

EVERYDAY

DECEMBER 1989

ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

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New Series
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INDEX
FOR
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The Magazine for Electronic & Computer Projects



BAKERS DOZEN PACKS

All packs are £1 each, if you order 12 then you are entitled to another free. Please state which one you want. Note the figure on the extreme left of the pack ref number and the next figure is the quantity of items in the pack, finally a short description.



- BD2 5 13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
- BD7 4 In flex switches with neon on/off lights, saves leaving things switched on.
- BD9 2 6V 1A mains transformers upright mounting with fixing clamps.
- BD11 1 6 1/2in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
- BD13 12 30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
- BD22 2 75 watt loudspeaker two unit crossovers.
- BD29 1 B.D.A.C. stereo unit is wonderful breakdown value.
- BD30 2 Nicad constant current chargers adapt to charge almost any nicad battery.
- BD32 2 Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
- BD42 5 13A rocker switch three tags so on/off, or change over with centre off.
- BD45 1 24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day. original cost £40 each.
- BD49 10 Neon valves, with series resistor, these make good night lights.
- BD56 1 Mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
- BD59 2 Fiat solenoids—you could make your multi-tester read AC amps with this.
- BD67 1 Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
- BD103A 1 6V 750mA power supply, nicely cased with mains input and 6V output leads.
- BD120 2 Stripper boards, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc.
- BD128 10 Very fine drills for pcb boards etc. Normal cost about 80p each.
- BD132 2 Plastic boxes approx 3in cube with square hole through top so ideal for interrupted beam switch.
- BD134 10 Motors for model aeroplanes, spin to start so needs no switch.
- BD139 6 Microphone inserts—magnetic 400 ohm also act as speakers.
- BD148 4 Reed relay kits, you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets.
- BD149 6 Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
- BD180 6 Neon indicators in panel mounting holders with lens.
- BD193 6 5 amp 3 pin flush mounting sockets make a low cost disco panel.
- BD196 1 in flex simmerstat—keeps your soldering iron etc. always at the ready.
- BD199 1 Mains solenoid, very powerful, has 1in pull or could push if modified.
- BD201 8 Keyboard switches—made for computers but have many other applications.
- BD211 1 Electric clock, mains operated, put this in a box and you need never be late.
- BD221 5 12V alarms, make a noise about as loud as a car horn. Slightly soiled but DK.
- BD242 2 6in x 4in speakers, 4 ohm made from Radiomobile so very good quality.
- BD252 1 Panostat, controls output of boiling ring from simmer up boil.
- BD259 50 Leads with push-on 1/4in tags—a must for hook-ups—mains connections etc.
- BD263 2 Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into patress.
- BD268 1 Mini 1 watt amp for record player. Will also change speed of record player motor.
- BD263 3 Mild steel boxes approx 3in x 3in x 1in deep—standard electrical.
- BD293 50 Mixed silicon diodes.
- BD305 1 Tubular dynamic mic with optional table rest.
- BD400 4 Books, useful for beginners, describes amplifiers equipment and kits.
- BD653 2 Miniature driver transformers. Ref. LT44. 20k to 1k centre tapped.
- BD648 2 3.5V relays each with 2 pairs changeover contacts.
- BD667 2 4.7 uF non-polarised block capacitors, pcb mounting.

There are over 1,600 items in our Bakers Dozen List. If you want a complete copy please request this when ordering.

EQUIPMENT WALL MOUNT It is a multi-adjustable metal bracket that could be used for mounting flood light, loudspeaker, TV camera, even a fan and on almost any sort of wall or ceiling even between wall and ceiling. The main fixing brackets rotate such that an inward or an outward corner can be accommodated. Front panel also tilts upward or downwards to a reasonable angle and can be easily removed separately for wiring. A very useful bracket. Regular price would be around £6 each. Our price only £3. Our ref 3P72. Or 2 for £5. Our ref 5P152.

SUB-MIN TOGGLE SWITCH Body size 8mm x 4mm x 7mm SBDT with chrome dolly fixing nuts. 3 for £1. Order ref BD649.

COPPER CLAD PANEL for making PCB. Size approx 12in long x 8 1/2in wide. Double-sided on fibreglass middle which is quite thick (about 1/16in) so this would support quite heavy components and could even form a chassis to hold a mains transformer, etc. Price £1 each. Our ref BD683.

POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, workroom etc. Makes you feel better and work harder—a complete mains operated kit, case included. £12.50 + £2 P&P. Our ref 12P5 1.

