRINGTON

Catalogue Received

Just to illustrate the varied range of stock carried, one of the more unusual items that caught the eye in the new **Bi Pak** 1983 Components catalogue was a television line output transformer tester that can be used for in-situ testing.

The 80-page catalogue contains an excellent semiconductor section, with package outlines and i.c. pinning information.

Renown for their special component Paks, they also list a p.c.b. etchant and drill kit. Additions to their plugs and sockets section are 23-way and 28-way edge connector, standard Dee range of 9 to 25-way plug/socket sets and 10-colour ribbon cable.

A separate price list booklet is issued with each catalogue and is updated fairly frequently. Copies of the 1983 Bi Pak Components catalogue cost 75p plus 25p postage and is available from: ***Bi-Pak Semiconductors, Dept EE, The Maltings, 63a High Street, Ware, Herts SG12 9AD.***

Newcomers

This month we welcome two newcomers to the ranks of component suppliers.

Carrying an excellent range of TTL, Linear and CMOS devices, **Circuit Board Components** also stock a range of "tactile feel" DIP switches, with upright actuator, in 2-pole to 10-pole versions. They also carry 16K and 32K memory chips.

For more details of their complete range of components write to: ***Circuit Board Components, Dept EE, Castle House, 1 Castle Lane, Bedford MK40 3QE.***

Readers in the Berkshire area will now be able to order components from a local stockists with the announcement of the opening of **Twyford Electronics Ltd.**

Formed to supply, at competitive prices, all components that the constructor is likely to need, Twyford claim they are the only major supplier in the area. They have also set up an express mail order service to serve the rest of the country.

A catalogue is now being printed and, by the time this issue is published, will be available for 25p plus postage from ***Twyford Electronics Ltd., Dept EE, 22 Station Road, Twyford, Reading, Berks.***

Bargain Buy

We see (Ad on inside back cover) that **BK Electronics** are "celebrating" being appointed main agent for Thandar Security equipment with probably one of the bargains of the year.

They are currently offering a discount of £100 on the Thandar "Minder" Home Protection System.

The Minder is a three unit microwave radar intruder alarm system capable of detecting a human target at 15 metres. The detector sensing is by the Doppler shift principle and uses a carrier frequency of 10·687GHz.

In addition, two or four wire pressure mats, door and window sensors can be connected to the control unit, as can independent panic buttons.

The claimed *usual* selling price for the Thandar "Minder" Home Protection System is £228.85, but BK Electronics are offering it at £128 plus £5 post and packing.

Combination Lock

It appears that some readers are having difficulty in locating a source for the electro-mechanical lock release mechanism for the *Push Button Combination Lock* featured in June '83.

We have been informed that the original supplier, Altype Security, have now ceased trading. However, a similar device for use with the latch type locks is carried by **TK Electronics.**

The mechanism appears to be suitable for this project, although we have not tried it in the model, and can be used in place of the one specified. The Electric Lock Mechanism cost £16.28 inclusive of VAT and p&p.

CONSTRUCTIONAL PROJECTS

Home Systems Monitor

A suitable reed relay for the *Home Systems Monitor* is stocked by Maplin Electronic Supplies. This is a 6V to 9V type with a coil resistance of 700 ohm and a package or body colour green. The order stock number is: FX50E (Reed Relay 6 to 9V).

Resistors R17 (7W) and R19 (2W) will have to be wirewound types. These are stocked by Cricklewood, TK Electronics, Rapid and Magenta Electronics.

The mains transformer for the prototype model uses a 18V 1A secondary. It is quite possible to use the more common transformer with two 9V secondary windings wired in series.

Mains Power Controller

The capacitor C2 used in the *1kW Mains Power Controller* must be rated for ***continuous*** mains operation. These are stocked by Maplin under their mixed dielectric range.

The mains outlet socket is a Euro style type also stocked by the above company. This is listed as a "Euro Facility Outlet", order code HL42V.

The BTY-79-400R thyristors (RS code 261-255), mounting kit—suitable for both thyristors—(RS 261-283) and the pulse transformer (RS 196-375) are stocked by RS Components. They will not supply to the general public but must be ordered through a local recognised stockist.

Car Intruder Alarm

The ORP61 used in the *Car Intruder Alarm* appears to be only available from Europa Electronics, Dept EE, 160 High Road, Willesden Green, London NW10.

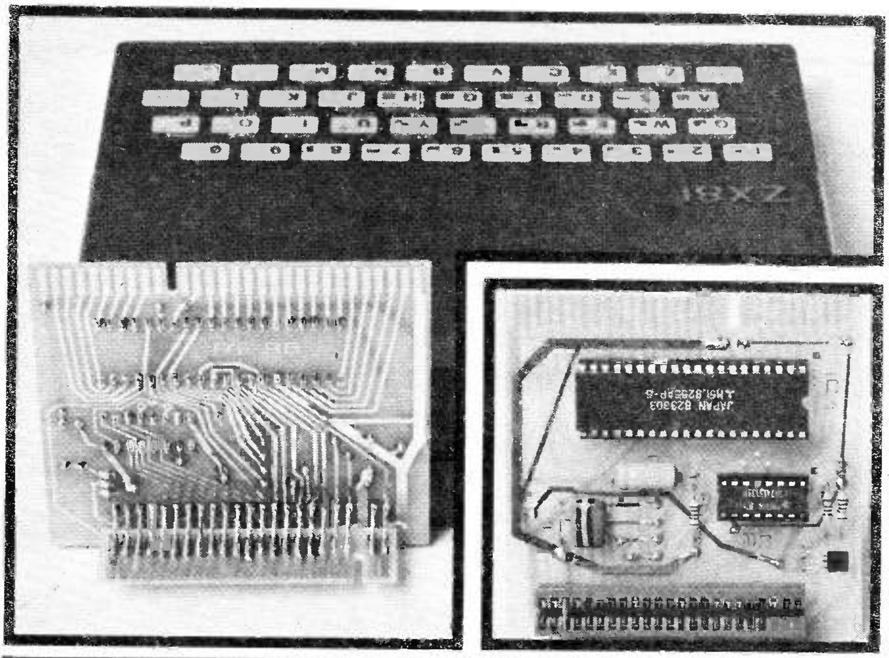
We do not expect any component purchasing problems for the *High Power Interface* and *Pedestrian Crossing Simulation* boards (see *Microcomputer Interfacing Techniques*), *Electronic Die* and the *Storage 'Scope Interface* projects.

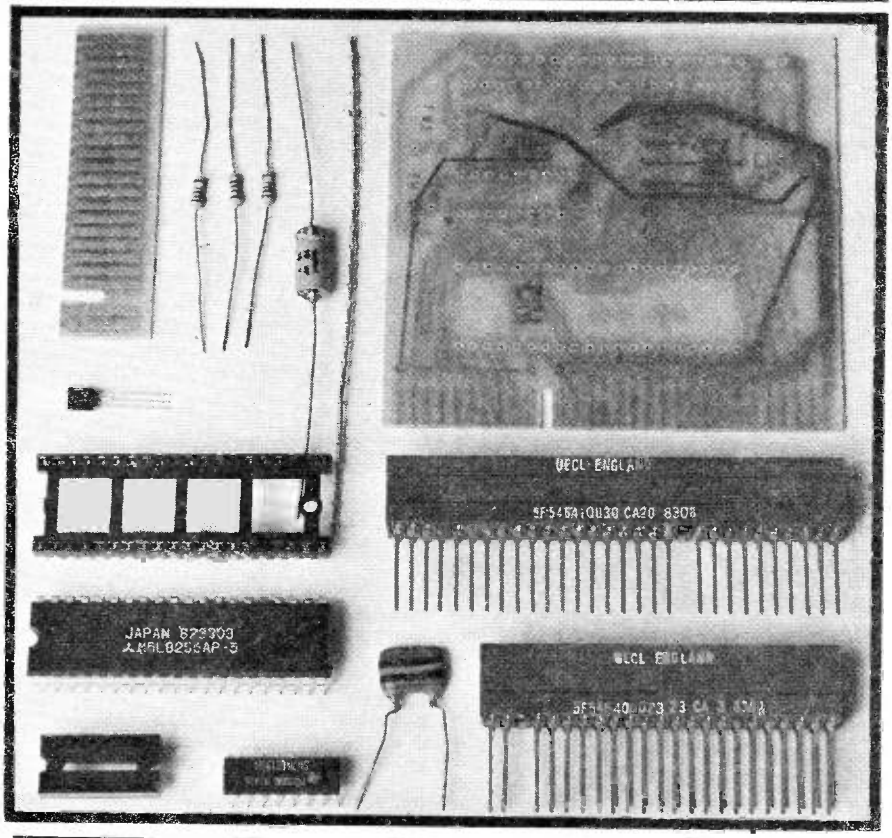
EE PRINTED CIRCUIT BOARD SERVICE

Printed circuit boards for certain EE constructional projects are now available from the EE PCB Service. These are fabricated in fibre-glass, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Remittances should be sent to: EE PCB Service, Everyday Electronics Editorial Offices, King's Reach Tower, Stamford Street, London SE1 9LS. Cheques should be crossed and made payable to IPC Magazines Ltd.

Readers are advised to check with prices appearing in current issue before ordering.

PROJECT TITLE	Order Code	Cost
Eprom Programmer (TRS-80)	8306-01	£6.95
Eprom Programmer (Genie)	8306-02	£6.95
Eprom Programmer (TRS-80 & Genie)	8306-03	£1.50
Storage 'Scope Interface (BBC Micro)	8308–01	£2.80
Car Intruder Alarm	8308–02	£4.49
Electronic Die	8308–05	£3.12
Microcomputer Interfacing Techniques		
User Port Input/Output	8307-01	£4.21
User Port Control	8307-02	£4.51
High Power Interface	8308–03	£3.99
Pedestrian Crossing Simulation	8308–04	£4.43





Many computers have on-board a user port which provides the machine with an easy means of "communicating" with the outside world, to measure, monitor and control "real" events. This is not the case with the basic ZX81—well, not until you add-on the RE98 from Redditch Electronics.

The RE98 is one of the products available from this Company for the ZX81. It is an input/output (I/O) port board which plugs into the expansion slot of the ZX81 to produce 24 lines that may be configured in several combinations to function as input lines and/or output lines.

KIT OF PARTS

This device is available in kit form (and ready built) and is complete. The package consists of a drilled and tinned double-sided p.c.b., 23 + 23-way edge connector, all board components including track pins, i.c. sockets, and a second finger p.c.b. to allow Rampacks to be attached. Also seen in the photographs is a 30-way single-sided edge connector to plug onto the top of main p.c.b. finger set which then allows the I/O lines to be accessed along with +5V, 0V and ROM $\overline{CS}$. This is the RE78B Connector available separately. It is possible to solder directly to the upper single-sided finger set, but the socket arrangement makes for a more versatile system.

The instruction and user's guide literature is brief but adequate. We found no problems in building the unit and it worked at the first time of asking. The majority of the assembly was straightforward and this could be tackled, it is estimated, even by those with limited knowledge of electronic component assembly and soldering.

The tricky part was fitting the finger-p.c.b. to the protruding leads of the 23 + 23-way connector. We used double-sided adhesive to hold the finger set close to the

(Top left). Assembled unit viewed from the rear when plugged into the ZX81 expansion slot.
(Top right). Face on view of the completed Input/Output board.
(Left). The complete set of electronic components in the kit including also the RE78B, 30-way single-sided card edge connector.

SPECIAL REPORT

IN/OUT PORT B

lead-out wires, soldered a few spot connections, then removed the tape to allow the rest to be soldered. The other line of lead-outs need to be formed to meet the p.c.b. contacts on the other side. A third hand would have been useful here to hold the pin in contact with the board whilst soldering it. A small screwdriver was used for this purpose after the lead had been formed.

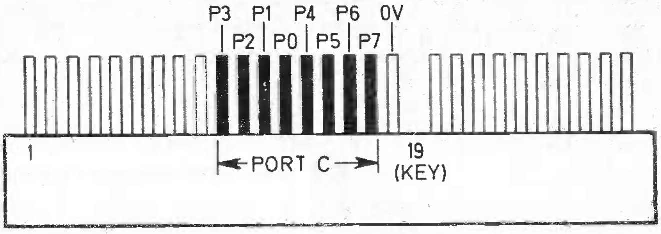


Fig. 1. Labelling of Port C on the RE78B connector.

USES 8255 PROGRAMMABLE INTERFACE

The heart of the unit is the 8255 a MOS i.c. known as a programmable peripheral interface. This has three 8-bit wide ports called Port A, Port B and Port C. These three ports may be set independently to be inputs or outputs in any combination. In addition, Port C may be split into two groups, the four most significant bits and the four least significant bits; one half may be outputs, with the other as inputs. This provides a total of 16 combinations of inputs and outputs to suit many applications.

MEMORY MAPPED PORTS

The ports A, B, and C are memory mapped into the ZX81, residing at 40960, 40961 and 40962, respectively. A further location at 40963 is the control port (register) which is used to set up the required I/O format of the 8255. It is a simple matter therefore using BASIC to set the required format by POKEing into 40963.

Information to be sent out or read by the ports is thus implemented by use of POKE and PEEK commands. Reading, writing and setting examples are provided in the literature accompanying the kit of parts.

SHIFTING ADDRESS OF PORTS

Address decoding to position the 8255 in the memory is accomplished using A12/A13 and A14/A15 into a 74LS139 2-to-4 line decoder. If 40960 to 40963 is required for other equipment then the port may be repositioned between 8192 and 8195 by simply making a wire link change and a track cut on the board.

This area in the ZX81 between end of ROM and start of RAM is not used by the system. The required "deselection" of ROM $\overline{CS}$ when addressing this area is provided by circuitry on board the RE98. It should be pointed out that certain add-on Rampacks for the ZX81 will not allow this modification.

SOFTWARE

Sufficient exercise software is provided to check-out the operation of the I/O Port System.

One example sets up Port A as outputs and sets them oscillating to produce a square-wave pulse train at 190Hz when run in FAST mode. This is the fastest that the port can operate when driven from BASIC. A second example illustrates how the port may be set up to produce square-wave pulse trains, each output line frequency being half the preceding one working down from PA7 to PA0. This leads to an application idea for one's ZX81 to employ it as a multi-channel programmable square-wave and pulse generator.

The third example illustrates how, when Port A is set to input mode, the 8-bits of information at the input may be displayed on the screen.

OUTPUT DRIVE

The 8255 has only a limited current drive capability being able to sink/source 16mA. This is sufficient for driving TTL and CMOS devices, l.e.d.s and some 7-segment displays, for example, but for driving filament lamps, power relays, suitable interfaces must be employed. Circuit ideas for output stages are contained in the literature, as are ideas for inputs.

ZX81 owners who may wish to "practically" follow our *Microcomputer Interfacing Techniques* series (Part 2 this month, see page 490) should be able to carry out many of the experiments in this series when equipped with a memory mapped Port system such as the RE98. The necessary software will of course have to be developed by the individual. It is thought that Port C is the best choice of port to use if adapting to follow the series as this may have mixed inputs and outputs.

Port C is located on pins 10 to 17 of the RE78B connector as shown in Fig. 1.

The kit of parts for the RE98 Input/Output Port Board costs £16.95 (£18.95 ready built) including VAT and p&p and may be obtained from Redditch Electronics, 21 Ferney Hill Avenue, Redditch, Worcester B97 4RU. The RE78B costs an additional £3.40 inclusive.

KIT OF PARTS

Resistors
4·7kΩ *(1 off)* 100kΩ *(1 off)*
15kΩ *(1 off)*

Capacitors
0·1μF *(1 off)* 10μF *(1 off)*

Semiconductors
BC2121 *(1 off)* 74LS139 *(1 off)*
8255 *(1 off)*

Miscellaneous
Main p.c.b. double-sided (RE98); double-sided finger set p.c.b. (RE88); track pins *(17 off)*; 23 + 23-way edge connector (RE80); 40-pin d.i.l. socket; 16-pin d.i.l. socket; assembly and testing instructions.

OARD for ZX81

BY B.W.TERRELL B.Sc.

MICROCOMPUTER INTERFACING TECHNIQUES

INCLUDING MANY USEFUL CONSTRUCTIONAL PROJECTS

PART TWO: EXPERIMENTS WITH THE USER PORT CONTROL BOARD

BY J. ADAMS B.Sc, M.Sc. & G. M. FEATHER B.Sc.

THIS month we shall be discussing uses for the User Port Control board with application ideas and linking this board to the next two projects in this series, a High Power Interface and a Pedestrian Crossing Simulation board.

INPUT

(1) Reed switch applications

Reed switches are magnetically operated switches and are normally arranged to be closed by the proximity of a small permanent magnet. Such switches may be connected to the inputs of the I/O Control board in conjunction with a suitable TTL level supply (a 4·5 volt battery is adequate). Lines P0 to P3 (set up as input) can be used to look for closure of the reed switches. There are many possible applications here, particularly in the field of automatic control and security systems.

An arrangement sometimes used by the authors provides one method for determining the acceleration of a dynamics trolley, used frequently in physics experiments.

Three reed switches are employed and the trolley is provided with a bar magnet which is affixed to its underside. The reed switches are set into recesses in the wooden runway upon which the trolley runs; they are set in a straight line with 50cm between them. See Fig. 2.1.

Another application allows the speed of a rotating disc or shaft to be measured. A small bar magnet is affixed to the disc and a reed switch placed adjacent to the disc, as shown in Fig. 2.2. Switch closures, due to the passage of the magnet once per revolution, are detected on one of the lines configured for input and the time between successive closures is measured allowing the speed of rotation to be determined.

Readers should note that this arrangement is only suitable for the determination of fairly slow shaft speeds, the operating time of the switch providing a limitation here.

When mechanical switches of any type are used as input devices, spurious signals can arise due to "switch bounce" effects. When a switch closes (or opens) several pulses are often generated before the current settles at its final on or off value. This is illustrated in Fig. 2.3.

Whilst the spurious pulses are of very short duration, TTL logic circuitry is very fast in its operation and will register their presence.

If difficulties are experienced with switch bounce a 4·7µF electrolytic capacitor conneced between 0V and the input line being used will often help.

The authors of this series hold senior lecturer positions at Tettenhall College, Wolverhampton:
J. Adams, B.Sc. M.Sc., Head of Science and Microelectronics
G. M. Feather, B.Sc., Head of Computer Resources

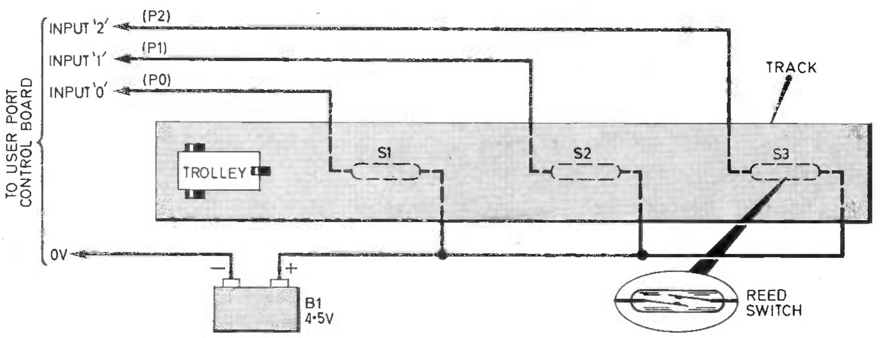


Fig. 2.1. Acceleration measurement set-up using the User Port Control board. A magnet is fitted to trolley underside.

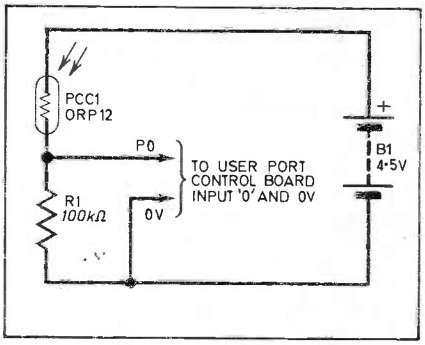


Fig. 2.4. Optical level detector circuit using a light dependent resistor, ORP12.

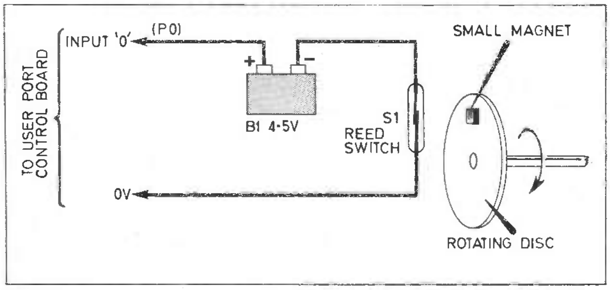


Fig. 2.2. Measurement technique for shaft/disc velocity.

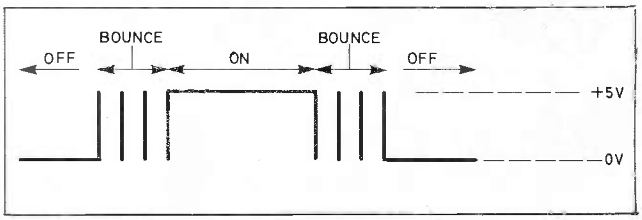


Fig. 2.3. Illustrating contact bounce.

(2) Opto-switching applications

Two basic opto devices have been used by the authors, the light dependent resistor (l.d.r.) and the phototransistor. Suitable types for the applications following are the ORP12 and MEL12, respectively.

The l.d.r. behaves as a resistor whose value changes from approximately 1MΩ when dark to about 100Ω when fully illuminated; it is convenient to arrange it in a potential divider circuit as shown in Fig. 2.4.

When dark, the p.d. across the 100kΩ resistor will be at a value corresponding to a TTL logic 0, but illumination of the l.e.d. will take this p.d. up to a TTL logic 1 level.

The response time (that is, the time taken for the l.d.r.'s resistance to change after a change in the level of illumination) is rather slow for these devices and this renders them not very useful for timing applications.

They can, however, be used to provide input signals to P0–P3 (or the edge-sensitive handshake line) when the level of illumination changes and this, once again, provides for applications in the field of security and control systems.

A suggested layout on stripboard of the components in the circuit of Fig. 2.4 is given in Fig. 2.5. This is referred to later as the "ORP12 Unit".

The MEL12 is a small, silicon *npn* phototransistor which is turned "on" when illuminated. The circuit used with the MEL12 is shown in Fig. 2.6.

When dark the phototransistor is "off" and no current flows so there is no p.d. and the input to P0 is a logic 0. On illuminating the device, current flows and a p.d. corresponding to logic 1 appears at the P0 input.

Unlike the l.d.r., the response time of the phototransistor is very rapid indeed and it is possible to detect and time short duration light pulses.

As with the l.d.r. opto-sensors, phototransistor switches may be used in conjunction with the User Port Control board to select, initiate and stop programs controlling devices on the output side of the board.

A useful trolley velocity/acceleration meter can be realised with a phototransistor attached to the User Port Control board together with the internal clock available on the BBC and Commodore machines. A card attached to the top of the trolley will interrupt the light beam received by the phototransistor for a period of time depending on the average velocity of the trolley. If a double card is used, as shown in Fig. 2.7, then three time intervals t_1, t_2 and t_3 (Fig. 2.8) can be measured and the acceleration of the trolley computed using the formula:

$$a = L(t_1 - t_3)/(50 \times t_1 \times t_3(t_1 + 2 \times t_2 + t_3))$$

where L is measured in cm.

It should be noted that the BBC Microcomputer increments the value of the pseudo-variable TIME every 10 milliseconds and thus counts in 1/100 second intervals whereas Commodore machines keep track of time in 1/60 second intervals stored as the variable TI.

Although the internal clocks are adequate for many purposes more sophisticated timing techniques are often required for more accurate work. In these cases it must be remembered that the overall accuracy is limited by the switching action of the phototransistor.

(3) Other switching possibilities

Many possibilities exist for providing signals to the inputs of the User Port Control board and some of these can be activated by some physical stimulus such as temperature, humidity, and so on.

A thermistor offers a simple temperature sensitive input and the arrangement shown in Fig. 2.9 can be used with the User Port Control board. VR1 provides a means of adjusting the temperature at which the P0 assumes a TTL logic 1 level.

A superior temperature sensing system can be realised by using the very versatile LM334 temperature sensor. This device is contained in a T0-92 package and resembles a small plastic cased transistor.

In the circuit shown in Fig. 2.10, the voltage across R2 will increase at a rate of 10mV K^{-1} temperature rise. This voltage is applied to one input of a LM339 analogue comparator. This device includes, in fact, four identical comparators in a 14-pin d.i.l. package, see pin-out diagram in Fig. 2.10.

The device compares the voltage present at its two inputs and, if the +ve input is larger, the output goes open circuit and, in this circuit, is pulled up to logic 1 by R3. If the −ve input is the larger, the output goes to 0V (logic 0). The comparison is very accurate, only a few microvolts difference between the two inputs being

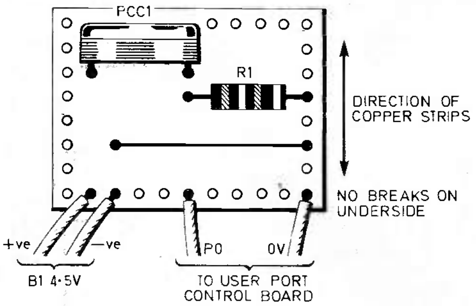


Fig. 2.5. A suggested layout on stripboard for the circuit of Fig. 2.4 the "ORP12 Unit".

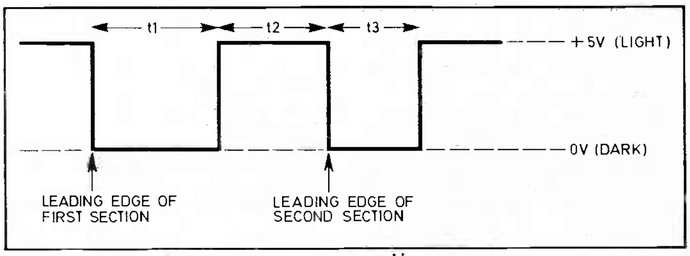


Fig. 2.8. Acceleration measurement phototransistor output.

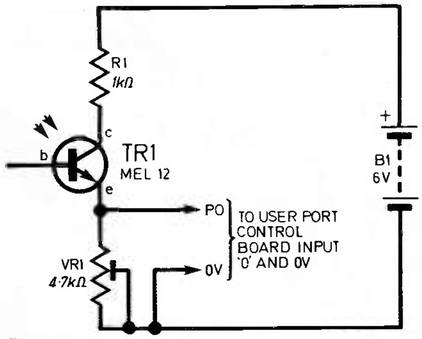


Fig. 2.6. Optical sensing using a phototransistor.

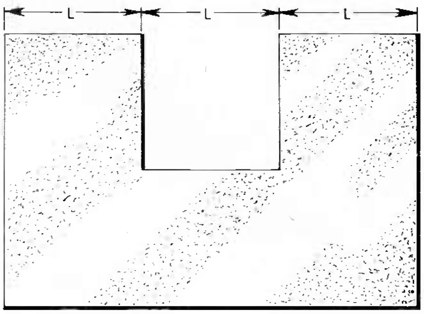


Fig. 2.7. Double card for acceleration measurement. "L" is not critical, but for a trolley is typically 8cm.

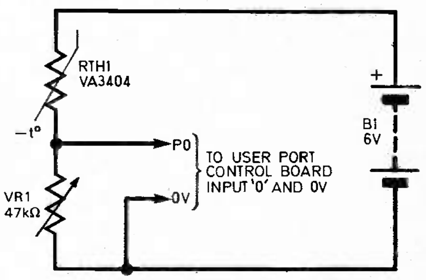
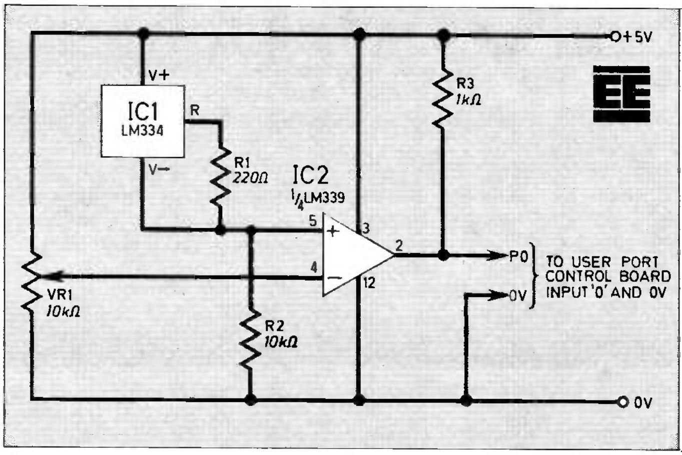


Fig. 2.9. Temperature sensing with a thermistor.



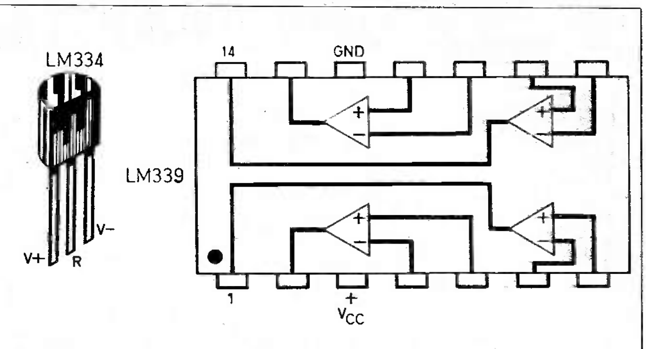


Fig. 2.10. Temperature level sensing using the LM334 i.c. showing lead-out connections for this device and IC2.

necessary to cause the output to change its state. Switching time is very rapid, typically less than 1μs.

The other input to the LM339, that is, the voltage with which the temperature sensor output voltages is compared, is derived from VR1 and may be varied between 0 and +5V thus enabling the temperature at which the output triggers to be varied.

Calibration can be achieved by setting the LM334 at the temperature level to be detected and then measuring the voltage across R2. VR1 can now be adjusted until the voltage at pin 4 on the LM339 is equal to this voltage.

The LM334 is a current source and thus the resistance and hence length of the leads connecting it to the comparator are not important. R1 can be soldered directly to the leads of the device and a simple twin lead used to connect it to the comparator circuitry.

Thermistors and l.d.r.s can be used with the LM339 comparator device to provide accurate and sensitive level detection circuits.

HANDLING INPUT SIGNALS

It is likely that the result obtained by testing the status of input signal lines will allow a software branching condition to be met. It is for this reason that both branch on condition commands and logical operators are employed when testing whether individual signal lines are high or low.

In the previous article, tables were constructed to represent the behaviour of the two logical operators AND and OR. Such truth tables contain rows completely specifying each possible combination of input states and the resulting outputs.

When the OR operator was introduced it was emphasised that an output of 1 was obtained if either input was a 1 or if both were at 1. An alternative operator that will give an output of 1 when either input is 1 but excluding the case when both inputs are 1 is termed the EXCLUSIVE-OR operator (EOR). This is summarised in the truth table, Table 2.1.

It should be noted that these programs contain the BBC byte indirection facility (?) provided to alter or inspect the con-

PROGRAM 1

```
1Ø REM TEST FOR BIT 3 CLEAR
   (BBC)
2Ø ?65122=24Ø
3Ø IF(?6512ØEOR8)AND8THEN
   4ØELSE3Ø
4Ø PRINT"BIT 3 CLEAR"
5Ø END
```

PROGRAM 2

```
1Ø REM TEST FOR BIT 3 SET (BBC)
2Ø ?65122=24Ø
3Ø IF(?6512ØEORØ)AND8THEN
   4ØELSE3Ø
4Ø PRINT "BIT 3 SET"
5Ø END
```

tents of particular I/O memory locations and will not work if a second processor is attached to the microcomputer. Readers who wish to use the OSBYTE routines provided for accessing I/O locations are referred to the BBC User Guide for further details.

Any logical operation will return a "bitwise" result where each bit of the result is determined by the corresponding bits in each argument. The result obtained from not only a single operation between operands but also a combination of such logical operations must of necessity be either zero or non-zero.

It is thus possible to test for a particular bit pattern by using one or more logical operators and checking whether the result is "true" (if a non-zero result is obtained) or "false" (if a zero result is obtained).

If the logical operator EOR is used in conjunction with the AND operator in a program, then bits in a specific location can be monitored until they change in a

Table 2.1

INPUTS		OUTPUT
A	B	
Ø	Ø	Ø
Ø	1	1
1	Ø	1
1	1	Ø

pre-determined way. This is illustrated with the two specific examples (programs) using the BBC Model B microcomputer, see left.

PROGRAM 1

Line 20: sets up the data direction register for mixed input/output. Each bits of this register controls the function of a single line at the User Port, the least significant bit controls P0, and the most significant bit P7. As bits 4 to 7 are set and bits 0 to 3 are clear, the lines P4–P7 are configured as outputs whereas lines P0–P3 will act as inputs.

Line 30: takes the contents of the I/O register, which reflects the state of the lines at the User Port, and performs an EXCLUSIVE-OR operation with the operand after the BASIC keyword EOR. The brackets ensure that the expression enclosed is evaluated before the logical AND operation. This is because logical operators have a strict hierarchy and in the absence of brackets the AND operation would have a higher order of precedence than EOR.

The result of the first logical operation is obtained by complementing or "flipping" those bits in the I/O register which correspond with bits set in the argument following the EOR operator. The second logical operation uses a mask to "filter out" those bits which are not to be tested.

This combination of logical operations will therefore yield a non-zero or "true" result only if the bit tested is clear. If the bit tested is set then a "false" result will be obtained.

PROGRAM 2

Similar reasoning applies when testing for a set bit. The EOR operation is optional in this case as no complementing is required. A non-zero or "true" result will only be obtained if the bit tested is set.

In Commodore BASIC, a WAIT statement takes the value in a particular memory location and performs the two logical operations EOR and AND successively. If the result is zero (false), the memory location is tested again until the result is non-zero (true) when execution continues with the next statement.

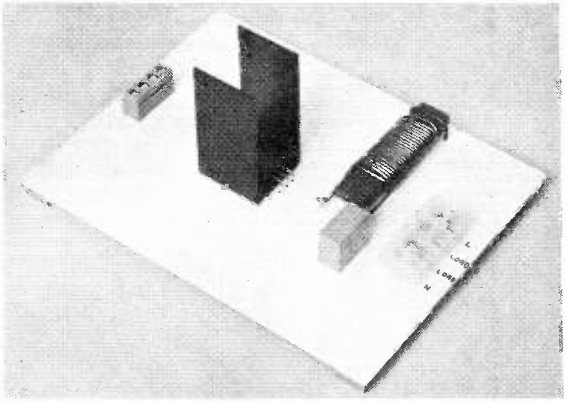
Program 1 (for BBC) rewritten for the VIC-20, PET and Commodore 64 is shown right:

Line 30: the contents of the I/O register are first EXCLUSIVE-ORed with the THIRD number (if present) and then logically ANDed with the SECOND number.

When testing for a set bit then the format is WAIT A,8,Ø where A is the decimal address of the I/O register. The zero corresponding to the argument for the EOR operation is again optional.