REAL POWER AMPLIFIER for your car, it has 150 watts output. Frequency response 20Hz to 20KHz and signal to noise ratio better than 60dB. Has built in short circuit protection and adjustable input level to suit your existing car stereo, so needs no pre-amp. Works into speakers ref. 30P7 described below. A real bargain at only £57.50. Order ref: 57P1.

REAL POWER CAR SPEAKERS. Stereo pair output 100W each. 4-Ohm impedance and consisting of 6 1/2" woofer, 2" mid range and 1" tweeter. Each set in a compact purpose built shelf mounting unit. Ideal to work with the amplifier described above. Price per pair £29.96. Order ref: 30P7.

STEREO CAR SPEAKERS. Not quite so powerful—70w per channel. 3" woofer, 2" mid range and 1" tweeter. Again, in a super purpose built shelf mounting unit. Price per pair: £27.95. Order ref: 28P1.

VIDEO TAPES These are three hour tapes of superior quality, made under licence from the famous JVC Company. Offered at only £3 each. Our ref 3P63. Or 5 for £11. Our ref 11P3. Or for the really big user 10 for £20. Our ref 20P20.



ELECTRONIC SPACESHIP.

Sound and impact controlled, responds to claps and shouts and reverberates when it hits anything. Kit with really detailed instructions. Ideal present for budding young electrician. A youngster should be able to assemble but you may have to help with the soldering of the components on the pcb. Complete kit £8. Our ref 8P30.

12" HIGH RESOLUTION MONITOR Black and white screen, beautifully cased for free standing, needs only a 12v 1.5 amp supply. Technical data is on its way but we understand these are TTL input. Brand new in makers' cartons. Price: £22.00. Post free. Order ref: 25P10.

14" COLOUR MONITOR made by the American Display Tek Company. Uses high resolution tube made by the famous Japanese Toshiba company. Beautifully made unit intended for console mounting, but top and sides adequately covered by plated metal panels. Full technical spec. on its way to us. We have a limited number of these. All brand new still in maker's cartons. Price: £89 each plus £6 insured carriage. Order ref: 89P1.

BUSH RADIO MIDI SPEAKERS Stereo pair. BASS reflex system, using a full range 4in driver of 40hms impedance. Mounted in very nicely made black fronted walnut finish cabinets. Cabinet size approx 8 1/2in wide, 14in high and 3 1/2in deep. Fitted with a good length of speaker flex and terminating with a normal audio plug. Price £5 the pair plus £1 post. Our ref 5P141.

3 1/2in FLOPPY DRIVES We still have two models in stock: Single sided, 80 track, by Chicon. This is in the manufacturers metal case with leads and IDC connectors. Price £40, reference 40P1. Also a double sided, 80 track, by NEC. This is uncased. Price £59.50, reference 60P2. Both are brand new. Insured delivery £3 on each or both.

ATARI 65XE COMPUTER At 64K this is most powerful and suitable for home and business. Brand new, complete with PSU, TV lead, owner's manual and six games. Can be yours for only £45 plus £3 delivery

65 XE COMPENDIUM Contains: 65XE Computer, its Data Recorder XC12 and its joystick with TEN games. £62.50+ £4 insured delivery.

REMOTE CONTROL FOR YOUR 65XE COMPUTER With this outfit you can be as much as 20 feet away as you will have a joystick that can transmit and a receiver to plug into and operate your computer and TV. This is also just right if you want to use it with a big screen TV. The joystick has two fire buttons and is of a really superior quality, with four suction cups for additional control and one handed play. Price £15 for the radio controlled pair. Our ref 15P27.

ASTEC PSU. Mains operated switch mode, so very compact. Outputs +12V 2.5A, +5V 6A, ±5V .5A, ±12V 5A. Size: 7 1/2in long x 4 3/4in wide x 2 1/4in high. Cased ready for use. Brand new. Normal price £30+, our price only £12.95. Order ref 13P2.

VERY POWERFUL 12 VOLT MOTORS. 1/2rd Horsepower. Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £20 plus £2 postage. Our ref. 20P22.

PHILIPS LASER This is helium-neon and has a power rating of 2mW. Completely safe as long as you do not look directly into the beam when eye damage could result. Brand new, full spec. £30 plus £3 insured delivery. Mains operated power supply for this tube gives 8kv striking and 1.25kv at 5mA running. Complete kit with case £15. As above for 12V battery. Also £15. Our ref 15P22.

ORGAN MASTER is a three octave musical keyboard. It is beautifully made, has full size (piano size) keys, has gold plated contacts and is complete with ribbon cable and edge connector. Can be used with many computers, request information sheet. Brand new, only £15 plus £3 postage. Our ref 15P15.

FULL RANGE OF COMPONENTS at very keen prices are available from our associate company SCS COMPONENTS. You may already have their catalogue, if not request one and we will send it FOC with your goods.

HIGH RESOLUTION MONITOR. 9in black and white, used Philips tube M24.306W. Made up in a lacquered frame and has open sides. Made for use with OPD computer but suitable for most others. Brand new. £16 plus £5 post. Our ref 16P1.

12 VOLT BRUSHLESS FAN. Japanese made. The popular square shape (4 1/2in x 4 1/2in x 1 3/4in). The electronically run fans not only consume very little current but also they do not cause interference as the brush type motors do. Ideal for cooling computers, etc., or for a caravan. £8 each. Our ref 8P26.

MINI MONO AMP on p.c.b. size 4" x 2" (app.) Fitted Volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1.15 each, or 13 for £12.00.



J & N BULL ELECTRICAL

Dept. EE 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT.

MAIL ORDER TERMS: Cash, PO or cheque with order. Orders under £20 add £2.50 service charge. Monthly account orders accepted from schools and public companies. Access and B/Card orders accepted—minimum £5. Phone (0273) 734648 or 203500.

POPULAR ITEMS — MANY NEW THIS MONTH

JOYSTICKS for BBC, Atari, Dragon, Commodore, etc. All £5 each. State which required.

TELEPHONE TYPE KEY PAD. Really first class rear mounting unit. White lettering on black buttons. Has conductive rubbers contacts with soft click operation. Circuit arranged in telephone type array. Requires 70mm by 55mm cut out and is connected by 10-pin IDC socket. Price: £2.00 each. Order ref: 2P251.

TELESCOPIC FM AERIAL. Stands up or folds over. Solidly constructed and heavily nickel plated. Supplied complete with fixing nut. Price £1 each. Order ref: BD741.

SUB-MIN PUSH SWITCHES Not much bigger than a plastic transistor but double pole. PCB mounting. Three for £1. Our ref BD688.

NICAD CHARGER UNIT Metal pronged, plastic case contains mains transformer and rectifiers with output lead and plug—made to charge two cells but no doubt adaptable or wonderful spares value. Only 50p each, two for £1. Our ref BD385.

EDGEWISE PANEL METER If you are short of panel space then this may be the answer. It has a FSD of 100uA and a nice full vision scale. It fits through a hole approx 1 1/4in x 1/2in. Another feature is that it has an indicator lamp behind the scale which you could light up, it would then serve as an on/off indicator. Price £1. Our ref BD700.

AA CELLS Probably the most popular of the rechargeable NICAD types. 4 for £4. Our ref 4P44.

600W HEATERS 240V Mobem coil suitable for air or liquid 2"x4" mounted on a circular plate. 24 months guarantee. Price only £4.00. Our ref 4P51 or 3 for £10. Ref 10P76.

20 WATT 40HM SPEAKER With built in tweeter. Really well made unit which has the power and the quality for hi-fi reproduction. 6 1/2in diameter. Price £5. Our ref 5P155. It is heavy so please add £1 to cover postage if not collecting.

MINI RADIO MODULE Only about 2in square with ferrite aerial and solid dia tuner with its own knob. It is a superhet and it operates from PP3 battery and would drive a crystal headphones direct but be better with our mini mono amp. Price £1. Our ref BD716.

BULGIN MAINS PLUG AND SOCKET The old faithful 3 pin with screw terminals. The socket mounts through a 1 1/2in hole and the mains is brought in by the insulated plug. Used to be quite expensive but you can have 2 pairs for £1 or 4 of either plug or socket for £1. You could make yourself a neat and compact bench panel with these. Our ref BD715, BD715S or BD715P.

MICROPHONE If you want a low cost microphone then just arrived we have a very small hand-held dynamic mic with on/off switch in the handle, its lead terminates with one 3.5 plug and the other a 2.5 plug for remote control. Price only £1. Our ref BD711.

EXTENSION CABLE WITH A DIFFERENCE It is flat on one side making it easy to fix and to look tidy. It is 4 core so suitable for telephone, bell, burglar alarms, etc. 50 yard coil for £5. Our ref 5P153.