Line	VIC-20	PET	Commodore 64
1Ø	< — — — — — — — REM TEST FOR BIT 3 CLEAR — — — — — — — >		
2Ø	POKE37138,24Ø	POKE59459,24Ø	POKE56579,24Ø
3Ø	WAIT37136,8,8	WAIT59457,8,8	WAIT56577,8,8
4Ø	< — — — — — — — — — PRINT "BIT 3 CLEAR" — — — — — — — — — >		
5Ø	< — — — — — — — — — — — — — END — — — — — — — — — — — — — >		

HIGH POWER INTERFACE BOARD CONSTRUCTION



OUTPUT

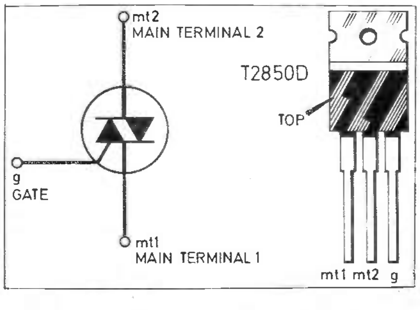
(1) Handling high power devices with the User Port Control board

As mentioned in the previous article, the output relays on the Control board can only handle contact currents of up to about 0·5A and whilst this is adequate for switching model motors, small lamps, and so on, the control of higher power devices, particularly mains driven equipment requires the addition of switching devices capable of handling higher currents associated with such devices.

It is possible, of course, to use the output relays to switch larger relays but such devices are not cheap and contact bounce on closure and opening of their contacts can cause problems of arcing and radio frequency interference.

A much more elegant solution is provided by the use of triacs to turn on and off the large currents in the loads.

Fig. 2.11. Triac symbol and pin-out for the T2850D used in the High Power Interface described below.



A full description of the characteristics and operation of triac devices is beyond the scope of this series and only a brief description is given; much literature is available on these devices and this can be consulted by interested readers.

(2) Using triacs with the Control board

The triac may be considered as being a device which can allow or block the flow of current in either direction through itself, the flow of current being initiated by a small signal to its gate electrode.

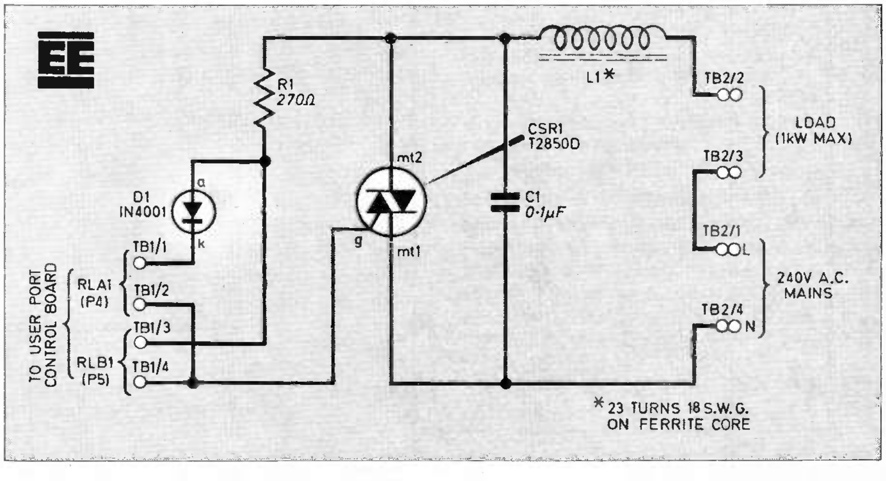
Main terminals mt1 and mt2 in Fig. 2.11 handle the current required by the high power device whilst the trigger signal is applied between the gate (g) and mt2.

Fig. 2.12 shows a simple a.c. power control circuit which is connected to the User Port Control board, and is capable of switching loads of up to 1kW to full power, half power or off.

On closure of the P5 relay, full-wave trigger cycles are applied to the triac gate which allows full power to flow in the load. Closure of P4 causes triggering of the triac on alternate half-cycles of the mains voltage and thus only half power flows in the load.

Triacs can cause considerable radio frequency interference (r.f.i.) which can, on occasions, interfere with the microcomputer. L1 and C1 provide a measure of r.f.i. suppression.

Fig. 2.12. Circuit diagram for the High Power Interface for triac controlled a.c. power.



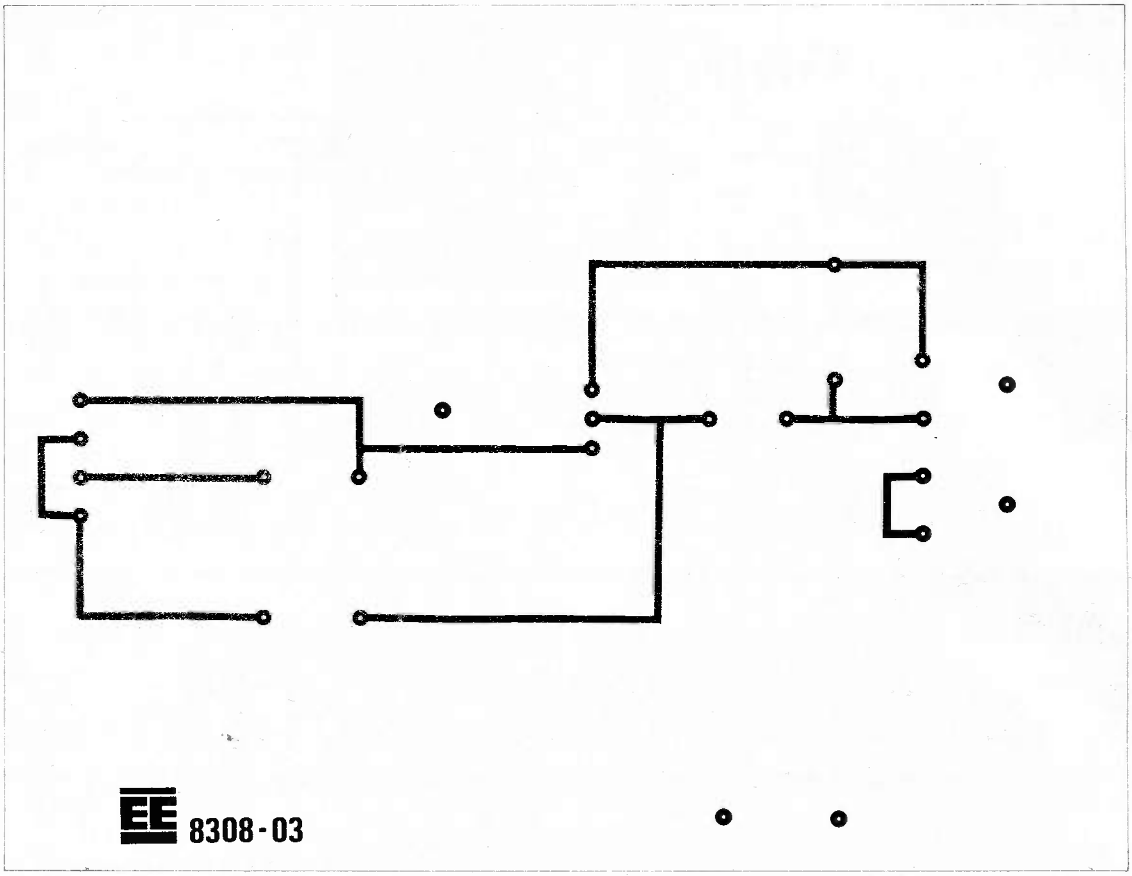


Fig. 2.13. Full-size master pattern for the High Power Interface board. (This board is available from the *EE PCB Service*, Order code 8308–03.)

COMPONENTS

Resistor
R1 270Ω ½W carbon ±5%

Capacitor
C1 0·1μF 300V a.c. polycarbonate

Semiconductors
D1 1N4001 or similar silicon diode
CSR1 T2850D 8A 400V triac

Miscellaneous
L1 23 turns 18 s.w.g. enamelled copper wire on 55 × 13 × 5mm ferrite core
TB1 4-way p.c.b. mounting screw terminal block
TB2 4-way screw terminal block

Printed circuit board: single-sided size 148 × 114mm, *EE PCB Service*, Order code 8308-03; 6BA nuts, screws and washers (3 sets); self-adhesive rubber feet (4 off); heatsink, plastic power, 10·5°C/W or greater thermal capacity; single-sided Veropins (2 off).

COMPONENTS approximate cost £7.00 complete

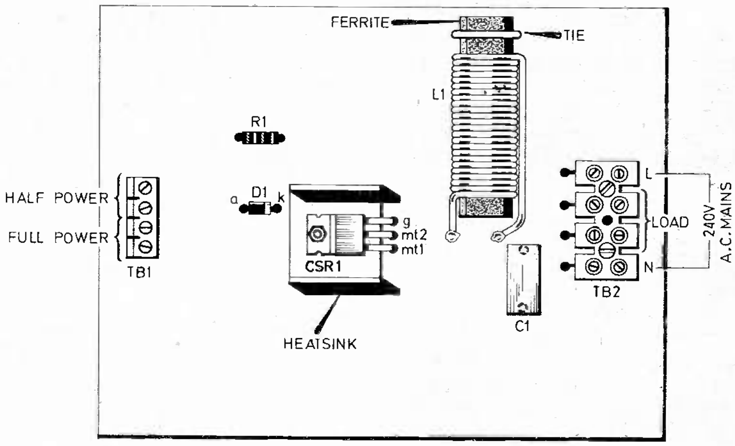


Fig. 2.14. Layout of the components on the topside of High Power Interface p.c.b. Note that C1 must be rated at 300V a.c. or greater. The ferrite may be a 10mm diameter type.

RANDOM DISCO LIGHTING

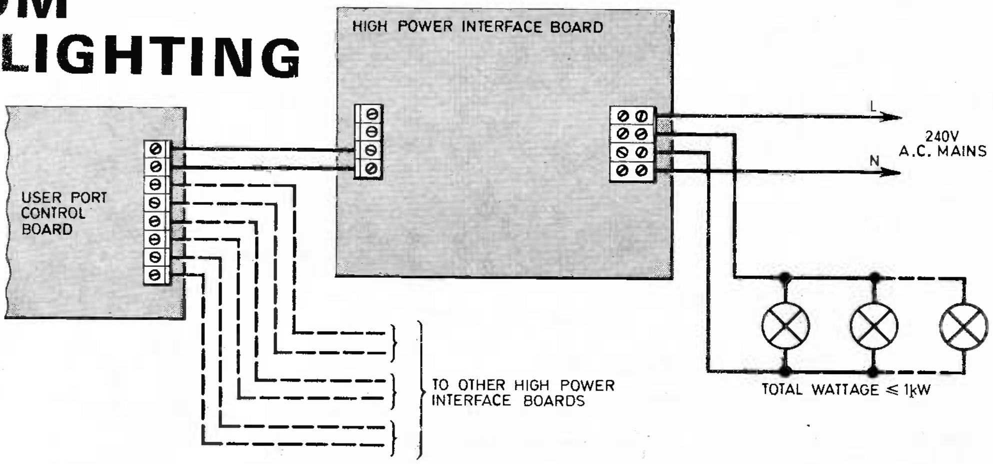


Fig. 2.15. Interwiring details for connecting the User Port Control board to 1–4 High Power Interface boards.

PRINTED CIRCUIT BOARD

The components forming the circuit of Fig. 2.12 are assembled on a printed circuit board, the full-size master of which is shown in Fig. 2.13. The black areas represent the copper tracks to remain after etching. This board is available from the *EE PCB Service*, Order code 8308-03.

The layout of the components on the topside of the p.c.b. are shown in Fig. 2.14. TB1 solders directly to the board whereas TB2 is held secure using two short 6BA screws and nuts.

L1 is a home-made coil which was constructed by winding approximately 23 turns of 18 s.w.g. enamelled copper wire on a 55mm length of ferrite rod of 13 × 6mm rectangular cross section. This assembly is anchored to the p.c.b. by a wire tie at one end and Veropins at the other which form the connection points to the board for the coil extremes. Tinned copper wire connects one side of each TB2 position to the p.c.b.

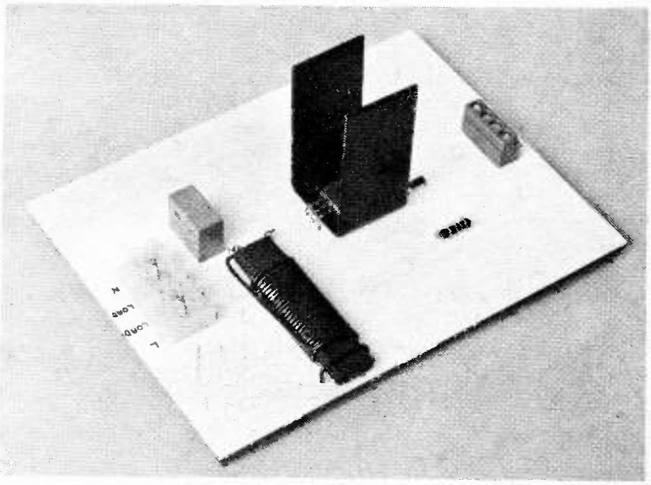
There is no need to use an insulating bush or mica washer when fitting the triac to the heatsink as the device tab is not internally connected. Screw the triac (with suitably formed leads) to the board such that the leads fit the allocated holes and the device and p.c.b. sandwich the heatsink. When secured solder the triac leads to the p.c.b.

The order of component assembly is unimportant. Check that the diode is correctly orientated before soldering. Self-adhesive rubber feet were fitted to the prototype board to keep the exposed soldered connections at a suitable distance from the testing surface.

The High Power Interface board may be connected to the User Port Control board as shown in Fig. 2.15.

It should be noted that the use of this circuit with the User Port Control board introduces quite high voltages on to the board. The relays provide complete protection for its circuitry and that of the microcomputer, but readers are reminded of the need for precaution against electric shock when handling mains operated circuitry.

Four circuits of this type could be constructed on one board to give random control of many lamps in a disco lighting system, for example, by connecting them as shown in Fig. 2.15. Software for random switching of P4–P7 output relays is given below. □

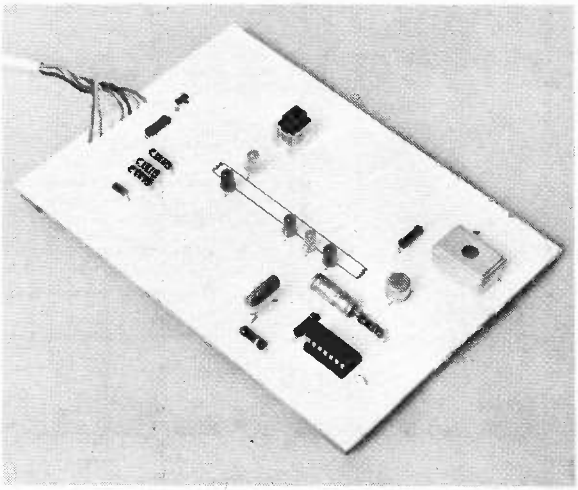


The prototype High Power Interface board.

Random Disco Lighting

Line	BBC	VIC-20	PET	Commodore 64
1Ø	<— REM RANDOM DISCO —>			
2Ø	?65122=24Ø	POKE37138,24Ø	POKE59459,24Ø	POKE56579,24Ø
3Ø	<— R=INT(RND(1)*15.999)*16 —>			
4Ø	?6512Ø=?6512ØORR	POKE37136,PEEK(37136)ORR	POKE59457,PEEK(56457)ORR	POKE56577,PEEK(56577)ORR

PEDESTRIAN CROSSING SIMULATION BOARD CONSTRUCTION



MIXED INPUT/OUTPUT

The applications that have been discussed so far have been restricted to either input only or output only. There is, of course, no reason why mixed input and output signals should not be employed simultaneously using the User Port Control board.

Fig. 2.16 shows the circuit of an arrangement of a pedestrian crossing board which the authors have used to demonstrate microcomputer control.

Red, orange and green l.e.d.s simulate the actual lights and the sequence is initiated by closing S1, a push-to-close momentary action press switch. An audible bleeping tone is actuated at the same time as the green pedestrian light is turned on. This signal is generated by IC1 and its associated circuitry which comprises a low frequency oscillator producing a gating signal at about 2Hz which is used to turn on and off a high frequency oscillator producing the actual note. TR1 amplifies the output from IC1b and drives a miniature loudspeaker.

PRINTED CIRCUIT BOARD

All the components forming the circuitry of Fig. 2.16 are accommodated on a printed circuit board and mounted on

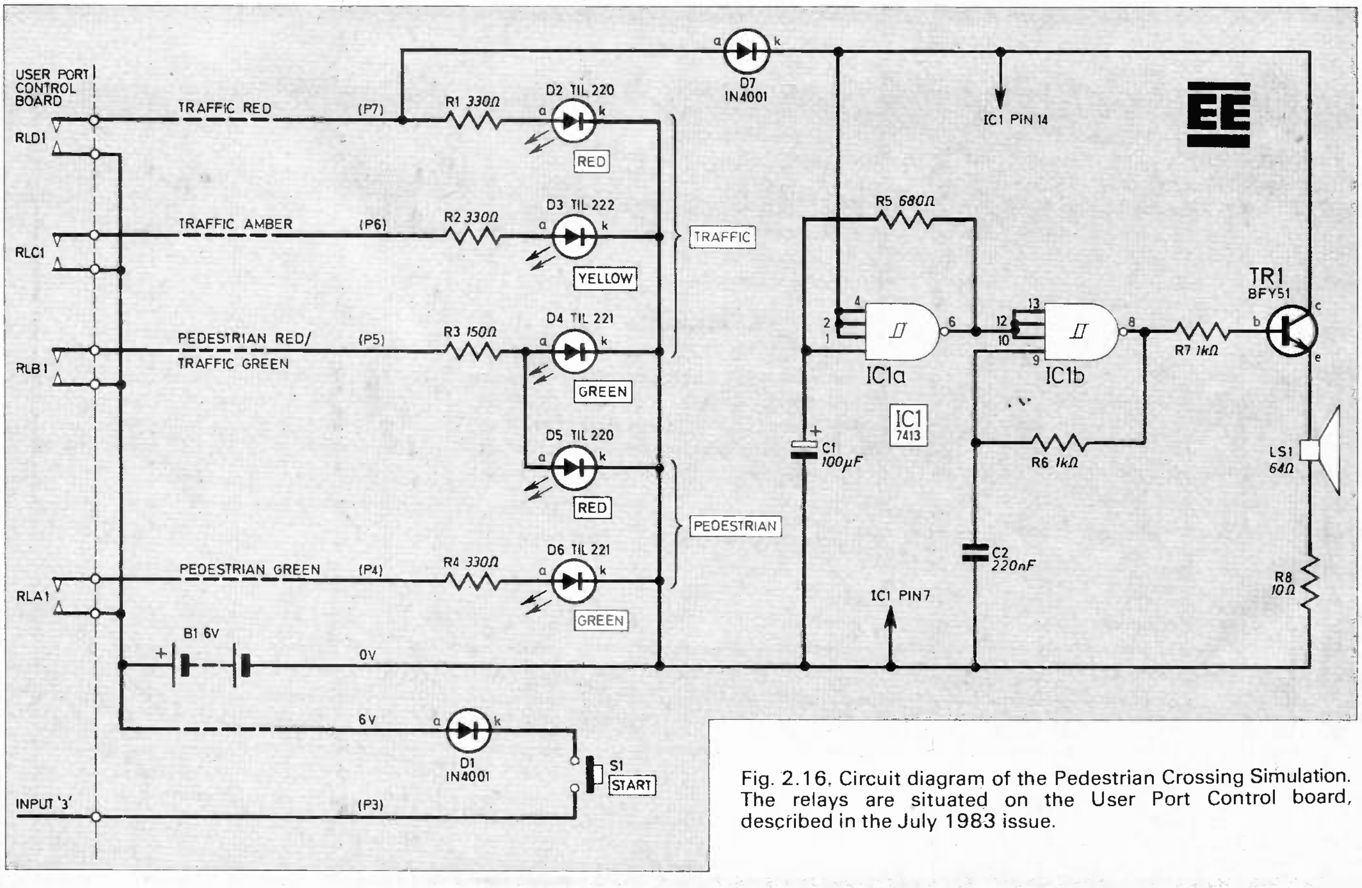


Fig. 2.16. Circuit diagram of the Pedestrian Crossing Simulation. The relays are situated on the User Port Control board, described in the July 1983 issue.

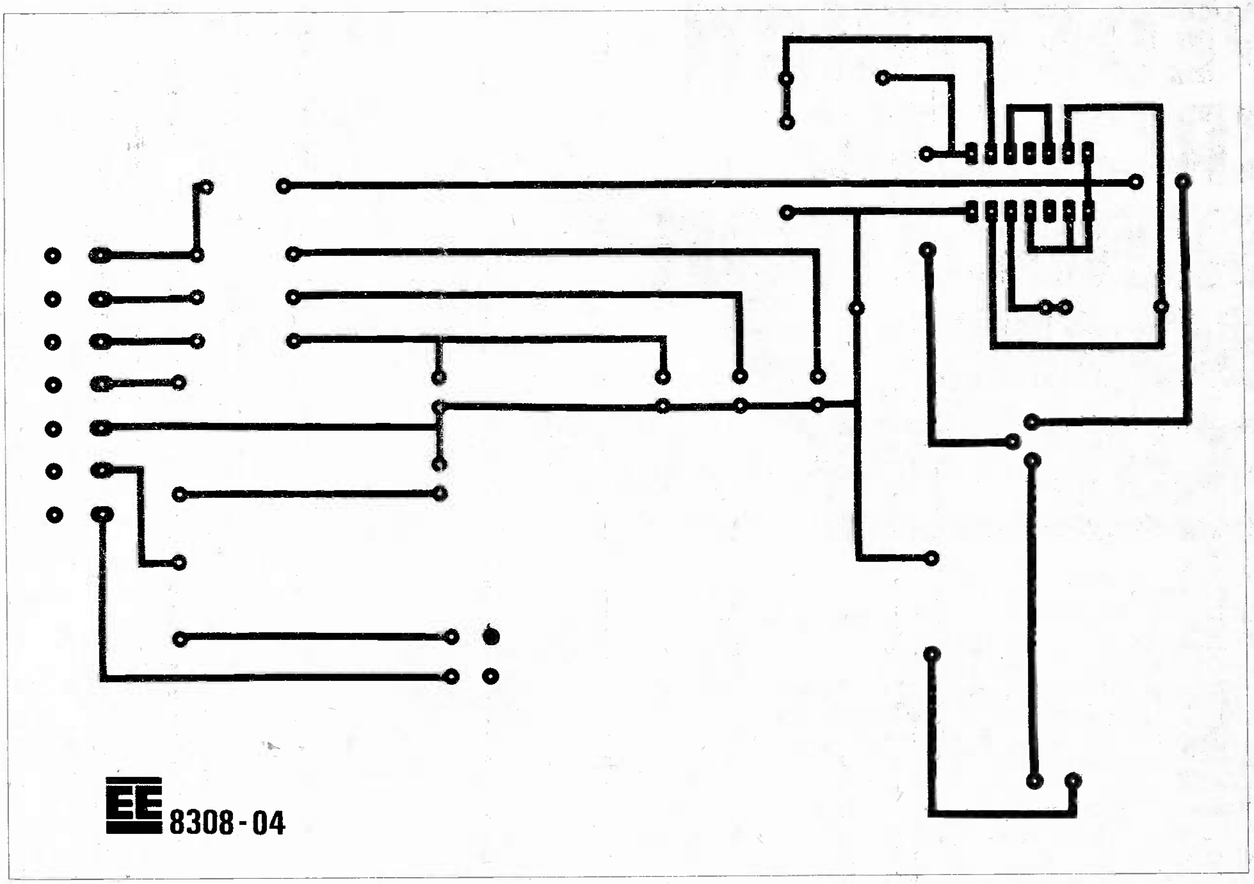


Fig. 2.18. The actual size master p.c.b. pattern to be etched for the Pedestrian Crossing Simulation board. (This board is available from the *EE PCB Service* Order code 8306–04.)

COMPONENTS

Resistors

R1	330Ω	R5	680Ω
R2	330Ω	R6	1kΩ
R3	150Ω	R7	1kΩ
R4	330Ω	R8	10Ω

All $\frac{1}{4}$W carbon ±5%

Capacitors

C1 100μF 6V elect. axial leads
C2 220nF polyester C280

Semiconductors

D1 1N4001 or similar silicon diode
D2 TIL220 0·2in red l.e.d.
D3 TIL222 0·2in yellow l.e.d.
D4 TIL221 0·2in green l.e.d.
D5 TIL220 0·2in red l.e.d.
D6 TIL221 0·2in green l.e.d.
TR1 BFY51 silicon *npn*
IC1 7413 TTL dual 4-input Schmitt NAND

Miscellaneous

S1 push-to-make momentary action p.c.b.-type (RS 337–611)
LS1 miniature moving coil speaker having coil impedance equal or greater than 16 ohms

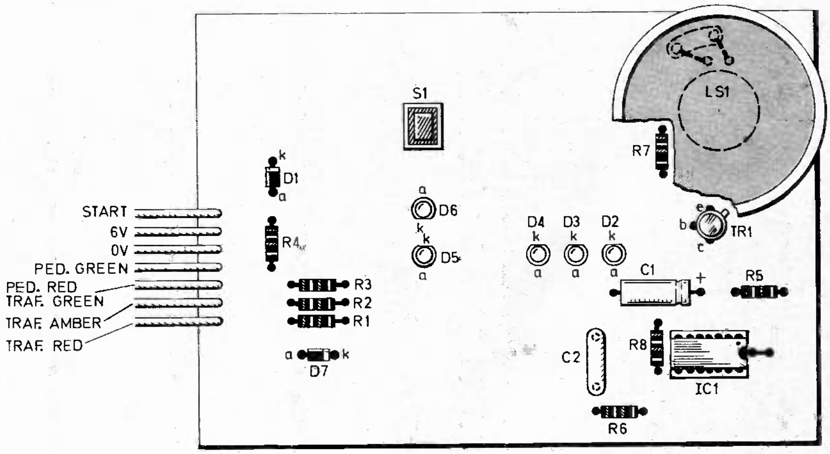


Fig. 2.17. Layout of the components on the topside of the Pedestrian Crossing Simulation board.

Printed circuit board: single-sided size 160 × 115mm *EE PCB Service,* Order code 8308-04; 14-pin d.i.l. socket; self-adhesive rubber feet (4 off); p.v.c. covered stranded wire, approx. 50cm of seven different insulation colours.

COMPONENTS approximate cost **£7.00** complete

Pedestrian Crossing

```
10 REM PEDESTRIAN CROSSING (BBC)
20 ?65122=240
30 ?65120=0
40 ?65120=?65120OR32
50 IF(?65120EOR0)AND8THEN60ELSE50
60 N=8:GOSUB1000
70 ?65120=?65120AND223OR64
80 N=3:GOSUB1000
90 ?65120=?65120AND191OR144
100N=8:GOSUB1000
110 ?65120=?65120AND127OR64
120 FORX=1TO10
130 N=0.5:GOSUB200
140 ?65120=?65120EOR80
150 NEXT X
160 GOTO 30
1000 T=TIME
1010 IF TIME-T<N*100THEN1010
1020 RETURN
```

the topside of the p.c.b. as detailed in Fig. 2.17. The master pattern (actual size) to be etched is given in Fig. 2.18 where the black areas represent the copper tracks to remain after etching. This board is available through the *EE PCB Service*, Order code 8308-04.

The order of component assembly is unimportant. IC1 should be mounted in a d.i.l. socket, but not inserted until construction is complete.

Ensure that the relevant components are correctly orientated. C1 is an electrolytic capacitor and must be connected in circuit the "right way round". There is an annular indentation at the positive lead end (+). The specified diodes have a silver band at the cathode end, while the l.e.d.s have a body flat alongside the cathode (k) terminal. TR1 must be correctly inserted. There is a body tag nearest to the emitter lead-out. There may be a circular indentation alongside pin 1 on IC1 or a larger indentation between pins 1 and 14. Ensure this device is correctly inserted.

The sound transducer seen fitted in the photographs was a piezo-electric type. This has been replaced in the layout diagram by a miniature loudspeaker which is in accordance with the original design. The speaker may be glued to the board with insulated wiring connecting its tags to the appropriate location holes in the p.c.b. The speaker may have an impedance of 15 ohms or greater. Fit self-adhesive rubber feet to each underside corner to hold the board clear of the standing surface.

The seven wires forming the input and output to the board were made using a variety of insulation colours of stranded

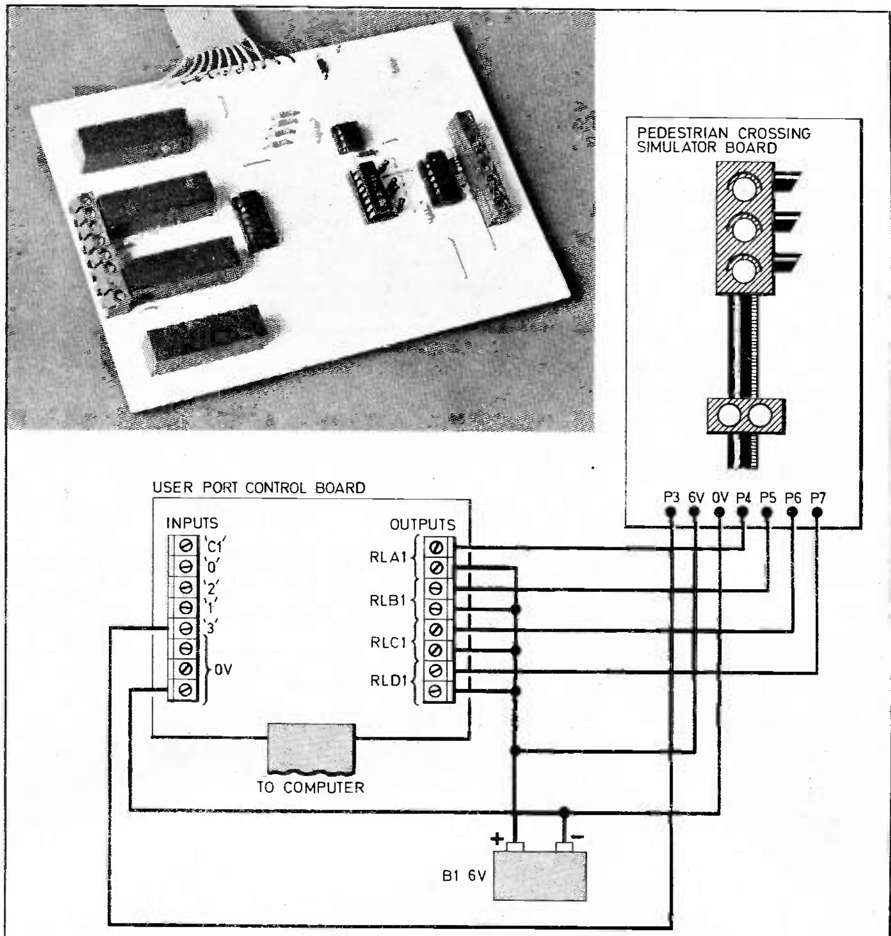
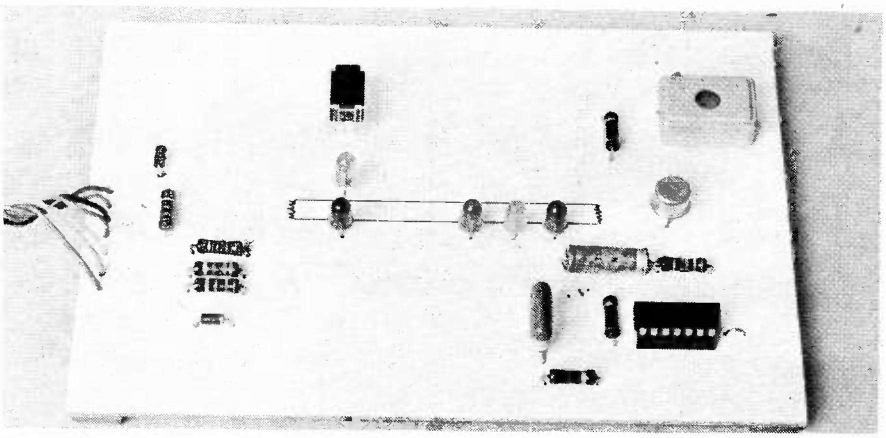


Fig. 2.19. Interwiring details for connecting the User Port Control board to the Pedestrian Crossing Simulation board.



wire (7/0·2mm), length as required. Tin the free ends of the wire so that they may be easily connected to the screw terminal blocks on the User Port Control board.

Interwiring details between the User Port Control board and the Pedestrian Crossing Simulation board are given in Fig. 2.19.

The program "Pedestrian Crossing" which controls the sequence uses the software techniques that have been discussed. BBC users may prefer to make the program more elegant by using procedures, REPEAT . . . UNTIL loops, hexadecimal notation, and so on. The program has been written in this form merely to facilitate rapid conversion to other BASIC dialects.

As an example of the use of mixed input/output in a very simple control system, Fig. 2.20 illustrates how two of the ORP opto-sensors discussed earlier, and the User Port Control board, can be used to cause a simple electric vehicle to reverse automatically on reaching either end of a track. □

Next month: Analogue-to-Digital Conversion.

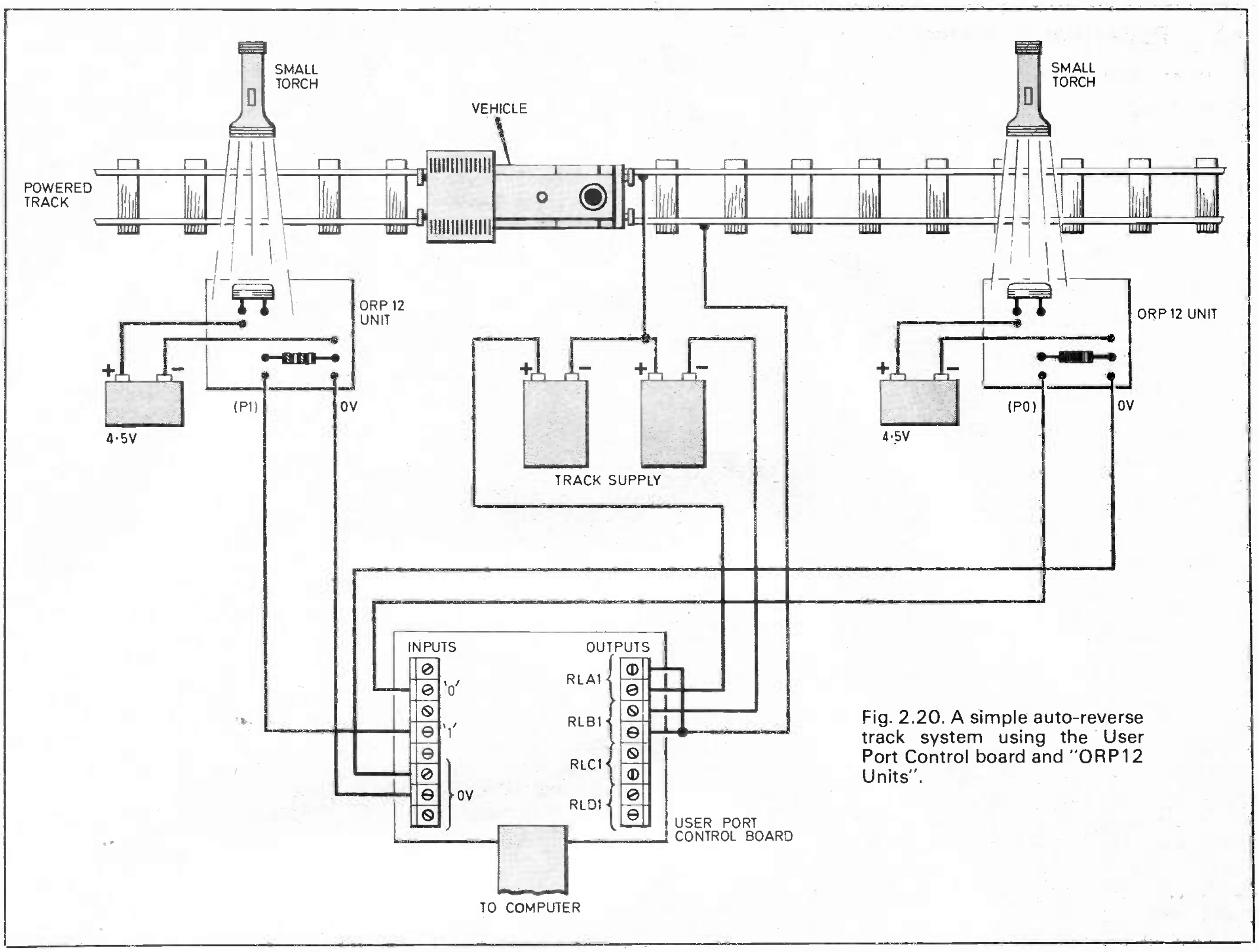


Fig. 2.20. A simple auto-reverse track system using the User Port Control board and "ORP12 Units".

EVERYDAY ELECTRONICS SOFTWARE SERVICE

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PROJECT TITLE	CASSETTE CODE	CASSETTE COST	LISTING CODE	LISTING COST
ZX81 SPEED COMPUTING SYSTEM (Feb 83)	T001	£2.95	L001	£2.95
REAL-TIME CLOCK (Apple) (May 83)	T002	£2.95	L002	£2.95
REAL-TIME CLOCK (BBC) (May 83)	T003	£2.95	L003	£2.95
EPROM PROGRAMMER (TRS-80 & GENIE) (June 83)*	T004	£3.95	N/A	—
STORAGE 'SCOPE INTERFACE (BBC) (Aug 83)	T005	£2.95	—	—

* Includes Command List with examples.

ELECTRONIC DIE

BY G. P. HAWKSFORD

THE traditional cubic die has two disadvantages. It is easily lost and young children often have some difficulty in throwing the die so that it stays on the table. So, to overcome this, an electronic alternative was built.

The prototype was originally designed to run from a 12V supply, which also makes it useful as a travelling die for in-car use, but a 9V battery is suitable, or a mains adaptor may be used.

The constructor may wish to build an integral mains power supply and a circuit is given for this.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Electronic Die is shown in Fig. 1. IC1 is a 555 timer running as an astable at about 10kHz, so fast in fact, that the point where the count is stopped by releasing S1 cannot be pre-judged and therefore may be considered random. R1, R2 and C1 set the astable frequency of IC1 in the usual way.

The output from pin 3 of IC1 is counted by IC2 which is a decade counter. This counter counts the number of input pulses to it and gives a binary output from 0 to 9, at pins 8, 9, 11 and 12. Table 1 may help in understanding this. Two problems are now created, firstly a die has no zero, and secondly we are not interested in any number greater than six.

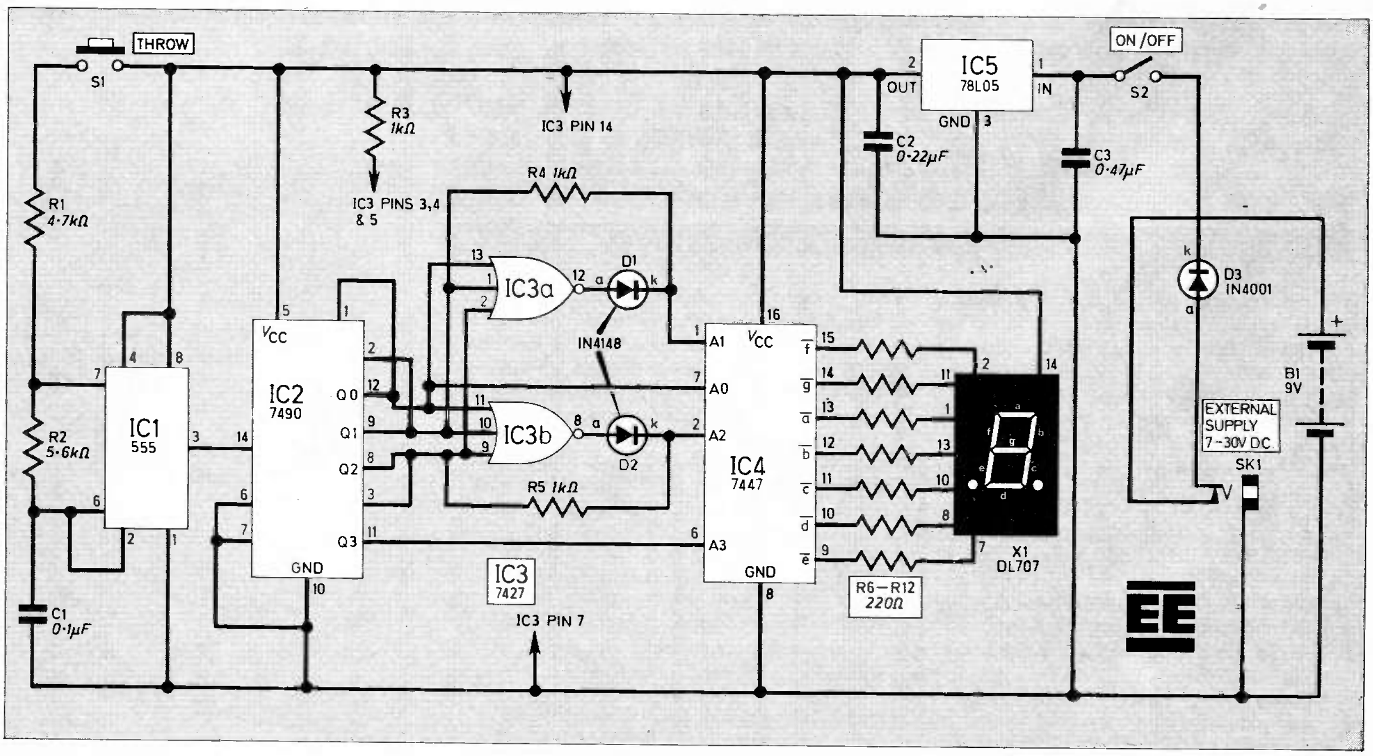
As the counter starts at zero this must be converted to an acceptable digit. A six is the most acceptable, as this allows the six output from IC2 free to be used to reset the counter. Conversion of a zero (binary 0000) to a six (binary 0110) is done by IC3, which is a 3-input NOR gate and the addition of D1, D2, R4 and R5.

A NOR gate only gives a high output if all its inputs are low. The only time all the counter outputs are low is for a zero, therefore we can use this condition to obtain two high outputs from IC3a and

Table 1

INPUT PULSE	BINARY OUTPUT Q_3 (pin 11)	Q_2 (pin 8)	Q_1 (pin 9)	Q_0 (pin 12)
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0

Fig. 1. Complete circuit diagram for the Electronic Die.



IC3b and treat them as if they were the Q_1 and Q_2 outputs from the counter, IC2. Thus changing the zero (binary 0000) to a six (binary 0110). It is only necessary to use a triple input device for IC3 as the fourth binary output (Q_3) is always low in the number range of zero to six that we are working with.

RESET PINS

IC2 has two pairs of reset pins, pins 2, 3, 6 and 7. The counter is set to give an output of 9 when 6 and 7 are high, and this is of no use in this design so they are grounded. The other pair, pins 2 and 3, are more useful and when both are high the counter is reset to give an output of zero.

Looking at a binary six (0110), it can be seen that this is the first time that outputs Q_1 and Q_2 are both high, so we can use these outputs to reset the counter to zero. This zero as described previously is then changed to a six by IC3, but because of the circuit design with R4 and R5, this "synthetic" six will not reset IC2.

The rest of the circuit is straightforward. IC4 and X1 together form the standard method of displaying a digit on a 7-segment display, with resistors R6 to R12 limiting the current to the display. IC5 is a 5V, positive voltage regulator with its associated capacitors C2 and C3. This i.c. can operate with an input voltage from 7V to 30V so a wide range of d.c. supplies may be used via SK1 which is wired as a switch socket to disconnect B1 when a plug is inserted. Protection against an incorrect supply polarity is provided by D3.

CONSTRUCTION

PRINTED CIRCUIT BOARD

When constructing the printed circuit board remember that i.c. pads, circles, curves and Ts are readily available on a single sheet of rub-down etch-resistant transfers. Lay out the position of the four i.c. pads and display first. Lines joining the components are best made using the self-adhesive etch-resistant tape available from most suppliers. Work methodically as you lay out the transfers and keep checking your layout against the published diagrams.

COMPONENTS

Approx. cost Guidance only **£12.00**

Resistors

R1	4·7kΩ
R2	5·6kΩ
R3,4,5	1kΩ (3 off)
R6–12	220Ω (7 off)

All $\frac{1}{3}$W carbon ±5%

Capacitors

C1	0·1µF polycarbonate
C2	0·22µF polyester
C3	0·47µF polyester

Semiconductors

D1,2	1N4148 (2 off)
D3	1N4001
IC1	NE555 timer
IC2	7490 TTL decade counter
IC3	7427 TTL triple 3-input NOR gate
IC4	7447 TTL b.c.d. to 7-segment decoder/driver
IC5	78L05 +5V, 100mA regulator
X1	DL707 common anode 7-segment

Miscellaneous

S1	push-to-make keyboard switch
S2	s.p.s.t. toggle switch
SK1	3·5mm jack socket
B1	9V PP3

Printed circuit board: single-sided size, 97 × 62mm; *EE PCB Service,* Order code 8308-05; plastic case, 150 × 80 × 45mm (ABS box type 2005); 16-pin d.i.l. holder (1 off); 14-pin d.i.l. holder (4 off); 8-pin d.i.l. holder (1 off); 6BA fixings; 7/0·2mm wire; battery clip.

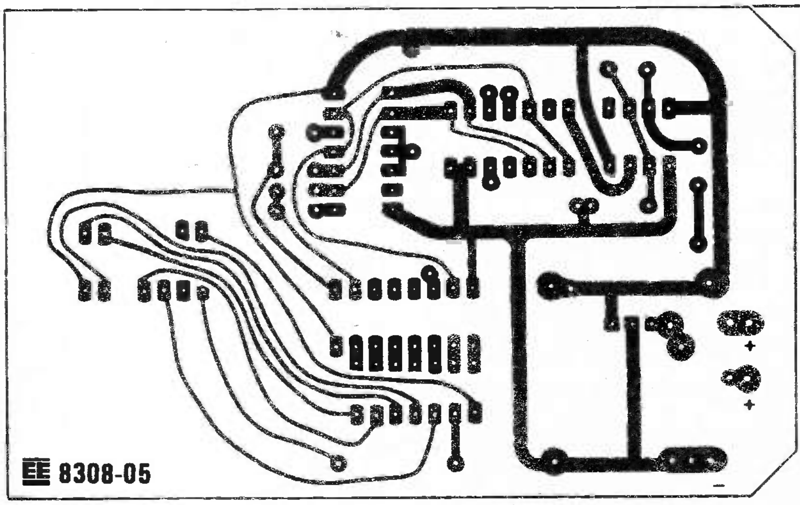
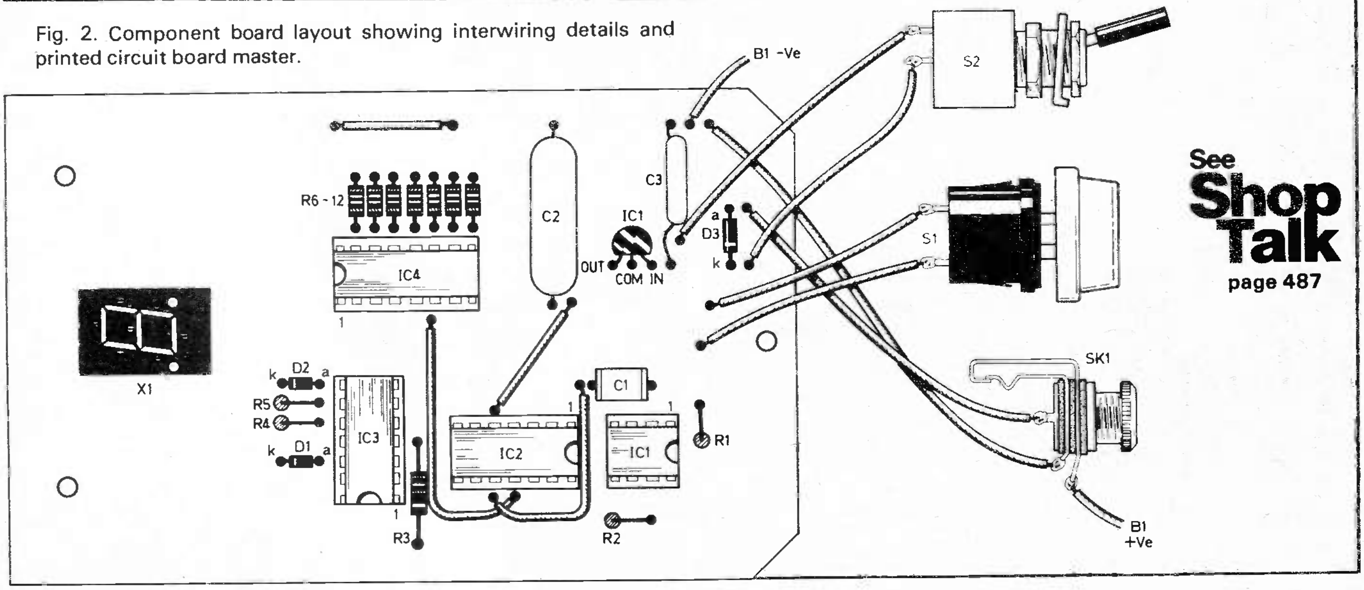
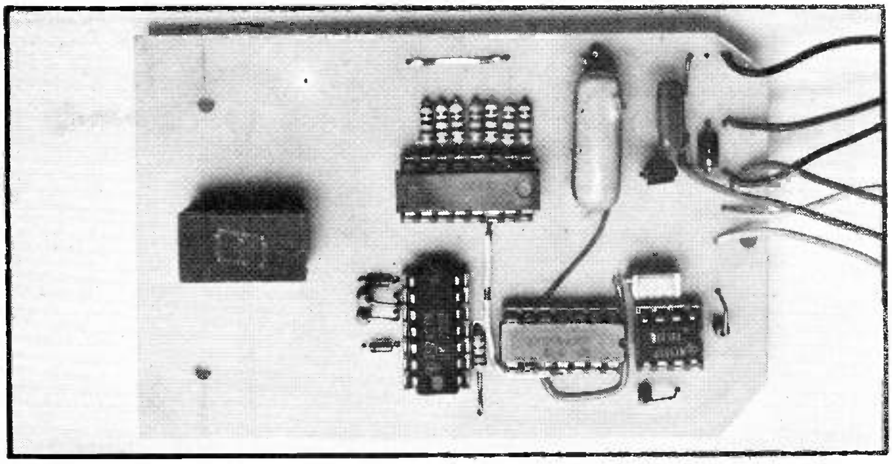


Fig. 2. Component board layout showing interwiring details and printed circuit board master.



See Shop Talk page 487


Layout of components on the Electronic Die display board.

Make a final check of your layout before etching (copper is easily removed but difficult to put back!), and during the etching process keep agitating the board using tongs to hold it, but take care that the tongs do not damage the transfers.

After etching is complete, wash the board and check that all unwanted copper has been removed, drill it using a 1mm drill (6BA mounting holes should be drilled using a 2·9mm drill) and then scour off the transfers to leave a good clean copper surface.

BOARD ASSEMBLY

Carefully solder the i.c. sockets in position and note that the i.c. socket used to hold the display has pins 3, 4, 5 and 12 removed. The five link wires can then be soldered, followed by the resistors and capacitors. Capacitor C3 is quite a tall component, so keep it as close to the board as possible. Fit resistors so that their colour codes all lie the same way as it makes checking easier. Orientate all board components with the correct polarity as shown in Fig. 2.

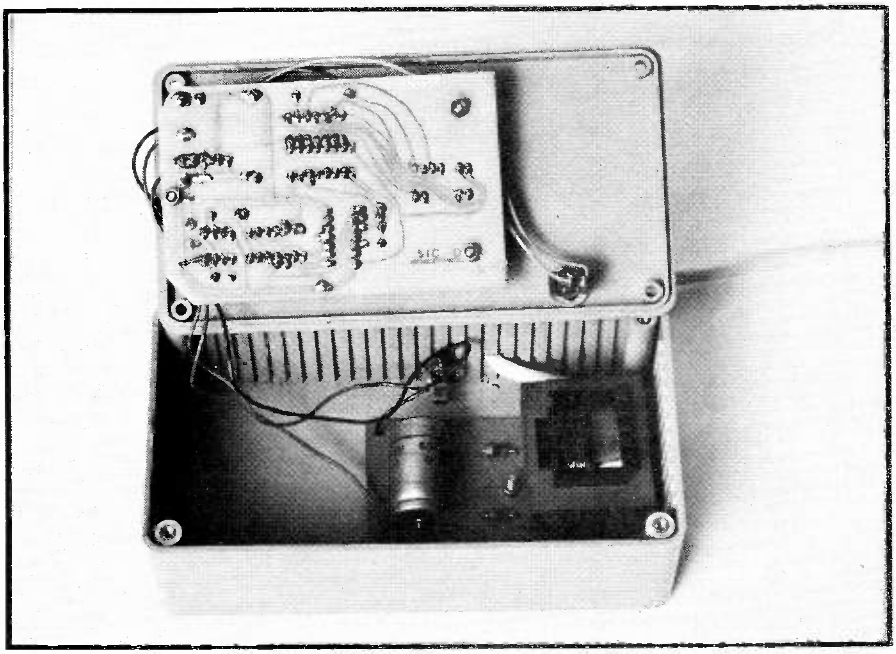
The diodes D1, D2 and D3 are soldered on next, be careful with the polarity. Finally, solder IC5 to the board, taking extra care to see that it is connected the right way round, and leave the leads long so that it can be bent over to clear S1.

MAINS POWER SUPPLY

The mains power supply unit (p.s.u.) is a full-wave rectified unit. A 0–6V, 0–6V mains transformer was used and was obtained from an old calculator power supply unit. The transformer is centre tapped and the output is full-wave rectified by D4 and D5, smoothing being provided by C4. See Fig. 3.

The p.s.u. as described gives an output voltage of about 9V which is quite adequate for the job, but bearing in mind the acceptable input voltage range to IC5, a variety of transformers will suffice provided they can deliver about 100mA.

Display board mounted on the lid and the mains power supply board wired and mounted inside the case, towards the right hand side.



If a different transformer is being used ensure that it fits the case and that it can be mounted well clear of the main p.c.b.

If building the p.s.u. (see Figs. 3, 4, 5), solder in the wires that will go to the transformer, fit the diodes D4 and D5 and then the smoothing capacitor C4, taking care with the polarity.

The output leads can then be soldered, the transformer mains input leads soldered on, not forgetting the tag on the earth lead, after which the leads from the p.c.b. to the transformer can be soldered.

Note that if the mains power supply is fitted, the jack socket (SK1) is not required. A cable restraint must also be used on the mains lead to prevent it from being pulled out. A knot is *not* recommended.

CASE

The case used to house this project has dimensions of about 150 × 80 × 45mm. The case top will have three cut-outs, and to avoid disfiguring the box with a slip of a file or drill the lid should be covered with masking tape.

The actual size of the cut-outs depends entirely on the components used. The square hole for the display X1 should be drilled around its edge, and the remaining plastic removed with a file. The mounting holes for S1 and S2 are 13mm and 6mm diameter, respectively.

The display can then be mounted in a free socket and this socket inserted into the display socket on the board. This gives the display enough clearance from the main p.c.b. Offer the whole p.c.b. with display up to the cut-out in the box lid, and fit S1. You should find that S1 fits neatly in between C1 and IC5, but if it is a bit tight, carefully bend the i.c. over.

The position of the three mounting holes can now be marked on the underside of the lid, the p.c.b. removed, and the holes drilled. Make the connections to S1, put the i.c.s into their sockets and refit the whole assembly using spacers (mains type earth sleeving make excellent spacers which have a little give and avoid breaking p.c.b.s) about 15mm long on the screws.

The bottom part of the case is next for attention. Place the power unit board and transformer in position, and offer up the lid with its p.c.b. and display to check that there is nothing close to, or touching, the power unit. If all is well, mark, drill and countersink the three 6BA holes that hold the transformer, plus its board, down. Mark and drill the hole in the side of the box for either the mains lead or the socket, again the use of tape avoids damage to the box.

The leads from the main p.c.b. to S2 and SK1 are then soldered, the p.s.u. bolted down, remembering that the earth tag should be fixed securely to one of the bolts.

OPERATION

Plug in or fit the battery, switch on and press S1. The display should show an 8,

ELECTRONIC DIE
MAINS POWER SUPPLY UNIT

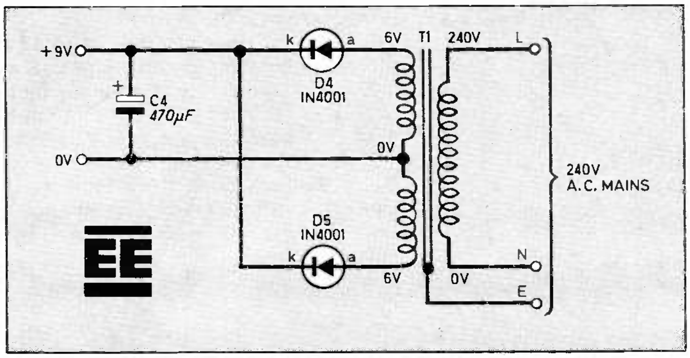


Fig. 3. Circuit diagram for a suggested mains power supply.

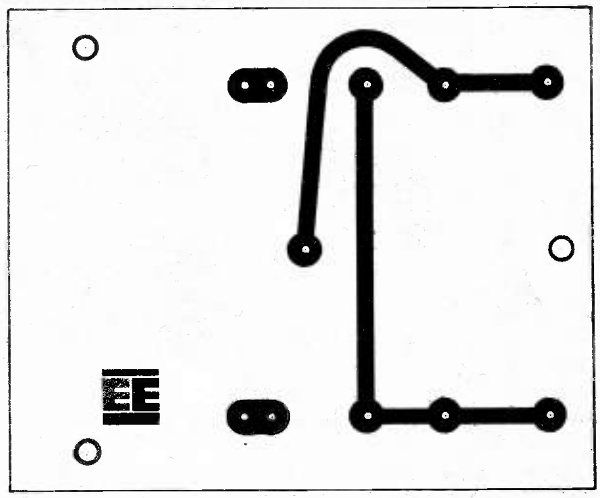
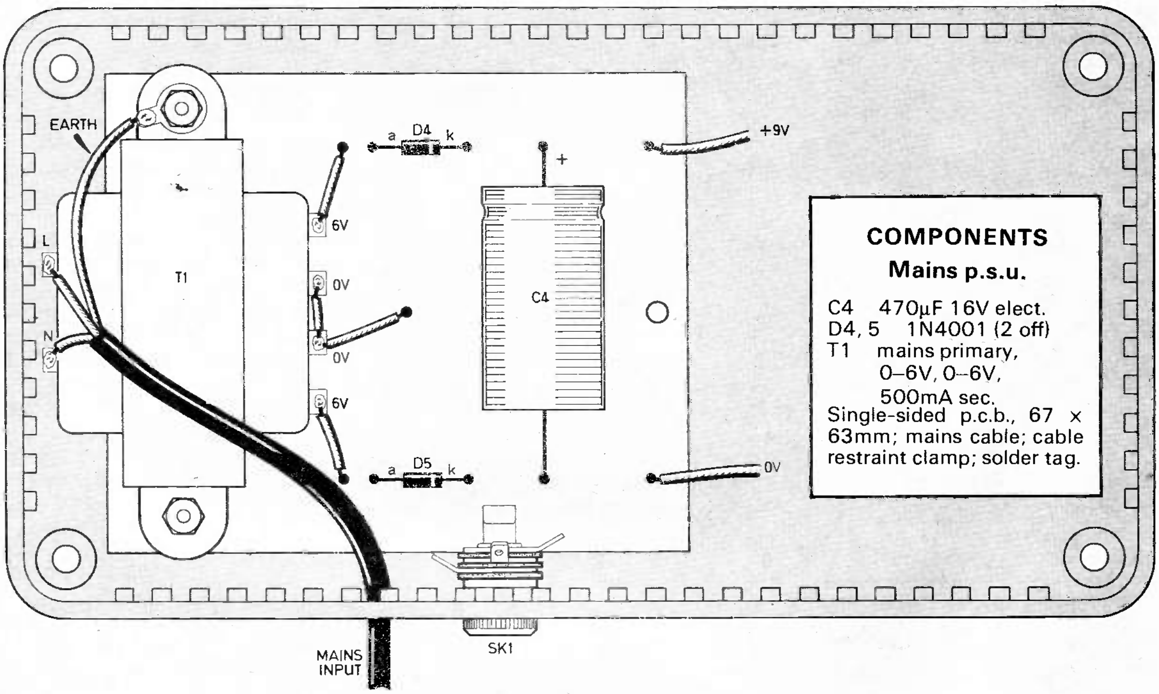


Fig. 4. Mains power supply printed circuit board master.



COMPONENTS

Mains p.s.u.

C4 470μF 16V elect.
D4, 5 1N4001 (2 off)
T1 mains primary, 0–6V, 0–6V, 500mA sec.
Single-sided p.c.b., 67 × 63mm; mains cable; cable restraint clamp; solder tag.

Fig. 5. Component board layout for the power supply unit showing SK1 which may be wired as a switch socket to allow external d.c. supplies to be used.

as the count runs too fast for the eye to resolve the different numbers. Release S1 and the count should stop, leaving a single figure from one to six on the display. Assuming the numbers roll over correctly, screw the lid down, fit the feet, label and decorate as required.

FAULT FINDING

Fault finding is a logical process of elimination. If nothing happened when you switched on, check the battery for polarity and life, or the mains plug fuse (if fitted). Now check that the diodes and i.c.s are in the right way round, look carefully at the p.c.b. (a magnifying glass helps), for broken or shorting tracks and solder bridges. The unit should work on anything over 7V and under 30V.

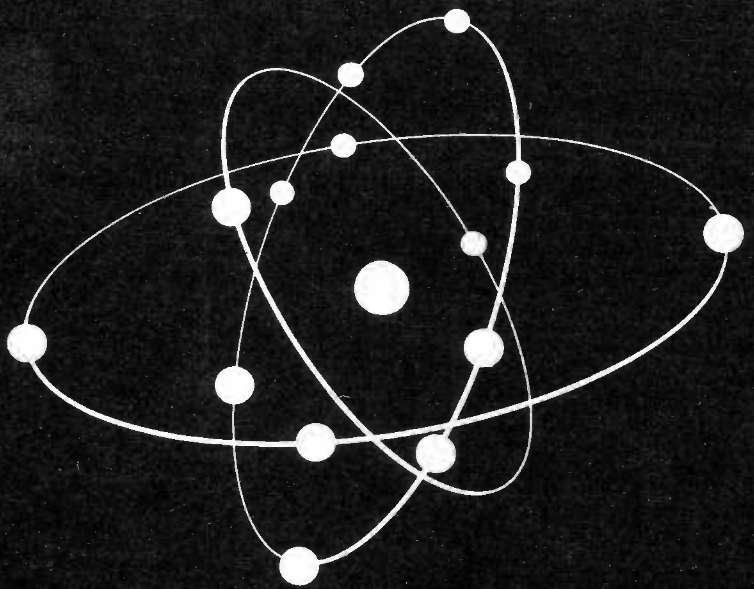
If all is well with the supply, check that on the output side of IC5 there is a voltage of 5V. If this voltage is not present the chances are that IC5 has expired.

If 5V is present, the next step is to obtain a TTL logic probe, and using the probe see that pin 3 of IC1 is pulsing when S1 is held down. If not, check the connections of R1, R2, C1, S1 and the socket; if these are sound, change IC1. From here on there is little to go wrong. A logic probe will quickly show if IC2, 3 and 4 are functioning.

If the display is lighting but with unrecognisable "hieroglyphics" then the fault lies with D1 and D2, or an error has been made on the p.c.b. connections between IC4 and X1. If these points are clear then one of the i.c.s is faulty, so systematically use the probe or change the i.c.s over.

It is unusual for an i.c. to be dead from new these days, and the chances of two in succession being faulty are remote, so, if despite having changed the i.c.s the unit is still not working, then there is some obscure fault or error, like an internally broken connecting wire or wrong p.c.b. layout, and the only cure is slow, methodical checking. □

ELECTRONICS and the ELECTRON



Part 4 CONDUCTION IN SEMICONDUCTORS

BY J.B. DANCE

Now that we have considered the way electric currents flow in metals, in liquids and in a vacuum, we can consider the somewhat more complex problem of conduction in semiconductors. However, it will help our understanding of this if we first consider the electron energy bands in various solids in a fairly simple way.

ENERGY BANDS

The electrons in a metal which can move and carry a current have a relatively high energy and are said to be in the conduction band. The electrons which have a lower energy are held in position by chemical valency forces and are said to be in the valency band.

The energy band diagrams for various materials are shown in Fig. 4.1. It can be seen that all of the conduction bands are above the valency bands, since the higher the position of an electron on this diagram, the higher the energy of that electron.

In the case of an insulator such as diamond, the valency band is fully occupied by electrons, whilst the conduction band is completely empty. It is not possible for an electron to have an energy corresponding to a level anywhere between the two bands. The gap between the two bands is therefore often known as the "forbidden region" or just as the energy band gap.

In the case of diamond, the gap between the two bands is about 5·2 volts. This means that an electron would have to gain an energy of 5·2eV (1eV = 1 electron volt) to enable it to jump from the valency to the conduction band. The energy an electron is likely to acquire from the heat energy present in all particles at room temperature averages about 0·05eV, so the chance that any electron will acquire enough energy to jump the band gap is very small indeed. Thus the conduction band remains empty and diamond is an insulator.

Although the band gap of sulphur is under half that of diamond, it is still wide enough to make sulphur a good insulator. In the case of the semiconductor material silicon however, the band gap is about 1.1eV. This is still much larger than the average energy acquired by an electron at room temperature, but nevertheless as the available energy is moved around between the electrons and atoms as they collide, one can show theoretically that there is a chance of about three in ten thousand million that any one electron will gain the energy required for it to jump the band gap.

SEMICONDUCTORS

Thus the conduction band in silicon contains a few, but not many, electrons and this enables it to show a limited amount of conduction.

A few electrons are therefore shown in the conduction band in Fig. 4.1, in the case of silicon. It is interesting to note that "holes" are left in the valency band, these being the points from which the electrons have jumped. These holes can be filled by an electron and we shall see later that they also contribute to conduction in the material.

In the case of germanium, it can be seen from Fig. 4.1 that the energy band gap is considerably smaller than that in silicon. The chance of an electron gaining enough energy from the heat present in the material is therefore greater than in silicon. There are therefore many more electrons in the conduction band of a piece of pure germanium at room temperature than in a piece of pure silicon at the same temperature, so germanium is a much better conductor than silicon.

Although the chance of any one electron being raised into the conduction band at room temperature is less than one in a million in germanium and even less in silicon, there are such an enormous number of electrons in any material that even this small chance can result in the materials being semiconducting.

METALS

In the case of metals such as lithium and magnesium, the valency band overlaps with the conduction band, whilst in the case of graphite the two bands just touch one another. Thus there is no energy band gap and electrons can pass freely into the conduction band without having to acquire any energy from other atoms or electrons. There are therefore plenty of electrons in the conduction bands of metals to ensure they are good conductors. Graphite is also a good conductor, although not as good a conductor as the metals.

It is interesting to note that mobile electrons are also very good carriers of heat energy, since they move so rapidly. It therefore follows that the metals are very good conductors of heat.

It may be noted that there are considerable differences between the various metals. For example, the valency band in lithium is only half filled, whilst it is completely filled in the case of beryllium. The bands overlap in both metals, so both are good conductors.

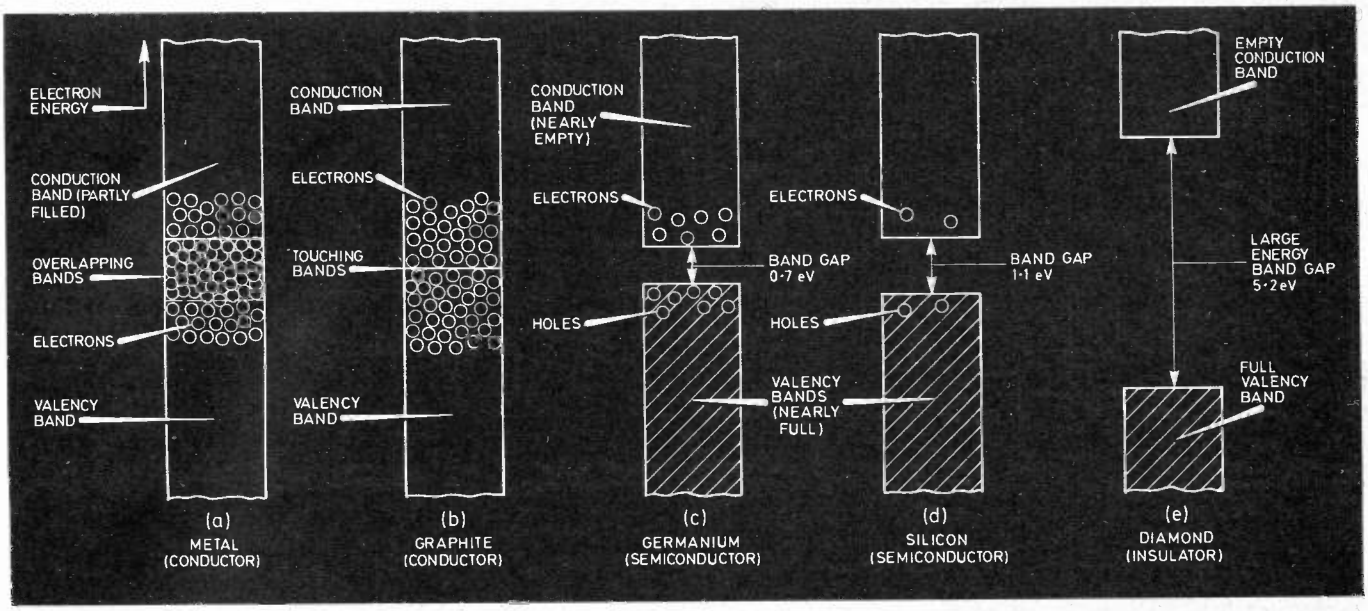


Fig. 4.1. Electron energy band diagrams for (a) a metal (b) graphite (c) germanium (d) silicon and (e) diamond.

TEMPERATURE

If silicon or germanium is cooled to a very low temperature, there is a far smaller chance of an electron in the valency band gaining enough energy to move into the conduction band. Thus either of these materials will become an insulator if cooled to a low enough temperature, but germanium must be cooled more than silicon owing to the smaller energy band gap.

It should be noted that the conductivity of a pure semiconductor material increases very rapidly with increasing temperature, whilst that of a metal decreases rather slowly with increasing temperature.

PHOTOCONDUCTIVITY

Particles of light (known as photons) can raise electrons from the valency to the conduction band if they have enough energy per photon. The energy band gap of diamond is too great for a particle of visible light to raise the electrons to the conduction band; the photons are therefore not absorbed and diamond is transparent.

On the other hand, visible photons are absorbed by metals and the latter are therefore opaque to light. The metals re-emit most of the light and appear lustrous.

If light is absorbed by a semiconductor material, electrons will be raised into the conduction band and the conductivity of the semiconductor material is therefore increased. This phenomenon is used in photoconductive cells to detect light, the semiconductor material used being cadmium sulphide or selenium for a good response to colours similar to that of the human eye. Cadmium selenide or silicon can be used for the detection of red and near infra-red radiation, whilst germanium with its smaller band gap energy is more suitable for purely infra-red.

It is interesting to note that the voltage at which a semiconductor diode commences to conduct is related to the band gap of the material used. For example, silicon diodes commence to conduct at about 0·55V, whereas a germanium diode will conduct at a much smaller forward voltage. Similarly, silicon transistors require a considerably greater bias voltage than germanium transistors, whilst gallium arsenide devices (band gap 1·4eV) require a still greater voltage.

HOLES

The concept of conduction by the so-called holes always causes some problems to inexperienced readers. Basically a hole is a point in the valency band from which an electron has jumped into the conduction band. It is thus a vacant position which can be filled by an electron from a neighbouring atom. If a hole is filled in this way, then another hole is left in the electron shell of another atom which can in turn be filled by an electron. Thus it is possible for the hole to move through the crystal in much the same way as the conduction electrons move through it.

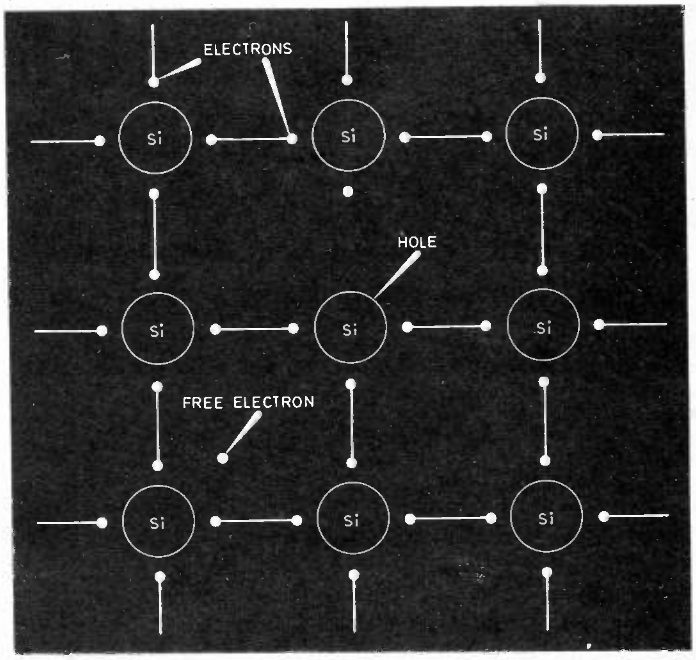
When dealing with holes one should remember that it is really electrons which are moving; no other particles are involved. Perhaps we should make it absolutely clear that holes are not positrons (the anti-particle of the electron). It is merely that physicists find it far easier to introduce the idea of a hole and its movement under applied voltages than to regard the problem as being one of very large numbers of individual electrons moving.

The hole behaves as a positive charge and tends to move towards the negative electrode just as the negative electron moves towards the positive electrode.

SILICON CRYSTAL

Let us consider a crystal of silicon to try to get a better understanding of how

Fig. 4.2. A silicon crystal containing a free negative electron and a vacant position known as a hole which behaves as a mobile positive charge.



holes and electrons cause conduction. The same theory applies to germanium and other materials.

Fig. 4.2 shows the crystal lattice of silicon, the individual silicon atoms being joined to neighbouring atoms by bonds containing two electrons. This picture is not quite correct for a number of reasons. For example, it is a two dimensional view, whereas the crystal actually occupies three dimensions. However, each silicon atom in an actual crystal is joined to four adjacent atoms arranged around it by bonds which are formed by electrons.

The central atom of silicon in Fig. 4.2 has lost one electron because this electron has picked up enough energy to move it into the conduction band. The free electron is shown moving through the crystal, whilst a hole or vacant position remains which can be filled by an electron from a neighbouring atom.

The movement of holes can be compared with the movement of an empty chair. If we have a row of chairs with one empty chair at one end, this chair can be filled by a person next to it and his chair (now empty) is in turn filled by another person and the process is repeated until the empty chair has, for all intents and purposes, moved to the opposite end of the row.

Actually the chair has not moved at all—only the people filling the chairs have moved. Similarly holes do not themselves move; only the electrons filling the holes can move. Nevertheless, it is easier to perform calculations by attributing the movement of the negative electrons to a movement of a positive hole in the opposite direction.

It is important to note that the movement of a hole occurs in the opposite direction to the movement of the individual electrons which really form the movement of the hole. It is just the same in the case of the empty chair which seems to move in the opposite direction to the actual movement of the people who are sitting on the chairs.

Next month we shall consider the effect of introducing impurities into semiconductor materials and how this leads to *p* and *n* type materials.

LETTERS

A TESTING TIME FOR TEST GEAR 83

One Meter . . .

Sir—We are in the process at the moment of building the *Transistor Tester* as shown in the June issue of EE.

Great difficulty has been experienced in obtaining the meter which is indicated at 100µA with 1·4 kilohm coil (type ML52). We have tried several companies, including Ambit International, without any success. Perhaps you could help in this matter.

K. D. Patterson,
Hall Green,
Birmingham.

Two Meters . . .

Sir—In the March issue of EVERYDAY ELECTRONICS you published the *Dual Power Supply* project in the *Test Gear 83* series.

Please could you give me the address of a supplier for both the mains transformer (with 24V, 1·5A and 9V, 1·5A secondaries) and the panel meter (1mA f.s.d. with 120 ohm coil, type ML52) which are used in this project. Also, the approximate prices of these items would be very helpful.

M. P. Davey,
Ipswich,
Suffolk.

Calibration

Sir—I am trying to build the *Dual Power Supply* from the March issue of EE. But unfortunately I have encountered two main problems.

Firstly, the bridge rectifier type KBL02 200V, 4A does not seem to be readily available. Could you please advise to a supplier or equivalent. Secondly, the panel meter, which I have already ordered from Ambit International, type ML52 1mA f.s.d. does not have a 120 ohm coil but a resistance of 200 ohms.

Also the scale graduation on the meter does not have a voltage scale as shown in the photograph of the Power Supply. Can this meter be used and if so, could you please advise as to the necessary alteration. Would appreciate any information regarding these matters.

B. M. Ansbro,
Hove,
Sussex.

First of all, to deal with the problems concerning the panel meters for both the Transistor Tester *and the* Dual Power Supply. *Regrettably, in both cases, the coil resistance was incorrectly stated in the relevant components list.*

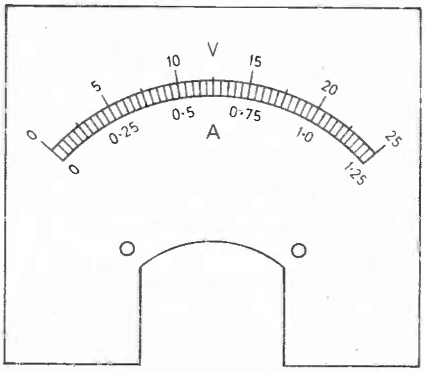


Fig. 1. The recommended scale calibration for the Dual Power Supply panel meter. Note that it is not shown actual size.

The Power Supply uses the 1mA, **200 ohm** *type ML52 (Ambit stock number 37–00521) and the Transistor Tester should specify the 100µA,* **3·5 kilohm** *type ML52 (Ambit stock number 37–00520). The prices are £5.98 and £6.45 (plus VAT), respectively. Ambit's address is 200 North Service Road, Brentwood, Essex CM14 4SG.*

We would like to apologise to all readers who have been inconvenienced by this (and to Ambit International, who have kindly advised purchasers). Note that no circuit modifications or value changes are required.

While on the subject of the Power Supply meter, it is very important to note that the values of resistors R9 and R13 were inadvertently transposed on the circuit diagram and the components list (see Please Take Note, *page 304, May '83). Failure to correct this can result in damage to the meter.*

Regarding the scale for the Power Supply meter, this can be modified by carefully unclipping the plastic cover and removing the scale by unscrewing the two Pozidrive screws. Take care not to bend the needle.

Trace off the arc of graduations and transfer to a piece of thin card cut to the same shape as the scale panel. These marks can then be inked in and the scale (a copy of which is included, see Fig. 1) added, using Letraset type transfers. This card is stuck to the original scale and the panel meter is reassembled, again with great care to avoid damage.

The mains transformer with 24V and 9V, 1·5A secondaries is available from Samson's (Electronics) Ltd, Dept EE, 9 Chapel Street, London NW1. The price is £6.30 inclusive.

The KBL02 4A, 200V in-line bridge rectifier is available from any RS component stockist (RS number 262–113). Remember that RS will not supply directly to the public but most component shops will have an account with them and can order on your behalf.

Alternatively, a 2A, 200V in-line bridge rectifier could be used (as the circuit only draws 1·2A maximum) and these are slightly more common. Verospeed stock a suitable device (order code 253–25512J) for 58p plus VAT. Their address is Stansted Road, Boyatt Wood, Eastleigh, Hants SO5 4ZY.

Back Numbers

Sir—You may like to make it known to your readers that I have some spare copies of EVERYDAY ELECTRONICS. They are April 1977; June 1977; August 1978; April 1978; and December 1979.

Enquiries should be sent to my address.

A. J. Dudley,
37 Ainsdale Drive,
Whitworth, Rochdale,
Lancs OL12 8QB.

NOTICE

Would Mr. Richard J. Hind, Doncaster, please contact the Editor regarding his Circuit Exchange entitled "2-way Intercom"—Full address please.

FOR YOUR ENTERTAINMENT

BY BARRY FOX

Surround-Sound Video

If you can lay your hands on a stereo video cassette recorder, or better still a LaserVision videodisc player and some stereo discs, and if you have some old quadraphonic hi fi equipment in the cupboard, then you're in luck. You can hook up the old quadrophonic system to produce some quite incredible "surround-sound" results from most stereo video tapes and discs.

Already the idea is catching on in America and the fact that it has not yet caught on here is, I'm afraid, just further proof that Philips in Britain is a very slow-moving organisation. As reported last month there still isn't a stereo V2000 recorder from Philips and although the sales division responsible for LaserVision talks long and loud about its hi fi sound, they don't seem yet to have woken up to the surround-sound potential.

Hopefully, after a few articles like this and some behind-the-scenes chiding, the message will get through. My bet is that surround-sound from LaserVision, properly demonstrated, would work wonders for sales.

LaserVision could certainly do with some wonders. Although Philips won't talk hard sales figures, the company admits that even after spending £3 million on promotion in just the second six months of 1982, it sold nowhere near the number of LaserVision machines it hoped for. In fact, over 600 dealers handling LaserVision, have still only sold a few thousand players between them!

In the USA, competition from the other videodisc system, SelectaVision, has actually helped LaserVision sales. Although many more SelectaVision players are sold than LaserVision, because they are much cheaper, the picture and sound quality isn't anywhere near as good as you get from LaserVision.

So SelectaVision turns people onto the idea of videodisc, and LaserVision technology delivers the quality. It could be the best thing possible for LaserVision if, as RCA still promises, SelectaVision is launched in Britain later this year.

The quadraphonics boom in the 70s died for two reasons. Firstly, there were too many systems; SQ, QS, CD4 and UD4. Secondly, there wasn't enough software, or recordings made in any one system, to justify buying hardware to decode it. So in chicken and egg fashion, the market never hatched.

This is where surround-sound video scores. There's only one coding system, a modified form of the SQ system originally developed by CBS Labs in America; and there's plenty of software on the market, even though hardware decoders are only just going on sale in America.

Stereo Film

The key to it all is Dolby stereo film. When you go to a West End, or first run, cinema to see a modern film, you'll often hear it in stereo across the screen with surround-sound from all round the auditorium. The film soundtrack is an optical track, split into two channels with Dolby noise reduction system to cut back hiss.

Dolby took a licence from CBS Labs, to encode surround-sound in the stereo track using a modified SQ system. The left and right channels decode as left, right, centre front behind the screen and a mono surround around the audience.

To improve separation between the four channels decoded from two, Dolby Labs use the Tate direction enhancement chip, developed and patented by inventors Martin Willcocks and Wesley Ruggles. Every cinema with Dolby surround-sound facility has a modified SQ decoder with a Tate chip built in.

Almost every Dolby stereo soundtrack has surround-sound information buried in the soundtrack. Of course, if the film is shown in a cinema without surround-sound, you just hear the sound in stereo, or mono.

When a Dolby stereo film is released on video cassette, or videodisc, the surround-sound information is there on the video soundtrack, whether anyone wants it or not. In fact, most people don't even know its there. But it is. And it can be decoded.

The ideal way to decode it is to use a modified SQ decoder which incorporates the Tate chip. Already in America you can buy such decoders from firms like Fosgate or Jensen.

Impressive Demonstration

One of the inventors of the Tate chip, Wesley Ruggles, was in Britain recently demonstrating videodiscs with the sound decoded through this equipment. The effect, with four loudspeakers round the room and a single TV screen centre front, was very impressive indeed.

It's only a question of time before this hardware goes on sale in Britain. Things will happen more quickly if Philips in Britain will only wake up to the potential, and use the system for demonstrations at public and trade shows.

But all is not lost in the meantime. I know (because I've tried), that you can use an ordinary SQ decoder to produce a very good effect.

So, if anyone has an old SQ surround-sound decoder in their cupboard, now is the time to get it out. You connect it up in exactly the same way that you would connect it up to a stereo record or tape deck, with two stereo amplifiers and two pairs of loudspeakers, front and rear.

Not many people, of course, will still have their own quadrophonic equipment. Often they have thrown it away in disgust. But all is not lost. In the 70s the hi fi press often recommended a useful stop-gap approach for anyone who wanted quadraphonic surround-sound, but refused to pay the high price for opting into any one system.

The stop-gap approach, named after the inventor David Hafler, was very simple to use and produced some surprisingly good results. It also produces equally good results from videodisc or tape.

Hafler System

The Hafler system relies on the fact that quadraphonically encoded sound produces a difference signal between channels. On a conventional stereo amplifier, phase differences between the left and right channel signals create an emphasised voltage gradient between the positive terminal of the left channel output and the positive terminal of the right channel output. All you have to do to tap this difference signal, is connect an extra loudspeaker (or speakers) across the positive output terminals of the left and right channel outputs.

When both channels are putting out exactly the same signal there's no difference signal, so no output to the extra loudspeaker. When there's a marked difference between channel outputs, for instance when there are marked phase differences between the left and right channels, there's a hefty output to the extra loudspeaker.

The surround-sound systems like SQ used phase difference to convey the rear channel information. So in the Hafler set up the extra loudspeaker reproduces the out-of-phase information quite efficiently. Put the extra loudspeaker at the rear and you get a good approximation to surround-sound decoding.

Setting-Up

So there you have it in a nutshell. To get a surround-sound effect from stereo video all you do is feed the stereo sound output from the video system into a stereo amplifier. You then connect an extra loudspeaker (or loudspeakers) between the positive terminals of the two amplifier output channels.

To set the system up you just play a mono signal and adjust the amplifier balance control so that there is minimum sound coming out of the extra loudspeaker. That's all there is to it.

The only possible problem, which was often written about in the 70s, is that some amplifiers don't like a connection of this type, especially if two extra loudspeakers are connected in parallel to present a very low impedance between channels. But most modern amplifiers have protection systems which will trip before there is any damage. In the 70s so many people used Hafler set ups, that most amplifier manufacturers took this into account when they designed their equipment.

BY H.G. FIELD

HOME SYSTEMS MONITOR

THE Home Systems Monitor has been designed to constantly assess the operation of up to ten home functions and to give both audible and visual warning of failure. The model described has only three channels fitted (although five lamps are installed on the front panel) but the construction permits a further seven boards to be added if necessary.

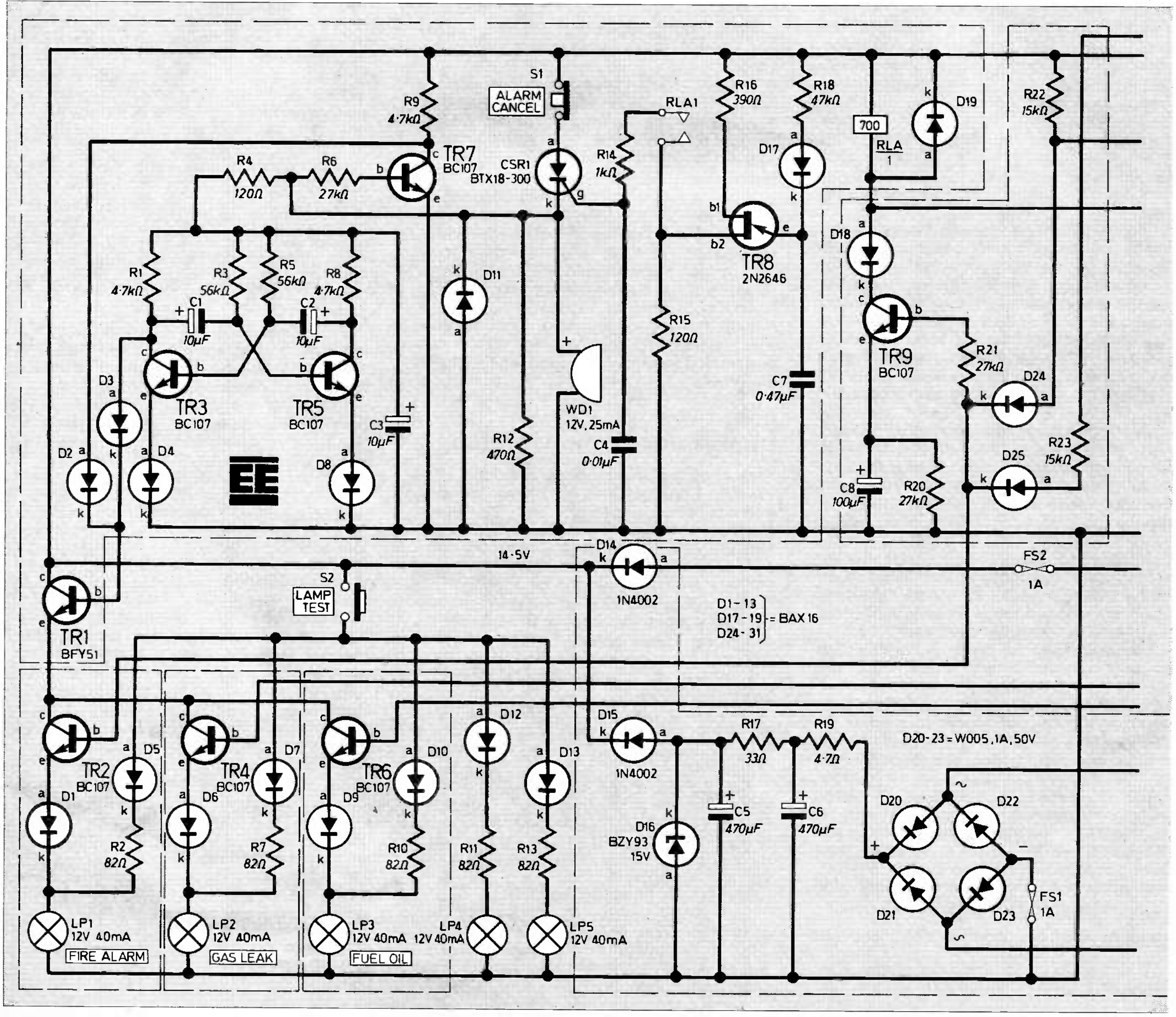
Each channel can monitor either a normally open or normally closed circuit, so when connected to the appropriate sensor (for example, a burglar alarm, gas sensor, fuel level switch and so on) most home systems can be monitored.

When a channel is triggered, the alarm will sound and the corresponding lamp will flash. On pressing the ALARM CANCEL button, the alarm ceases to sound and the lamp stops flashing but remains on until the fault is rectified.

CIRCUIT DESCRIPTION

The circuit diagram in Fig. 1. shows the three identically wired channels plus the two additional lamps connected to the

Fig. 1. The complete circuit diagram of the Home Systems Monitor with three channels shown. Up to ten channels can be fitted if necessary



LAMP TEST switch ready to accept additional channels if required. Only one channel will be described.

The initiation contacts (from the external monitored systems) are wired to the terminal blocks TB1 and TB2. If the contacts are normally open (closed when activated), they are wired to the "A" pair of terminals.

If normally closed sensors are used (open when activated), they are connected to the "B" pair of terminals. For this reason, there are six pairs of inputs, two for each channel, and the "B" inputs (normally closed) must be linked as shown when not in use.

When an input is received from the initiation contacts, the output of the wired OR gate (R22, R23, D24 and D25) will go high. This occurs if the "A" input (TB1/1 and 2) is closed, resulting in a positive potential on R23, or the "B" contacts (TB1/3 and 4) are opened, removing the 0V line from one end of R22, thus causing the positive potential at the other end of R22 to be seen as a logic high.

The high output from this OR gate will turn on transistors TR2 and TR9. TR9 will only be on whilst capacitor C8 is charging and during this charge period, relay RLA will be activated and the contacts will close. This in turn creates a pulse from the unijunction transistor (TR8 and its associated circuitry) on the gate terminal of thyristor, CSR1.

CSR1 will now conduct and sound the alarm, WD1. It also supplies power to the multivibrator circuit around TR3 and TR5.

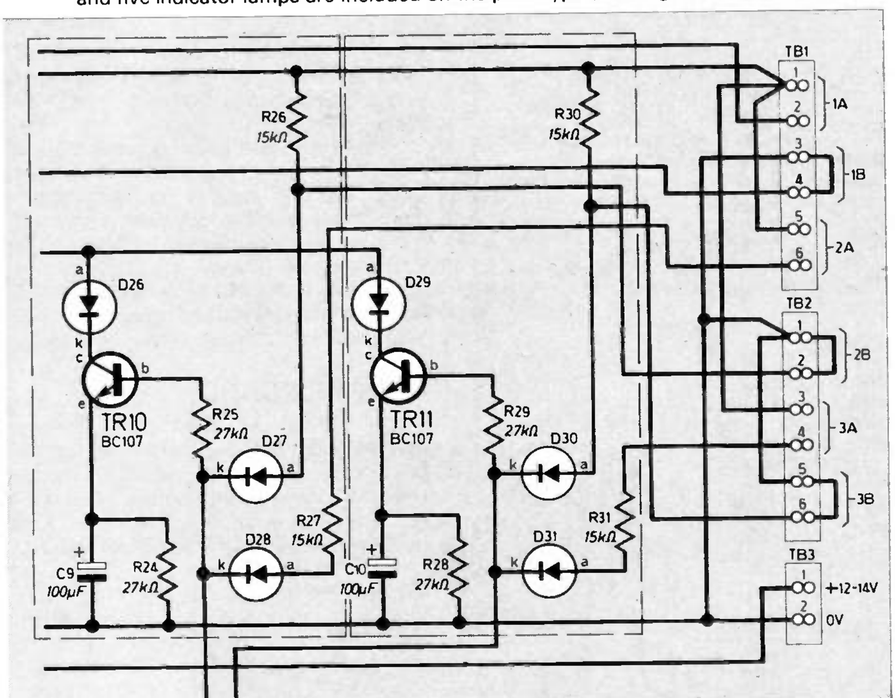
FLASHING INDICATOR

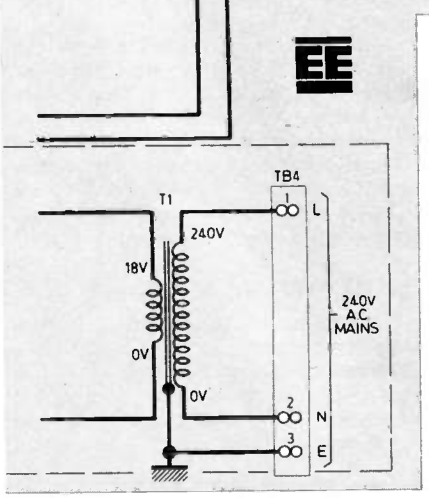
The base of TR1 is connected via a diode to the collector of TR3 and so will be turned on and off in sympathy with the multivibrator. As previously stated, TR2 is turned on by the high output from the wired OR gate, so LP1 will flash on and off at the same rate as TR1 is turned on and off by the multivibrator.

When CSR1 conducts, it also turns TR7 on, bringing its collector voltage down to nearly 0V. However, when the current flow through CSR1 is interrupted by pressing ALARM CANCEL S1, it ceases to conduct and turns off the alarm, the multivibrator and TR7. This results in the collector potential of TR7 returning to the positive supply rail, and as it is connected via a diode to TR1 base, TR1 will now be continually on. Therefore, LP1 stays on until the fault has been rectified.

The circuit can still monitor all other channels and the alarm will activate if another fault occurs without affecting the status of the triggered channel.

and five indicator lamps are included on the prototype (although only three are used).





LAMP TEST

A facility is provided to check the operation of the five (or more) indicator lamps. A push-button switch, S2 (LAMP TEST), connects the positive rail, via a limiting resistor and diode, to the lamps.

The diodes in the emitter lines of TR2, 4 and 6 are to protect these transistors from this lamp test voltage. It is recommended that the lamps are tested at least once a month.

The flasher section of the circuit is a simple two transistor astable multivibrator the frequency of which is governed by R3/C1 and R5/C2 and in practice is about 1Hz.

The diodes in the emitter circuits protect the transistors against reverse base-emitter breakdown. The supply to the multivibrator is decoupled with R4 and C3 to prevent the timing period from being affected by supply line ripple.

POWER SUPPLY

The power supply is a conventional full-wave rectified mains supply with a Zener diode regulator. The 18V a.c. from the secondary of T1 is rectified by D20 to D23 and then smoothed with the pi filter, C5/R17/C6. (This is so called because it resembles the Greek letter pi, π.)

This smoothed d.c. is regulated with 15V Zener diode D16 and after diode D15, the positive supply rail is 14·5V at 600mA. Note that no on/off switch is provided as this was not thought to be necessary as the equipment is to be left on at all times. Note also the 1A fuse, FS1, in the negative output of the bridge rectifier.

An additional 12V d.c. input is provided for connection to a car battery to continue surveillance of all systems in

The Home Systems Monitor unit (below) with front panel labelled to show the monitored functions.

the event of a power failure. D14 prevents incorrect polarity connection and also stops the battery receiving charge when the mains supply is on. D15 stops the battery voltage getting back to the Zener diode. This supply is also 1A fused with FS2.

CONSTRUCTION

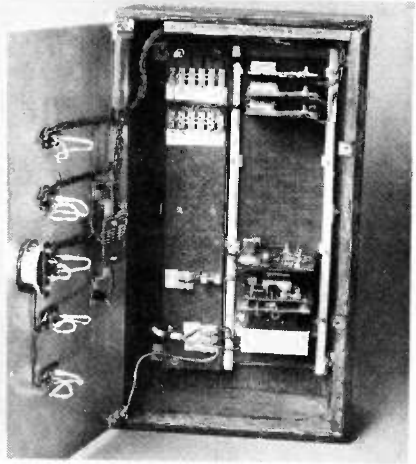
MODULAR ASSEMBLY

The Home Systems Monitor has been designed on a modular basis to allow expansion to up to ten channels. A rack system was considered but the cost was not thought to be justified so a mother/daughter board construction was adopted.

The back plane or "mother board" is made from a piece of 0·1in matrix stripboard, 34 strips by 80 holes and into this the daughter boards are soldered by means of solid wire leads. Common connections between the master control board, power supply and each channel board are made along the lengths of copper strips on the mother board.

The master control board is mounted at one end of the back plane and this contains the multivibrator, alarm circuit and relay. Each channel board carries a wired OR gate, lamp driving transistor and relay triggering transistor. These are mounted, at equal pitches, along the remaining length of the back plane. Three are shown in the photographs although provision is made for ten channels if required.

The power supply is not on the mother board, but screwed to an aluminium heatsink which houses the Zener diode and then mounted to a piece of hardboard alongside the mother board. This hardboard also holds the mains transformer.



View inside the prototype unit.

COMPONENTS

Resistors

R1	4·7kΩ	R12	470Ω	R23	15kΩ
R2	82Ω	R13	82Ω	R24	27kΩ
R3	56kΩ	R14	1kΩ	R25	27kΩ
R4	120Ω	R15	120Ω	R26	15kΩ
R5	56kΩ	R16	390Ω	R27	15kΩ
R6	27kΩ	R17	33Ω 7W	R28	27kΩ
R7	82Ω	R18	47kΩ	R29	27kΩ
R8	4·7kΩ	R19	4·7Ω 2W	R30	15kΩ
R9	4·7kΩ	R20	27kΩ	R31	15kΩ
R10	82Ω	R21	27kΩ		
R11	82Ω	R22	15kΩ		

All ½W carbon ±5% unless otherwise stated

Capacitors

C1	10μF 25V elect.	C6	470μF 63V elect.
C2	10μF 25V elect.	C7	0·47μF polycarbonate
C3	10μF 25V elect.	C8	100μF 25V elect.
C4	0·01μF polyester	C9	100μF 25V elect.
C5	470μF 63V elect.	C10	100μF 25V elect.

See Shop Talk page 487

Semiconductors

D1–13, D17–19, D24–31	BAX16 silicon (24 off)
D14,15	1N4002 (2 off)
D16	BZY93 15V Zener diode (DO4 stud package)
D20–23	W005 1A, 50V bridge rectifier
TR1	BFY51 *npn* silicon
TR2–7, TR9–11	BC107 *npn* silicon (9 off)
TR8	2N2646 *n-type* unijunction
CSR1	BTX 18–300 1·6A, 300V thyristor

COMPONENTS approximate cost £31 For three channels (excluding case)

Miscellaneous

T1	mains transformer, 18V, 1A secondary
S1	miniature push-to-break switch
S2	miniature push-to-make switch
WD1	audible alarm 12V, 25mA
RLA	encapsulated reed relay, normally open with 700Ω coil
LP1–5	miniature panel mounting indicator lamps, 12V, 40mA (5 off)
TB1,2	6-way terminal block (2 off)
TB3	2-way terminal block
TB4	3-way terminal block
FS1	20mm 1A fuse with p.c.b. mounting clips
FS2	20mm 1A fuse with chassis mounting holder

0·1in matrix stripboard, 38 strips wide (2 off—one for backplane and the other for daughter boards); Swish type curtain rail (approx. 700mm); 8mm thick plywood, hardboard, aluminium sheet (for cabinet and sub-frame—see text for dimensions); 7/0·2mm wire; mains lead; P-clip; assorted mounting hardware.

Both the mother board and the power supply module are inserted into two strips of "Swish" type curtain rail secured to the rear panel of the wooden cabinet used to house the monitor. Below this assembly is a further piece of hardboard on which is mounted the input terminal blocks and power supply inputs (mains and 12V d.c.).

One other small board is required, and this is for the LAMP TEST circuit (one diode and one resistor for each lamp). This board is mounted behind the front panel close to the indicator lamps.

Finally, the hinged aluminium front panel houses the lamps, ALARM CANCEL and LAMP TEST switches, warning device, WD1, and the lamp test circuit board.

MOTHER BOARD

The mother board is made from a piece of stripboard 34 strips wide and 80 holes long. This is the standard width available from stock and the additional two un-drilled strips along each side must be left on. The layout is shown in Fig. 2.

Only three channels are shown but additional channels can be added on a seven hole pitch. The position of the tenth channel (on row 69) is shown. If more channels are used, four extra terminal block positions must be added per channel.

Note that the wires to the input terminal blocks, TB1 and 2, are taken directly from the mother board. Due to this, track breaks are required on strips *M* and *P* between each channel (as shown). The 0V and 14·5V bus lines on the mother board are double tracks utilising strips *C,D* and *AA,BB* respectively. Short links are required to join these pairs.

DAUGHTER BOARDS

Each channel is assembled on its own piece of stripboard, 29 strips by 23 holes. Channel one is shown in Fig. 3 but each board is identical. The component references for the other two channels can be cross-referenced from the circuit diagram.

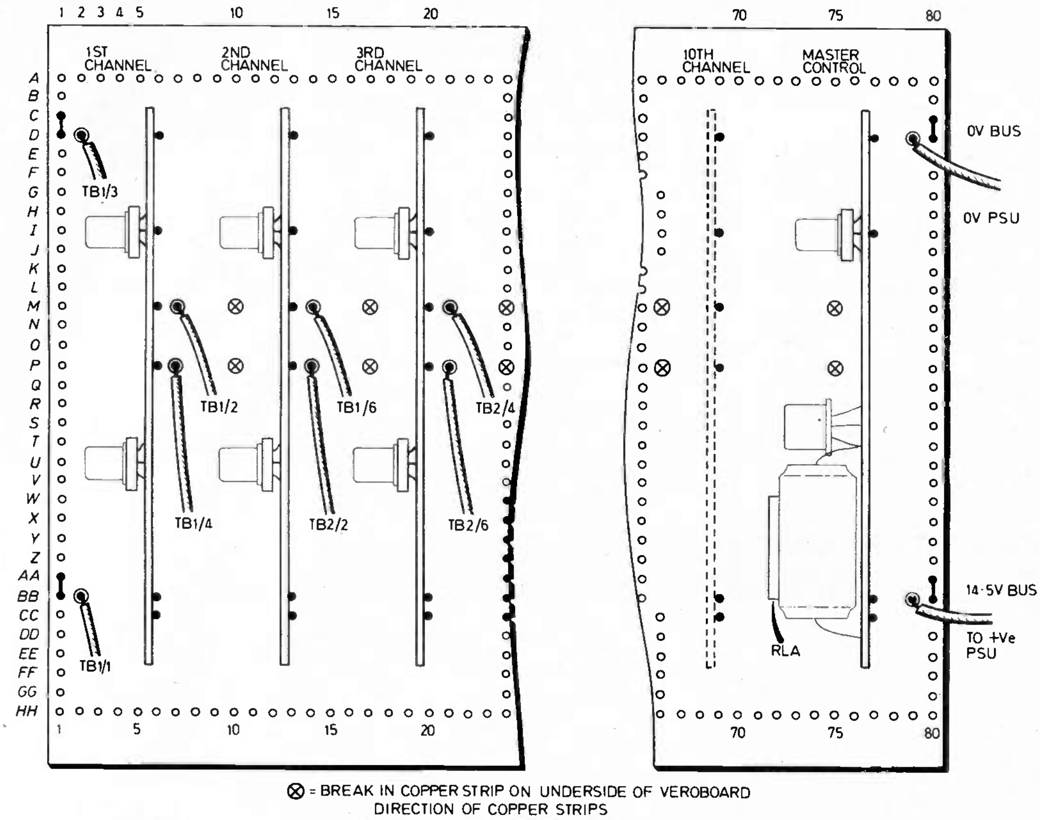
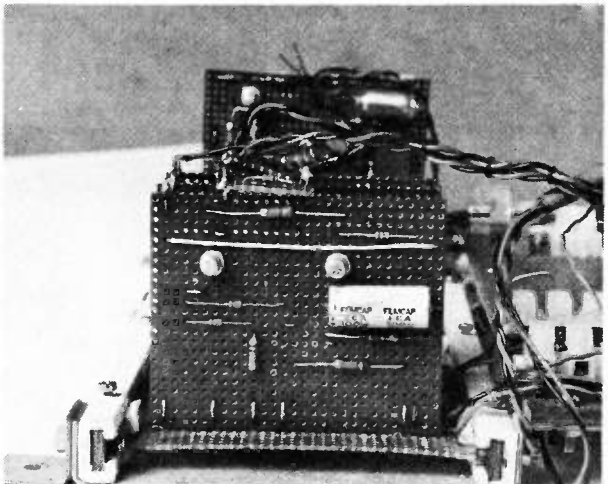


Fig. 2. The mother board (or backplane) stripboard layout showing the positions of the daughter boards. Note that this is a standard width piece of board and the two undrilled strips along either side are not removed.



End view of the sub-frame assembly clearly showing the "Swish" type curtain rail used as a guide for the mother board.

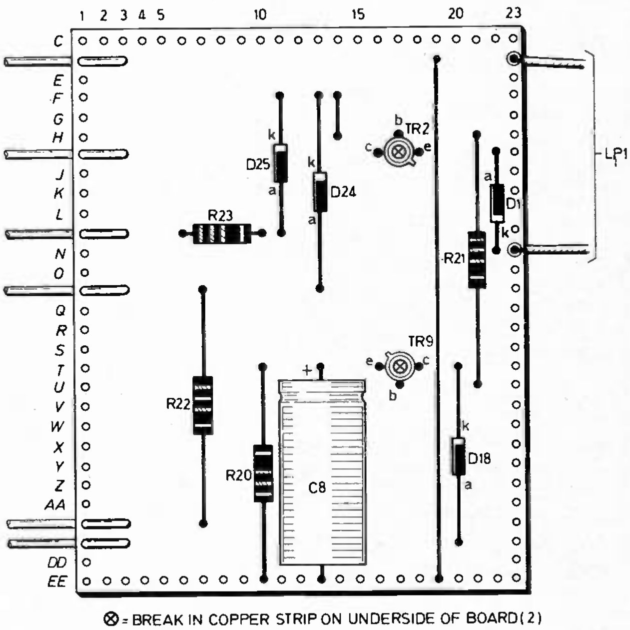


Fig. 3. Stripboard assembly of one channel. Note the track breaks beneath the two transistors, TR2 and TR9. Component references are for 1st channel, see circuit diagram for references of other two channels.

Note that the lettering of the strips starts at *C*; this is to correspond with the lettering on the mother board, Fig. 2. The six leads connecting the daughter boards to the mother board are made from solid tinned copper wire (about 22 s.w.g.) threaded through two holes and firmly soldered to the track side as shown.

Only one master control board (shown in Fig. 4) is required and this is built on a piece of stripboard 30 strips by 30 holes. All the usual precautions must be taken when building these circuit boards. The small lamp test board, 20 holes by 13 strips, is shown in Fig. 7.

HEATSINK

The power supply module is also made from a piece of stripboard 29 holes by 29 strips, but it is not mounted onto the mother board. It is secured to an aluminium heatsink with four 10mm long plastic spacers. Fig. 5 shows the power supply board assembly and Fig. 6 gives the dimensions of the heatsink.

The stud type Zener diode, D16, is mounted into the 5mm diameter hole in the centre of the heatsink. The stud is the cathode (k) and requires a solder tag to make a wired connection to the board. When the board is fixed to the heatsink, the anode (a) of the Zener diode protrudes through the large hole in the stripboard.

Some special precautions are necessary when constructing the power supply board. When soldering the bridge rectifier, D20 to D23, the device should be mounted at least 7mm from the board as the extra lead length acts as a heatsink. The connections to the a.c. terminals of the bridge (to the transformer, T1) are made directly to the pins. These joints must be thoroughly sleeved to prevent a short circuit on the heatsink.

The 4·7 ohm resistor, R19, and the 33 ohm resistor, R17, are also spaced off the board to assist in cooling. The board mounting fuse clips for FS1 will require slightly enlarged holes in the stripboard. This can be done with a small drill or round needle file.

The power supply module and transformer are then mounted onto a piece of hardboard, 95 × 100mm long. This will be inserted into the Swish type curtain rail alongside the mother board when the assembly is complete.

SUB-FRAME

The mother board, power supply board, curtain rail and an additional hardboard panel, 60 × 330mm, are all mounted onto a sub-frame assembly. The hardboard panel is for the input terminal blocks, TB1 and 2, the mains input 3-way terminal block and P-clip and the d.c. power input fuse (FS2) and 2-way terminal block.

The sub-frame assembly is held together with three identical fabricated metal brackets and an end view is shown in Fig. 8. Note the curtain rail forms a slot into which the power supply and

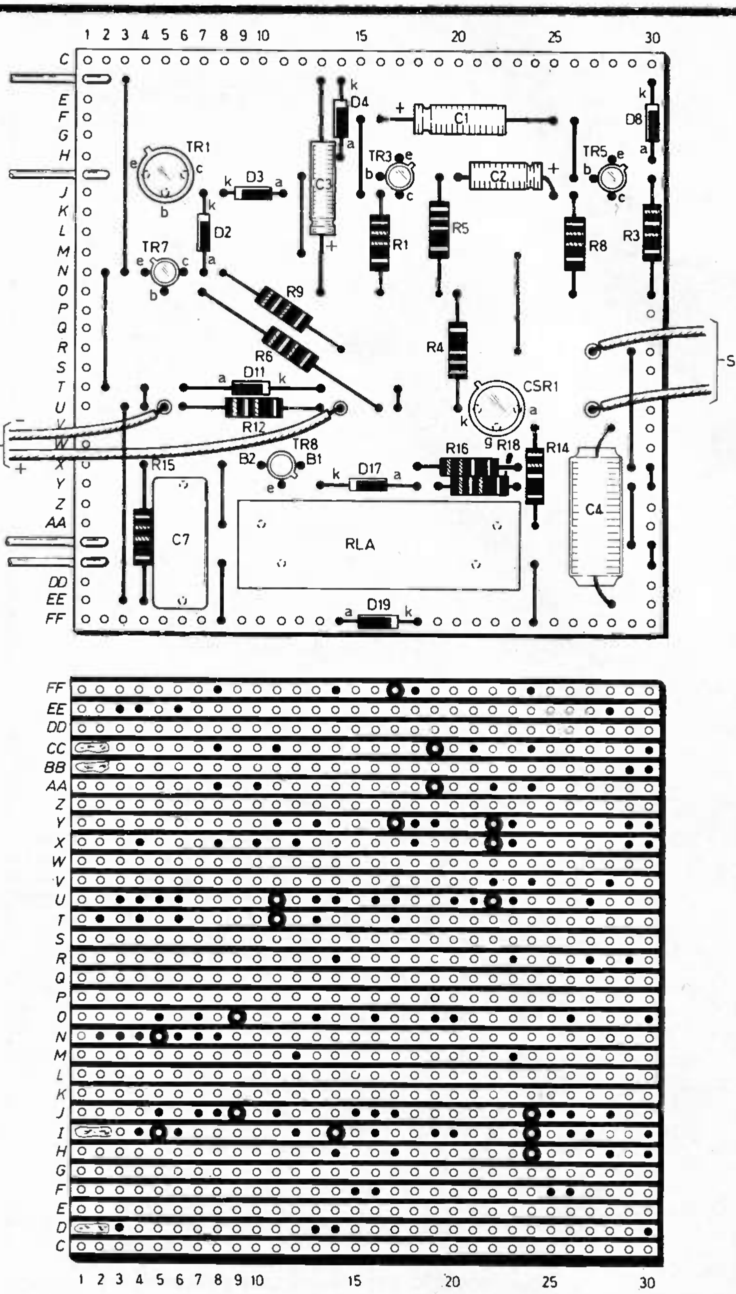
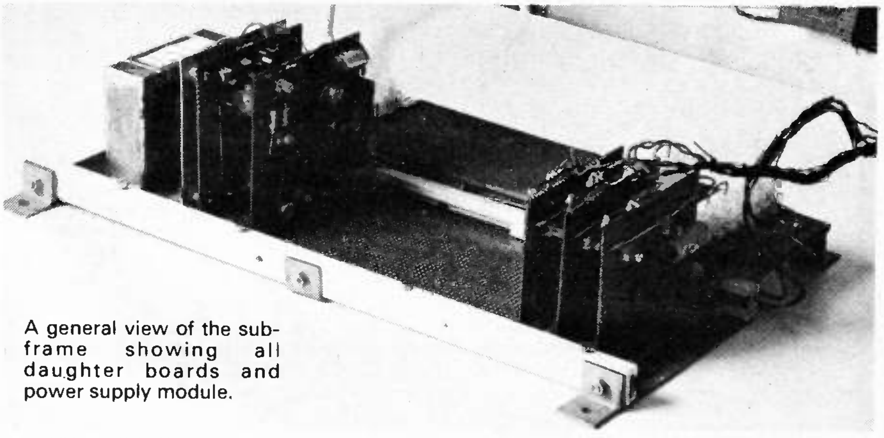
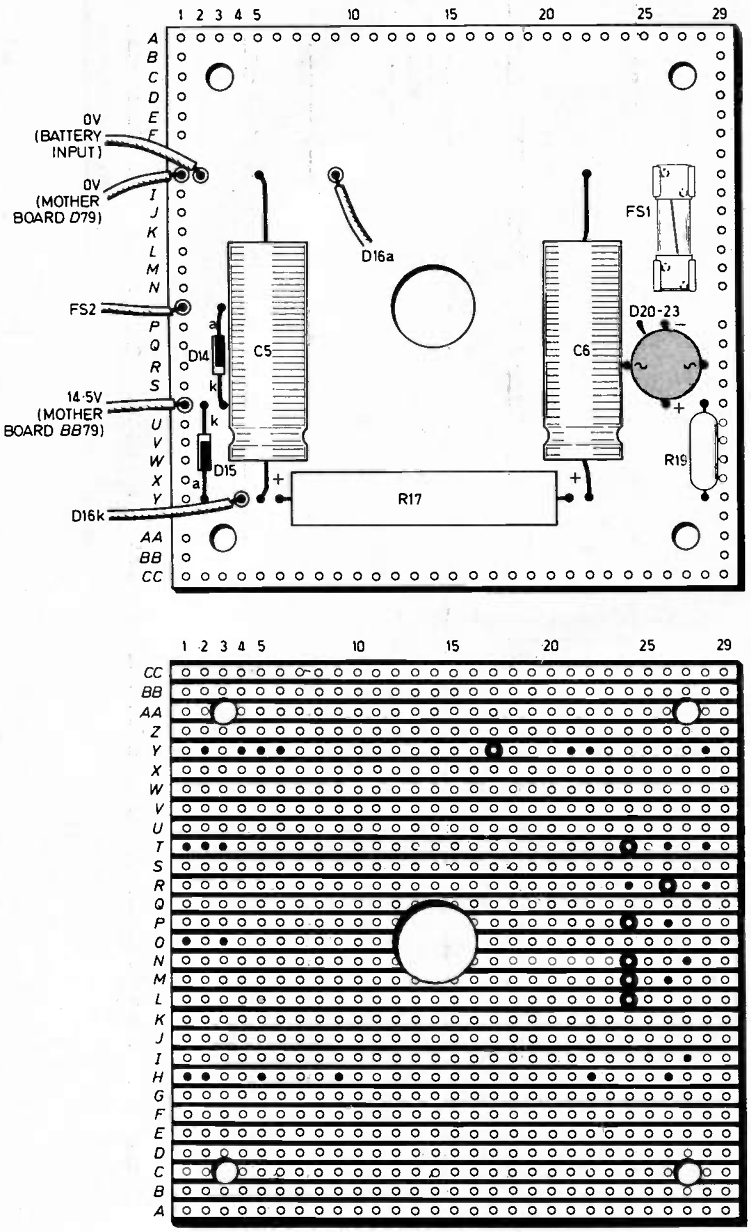
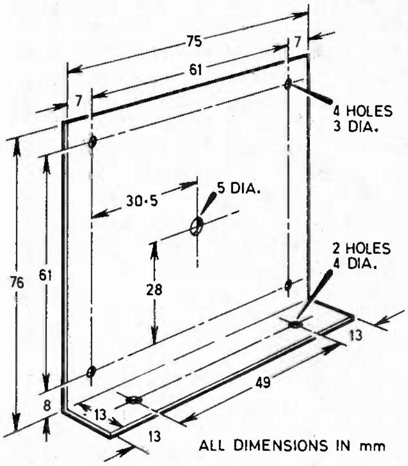


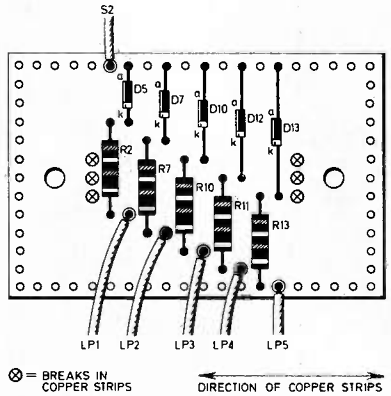
Fig. 4. The stripboard layout of the master control board.



A general view of the sub-frame showing all daughter boards and power supply module.







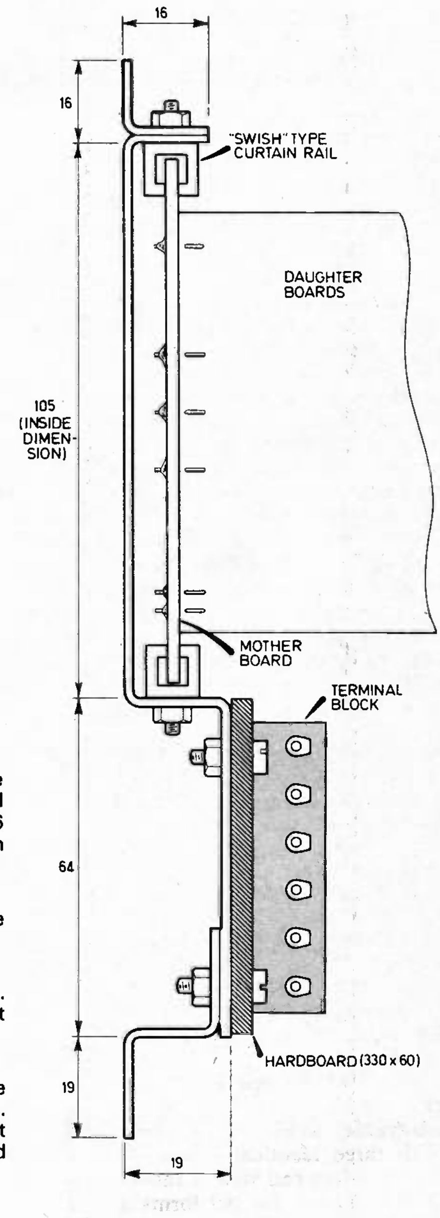
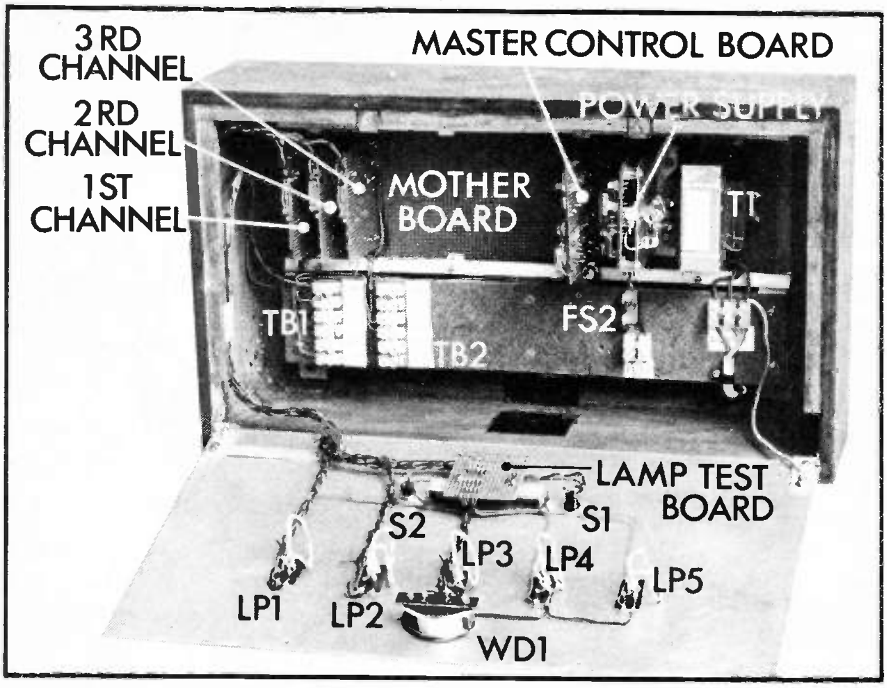


Fig. 5 (above). Stripboard layout of the power supply. Note that when mounted onto the heatsink, Zener diode D16 protrudes through the large hole centred on reference O14.

Fig. 6 (top right). The dimensions of the aluminium power supply heatsink.

Fig. 7 (left). The lamp test stripboard layout. This is mounted onto the rear of the front panel.

Fig. 8 (right). End view of the sub-frame assembly giving important dimensions. Three fabricated aluminium brackets about 16mm wide are required, one at either end and one in the centre.



The Home Systems Monitor unit with front panel hinged down showing the modular construction. All major components and circuit boards are labelled.

mother board can be slid and secured with small pieces of plastic screwed into the side of the rail to create a tight fit.

The sub-frame is affixed to the rear panel of the specially constructed wooden cabinet. This was made from 8mm thick plywood and measures 405 × 240 × 110mm (outside dimensions). It has an aluminium front panel, 390 × 225mm, and this hinges forward from the bottom. (See photographs.)

The front panel is flush fitting and is secured to battens fixed to the inside walls around the cabinet. The hinges on the prototype were home-made but piano hinges can be used. If brass hinges are fitted, they must be painted as brass and aluminium produces an electrolytic reaction.

The front panel is then drilled, using the photographs of the prototype as a guide, to house two push-button switches, warning device and five lamps. The cabinet is finished with four stick-on rubber feet.

FINAL WIRING

When all assembly is complete, the final wiring can be carried out. It should be done with a 7/0·2mm stranded wire using different colours where possible. For example, red for positive, black for 0V, and so on.

Following the information given on the individual component layout diagrams and using the circuit diagram as a guide, all wires are routed as shown on the prototype, still allowing the front panel to hinge downwards. When complete, the wires should be laced together to create a cable-form. Fig. 9 shows the wiring of the terminal blocks.

The mains lead is passed through the rear of the case and secured to the hardboard panel on the sub-frame with a P-clip. The three cores are then inserted into a 3-way terminal block. The transformer primary is wired to the live (brown) and neutral (blue). The earth (yellow/green) is wired to the transformer case and to the front panel via a solder tag on a hinge fixing screw.

The 12V d.c. power input (if used) is wired to a 2-way terminal block and the positive is then connected, via fuse FS2, to the position indicated on the power supply module.

INSTALLATION

When wiring the Home Systems Monitor to the initiation contacts (gas sensors, alarms and so on), twin core "bell wire" should be used. It is not recommended to run the wires parallel to mains cables; a gap of at least 150mm must be left.

The initiation contacts must be clean and all joints well made as the switching current is less than 1mA.

On the prototype model, a cable gland for the mains lead was provided on both the base and the back of the unit. This permits either wall or table top mounting. The mains plug fuse should be 2A.

APPLICATIONS

The Home Systems Monitor is designed as a full-time watchdog to be connected to a whole range of sensors. For example, a fire alarm could be connected using a smoke sensor, ionised chamber or a photo-electric detector.

A float switch can monitor fuel oil level or can also be used as a flood warning device. To check on the operation of a freezer or electric motor overheating, a thermal switch can be employed.

Gas leaks can be detected with gas sensors, currently available to detect propane, methane, town gas, natural gas and liquid petroleum gas to name but a few. For high or low pressure monitoring, a pressure switch can be utilised. And finally, for equipment attitude, a mercury position sensor is ideal. □

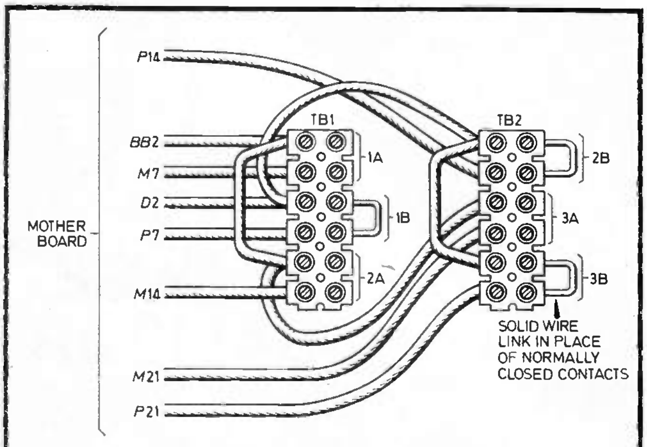
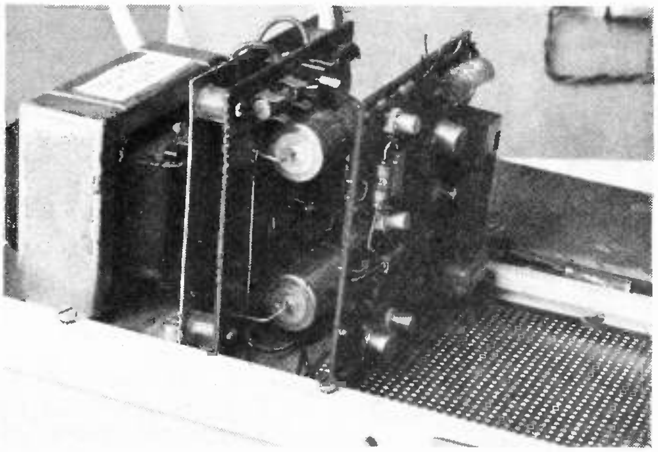
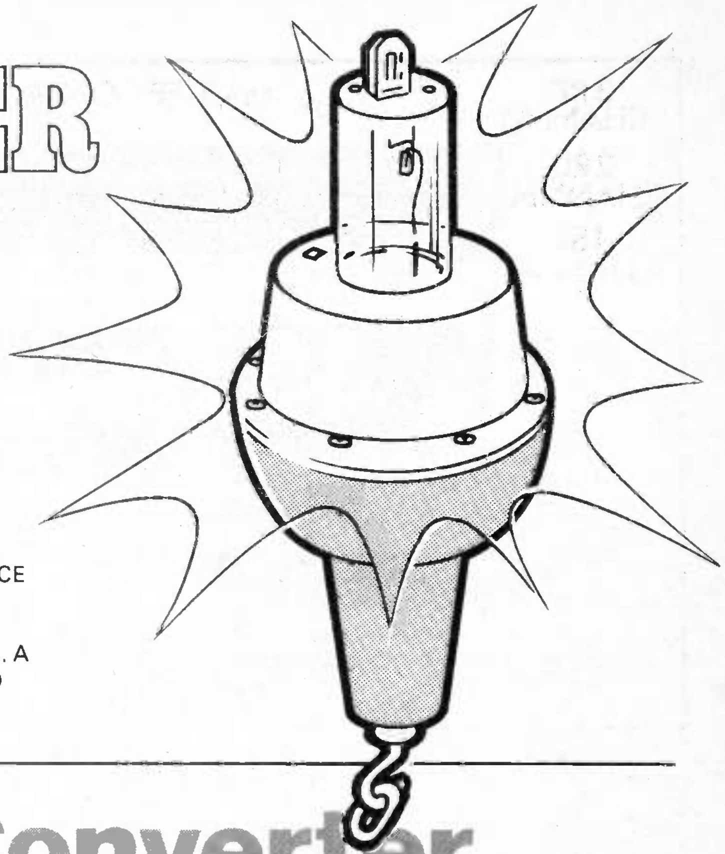


Fig. 9. The wiring of the input terminal blocks to the mother board.



The power supply board fixed to its heatsink and mounted onto the hardboard base adjacent to the transformer.

SEPTEMBER FEATURES



DISTRESS BEACON

MAN OVERBOARD AT NIGHT IS A FRIGHTENING EXPERIENCE FOR BOTH VICTIM AND CREW. THE DISTRESS BEACON PROVIDES A CENTRAL POINT OF REFERENCE FOR HELMSMAN AND SWIMMER TO EFFECT A SPEEDY RESCUE. A HAND-HELD VERSION SPECIALLY FOR FELL WALKERS AND CLIMBERS IS ALSO DESCRIBED.

A to D Converter for Research Machines RM380Z Computer with Experiments for the Physics Lab.

A MULTIPLEXED 8-CHANNEL ANALOGUE-TO-DIGITAL SYSTEM TAILORED ESPECIALLY FOR USE WITH THE 380Z COMPUTER USER PORT BUT WHICH CAN BE EASILY ADAPTED FOR USE WITH OTHER PERSONAL COMPUTERS. THE ELECTRICAL SIGNALS FROM TEMPERATURE, LIGHT INTENSITY, SOUND AND OTHER TRANSDUCERS ARE PROCESSED AND PRESENTED TO THE COMPUTER IN DIGITAL FORM. SOFTWARE LISTING PROVIDED FOR STORING RESULTS AND REAL-TIME PLOTTING ON SCREEN.

SEDAC 1983 Report & Results

The outcome and Prize-giving ceremony of this year's Schools Electronic Design Award Competition with synopses of the top 12 prize-winning entries.

EE

STYLUS ORGAN

A full two octave stylus keyboard and switchable vibrato oscillator give this miniature organ a rich and interesting sound. A variable envelope filter enhances output.

EVERYDAY ELECTRONICS and computer PROJECTS

SEPTEMBER 1983 ISSUE ON SALE FRIDAY, AUGUST 19

VOLTAGE DUALISER

A dual power supply unit that provides a plus and minus 8V output from a single 9V source. Features include a built-in overload protection system.

EVERYDAY news ... from the world of

BRITISH MAESTRO SPEAKS OUT

Electronics help orchestrate the drive of a new British car set to lead the World in design innovation, with a little help from Germany and Japan.

POOLING their specialist knowledge, British Leyland (Austin-Rover Group) and Smiths Industries have joined forces to produce a world beating new small car which uses advanced technology, including speech synthesis, monitoring most driving and operating conditions.

The top of the range MG and Vanden Plas models incorporate a voice synthesiser that "instructs", in a female voice, the driver of 15 different possible warning and abnormal driving conditions. The speech information is transmitted to the driver through one channel of the car's radio/stereo cassette player system. For overseas models the "voice" is male.

Voice Synthesiser

After several different devices were evaluated, we understand that the voice synthesiser module is built around a standard Hitachi integrated circuit which has its integral 32K store or memory programmed with speech generation data devised at Smiths' R&D facility at Witney, Oxford. The i.c. synthesises the 15 phrases in English.

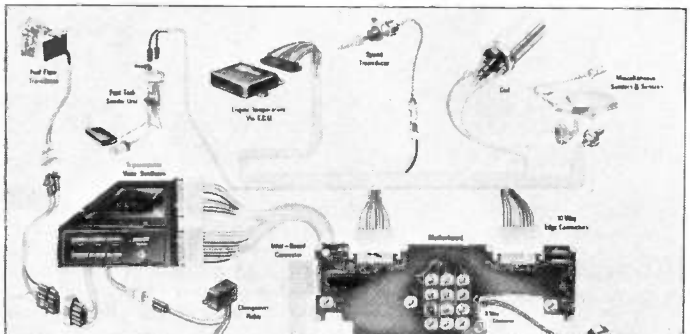
On cars for sale in foreign countries, the processing and tone generating sections of the i.c. work with an additional 128K ROM. This contains speech generation data for synthesis in German, French and Italian.

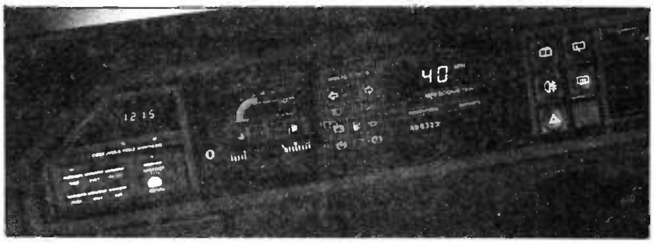
Electronic Engine Management

Austin-Rover and Smiths engineers, after much research, decided to introduce what they call "electronic engine management" to give the most cost effective motoring.

This system consists of an on-board microprocessor which monitors the fuel by controlling an automatic choke and also regulates the fuel mixture to the engine. By cutting off fuel on deceleration and, by means of an electronic idle speed control, by reducing engine idle speed quite a saving on fuel consumption and engine efficiency is attained. The car also features a contact breakerless ignition system.

Maestro solid-state instrumentation system layout.





Instrumentation panel features include vacuum fluorescence display, voice syntheses and trip computer.

Sensors for the input of information are fitted to monitor coolant temperature, ambient temperature in the engine compartment, engine speed, throttle open or closed and acceleration or deceleration. After processing, the output from the sensors is fed to a stepping motor to control idle speed through the fast-idle cam and cold mixture enrichment through the carburettor cold-start valve.

The microprocessor also controls a solenoid valve mounted on the carburettor to shut off the fuel supply. Calibrations for the cold-start enrichment are stored in the microprocessor ROM (Read Only Memory).

Trip Computer

A trip mileage recorder is fitted to all versions and all analogue instrument pointers are illuminated at night by a fibre-optic light pipe.

The trip computer takes information on fuel flow and vehicle speed from a special sensor and electronic speed transducer. Using its own highly accurate internal timebase, it then computes and displays digitally information selected by the driver during the journey.

Electronic Instrument Display

Instruments are grouped in a padded binnacle directly in front of the driver.

On Vanden Plas and MG models, an advanced solid-state electronics instrumentation system is fitted, controlled by two Motorola series 6800 microprocessors. Other than for the mileage recorder, there are no moving parts. The combined processing capacity of each instrument is over 40K (kilobytes) or about twice that of a home computer system.

Instead of the conventional speedometer cable, an electrical sensor on the gearbox casing sends speed signals to one of the microprocessors in the instrument assembly, which uses vacuum fluorescent displays for speed, engine revs, temperature and fuel tank contents.

Large digits show the vehicle speed, updated every half second with special provision in the control programme to ensure smooth transitions between readings at low speed.

For the fuel gauge, a series of 10 chaplets is used with the lowest two coloured red instead of green. This display is updated every 30 seconds but starts up when switched on in only 2 seconds. When the fuel level falls to the point where the last chaplet would normally go out, it flashes instead, in phase with a low fuel warning in the central cluster.

A similar gauge is used for engine temperature, updated every 4 seconds, with two red chaplets at the upper end of the scale which also flash with the high temperature warning. Both auxiliary gauges are also linked to a voice synthesis system, which supplements the operation of the instruments and the trip computer to monitor selected operating functions and provide audible warnings.

The German connection is through the use of Volkswagen AG transmissions.

Maplin Electronic Supplies have been awarded the Sole UK Agency for the world famous Heathkit Electronic Training range of products.

Kits range from a basic clock to a more advanced level Robot.

Fast Take-Off

The fast expansion in demand for the avionics and military communications equipment produced by Plessey has led to the formation of two new companies.

They are Plessey Avionics, to be based at West Leigh and Plessey Military Communications, based at Ilford and South Leigh.

The National Farmers Union Monmouth County offices are to install Tandata Prestel/Viewdata equipment as part of a plan to link up all the NFU's Welsh offices via Prestel.

Cold Store

For testing the company's latest range of fridge freezers, Electrolux have chosen the Burr-Brown's CS450 data acquisition and control system.

Once assembled, the fridge/freezers are passed to a forty station test area where performance is monitored in real time to ensure that seals, insulation and refrigeration equipment are working correctly.

The CS450 continually scans the inputs and displays the resulting data once per minute.

A group of 20 companies from the Japanese electronics, camera and magnetic tape industries have reached an agreement on basic specifications for the magnetic disc to be used in electronic still camera systems (still video camera based on magnetic recording).

CB Changes

The UK channels for 934MHz CB Radio are to be adjusted in line with a recent international agreement on a channel plan for Europe.

The agreement, which was reached by the Conference of European Posts and Telecommunications Administrations (CEPT), means that the UK channels will be moved downwards by 12·5kHz. All other technical requirements will be unchanged.

ORIC Goes to Japan

To meet increasing demands, Oric Products International have announced that a new company is being formed in Japan to sell and manufacture the Oric range of home and personal micros and peripheral equipment.

The new company, Oric Japan, is a joint venture between Oric and a team of specialised personnel in Japan whose skills include both manufacturing and marketing micros.

Oric sales director, Peter Harding explains that "The Japanese marketplace is a tough nut to crack. However, our technical team have developed the Kana character generator set which can now be used in the Japanese version of Oric.

"We believe this is a 'first' for any non-Japanese manufacturer."

TV POST

To help boost sales and promote the wide range of services available across Post Office counters, European Marketing Consultants are supplying 500 TV-style monitors for installation in Sub-Post Offices throughout the UK.

The monitors switch on automatically as customers walk into the range of a sonar sensor. A variety of Post Office products and services are described in colour slides and sound on a five to ten minute promotional tape.

APPOINTMENTS

Professor John Michael Ashworth, PhD, DSc, FIBiol; Vice-Chancellor of the University of Salford since 1981, has been appointed Chairman of the National Computing Centre from 27 July, 1983. He succeeds Dr. J. H. H. Merriman who was appointed Chairman in 1977.

Mr. John G. Payton, CEng, MIMechE, MIProdE, MBIM, has been appointed managing director of Thorn EMI Instruments. He succeeds Mr. Christopher Power, who was recently appointed president of Systron-Donner Inc., Thorn EMI's American electronics subsidiary in California.

For his pioneer work in bringing the computer into the home and for his many electronic innovative ideas, Clive Sinclair was awarded a knighthood in Mrs T's first honours list after her return to Government.—Well done Sir Clive!

Dr. Ivan Dunstan has been appointed Standards Director of the British Standard Institution. In his new post, Dr. Dunstan will be responsible for the technical aspects of BSI's national and international standards programme which covers some 8500 standards.

British Telecom has now formally approved the ruggedised version of the Swedish Stratos fibre optic connector, for use on all standard optical systems.

Acting quickly on the BT approval, Stratos have set up a UK office in Suffolk and appointed Andy Harding as UK product manager.

Sales remain in the hands of sole UK agents MCP Electronics, but technical support and applications advice will be supplied by Mr. Harding.

QUEEN'S AWARD FOR TELETEXT

THE IBA's Engineering Division and the BBC's Engineering Directorate have been jointly granted the Queen's Award for Technological Achievement for their pioneering work on the development and transmission of Teletext, the basic concept of which has been adopted worldwide. It is the third time that the BBC has received such an award. Teletext-Independent Television's ORACLE and the BBC's CEEFAX—uses four spare lines in the unseen part of a TV picture to transmit pages of data which can be received by television sets equipped with a special decoder.

The success of the Teletext system has followed many years of co-operation between the two companies and also acknowledges the significant contribution made by British industry in the design and production of economical Teletext receivers used by the viewing public.

The UK system has been adopted as an international standard by broadcasting organisations in Europe, America, Australia and the Far East. Apart from general information pages, including news, weather, latest scores and so on, it also carries pre-recorded sub-titles for the hard-of-hearing on selected programmes. The latest innovation from CEEFAX is the transmission of Telesoftware, that is, computer programs that can be down-loaded directly into the BBC's home computer.

The idea of displaying data on domestic TV screens was first mooted in 1970 when the then head of the BBC's design department, Mr. P. Rainger suggested a system of alphanumeric character generation whereby up to 30 pages of text could be continuously updated. He concluded that the information could be sent over the telephone line or within the existing television signal; he thus anticipated both Viewdata and Teletext!

A year later work was started on the then called Teledata and in 1974, a common standard was drawn up between the BBC and the IBA embodying the best features of each of the companies two systems, for the IBA had also been developing a similar system.

Teletext was officially born on 18 September of the following year when the Home Secretary approved a two-year experiment using pages carrying news and similar material on both CEEFAX and ORACLE. Since then, development work has continued, enabling better graphics and different character sets for foreign language users and culminating in photographic quality pictures being transmitted over the CEEFAX system in March 1982.

COUNTER INTELLIGENCE

BY PAUL YOUNG

Calculated Lesson

In view of the growing importance of computers, it is almost inevitable that I give them a mention. The smallest type, the pocket calculator are now being issued to children in schools, along with the pencils and rubbers. I suppose it had to happen!

There is a sound argument in favour—why tire your brain with difficult problems, when with a few dabs at the calculator's buttons and you have the answer. At the same time, I feel it is essential to learn the basic rudiments of mathematics; it is so easy to misplace the point, or slip in an extra zero, so you need enough knowledge to see if the answer on the calculator looks right. Also, don't use the machine to add up long columns of figures, unless it has a print-out, because it is impossible to check on an incorrect or missing figure.

One must use common sense, as the following will illustrate. A class was set the following problem. Ninety children have to be driven to school by bus, each bus holds thirty-three children. How many buses will be needed?

Out come the calculators, click, dab-dab dab, click—up go all the hands, the teacher asks a pupil for the answer. "Two point seven two, recurring, Miss!! Anyone who has waited for a number 14 in the rain will tell you that there is no such thing as a recurring bus!!!

Service Bar

I am still surprised at the number of people who come into the shop clutching an odd plastic cog wheel or weird value potentiometer and ask plaintively "have you one of these"? I usually have to break it to them gently by explaining that the part will only be obtainable from the manufacturer, and suggest they approach the Dealer from whom they bought the radio or tape recorder or whatever. Again, I am astonished at the number who say, "Oh, I've already done that, but he doesn't want to know"!

If I had sold a piece of equipment to a customer, who later asked me for a spare part, I would do my utmost to obtain it, indeed, I would consider the onus to be on me to do so. Had I ever made a declaration of "not wanting to know" I would have expected my customer to start dismantling the shop and probably me as well! With the very sophisticated machines we have on offer today, good service is more vital than ever before, and that includes easily obtainable spare parts.

Talking of service reminds me that in my locality a television repair bar has recently opened, on the lines of the well known heel bars. You pop in with your "telly" and sit and wait until it is repaired, or as the repairers wisely suggest, "drop it in on your way to work and collect it on your way back". This strikes me as a step in the right direction.

Idiot Keyboard

I was talking to a friend the other day, who had purchased an electric organ a few months ago, and he made the following statement:

"Now that we have electronics I wonder how much longer the piano-type keyboard will survive? When I started to learn to play the electronic organ I quickly decided that the keyboard and music systems had been designed by idiots for idiots.

Of course, it was necessary to have the piano-type keyboard when the system was entirely mechanical with rods and pulleys and bits of string. Now, however, the obvious method is a typewriter or computer-type keyboard. This would have the advantage of always being able to use the same finger for a particular note, which would make learning so much easier.

I found using different digits to play a particular note, depending on the score, very frustrating and counter-productive. Whereas I learnt to touch-type reasonably proficiently in about three months, there was no way that I could learn to read and play music to the same level in this sort of time.

Incidentally, the BBC are now putting out music programs for computers on Teletext which does convert the computer keyboard into a musical instrument, complete with about six different voices or stops."

Now while I enjoy music from the Beatles to Beethoven, my achievements as a performer have never progressed beyond "Chopsticks" and Chopin's Funeral March, played with two fingers, and so I asked the opinion of a few musical friends, the majority of whom did not agree with the computer-type keyboard idea. As my friend never makes a statement of any kind without good reason, I thought I would throw his statement open to any of our readers who are musically inclined, and I await their answers with expectation.

PLEASE TAKE NOTE

Eprom Programmer for TRS-80 & Genie *(June 1983)*

In Fig. 4, page 341, the view of the expansion slot for the TRS-80 has been incorrectly labelled. The address, data and control lines are shown in their correct positions but have been given the wrong position number. See Fig. 1 below for correct numbering according to the TRS-80 Manual.

This error has generated a second error, in the circuit diagram, Fig. 3b, where all the expansion slot position "numbers" are incorrect. Re-label each line according to Fig. 1.

In the component layout diagrams (Fig. 9 and Fig. 10), diodes D6 and D7 have been shown connected the "wrong way round". The correct orientation of these devices can be seen in Fig. 2.

In the circuit diagram, Fig. 5 there should be no link between TR3 base and 0V.

In the components list, make the following changes to agree with the circuit and layout diagrams: D1 TIL220 red l.e.d.; D2, D3 1N4148 small signal silicon (2 off); C1 0·1μF plastic or ceramic.

Real Time Clock, Apple *(May 1983)*

In Fig. 4, the lead from IC2 pin 13 is incorrectly labelled. It should connect to edge contact position 30 (as in the circuit diagram, Fig. 2) and not contact position 8 as shown.

A connection between B1 -ve terminal and the system 0V has been omitted from Fig. 2.

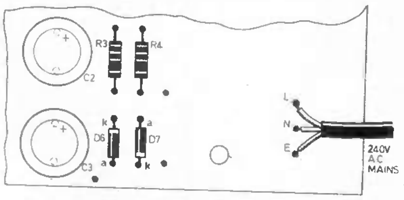


Fig. 2

This must be made otherwise there will be no back-up supply in the clock chip, IC1, when the computer is turned off.

Cyclic Redundancy Check for the Acorn Atom *(July 1983)*

On page 423, under THE PROGRAM, second paragraph, line 9, should read ". . . 300 Baud) or # SAVE the two . . ."

Two programs are listed, the left-hand column contains the Source, Program, and the right-hand column contains the Dis-assembled Program.

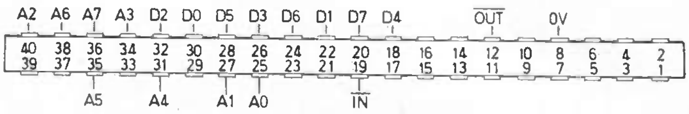
Dual Power Supply, Test Gear 83 *(March 1983)*

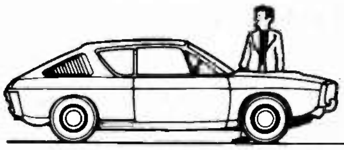
The coil resistance for the panel meter, ME1, was incorrectly specified as 120 ohms in the components list. It should be the 1mA, **200 ohm** type ML52 meter.

Transistor Tester, Test Gear 83 *(June 1983)*

The coil resistance for the panel meter ME1 was incorrectly specified as 1·4 kilohms in the components list. It should be 100μA, **3·5 kilohm** type ML52 meter.

Fig. 1





BY P. BARBER

CAR INTRUDER ALARM

THE alarm is designed to provide a cheap and effective method of preventing the theft of the car or its contents. It is designed to allow easy installation within the vehicle, with as little integration with the car electronics as possible.

There are already many types of car intruder alarms on the market, most of which fall into one of two categories; either the device detects movement within the car using an ultrasonic transmitter/receiver system, or the alarm is triggered by a mechanical switch in the door, often the courtesy light switch, when the door is opened.

The Car Intruder Alarm is based on the second method, but with a difference. Instead of detecting a voltage, this device detects the actual light emitted by the courtesy light, thus eliminating the need to have any physical connections between the alarm, door switches and the interior light.

As the device is therefore a "stand-alone" type alarm which operates on a light sensing basis, it is envisaged that it could be employed elsewhere; for example, to protect jewellery in a darkened room where any light caused by an intruder would trigger the alarm.

DESIGN CRITERIA

The Car Intruder Alarm is designed for installation within the car; it can be placed in any convenient position probably bolted under the dashboard, or even under the driver's seat.

Because of its situation, a normal on/off switch is clearly impractical because an intruder could simply switch the alarm off! To overcome this, a simple key switch is used. The "key" is a standard DIN plug PL1 which, when inserted into the device, switches it off, and when removed causes the alarm to take up a "ready" state.

The actual alarm itself has three phases; phase one is the intermittent sounding of an internal warning device (WD1) attached to the case of the unit, phase two switches the warning device full on, and phase three operates an external alarm for which the car horn is ideal. Phases one and two are designed mainly to disturb the intruder and each lasts for about ten seconds, the final phase obviously has more general effects, and this stage can be set to last up to seven minutes before the alarm automatically shuts down.

The light detector is an ordinary light dependent resistor (PCC1), which is positioned adjacent to the courtesy light and protected from other light sources by insulating tape. Provided that care is taken to install it correctly, this produces a most reliable indicator.

FURTHER FEATURES

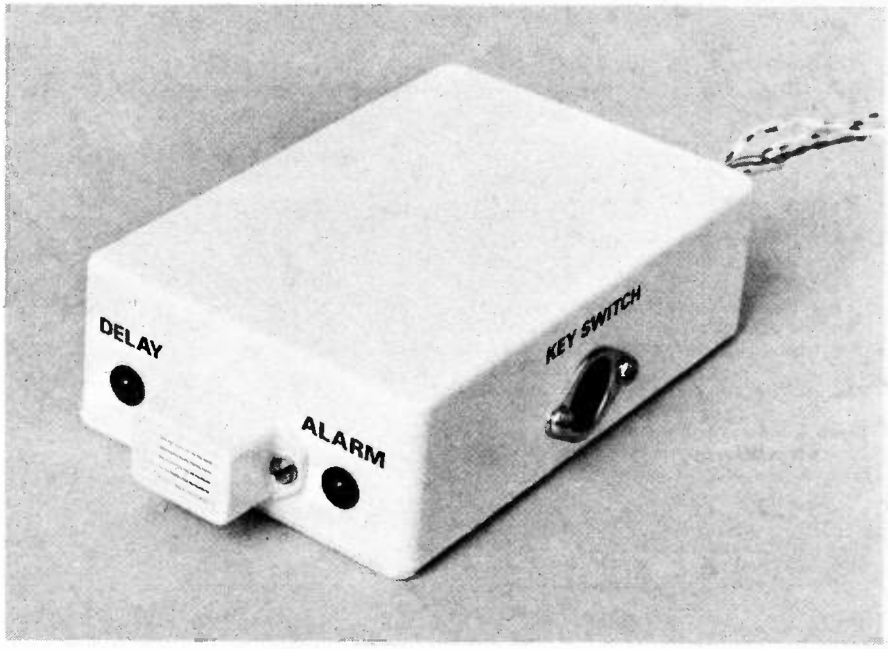
Two further features are included in this design. Firstly, it can be seen that the alarm will be triggered immediately a door is opened, regardless of whether or not it is an intruder who opens it. As the device cannot be switched off from outside the car, every time the owner enters the vehicle he or she will have to contend with the uncomfortable internal warning device until PL1 is inserted. As this is clearly rather unsatisfactory, a "mute" touch switch is incorporated into the design.

The touch-switch is positioned inside the car near the driver's side door, where it can easily be touched as soon as the door is opened. The touch-switch silences the alarm for the duration of phase one (about 10 seconds) and therefore allows the owner plenty of time to switch the device off permanently using PL1, without the alarm sounding. Once phase one is over, the other phases continue uneffected if the alarm has not been switched off.

The second feature allows the owner to leave the car without triggering the alarm. If this feature was not incorporated, the owner would trigger the alarm just by opening the door (thereby switching on the courtesy light) to get out. Therefore on removal of the PL1, there is an automatic one to six minute delay before the device is "armed", which allows plenty of time for the doors to be shut again.

The Car Intruder Alarm is built around simple CMOS dual input OR, NOR, and NAND gates, as these are cheap, easy to use, and most importantly require very little current when operating. This is vital because the device will very rarely, if ever, be physically disconnected from its power source, and will also spend long periods of time in the "armed" state. The actual power source is provided by the car battery; in addition to this an internal back-up battery B1 is included which is only used if the normal supply is cut, or falls below a minimum level of voltage.

Car Intruder Alarm with finished lettering indicating the operating functions.



CIRCUIT DESCRIPTION

To simplify explanations, each part of the circuit will be dealt with separately. Generally, the design uses the Schmitt trigger technique to form fast switching timing and light detection networks, with bistable latches to store conditions. The complete circuit diagram is shown in Fig. 1.

KEY SWITCH

This consists of the Schmitt trigger built around IC1a and IC1b. The key plug (PL1) and socket combination are wired so that when the plug is inserted, SK1/4 and SK1/5 are connected together. The inputs of IC1a (pins 5 and 6) are then held low by R4. When PL1 is removed the inputs of IC1a are taken high via R10, a pull-up resistor, causing the output of IC1b (pin 3), to rapidly go high in turn. This effectively switches the device on.

LIGHT DEPENDENT RESISTOR

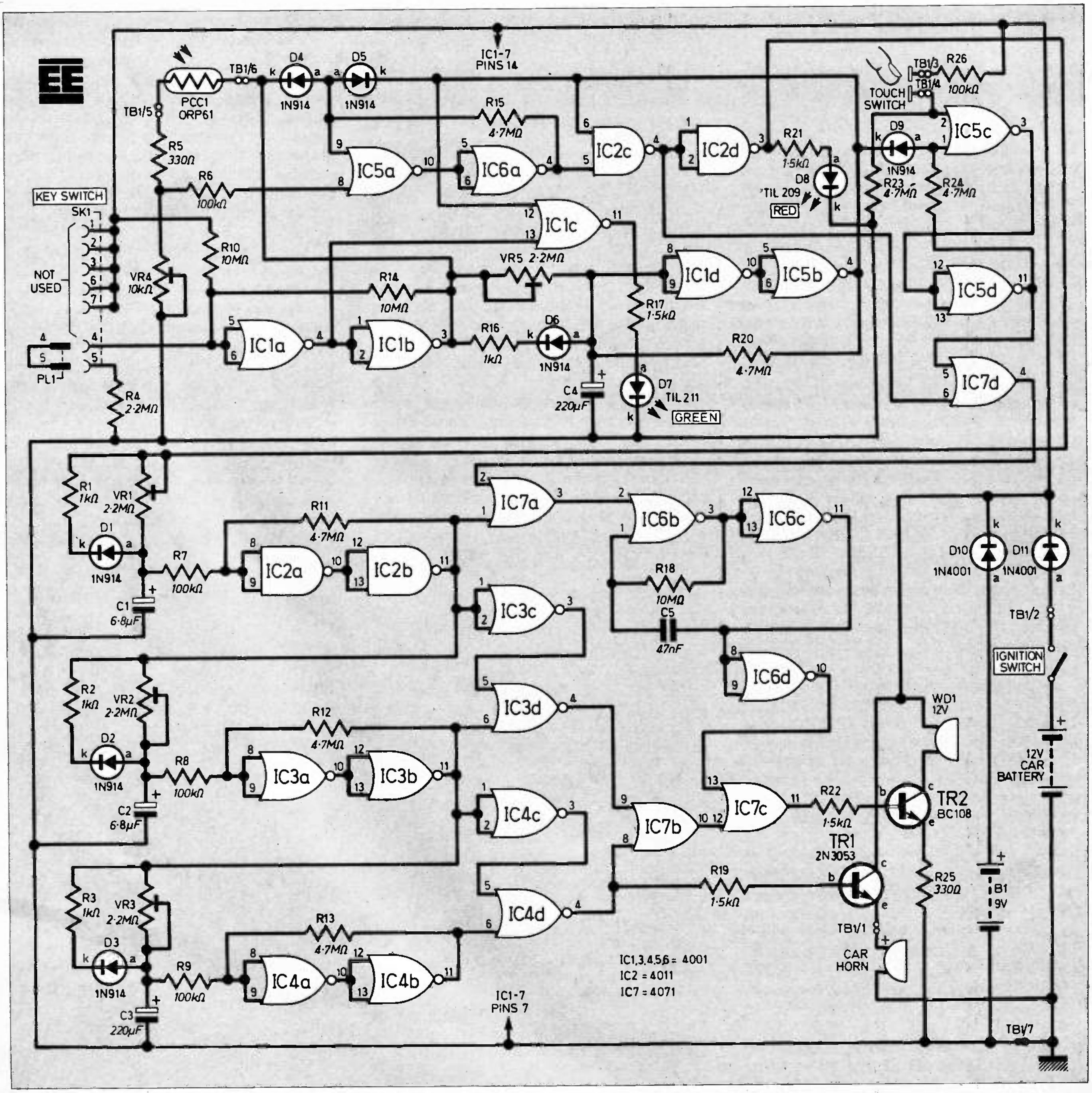
When the output of IC1b goes high, PCC1, R5 and VR4 form a potential divider used to trigger the bistable latch of IC5a, IC6a and R15. As the resistance of PCC1 depends on the amount of light falling upon it, at a certain intensity the voltage at the inputs of IC5a (pins 8 and 9) will cause the bistable latch to operate and hold the output of IC6a (pin 4) high.

VR4 is used to set the light level needed to the required amount. D4 is included to reset the latch when the output of IC1b goes low (PL1 is inserted).

INITIAL DELAY TIMER

When the output of IC1b goes high, C4 begins to charge through VR5. When the transfer voltage of the Schmitt trigger formed by IC1d, IC5b and R20 is reached, the output of IC5b goes high

Fig. 1. The complete circuit diagram for the Car Intruder Alarm.



and arms the device by taking IC2c high. IC2c can be regarded as the control gate as it is this gate that starts the alarm if required. D5 prevents PCC1 from latching until after the delay phase by holding the latch input low.

While the delay is in operation, both inputs of NOR gate IC1c are in a low state which causes the output to go high and thus illuminate the green l.e.d., D7. Note that when the output of IC1b goes low, C4 rapidly discharges through R16 and D6.

This technique is used for all the timing systems in the design to make the device instantly ready for re-use once PL1 has been inserted. D6 prevents the capacitor from charging through R16, which in turn is included to limit the current flowing to the output of IC1b.

ALARM CONTROL AND MUTE SWITCH

As IC2c controls the alarm by checking the condition of the outputs of IC5b (the initial delay timer) and IC6a (the light detector). If both of these are high (and only then), the output of IC2c (pin 4) goes low, which is then inverted by IC2d. This causes the red l.e.d. D8 to be illuminated, showing that the alarm has been triggered.

The various phases of the alarm now begin to operate, as described in the following sections. When the alarm is not in the "triggered" state, the output of control gate IC2c is high and therefore the output of IC7d is also high. This blocks phase one of the alarm, the intermittent warning device, by preventing the astable multivibrator from oscillating.

However, IC7d is also used to block the oscillator when the touch switch is pressed, using the same method. IC5c, IC5d and R24 form a bistable latch, normally held low by R23. When the touch-switch is pressed, R26 takes the input of IC5c high, causing the output of IC5d to latch in the high state. The output is then fed to one input of IC7d. D9 prevents the latching until after the initial delay is complete.

ALARM PHASE ONE

The high state of the output of IC2d causes C1 to start charging through VR1. At this point, the output of the Schmitt trigger formed by IC2a, IC2b and R11, is low, and as the output of IC7d is also low (unless the touch-switch has been operated), then the output of OR gate IC7a will be low as well. This enables the astable multivibrator formed by gates IC6b and IC6d to oscillate at a frequency of about 1Hz.

These pulses are fed through to operate the warning device circuitry of R22, TR2 and WD1. (Note that if the enable input of NOR gate IC6b is high, its output is low, thus preventing the astable from oscillating.) When the state of the Schmitt trigger changes, the output of IC7a goes high and blocks the oscillator as described.

ALARM PHASE TWO

When the output of IC2b goes high, C2 begins to charge through VR2, eventually causing the output of the Schmitt trigger formed by IC3a, IC3b and R12 to go high. Until this occurs, both inputs to NOR gate IC3d are low (IC3c inverting the high output of the phase one timer), and therefore its output goes high and the two OR gates (IC7b and IC7c) transmit this to the warning device circuitry, switching WD1 full on.

ALARM PHASE THREE

This stage is built around the timer and Schmitt trigger network of IC4a, IC4b, R13, VR3 and C3. The operation of this stage is identical to that of phase two, with the high output of the previous phase timer being inverted, this time by IC4c, to give a low state to both inputs of IC4d and thereby switching WD1 full on.

In addition though, while the output of IC4c is high (before the timing is complete), TR1 is also switched on, taking terminal block TB1/1 to about supply line potential. This high voltage supplies the external alarm (car horn). When the output of IC4b finally goes high, the output of IC4d goes low. This prevents TR1 from conducting, and the external alarm is switched off.

Both inputs of IC7b are now low, so that WD1 is also disabled. This means that the alarm has effectively shut down.

POWER SUPPLY

The Car Intruder Alarm has a dual power supply. The positive line from the car battery is connected to TB1/2 and the positive terminal of the internal battery is connected to the anode of D10. D11 and D10 form a discrete OR type gate, with the output potential depending on the higher input. As the car battery will normally have a voltage of about 12V, and the internal battery only 9V, under normal conditions no current is drawn from the internal battery. Should the power supply from the car battery be cut, however, the internal battery would then supply the alarm to enable it to continue.

CONSTRUCTION

CIRCUIT BOARD

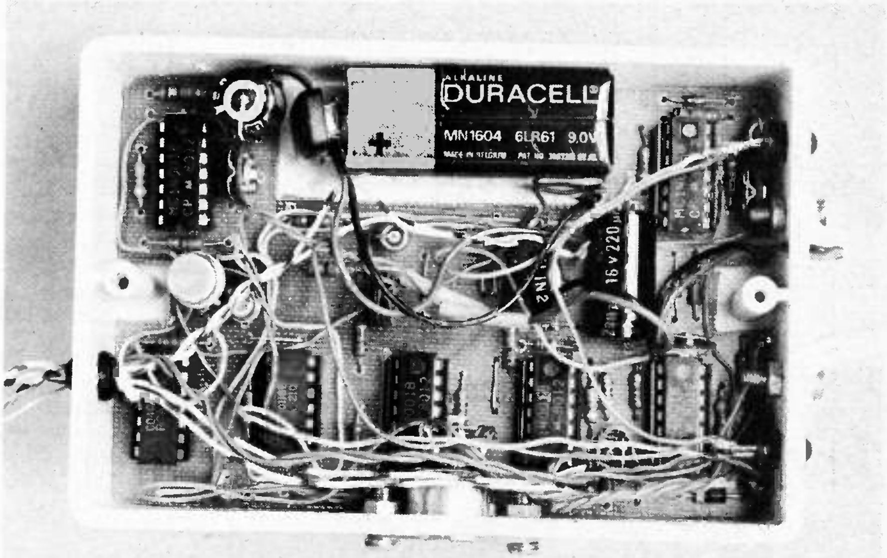
The author found that the circuit board was a sufficiently tight fit in the case to render retaining bolts unnecessary; however, if the constructor finds that this is not the situation, then holes for bolts should be drilled as required. Once the printed circuit board has been etched and drilled the components can be mounted as shown in Fig. 2. It is recommended that the i.c. holders are positioned first, but the actual i.c.s not inserted until all other components and links are in place. Care must be taken to ensure that all links are inserted correctly and these should be added after all the main components are in place.

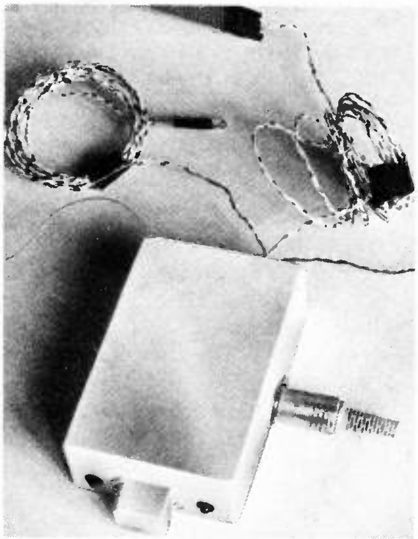
This board is available from the *EE PCB Service*, Order Code 8308-02.

Finally, Veropins should be soldered in place to connect all flying leads to the board. Note that all unused pins of the on/off DIN socket (SK1) are connected to the positive supply line, this is to safeguard against the use of a "master" key plug, which has all its pins connected together. The constructor should wire PL1 to match SK1; by doing this the constructor is "personalising" the system thereby severely decreasing the chances of an intruder having a suitable on/off "key" himself.

Once the circuit board is complete, it should be completely tested before installing it and all connections to the board should be made before the board is fitted into the case.

The prototype circuit board mounted inside the plastics case. The cut-out in the p.c.b. to take the back-up battery can be seen.





The prototype ready for installation in the car, showing buzzer and l.e.d.s mounted on the front and the "key" inserted in the side DIN socket.

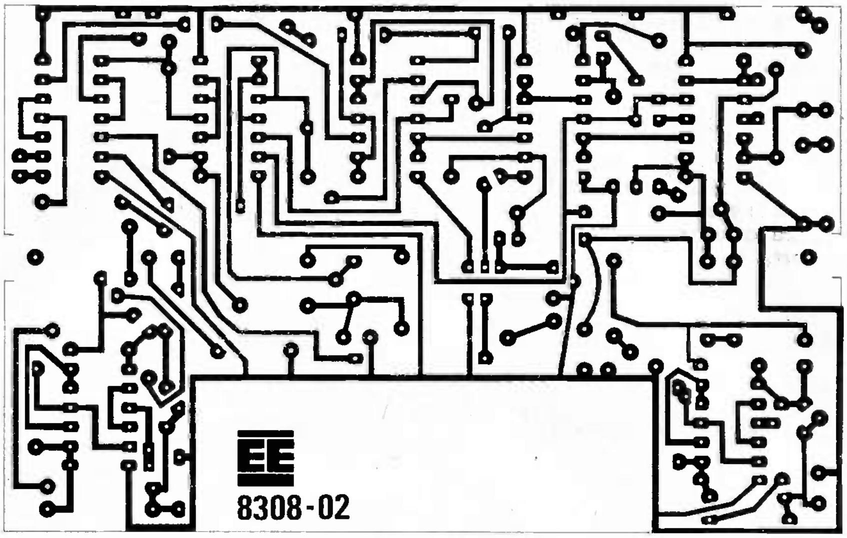
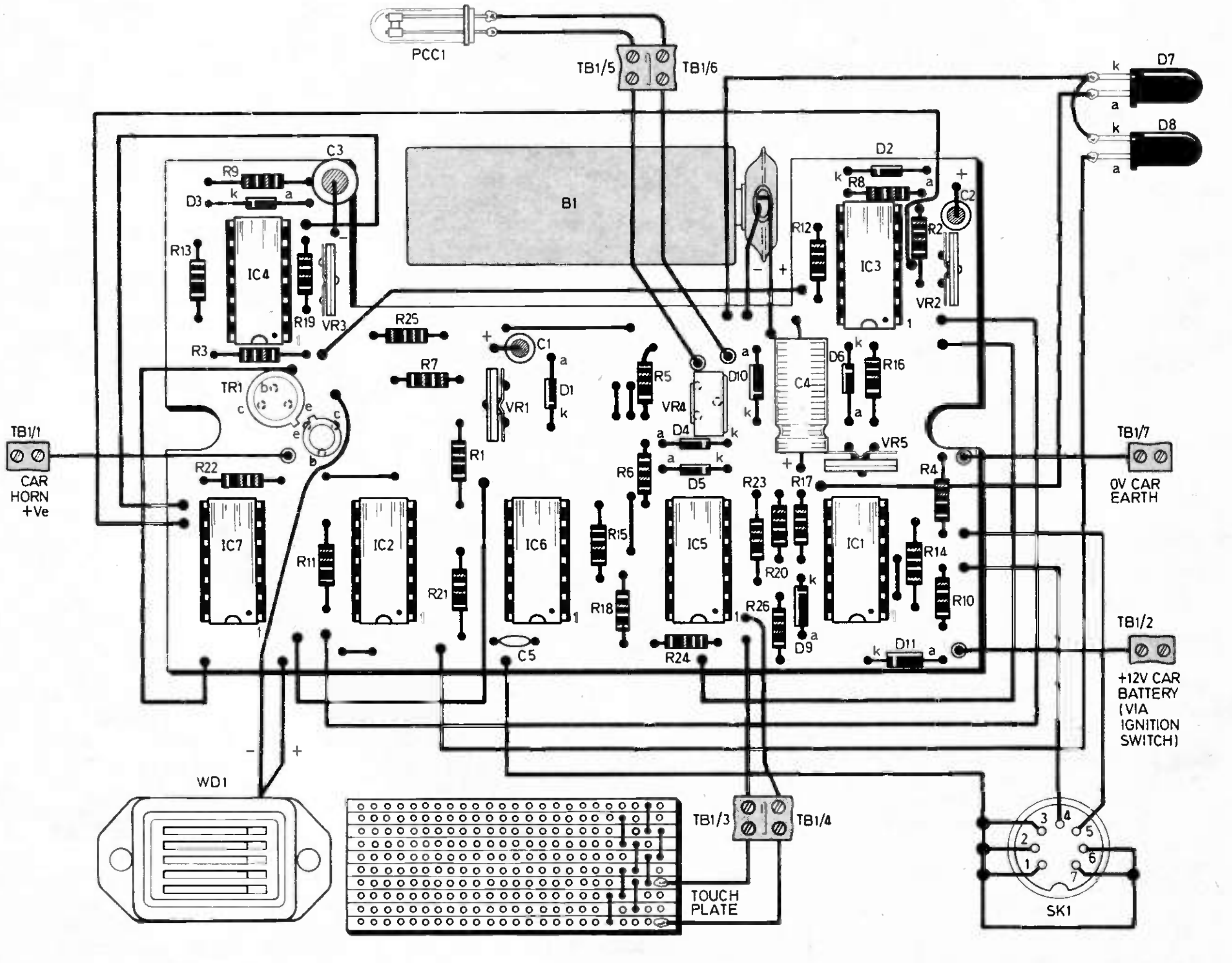


Fig. 2. Full size master printed circuit pattern. The black areas represent the copper tracks remaining after etching. The complete component layout and wiring to the circuit board is shown below. The terminal to connect remote components and for wiring to the car should be mounted on the outside rear of the case. (This board is available from the *EE PCB Service,* Order Code 8308-02.)



The Car Intruder Alarm is built into a small but strong plastic case, the size of which is about 115 × 76 × 38mm, although any box of approximately the same size should be suitable. The internal warning device WD1, the DIN socket, and the two l.e.d. indicators D7, D8 are mounted on the case. The fixing holes for these should be drilled before the p.c.b. is mounted in the case. A hole should also be drilled to accommodate a small rubber grommet.

TESTING

As already stated, the testing of the unit should be carried out before the board is permanently installed in its case, to allow any modifications to be effected if required. The various external components should therefore be temporarily connected at this point.

COMPONENTS

Resistors

R1,2,3,16	1kΩ (4 off)
R4	2·2MΩ
R5,25	330Ω (2 off)
R6,7,8,9, 26	100kΩ (5 off)
R10,14, 18	10MΩ (3 off)
R11,12, 13,15,20, 23,24	4·7MΩ (7 off)
R17,19, 21,22	1·5kΩ (4 off)

All $\frac{1}{4}$W carbon ±5%

See Shop Talk page 487

Capacitors

C1,2	6·8μF 40V miniature elect. (2 off)
C3,4	220μF 16V elect. (2 off)
C5	47nF disc ceramic

Semiconductors

D1-6,9	1N914 silicon (7 off)
D7	TIL211 0·2in green l.e.d.
D8	TIL209 0·2in red l.e.d.
D10,11	1N4001 rectifier (2 off)
TR1	2N3053 silicon *npn*
TR2	BC108 silicon *npn*
IC1,3,4, 5,6	4001 CMOS quad 2-input NOR gate (5 off)
IC2	4011 CMOS quad 2-input NAND gate
IC7	4071 CMOS quad 2-input OR gate

Miscellaneous

VR1,2,3,5	2·2MΩ lin. skeleton vertical presets (4 off)
VR4	10kΩ lin. skeleton vertical preset
PCC1	ORP 61 light dependent resistor
WD1	6–12V buzzer
SK1	7-pin DIN socket
PL1	7-pin DIN plug

Printed circuit board: single-sided size, 109 × 71mm *EE PCB Service* Order Code 8308-02; case, 116 × 78 × 35mm; terminal block 7-way; rubber grommet; insulated connecting wire; 0·1in matrix strip-board, 10 strips by 24 holes; Vero-pins; 14-pin d.i.l. holder (7 off); battery clip.

Approx. cost Guidance only £18

Set the preset potentiometers (VR1–5) to their mid-point positions. Connect a 9V battery to the unit, and remove PL1. The green l.e.d. (D7) should light up, and the alarm stay silent. Shine a bright light on PCC1. This should have no effect. After a couple of minutes D7 should extinguish. This time, when light is applied to PCC1 the warning device (WD1) should immediately start sounding intermittently. If the touch-switch is touched, the alarm should be switched off, to come on again a few seconds later.

Connect a voltmeter to the emitter of TR1. The voltage should normally be 0V, rising to about 8V after a short while. Now leave the device alone for a few minutes. (It may be an idea to disconnect WD1.) Eventually the voltage reading should drop back to 0V. Re-connect WD1 if necessary, this should now be silent. When the alarm is sounding, and until PL1 is inserted, the red ("alarm") l.e.d. D8 should be on. Once the PL1 is inserted the alarm should immediately go off.

Finally, check the current consumption of the unit with an ammeter. With PL1 inserted this should be less than 1μA, rising to 5–8mA as soon as PL1 is removed (due to D7). In the "armed" state, the current should not be greater than 3mA, depending on the ambient light conditions.

INSTALLATION

It is recommended that some thought is given to installation before the unit is built. The positioning of the device within the car is very much the choice of the owner, any holes for mounting brackets and bolts will normally have to be made in the case at an early stage of construction. Right angle brackets bolted to the side of the case provide a good method for mounting the unit below a shelf or the dashboard, or against the side of the car. The distance between the proposed position for the main unit, and its peripherals (the light detector and touch-plate), can then be measured so that the leads to these items can be made the correct length.

Once the unit is completed it can be mounted in the car. PCC1 should be attached with insulating tape to the side of the courtesy light, making sure that the sensitive side of PCC1 is facing into the light. The two leads to the external power source can now be connected, the earth to the body of the car at a convenient point, and the positive to the battery. It is advisable to put an in-line fuse on this lead, with a value of about 2A.

The lead to the car horn can be attached to the positive side of the horn (TB1/1) at this point. When this is done, the light detection circuitry can be set to trigger the alarm when the courtesy light comes on. This is achieved by adjusting the preset potentiometer VR4. Disconnect the positive lead from the car battery and check that the alarm will still trigger correctly; it should be possible to set the light detector to work correctly from both supplies, although the main supply will be the car battery and this therefore is the most important.

Finally, to check that the light detector system is sound, shine a torch from various angles and positions onto PCC1 and ensure that it will not trigger the alarm.

The touch-switch can then be attached to the side of the car near the driver's door, or behind the driver's seat. This can be done by fixing strips of insulating tape to the required area, and then glueing the touch-switch to them.

SETTING UP

The last stage is to set the timing of the various phases as required. The initial delay phase should be set to last about 3 minutes, using VR5. To set the length of the first alarm phase, the constructor should first find out how long it takes for him or her to insert PL1 into the unit from the moment the door is opened. Add a couple of seconds, and then use VR1 to set the timer to this value. VR2 can then be set to operate phase two of the alarm for about 10 seconds. The final alarm phase should be set to last longer, say about 3–6 minutes, using VR3.

TERMINAL BLOCK CONNECTIONS

To make the internal car connections easier it is advisable to use terminal block connectors. It is suggested that a 7-way block is used, this can then be fixed to the outside of the plastics case.

The terminal block connections are as follows: the positive side of the car horn is connected via TB1/1, and the positive side of the car battery is connected via TB1/2. The touch-switch is connected via TB1/3 and TB1/4, PCC1 is connected via TB1/5 and TB1/6. The remaining terminal block connection is used for the car earth (TB1/7).

PERFORMANCE

Provided that the unit is carefully built and installed, the Car Intruder Alarm should prove most reliable. Obviously a device of this nature cannot be absolute protection against theft, but it should go some way towards it, and for a very modest outlay in terms of cost.

The unit consumes very little power; indeed with PL1 in place the current consumption is less than 1μA. In the "armed" state the current rises to about 3mA, and with the alarm sounding to about 35mA (not including the car horn). From these figures it can be seen that battery life would be considerable even if the unit was run entirely from the small internal battery; the effect on the life of the car battery is negligible. □

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TEMPERATURE INTERFACE FOR TANDY TRS-80 — ***Aug/Sept 1982***
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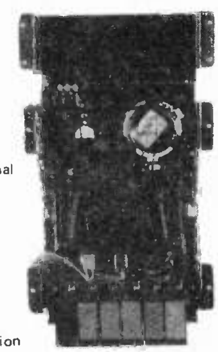

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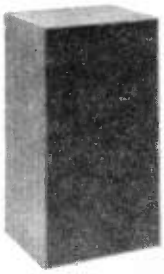

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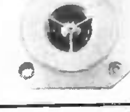

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R T V C

1kW MAINS POWER CONTROLLER

BY T. R. de Vaux – Balbirnie

Good lighting greatly enhances the quality of amateur stage productions, however, many dramatic societies still rely on the most basic equipment. Effective control of the lights is essential yet overheating, jerky, slide-type dimmers are used in many church and school halls.

Slide dimmers are just heavy-duty wirewound, variable resistors. To reduce the power supplied to a load (for example, a lamp), the excess energy is turned into heat within the winding. The device must therefore be large and well-ventilated thus portable use is not practical.

Although this type of dimmer has endeared itself to many by its characteristic smell of burning dust, the system described here uses electronic phase control and has several advantages. It operates by allowing only part of the a.c. mains wave to be used and produces very little waste heat so remains relatively cool and does not waste energy. Smooth control of the power is provided by a small potentiometer.

SINGLE CHANNEL

The basic design is given for just one channel but could be repeated any number of times subject to the maximum current allowed by the existing mains wiring. Note that the project is only suitable for use on a.c. mains and the prototype was tested on 240V 50Hz supplies only.

The prototype was designed specifically for dimming large filament lamps of the kind used for stage lighting but the circuit could be used for other purposes, for example, controlling an electric heater. It is unsuitable for controlling fluorescent lights and certain types of electric motors, however.

The rated maximum handling capacity is 1kW, that is, a single 1kW bulb or two 500W bulbs in parallel, but in tests the prototype was over-loaded by 50 per cent without ill-effect. Naturally, such overloading must be avoided in actual use but it confirms the heavy-duty nature of the design based on industrial rather than domestic practice.

One special feature, especially useful in stage lighting, is a miniature toggle switch which can switch the lamp on and off at any preset level of brightness. This is far more convenient than using the much "heavier" mains on-off switch. This switch may be omitted where the project is being used for other purposes.

SURGE CURRENT

Light dimming circuits present one major problem. The design must be conservative to handle the massive surge current which occurs when switching on a lamp. The "cold" resistance of the tungsten filament is much less than its "hot" resistance. The current flowing at the instant of switching on will therefore be much greater than the normal working figure. The "cold" resistance of a typical 1kW lamp is 3·5 ohms. When operating from 240V mains, the initial current may be found by Ohm's law:

$$I = \frac{V}{R} = \frac{240}{3 \cdot 5} = 68\text{A}$$

As the filament heats up, its resistance quickly rises and the current drops to a nominal 4A. Although the surge current lasts only for an instant it can be destructive to semiconductor devices which are not up to the job. For this reason, readers are advised to use the thyristors specified in the parts list. Cheap ones may seem adequate "on paper" but may fail in service.

CIRCUIT DESCRIPTION

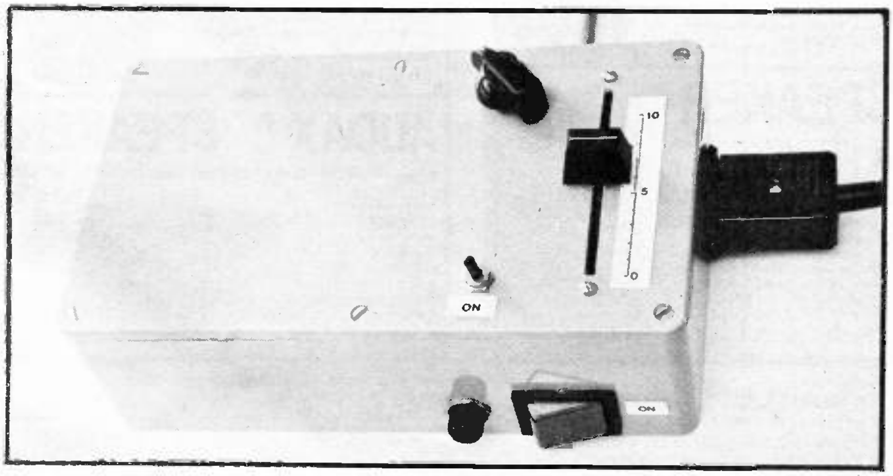
The circuit for the 1kW Mains Power Controller is given in Fig. 1. It is convenient to describe it "back to front", that is, from the load back to the circuit which controls it.

Current is supplied from the mains to the load through two thyristors CSR1 and CSR2. These are connected in "inverse parallel" so that each will be responsible for just one half of the a.c. wave. On each mains half-cycle one thyristor will be forward biased and ready to pass current while the other is reverse biased and unable to conduct.

The forward-biased thyristor will conduct if it is "triggered" by a positive pulse applied to its gate terminal. After having this pulse applied, the thyristor will remain conducting until the current through the load falls below a "threshold" value. This will happen towards the end of the half-cycle. The thyristor will then remain "off" until it is forward biased again and receives another firing pulse.

It will be evident that a thyristor fired near the beginning of a half-cycle will remain conducting right through to the end and the load will receive virtually full power. If, on the other hand, the pulse is delayed then only part of the a.c. wave will be allowed to pass. If the pulse occurs near the end of the half-cycle then the load will receive practically no power at all.

The 1kW Mains Power Controller Unit. The small toggle switch on top of the case is the "instant blackout". Note the Euro style mains output connector.



OSCILLATOR

The circuit consisting of TR1 and associated components produces the firing pulses. TR1 is a *unijunction transistor* and is the main component of a relaxation oscillator. With power applied, C1 charges up through VR1, VR2, R1 and R2. When a certain voltage exists across C1, TR1 suddenly conducts and allows C1 to discharge through the primary winding of the pulse transformer T2. The cycle then repeats.

The time taken for a pulse to be produced depends on the time taken for C1 to charge to threshold level and this depends on the values of C1, VR1, VR2, R1 and R2. The pulse of current in the primary of T2 causes similar pulses in the twin secondaries—one responsible for each thyristor. The thyristor which is forward biased will then be fired. The secondary windings of T2 are connected in such a way that the trigger pulse is positive-going for the gate of the forward-biased thyristor.

The oscillator circuit receives its power from the mains via transformer T1. The output from T1 is rectified by the bridge rectifier, D1 to D4. The oscillator then operates on both half-cycles since both are made positive-going. When the oscillator is operating quickly, several pulses will be applied to the thyristors during each half-cycle. This is of no consequence since it is the first one which fires the device.

The main adjustment to the rate of oscillation and hence to the power supplied to the load, is provided by VR1. In the prototype this was a slide potentiometer and thought to be more convenient than a rotary one. Due to the complex nature of the observed brightness of a lamp compared with the current flowing through it, better control was provided by a *logarithmic* (log. law) component.

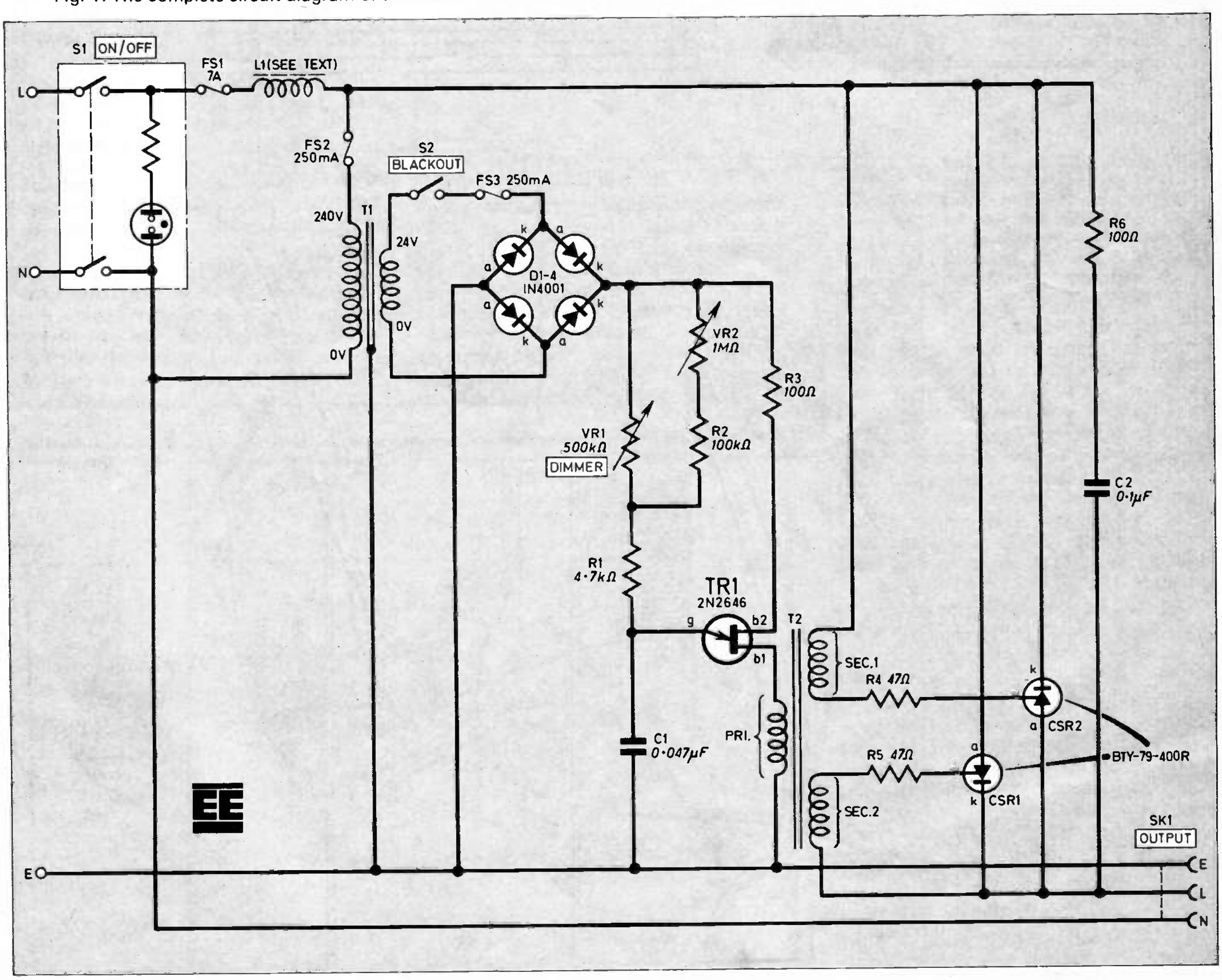
Tests using a linear component also proved satisfactory, however. VR2 is a subsidiary control allowing the minimum power to be preset. Thus, VR2 is adjusted in use so that the lamp is at its minimum required brightness with VR1 set at minimum. VR2 is a rotary control with either a logarithmic or linear track.

S2 is the "instant blackout" switch and simply interrupts the a.c. supply to the oscillator. Without pulses, the load remains "off". The network consisting of C2 and R6 limits the voltage rise time across the thyristors. This prevents possible false triggering and damage. Note that C2 *must* be correctly rated for continuous mains use.

The mains switch, S1, is of the double-pole type incorporating a neon indicator. This provides isolation of the project from the mains when off. Following S1 is a fuse mounted in a holder accessible from outside the case. This provides protection to the thyristors in the event of a short circuit. This sometimes happens when a lamp fails. This fuse should be included even when the device is connected to the mains by means of a fused plug. Note that the fuse should be of the ceramic (HRC) type and it is advisable to carry a spare.

Two more fuses are provided. Since these are unlikely ever to require attention, they are mounted in holders inside the case.

Fig. 1. The complete circuit diagram of the Mains Power Controller. VR1 is the slide dimmer and VR2 sets the minimum brightness.



1kW MAINS POWER CONTROLLER

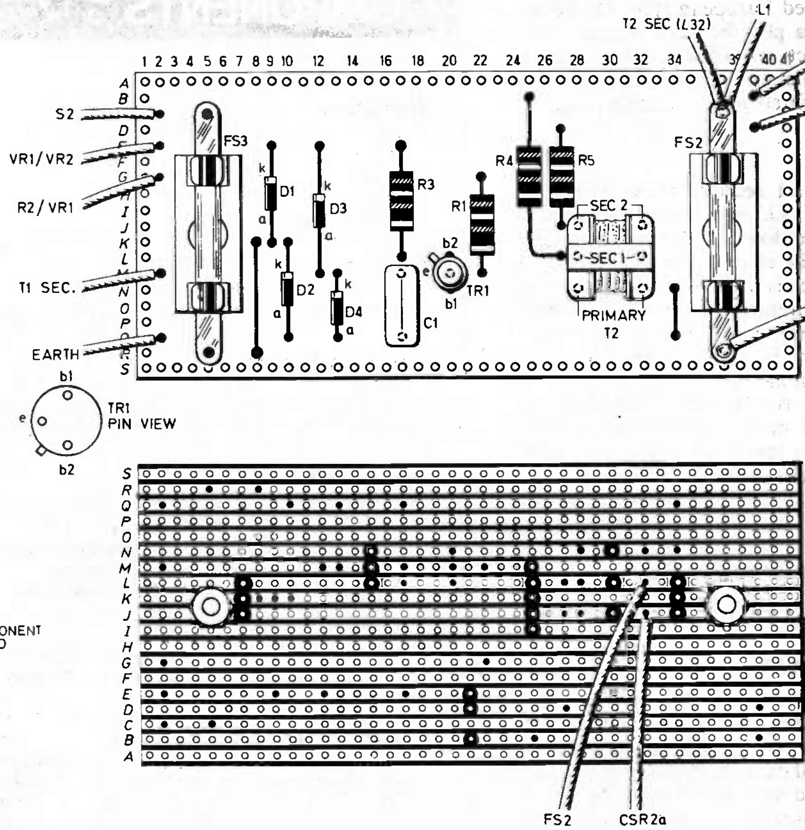


Fig. 2 (Right). The stripboard layout. The connections to FS2 are made directly to the tags whereas FS3 uses a wire link to the copper strips.

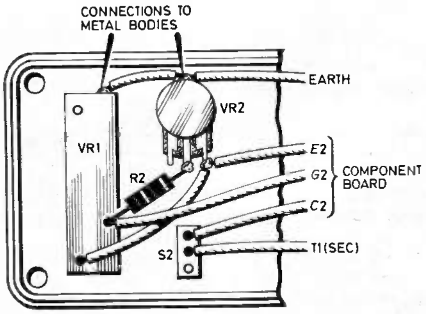
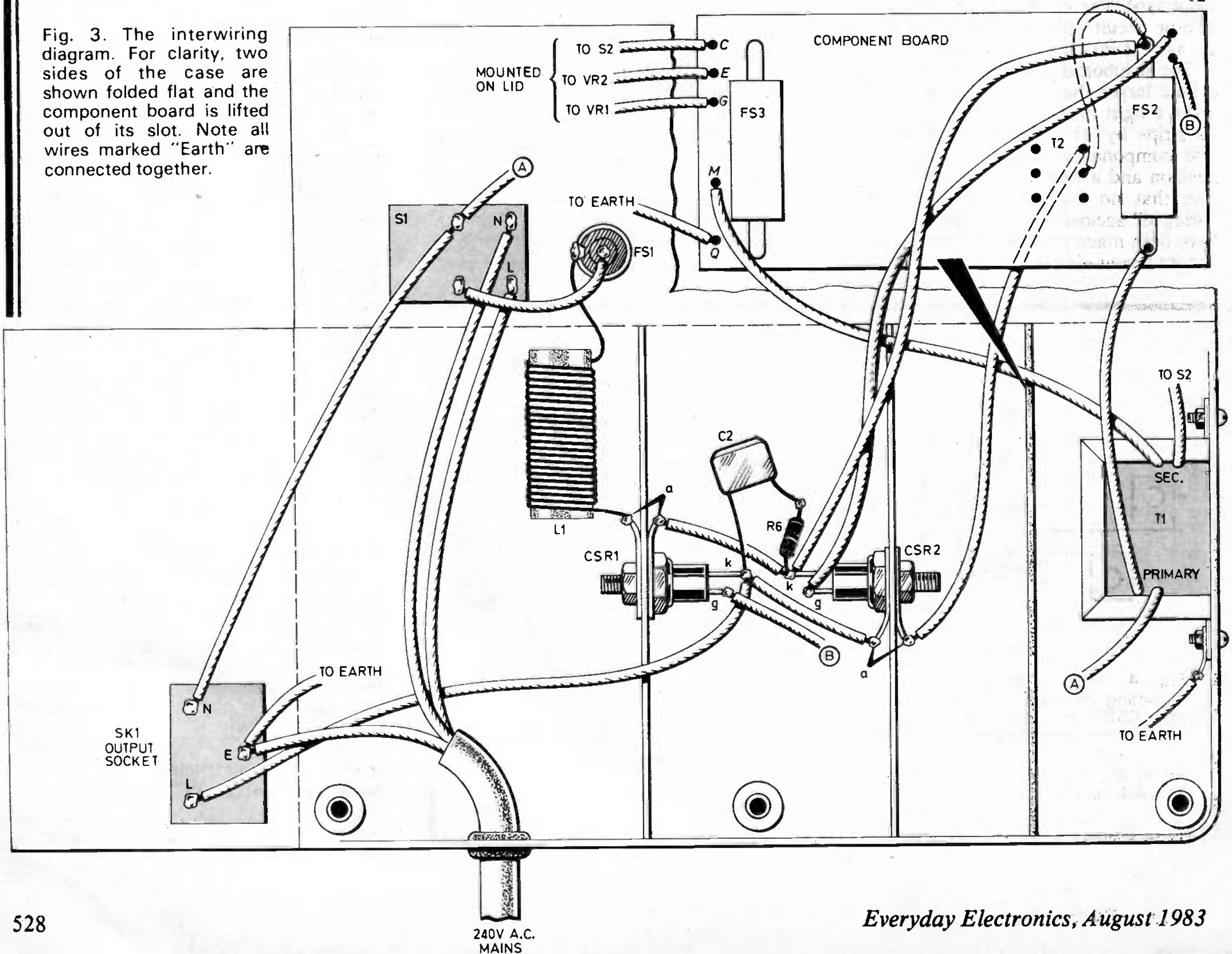


Fig. 3. The interwiring diagram. For clarity, two sides of the case are shown folded flat and the component board is lifted out of its slot. Note all wires marked "Earth" are connected together.



The outlet socket in the prototype was a 6A shuttered European type. **On no account must a plug be used** instead since mains connections could then be touched. The mains inlet consists of a length of 6A mains cable fitted with a suitable plug.

COIL

The coil, L1 reduces radio frequency interference (r.f.i.) which may cause buzzing from the loudspeaker of a nearby radio when the circuit is in use. This type of interference is always produced by circuits of this nature due to the extremely rapid switching action of the thyristors. The problem is worse when the load receives about half power.

There are two types of interference, radiated and mains-borne. Mains-borne interference is sent back along the mains wiring. L1 "chokes" this. Radiated interference is less of a problem and produces only a short range effect.

CONSTRUCTION

CIRCUIT BOARD

Construction is based on the internally-slotted plastic case specified in the components list. For reasons of safety, a metal case *must not* be used. The case has three internal panels: two of 18 s.w.g. aluminium and one of 0·1in matrix stripboard. The stripboard carries the oscillator circuit while the aluminium panels act as heatsinks for the thyristors.

The stripboard panel should be cut out a little larger than required then filed to make a tight fit in the slots. The size was 19 strips by 41 holes in the prototype. The components should be soldered in position and a careful check made to ensure that no copper tracks have been "bridged" accidentally and that all breaks have been made as indicated on the component layout diagram, Fig. 2.

COMPONENTS

COMPONENTS approximate cost £17

Resistors

R1	4·7kΩ
R2	100kΩ
R3,6	100Ω (2 off)
R4,5	47Ω (2 off)

All ½W carbon ±10%

Capacitors

C1	0·047µF polyester
C2	0·1µF mixed dielectric or polypropylene, mains rated

Semiconductors

D1-4	1N4001 silicon (4 off)
TR1	2N2646 *n-type* unijunction
CSR1,2	BTY-79-400R 400V, 6·4A stud type thyristor (2 off)

Miscellaneous

T1	miniature mains transformer, 12-0-12V or 24V secondary
T2	pulse transformer with twin secondaries, ratio 1:1+1
S1	d.p. on-off mains switch with integral neon
S2	s.p.s.t. miniature toggle
FS1	20mm 7A anti-surge fuse
FS2, 3	20mm 250mA anti-surge fuse (2 off)
SK1	6A Euro style mains socket
VR1	500kΩ slide potentiometer, log. track
VR2	1MΩ control potentiometer, log. or lin. track
L1	See text

Plastic case, with internal slots, 190 × 110 × 60mm; 0·1in matrix stripboard, 19 strips by 41 holes; 18 s.w.g. aluminium sheet, 108 × 50mm (2 off); panel mounting fuse holder (for FS1); chassis mounting fuse holder (2 off—for FS2,3); insulated mounting kits for CSR1,2; 22 s.w.g. enamelled copper wire (approx. 1m—for L1); 10mm dia. ferrite rod, 30mm long (for L1); control knob (for VR2); slider knob (for VR1); 6A, 3-core mains cable; 7/0·2mm wire; mounting hardware.

See Shop Talk page 487

The breaks may be made by using a small twist drill turned by hand. Note that the connections to the secondary windings of T2 are made *direct* to the pins—*not* using copper strips. This is important since T2 provides isolation between the "mains" and "low voltage" sections of the circuit.

Note the positions of the two panel mounted fuseholders. Again, note that the mains fuse (FS2) has connections made direct to its terminals while the low voltage fuse (FS3) uses the copper strips.

The two aluminium heatsinks must be tight enough to ensure that there is no possibility of them breaking free. The holes for CSR1 and CSR2 are drilled a little larger than the studs to allow clearance for the plastic washer in the mounting kits. See Fig. 4 for details of mounting the thyristors. It is essential to use mounting kits since they provide isolation from the mains and this is an important safety precaution.

For ease of construction, solder tags are placed on each side of the panel. Although this is slightly unconventional there were no problems with heat transfer in the prototype. C2 and R6 may be mounted between the heatsinks as shown in the illustration, Fig. 3.

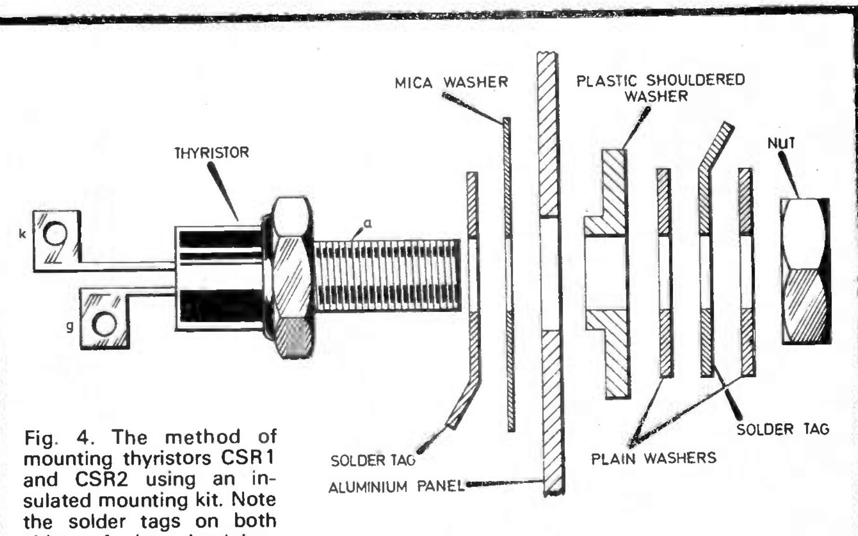
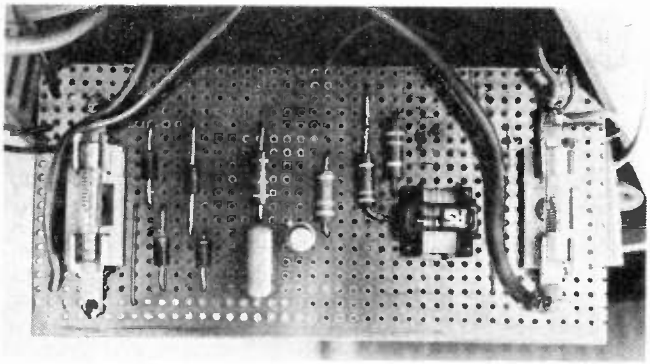


Fig. 4. The method of mounting thyristors CSR1 and CSR2 using an insulated mounting kit. Note the solder tags on both sides of the aluminium heatsink panel.

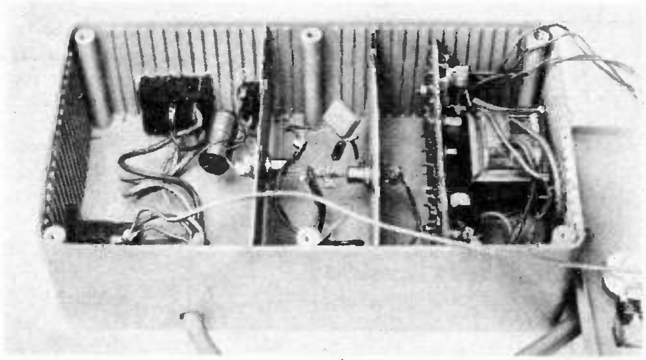
WIRING

When mounting T1, a solder tag must be placed under one of the fixing nuts for the earth connection. The unused centre tap of the transformer should be taped up. A single piece of terminal block may be needed to extend one of the primary connections. *Do not* use a taped joint for this.

The slot for the slider potentiometer may be made by drilling a line of small holes and joining them together with a file. The potentiometers VR1 and VR2 should be kept well clear of the heatsinks



The stripboard panel from the prototype Power Controller.



Internal view showing the board and heatsink mounting.

and earth wires should be soldered to the metal body of each.

For the mains wiring inside the case, strip the thick outer insulation from a length of 6A 3-core mains flex and use the individually insulated wires within. Where wires pass a heatsink, the corner of the panel should be cut off. The "raw" edge should be smoothed with a file and protected by a short piece of the outer plastic insulation slit along its length. This will be found to grip the edge and provide good protection to passing wires. On *no account* must any wire be routed in such a way that it may be cut or squashed.

The negative line of the circuit panel, together with the metal bodies of the potentiometers and transformer laminations, are all wired back to the earth connection on the mains inlet socket.

L1 consists of 30 turns of 22 s.w.g. enamelled copper wire wrapped around a piece of 10mm diameter ferrite rod, 30mm long. This may be "free mounted" as shown in the photograph. This coil becomes warm in use so must be kept clear of the case and anything else which could be harmed. Ventilation holes were not required in the prototype and the project is considered safer without them. There will then be no chance of metal objects falling into the case.

T1 should be of reliable manufacture since cheap components tend to overheat.

TESTING

This project must only be used on earthed mains supplies and never with the lid off.

Connect a table lamp fitted with a 100W bulb to the outlet socket and switch the dimmer on. Check that the brightness of the bulb can be varied by VR1 in conjunction with VR2. Check also the operation of S2, the BLACKOUT.

If all is well, run the project for one minute, **unplug from the mains** and remove the lid of the case. Feel the heatsinks, T1 and L1. These may have become slightly warm. Replace the lid and operate for increasingly longer periods and with higher loads up to the rated maximum of 1kW. It is normal for the case to become warm after prolonged use but should *not* become hot. A clicking noise may be heard from the thyristor panels when the project is in use.

If it is impossible to obtain a good range of brightness then it may be necessary to change the value of C1. This is unlikely unless this component is out of tolerance. However, a lower value will extend the "bright" end and vice-versa.

It only remains to make the scale for VR1 and, perhaps, VR2. □

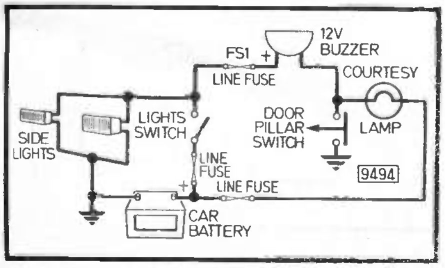
CIRCUIT EXCHANGE

CAR LIGHT ALERT

I HAVE devised an easy and cheap circuit for alerting the driver when the car lights have been left switched on unintentionally. All that is required are a 12V solid-state buzzer, one line fuse, some auto connectors and some light duty auto cable.

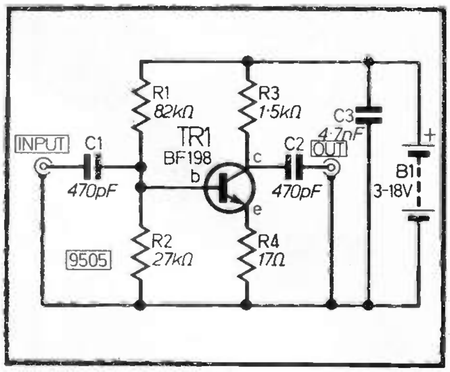
The diagram shows how the buzzer is connected into the existing electrics of the vehicle. The warning will sound when the driver's door is opened and the lights are switched on.

J. Parmar,
Alford, Lincs.



V.H.F. AERIAL PRE-AMPLIFIER

THIS circuit was used in my home for amplification of television (VHF) signals and the result of using it is very good. The BF198 provides a simple amplifier stage and the gain of the circuit is



between 5dB and 28dB. For In and Out leads 300 ohm twin feeder must be used. The supply voltage can be variable from 3V to 18V. Power consumption of the circuit is very low and the life of the battery should be almost as long as its shelf life, that is 28 months or more.

Hamid Reza Tajzadeh,
Tehran,
Iran.

MORE ON PAGE 532

SQUARE one FOR BEGINNERS

MANY electronic components are polarity conscious, that is to say they may only be connected one way round in their circuit design if they are to function as expected and not become damaged or cause damage to other components in the circuit.

POLARISED COMPONENTS

Fixed value resistors of all kinds may be connected in circuit either way round, as can fixed value non-electrolytic capacitors, whether they be polyester, ceramic, polystyrene Mylar, silvered mica and so on. Electrolytic capacitors on the other hand should only be connected one way round. This is with the +ve terminal connecting to the most positive of the two parts of the circuit the capacitor connects to.

It is this correct connection that actually sets up the chemical dielectric between the internal plates. Polarising the electrolyte in this way causes an interplate oxide layer to form which acts as the dielectric. If incorrectly connected, no dielectric is produced (no capacitor exists) with the possibility of plate destruction and in some instances may cause damage to other local circuitry.

In EE the electrolytic capacitor in circuit diagrams is drawn differently to non-electrolytic types. The positive terminal is an open rectangle with an adjacent "+" sign. This "+" is also drawn on the physical layout diagram.

The capacitor itself is sometimes marked with a "–" and/or "+" sign. If marked "–" only, the other lead is the "+" lead. For axial lead components—one lead from each end—there is usually an annular indentation at the "+" end of modern day electrolytic capacitors.

Tantalum capacitors also need to be inserted the correct way round. These bead-like devices are available "plain" with a spot or "+" sign printed nearest the positive (+) lead, and in colour-coded versions. With the central coding spot towards the viewer, the right hand lead is the positive (+) one. See Fig. 1(a) and (b).

DIODES

Another polarity conscious component is the diode, see Fig. 2. The l.e.d. for example, will only light up when correctly orientated. In all our circuit diagrams the device is clearly marked *a* (anode), *k* (cathode). For an l.e.d. to light, the anode must be made more positive by at least 2 volts than the cathode.

They may not necessarily become damaged if incorrectly connected, this depending on the applied voltage which is controlled largely by its series connected current limit resistor. The l.e.d. has usually two polarity markings: (i) a flat notch or paint on the body side closest to the cathode; (ii) one lead is longer than the other. We have types where the anode is longer than the cathode, and others where the cathode is the longer lead.

It is not always easy to determine which lead is which when, for example, the leads have been trimmed during assembly or the l.e.d. is fitted in its clip on a front panel. For this reason, trim the leads with say the cathode longer than the anode to standardise your identification method.

If in doubt as to which lead is which, connect a 9V battery with a 1·5 kilohm resistor in series with its positive battery terminal, across the l.e.d., see Fig. 3. The l.e.d. will light up when its *cathode* connects to the negative side of the battery. In EE layout diagrams, l.e.d.s are drawn with an exaggerated flat on the cathode side with both leads marked.

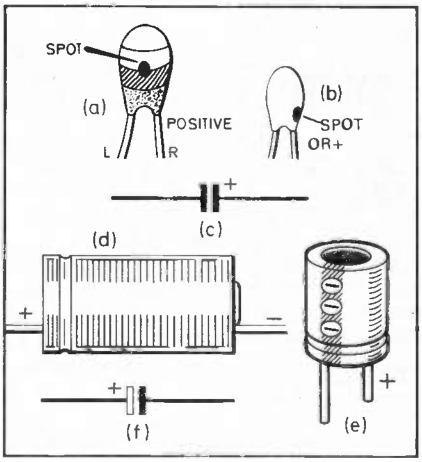


Fig. 1(a). Colour coded tantalum; (b) "plain" tantalum capacitor; (c) tantalum circuit symbol; (d) axial electrolytic capacitor; (e) radial electrolytic capacitor; (f) circuit symbol for an electrolytic capacitor.

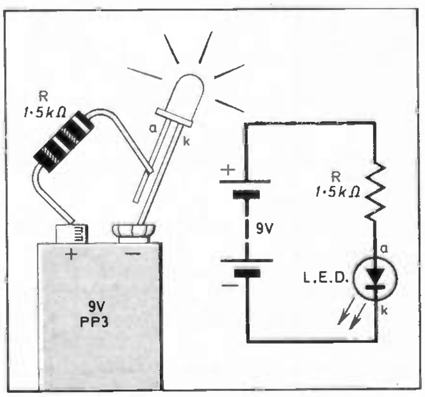


Fig. 3. Circuit for determining l.e.d. anode and cathode leads.

Signal and rectifier diodes have two lead-out wires, an anode (a) and cathode (k). The design will only function correctly if the diodes are correctly orientated. The cathode is the end marked with a band as seen in Fig. 2.

If in doubt, make up the small circuit of Fig. 4. The l.e.d. will only light up when the diode cathode is connected to *B* with its anode to *A*. Both leads are identified in circuit diagrams with *a* and *k* as well as on the layout diagram. The latter also shows the band, usually white on a black body.

SEMICONDUCTORS

Other semiconductors (transistors, thyristors, triacs, voltage regulators, etc.) with three or more lead-out wires must of course be connected exactly as instructed. There is no standard arrangement of the pins on transistors of even the same family type, for example, bipolar types (2N3702, BC108, ZTX300), and pin-out diagrams should be consulted in all cases before connecting and testing.

This information is usually provided alongside the layout diagram where a plan view of the lead-outs appears viewed from the pin-side. In some cases, one of the lead-outs is made at the case itself. Others have an internal connection between lead and case.

In such instances care must be taken so that the case does not come into contact with other parts of the circuitry. For example, the common BC108 device has an internal connection between its collector (c) and metal case. This is of particular importance when mounting power devices on heatsinks. A mica washer and insulating bush should be used to electrically isolate the device from the heatsink.

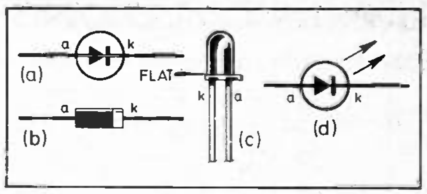


Fig. 2(a). Diode circuit symbol; (b) diode representation on layout diagrams; (c) l.e.d.; (d) l.e.d. circuit symbol.

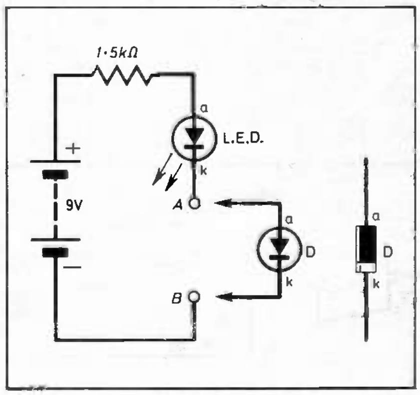


Fig. 4. Circuit for determining diode anode and cathode leads using an l.e.d. indicator.

CIRCUIT EXCHANGE

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised. Payment is made for all circuits published in this feature. Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

UTILITY AUDIO AMPLIFIER—DOORBELL-LATCH ALARM

HERE is my design for a utility audio amplifier—doorbell-latch alarm.

I have used two *pnp* transistors to form the stabilised pre-amplification stage, which also provides high input resistance to cater for most input signals. For stability the first transistor (BC179) requires a high value emitter resistor (R8, R9), being the signal frequency feedback resistor and capacitor C4 acts as a decoupler. R12 relates stabilisation with input resistance; for example, high value reduces stability but would give a high input resistance. I have selected a value of 22 kilohms for R12. R11 dictates the output resistance. Transistor TR3 is used to provide current gain and thence power amplification. I have chosen BC141 for TR3 because this was what I had available. Perhaps another transistor of better gain and higher current capacity would possibly do a better job in providing a greater output power. I would estimate the BC141 in this circuit to give an output performance of about 200 milliwatts or so. Capacitor C9 (0·01µF) has been incorporated to stabilise output at high frequencies. The final transistor TR3 must be mounted on a heatsink and a 1 watt resistor should be used for R20.

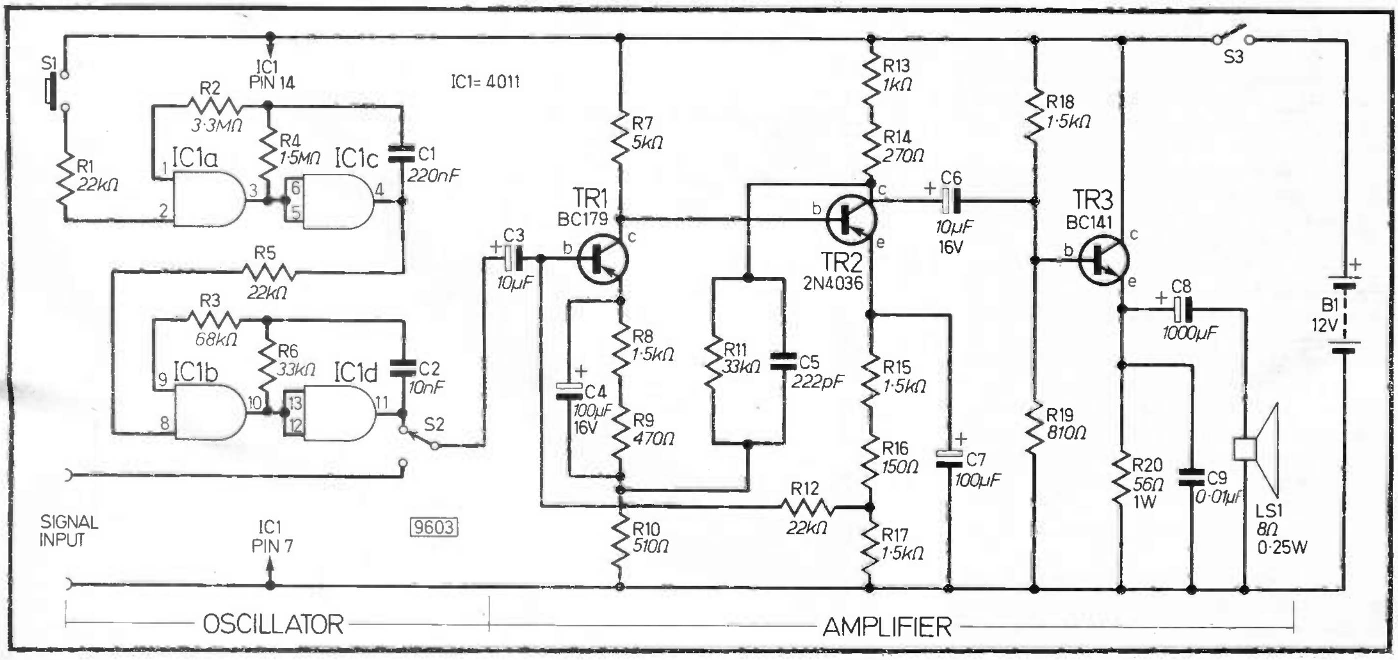
I designed the circuit to run on 12 volts d.c. but I believe it will also satisfactorily run on 9 volts d.c. as well.

The audio oscillator is made up of CMOS 4011 (NAND gates). The first pair of gates IC1a, c runs at about 1·2Hz and drives the second pair of gates IC1b, d which runs at around 1·2kHz. In combination they give a bleeping tone.

Intermediate switch S2 connects the audio oscillator to the amplifier; alternatively it could switch the amplifier to some other external signal inputs. This has been done deliberately to enable the amplifier to be used for other purposes, for example, as an audio continuity tester amplifier.

S1 is shown as a push-button switch and that works well for the unit as a doorbell. Alternatively S1 could be a latch-type switch and thence could be used as anti-theft alarm or even as emergency alarm in automation and controls applications.

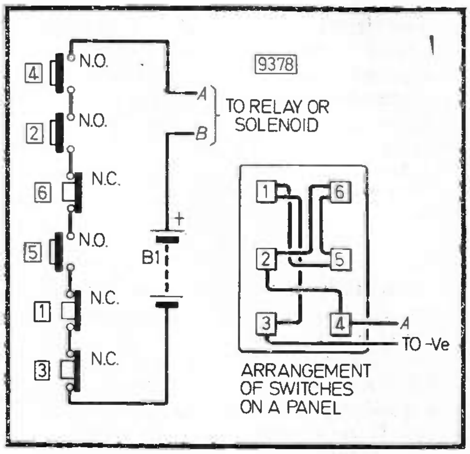
Toh Eng Kiong,
Singapore.



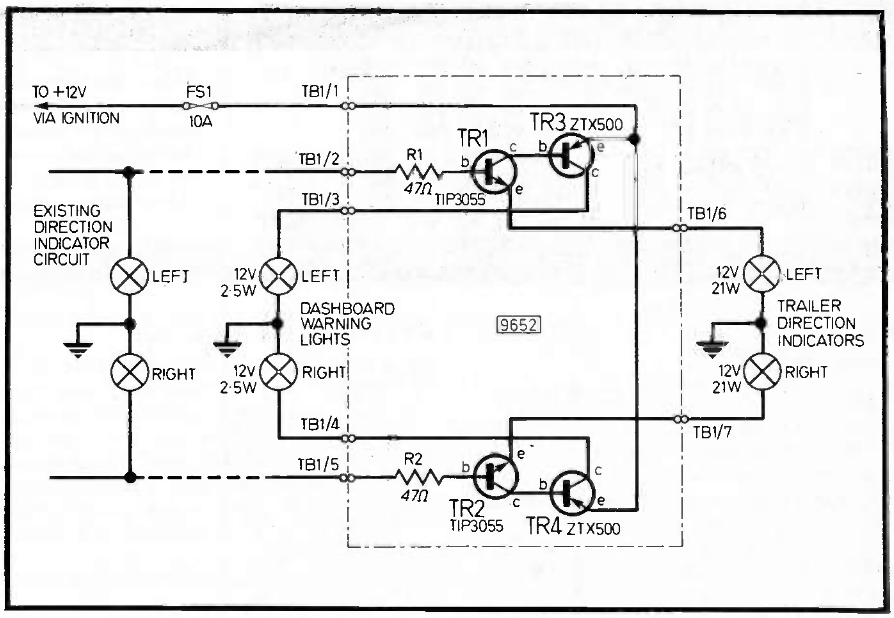
COMBINATION LOCK

THIS is a very simple circuit for a combination lock and will work just as well as one using several i.c.s. To operate the lock the switches in the combination must be depressed together. As shown, the combination is 2,4,5. The device is connected to points A and B. Though the circuit is shown with a battery, a power supply could be used. The circuit could operate a relay, solenoid, whatever you like. To change the combination you just have to change the connections to the push-to-make and push-to-break switches.

Andy Stevenson,
Basingstoke,
Hants.



TRAILER FLASHING DIRECTION INDICATOR SWITCHING UNIT



THIS circuit was produced after a request from a neighbour for a modified car flasher unit that can carry the load for direction indicator lights on a trailer, that can easily be changed from car to car, and which does not need excessive alterations to existing car wiring.

The circuit was designed around parts on hand in the scrap box (lower power transistors could be used, for example) and operates as follows:

A current of 15mA is drawn from the existing flasher circuit. This is insufficient to upset the existing circuit but sufficient to switch on TR1/TR3. A current of 1·8 amps is drawn through TR2/TR4 to illuminate the trailer direction indicator lamp; transistors TR2/TR4 being switched on in the process, allowing 1·6 amps to flow through the dashboard warning lamp so switching it on. If the trailer direction indicator lamp fails, TR2/TR4 will be switched off, extinguishing the dashboard warning lamp. If only one dashboard warning lamp is required, terminals 3 and 4 can be strapped together and fed to a single lamp.

Resistors R1 and R2 must be of 3 watts minimum rating to allow for a 250mA flow of current in the event of failure of fuse FS1. The 12V supply can be taken from the auxiliary circuits on the car ignition switch.

The unit was constructed on Veroboard and housed in a plastics case with terminals on the outside to facilitate easy connection/disconnection. Heatsinks are not required with the transistors stated. A 10 amp fuse is required to facilitate the use of hazard warning indicators, that is, all lamps lit simultaneously. Note that if only one dashboard warning lamp is used, it will not indicate the failure of either one trailer direction indicator lamp alone when the hazard warning indicators are in use.

The unit has performed perfectly in regular and rugged service for the last twelve months.

F. Sperritt,
St. Austell,
Cornwall.

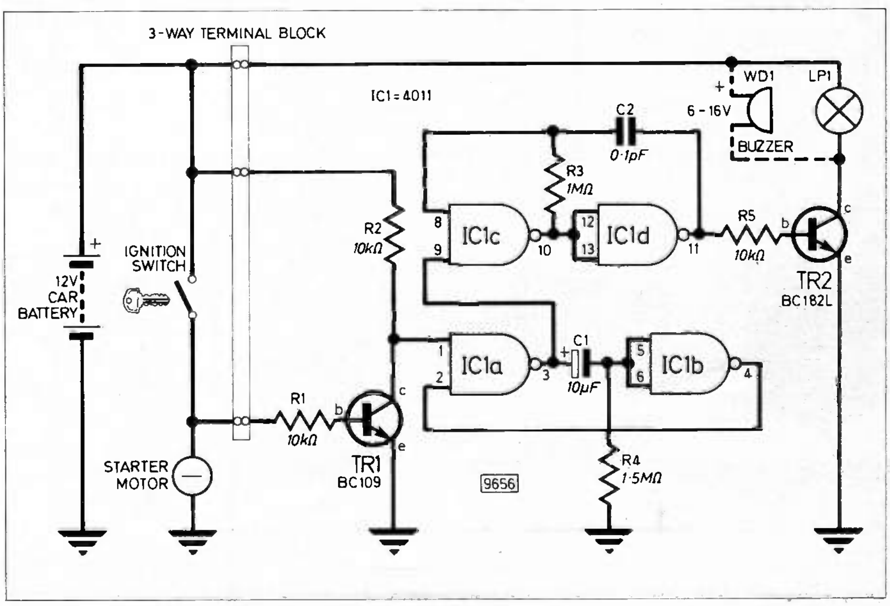
SEAT BELT REMINDER

THE circuit uses a CMOS 4011 Quad 2-input NAND gates with IC1a and IC1b used as a monostable with a period of about 10 seconds; IC1c and IC1d are used as an astable with a frequency of 1Hz. The display uses a legendable indicator from RS Components. The indicator consists of two T1½LES 6V 1W bulbs mounted behind a red screen which has written on it "SEAT BELTS". Graphic transfers were used for the lettering.

Each time a person commences a journey they turn the ignition key to turn the starter motor and this turns on transistor TR1. Pin 1 of IC1a then goes negative (or low) and this enables the monostable formed by IC1a and b. The output of the monostable at pin 3 goes high or positive and this is applied to pin 9 of IC1c. IC1c and IC1d form an astable with a frequency of 1Hz. The astable output therefore goes high once every second for 10 seconds. The output of the astable turns on transistor TR2 once every second for ten seconds and then stops.

The collector load for TR2 is the legendable indicator which flashes to remind the driver to fasten his seat belt. A 12V buzzer could also be connected across the bulbs as an added warning to the driver. *Constructional Details.* The box used had aluminium front, rear and bottom, and the sides and top were steel sheeting with black vinyl covering. The area around the indicator was covered with teak-grained contact paper to match the dashboard. A hole was bored in the dashboard to allow wiring through, and the box was secured in this hole using RS cable glands which gave the unit a nice appearance.

Terry Murphy,
Co. Carlow,
Eire.



NEW · NEW · NEW · NEW PRODUCTS NEW · NEW · NEW · NEW

RADIO MATE

NOT only is it possible to fit the latest f.m. radio chip inside a pencil or pen, but **Mullard** claim it will also find use as a wristwatch or key-ring radio. The only external requirements for the chip are a tunable resonant circuit, fourteen ceramic capacitors, power amp and speaker/earphone.

The TDA7000 i.c. operates from a supply voltage range of 2·8V to 10V and current consumption at 4·4V is claimed to be 8mA. The intermediate frequency of the i.c. is 70kHz, compared with 10·7MHz in a conventional receiver. Frequency demodulation with feedback is used to reduce the i.f. deviation to ±15kHz. It is claimed that the ±75kHz deviation common for f.m. would cause unacceptable harmonic distortion.

The i.f. of 70kHz gives excellent selectivity and allows band-pass filters to be replaced by RC filters which can be partly or completely integrated on to the chip. A patented muting circuit supresses inter-station noise during tuning and the i.c. can also drive an l.e.d. or tuning meter to indicate maximum signal.

Another use for the TDA7000 is as a receiver in cordless telephone sets, paging systems or the f.m. section of a TV.

Mullard Ltd.,
Dept EE, Mullard House,
Torrington Place,
London, WC1E 7HD.

MOUNTAIN BREEZE

THE popularity of negative air ionisers or generators seem to be gaining in public favour and it was only a matter of time before their use in cars was investigated. One company that has been active in this area and now marketing a car version is **Sidha Technology**.

It is claimed that an ioniser cleans and freshens the air without the scent of an air freshener or draughts from an open window; town air can hardly be described as fresh! It works by emitting a constant stream of negative ions, which, it is claimed, tone up the system and even help sufferers from hayfever and catarrh and reduce the risk of car sickness.

With modern use of plastics and artificial fabrics in a car interior, the negative ion count is very low. Cigarette smoke reduces the ion level to almost zero.

The Mountain Breeze, as it is called, is claimed to be the first car ioniser to be sold through High Street shops and is expected to sell for around £30. It simply plugs into the car cigar lighter socket or can be wired direct to the car battery. Power consumption is 0·4W at 13·8V d.c.

For more information write to:

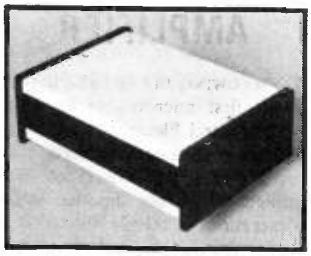
Sidha Technology Ltd.,
Dept EE, 15 Pit Hey Place,
West Pimbo, Skelmersdale,
Lancs WN8 9PS.

PROJECT CASE

THE introduction of a new range of modular case systems for housing electronics assemblies and instrument displays are now being marketed by **Elinca Products**.

Developed from their range of BEC cases, the new system comprises pre-formed body panels, facias and moulded end cheeks. This enables a variety of cases to be made up, ranging in size from 51mm × 127mm × 152mm up to 51mm × 127mm × 330mm.

All case sections are prepunched and are available in a choice of white or black, with natural aluminium or black facia panels. Polished teak veneered end cheeks are also available.

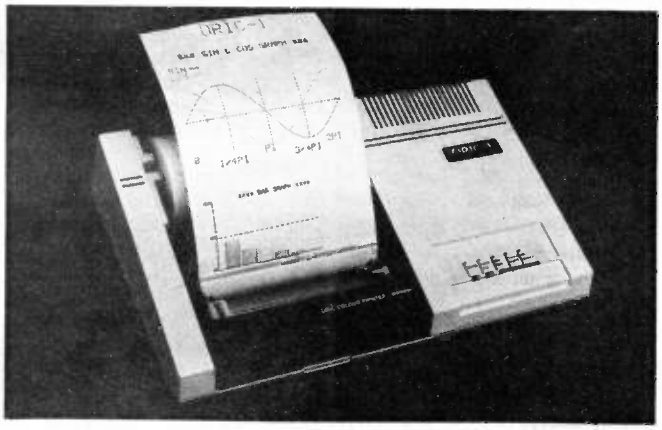


The cases are manufactured in plastic-coated metal which is claimed to be antistatic with high insulation and screening properties.

Details of prices and local stockists can be obtained from:

Elinca Products Ltd.,
Dept EE, Lyon Works,
Capel Street,
Sheffield, S6 2NL.

COLOURFUL ORIC



THE first peripheral for the Oric 1 from **Oric Products International** is now in the shops and is a specially designed four-coloured plain paper printer.

The printer, selling for £169.95 including VAT, features the Alps mechanism and an internal power supply. The Oric MCP40 printer has a standard Centronic interface and can therefore be used with any microcomputer having a Centronic's interface.

The printer is plugged directly into the Oric expansion port by a single connecting lead and can be used with both the 48K and 16K models.

The four colours—black, blue, red and green—are provided by rolling ball-point pen dispensers. Printing speed is 12 characters per second. Characters per line are 80 or 40 (Text Mode).

Until mid-September, Oric Products International are offering a start-up pack of software valued at £40 absolutely free with every 48K Oric Microcomputer sold. The 16K version will contain a software pack worth £30.

Stockists of Oric 1 include W.H.Smith, Dixons and Laskys.

A/D CONVERTER

A DESIGN for a high performance Video A/D Converter has just been published in a 30-page application's booklet (No PS 1993) by **Plessey**.

The booklet gives the circuit description, printed circuit board layout and testing details. The A/D described operates up to 20MHz clock and 10MHz analogue bandwidth and incorporates both the Plessey SP9754 and SP9768 converters, and the SL541 video operational amplifier.

The A/D Converter booklet (No PS 1993) is available Free-of-Charge from Plessey Semiconductors or its distributors.

Plessey Semiconductors,
Dept EE, Cheney Manor,
Swindon, Wiltshire SN2 2QW.

MICROPHONE AMPLIFIER

FOLLOWING the introduction of its first microphone amplifier i.c., **Ferranti Electronics** have extended the range with three new i.c.s. The new devices are designed for use in the latest generation of telephones as well as for the replacement of existing carbon granule telephone inserts.

The ZN475E, ZN476E and ZN477E are designed to be used with piezo-electric, moving-coil and simple electret transducers in telephone handsets. They can also be used in a range of microphones.

The ZN475E is a reduced cost version the original i.c. (ZN740AE) and for use with electrets. The ZN476E is designed to be compatible with the less sensitive moving-coil transducer.

A feature of the electret transducer is the very high impedance which can cause problems when the transducer is remote from the amplifier circuit. An example of this is the boom used by operators where the small size of the microphone makes it difficult to place the amplifier close to the transducer.

Another difficulty arises if the amplifier is connected directly to the electret via a long length of wire. The result is that due to the high input impedance of the electret the circuit is susceptible to radio frequency interference (r.f.i.)

Manufacturers have overcome this by incorporating a f.e.t. close to the electret, resulting in a sealed unit, and this is now the most common form of electret transducer. The ZN477E i.c. is designed to be compatible with this type of transducer.

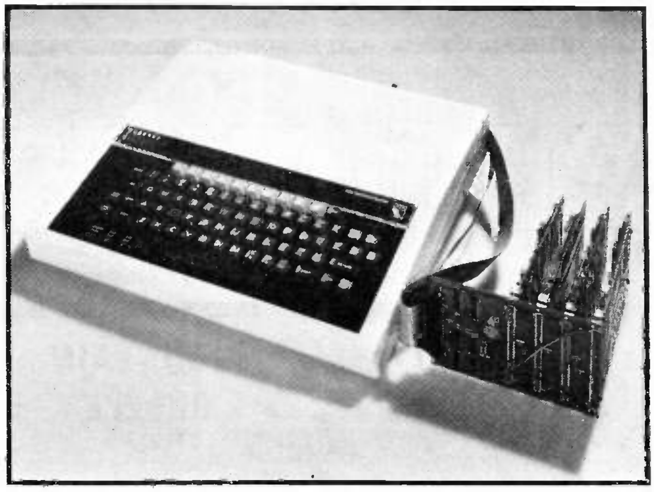
Ferranti Electronics Ltd.,
Dept EE, Fields New Road,
Chadderton, Oldham,
Lancs OL9 8NP.

BBC MICRO EXTENSION

OF particular interest to users of the BBC Microcomputer, the BEEB-EX from **Control Universal**, is a simple, low-cost interface card which attaches by a 34-way ribbon connector to the 1MHz bus port.

The new card is compatible with the complete CUBE range of Eurocards produced by Control Universal. BEEB-EX is also compatible with Acorn Eurocards. The CUBE range, in the forefront of Cambridge-based Eurocard development, now comprises over 30 master modules.

It is not easy to pick a "typical" application for BEEB-EX, but most likely passengers on the bus will be 64/80 channel digital I/O, 8- or 12-bit analog interfaces and extra memory. 256 bytes of memory are addressed directly, but up to 1 Mbyte may be addressed in page mode.



The BEEB-EX itself is in Eurocard format (100 × 160mm) and is available in two versions. The first is a stand-alone unit which holds up to four other Eurocard devices by their edge connectors, and costs £49.00. The second type is designed for more ambitious applications, slotting into a standard rack-mounted system of up to 14 backplane connectors. It costs £41.00 for the interface, with racks from £72.00.

Data transfer along the 1MHz bus is achieved by using "FRED" and "JIM", the two special pages of the BBC's MOS (Machine Operating System) which control memory mapped I/O. To make programming of data transfer even easier, Control Universal will soon be releasing a paged ROM—entered simply by using *IO. This will enable BBC BASIC to talk directly to the input/output devices.

For further information contact:

Control Universal Ltd.,
Dept EE, Unit 2, Anderson's Court,
Newnham Road,
Cambridge, CB2 9EZ.

POWER BOOSTERS

IN addition to their existing C15, 15W r.m.s. mono power booster amplifier, **ILP Electronics** have just introduced a new stereo 15W per channel version designated type C1515.

Both modules are designed to increase the output power of existing car radio/cassette players and claim to "overpower" road and engine noise without introducing annoying distortion. The amplifiers are encapsulated to an integral heatsink which gives them a compact, modular form characteristic of all **ILP** audio products.

The amplifiers feature two hole fixing for mounting anywhere in the car, such as, the boot or under the dashboard; selectable input level facility so that they can be driven from either low signal levels from the preamplifier of the car radio or straight from the existing unit's loudspeaker leads; and, screw terminal connection blocks for easy wiring-up.

A typical continuous output power figure of 15W r.m.s. into 4 ohms and a frequency response (−3dB) of 15Hz to 30kHz is claimed for both modules. The input sensitivity and impedance is selectable and is: 700mV into 15 kilohms or 3V r.m.s. into 8 ohms. Total harmonic distortion (THD) is claimed to be 0·1 per cent at 10W, 1kHz.

For more details of the C15 and C1515 power booster amplifiers, and information of local stockists, readers should write to:

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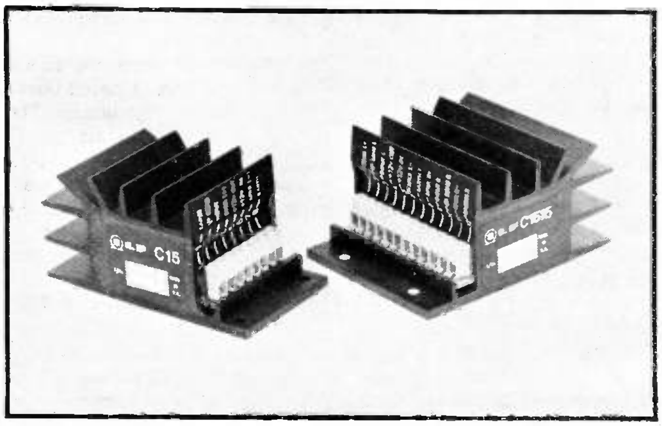

RADIO WORLD

BY PAT HAWKER G3VA

European DX Council

The seventeenth annual conference of the European DX Council was the first I have attended but it proved well worth the effort.

The Council represents a considerable number of different clubs, societies and associations, whose members are keenly interested in reception of unusual, difficult transmissions to receive or long distance, on medium or short-waves. However the annual conferences are also supported on an impressive scale by the h.f. broadcasters.

Many of the delegates are people concerned with running the various short-wave listener, DXer and listener-advice programmes such as the BBC World Service's "Waveguide". This year the conference attracted to London some 160 delegates and organisers, was hosted by BBC External Services, sponsored by Marconi Communication Systems, and organised by the DX Association of Great Britain.

Indeed it was all very professional, including a series of lectures on the Saturday morning that ranged from the problems of h.f. spectrum planning, the Marconi "Pulsam" high-efficiency modulation system for super-power transmitters, to a detailed description of the news-gathering activities of the BBC Monitoring Service at Caversham Park and its associated receivers and aerials at Crowsley Park. Also there was an account of how Eddystone Radio progressed from ladies hair-pins in the 1920s to early h.f. receivers for rubber-planters and missionaries in the 1930s and professional communications receivers today.

One should also mention George Wilcox's talk on medium-wave DXing which provided a sharp reminder of the advantages as well as disadvantages of m.f. broadcasts. By making good use of the directional properties of ferrite-rod and frame aerials it is still possible to receive programmes consistently from most countries of Europe, much less subject to selective fading and other distortions of h.f., to the vagaries of h.f. propagation or the limited range of v.h.f.

Some broadcasters take listener-advice very seriously and I was much impressed by the 16-page booklet "Receiver Shopping List" compiled and issued by Radio Netherlands International (Public Relations Department, P.O. Box 222, 1200 JG Hilversum, The Netherlands) whose English language broadcasts for West Europe go out on 5955, 6045, 9895kHz at 0930 and 1330 G.M.T. daily. The receiver booklet lists and describes most of the current receivers that make a feature of good h.f. reception.

Radio Netherlands also has publications on aerials—"Give your antenna some air"—"Writing useful reception reports" and a booklist giving titles of books and periodicals on short-wave listening and amateur radio. A valuable service for DX-minded listeners.

CB Collapse

It is far too early to say that CB radio in the UK has already gone into a steep decline, although Fidelity Radio has talked of "the collapse of the CB radio market" in admitting that it lost £700,000 from the activities of its CB division in the year to March 1983, before disposing of the division "for a nominal sum".

However, the Home Office has given me some interesting figures that show that the number of valid licences is going down. At the end of April 1983 these amounted to 289,108 compared with 313,318 at the end of November 1982.

The percentage of CB users who are renewing their licences seems to vary widely from month to month: only 42 per cent of the first batch that came up for renewal in October 1982; November 1982 saw a jump to 72 per cent; but December (Christmas expenses?) saw only 27 per cent renewals. Then again one does not know how many legal CB'ers became illegal CB'ers or whether they had had enough.

One thing is certain. Some of the early suggestions that legal CB would be a boost to British industry now look very sour.

Topics In The Air

From June 1, the annual cost of a British amateur radio licence was increased by 50 per cent to £12 per annum. Taken together with the cost of sitting the Radio Amateurs Examination and taking (for Class A licences) the Morse Test it is becoming a costly business to acquire a licence.

A famous callsign from the distant past—Two Emma Toc (2MT)—once used for the experimental broadcasting station at Writtle, from which the first regular British broadcast transmissions were made, is being re-activated by the newly-formed Marconi Radio Society, at the Stanmore headquarters of Marconi Space and Defence Systems.

Large-scale CB Fraud

If it is now difficult to avoid making losses in marketing CB equipment there must be some traders who almost sigh for the days when "illegal" CB had something of the attraction of "hooch" in the days of American prohibition.

But Customs men in Hull finally caught up with two Leicester traders who brought in from Belgium 13,262 CB radios, valued at almost £900,000 wholesale, in 18-months during 1980–81, using two lorries fitted with secret compartments in false bulkheads. When caught on July 25, 1981 the two lorries contained 1402 CB radios.

In March this year Anthony Lavell received a 9-month jail sentence and had to pay £1000 costs; his brother and a driver had suspended sentences and were ordered to pay £1000 and £250. The brothers are partners in Ham International (UK) that now appears to have moved out of CB into the amateur radio field.

One could argue that if there had not been the long delay in making 27MHz f.m. CB legal this type of undercover operation would never have occurred. However, the thought that over 13,000 transceivers could be successfully smuggled into the country before the secret compartments were found does seem remarkable.

Long-distance TV

During periods of maximum sunspot activity reception of TV signals on around 40–50MHz have often been reported over long distances due to reflection from the ionosphere. Even in the late 1930s Alexandra Palace pictures were seen in the USA and there have been authenticated reports from South Africa and even Australia. The phenomenon of trans-equatorial propagation, first observed regularly on 50MHz amateur signals, has also meant that TV from southern Africa has been seen in Cyprus.

In 1980 the research department of All-India Radio and Doorarshan India began to study "interference" on the Delhi transmissions (62·25MHz vision, 67·75MHz sound) and found that at times signals from Bangkok over 3100km away and using an adjacent channel to Delhi were only a little less (6dB down) than those from Delhi. The maximum usable frequency for F2 layer reflection was then rising to 50–55MHz for 10 per cent of the time, 60–65MHz for about one per cent of the time over a path not crossing the equator.

This year, now well past the sunspot maximum of 1979–80, the "mufs" have fallen sharply and I doubt if Delhi is being troubled by Bangkok.

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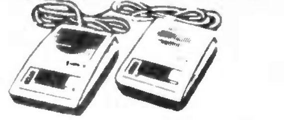

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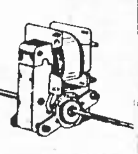

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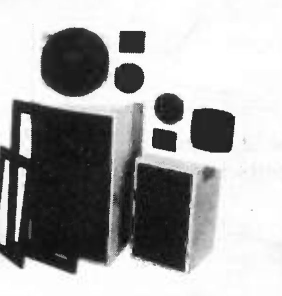

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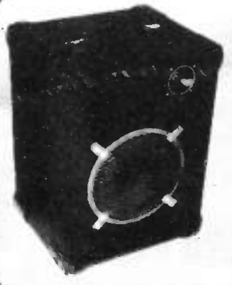

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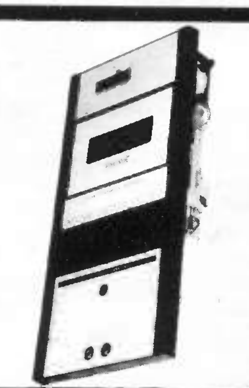

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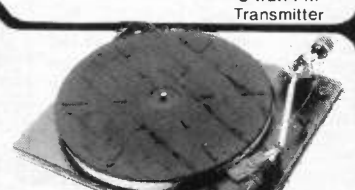

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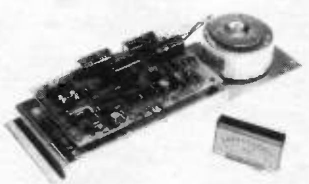

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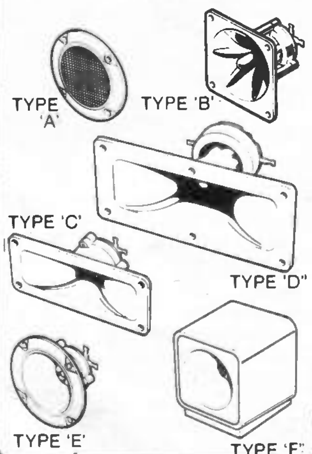

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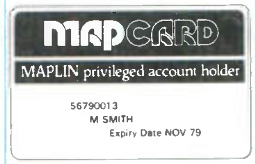

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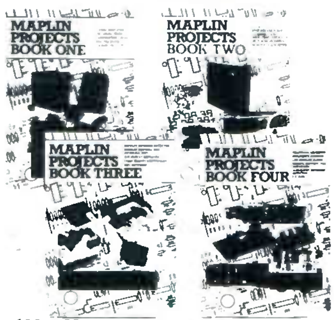

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