MOSFETS FOR POWER AMPLIFIERS AND HIGH CURRENT DEVICES 140v 100w mA made by the famous Hitachi Company. Reference 25K413 and its compliment 25J118. Only £4 the pair. Our ref 4P42.

BATTERY OPERATED TRAVEL MECHANISM On a plastic panel measuring approx. 9in x 3 1/2in. Is driven by a reversible 12v battery motor, fitted with a pulley and belt which rotates through a threaded rod and causes a platform to travel backwards and forwards through a distance of approx. 5in. Price £5. Our ref 5P140.

MAINS OPERATED WATER VALVE with hose connection for inlet and outlet suitable for low pressure. Auto plant watering, etc. Only £1 each. Our ref BD370.

20 VOLT 4 AMP MAINS TRANSFORMER Upright mounting with fixing feet. Price £3. 3P59.

16 OHM PM SPEAKERS Approx. 6in x 4in. 5 watts. Offered at very low price so you can use two in parallel to give you 10 watts at 8 ohms. £1 for the two. Our ref BD684.

EHT TRANSFORMER 4kv 2mA Ex-unused equipment. £5. Our ref 5P139

4 CORE TINSEL COPPER LEAD As fitted to telephones, terminating with flat BT plug, 2 for £1. Our ref BD639.

EHT TRANSFORMER 8kv 3mA. £10. Our ref IOP56

VERY USEFUL MAGNETS Flat, about 1in long, 1 1/2in wide and 1/4in thick. Very powerful. 6 for £1. Our ref BD274(a).

ACORN COMPUTER DATA RECORDER Ref ALF03. Made for the Electron or BBC computers but suitable for most others. Complete with mains adaptor, leads and handbook. £10.00. Ref 10P44. Add £2 special packing.

SOLAR CELLS Will give good current (depending on size) from sunlight or bright daylight. Module A gives 100mA. Price £1. Our ref BD631. Model C gives 400mA. Price £2. Our ref 2P199. Model D gives 700mA. Price £3. Our ref 3P42.

SOLAR POWERED NI-CAD CHARGER 4 Ni-CAD batteries AA (HP7) charged in eight hours or two in only 4 hours. It is complete, boxed ready to use unit. Price £6. Our ref 6P3.

METAL PROJECT BOX Ideal for battery charger, power supply etc., sprayed grey, size 8"x4 1/4"x4" high, ends are louvred for ventilation other sides are flat and undrilled. Price £3. Order ref 3P75.

CAPACITOR BARGAIN Axial ended—4700uF at 25v. Jap made. Normally 50p each, but you will get 4 for £1. Ref 1.613.

SINGLE SCREENED FLEX 7.02 copper conductors, pvc insulated then with copper screen, finally outer insulation. In fact quite normal screened flex. 10m for £1. Our ref BD668.

3 CORE FLEX BARGAIN No. 1 Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15m £2. Ref 2P189

3 CORE FLEX BARGAIN No. 2 Core size 1.25mm so ideal for long extension leads carrying up to 13 amps or short leads up to 25A. 10m for £2. Order ref 2P190

ALPHA-NUMERIC KEYBOARD This keyboard has 73 keys with contactless capacitance switches giving long trouble free life and no contact bounce. The keys are arranged in two groups, the main area field is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13" x 4" — brand new but offered at only a fraction of its cost namely £3 plus £1 post. Ref 3P27.

1/2 HORSEPOWER 12 VOLT MOTOR Made by Smiths, the body length of this is approximately 3in., the diameter 3in. and the spindle 3/16th of an inch diameter. It has a centre flange for fixing or can be fixed from the end by means of 2 nuts. A very powerful little motor which revs at 3,000rpm. We have a large quantity of them so if you have any projects in mind then you could rely on supplies for at least two years. Price £6. Our ref 6P1, discount for quantities of 10 or more.

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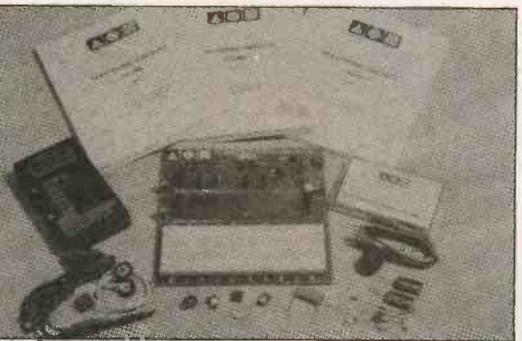
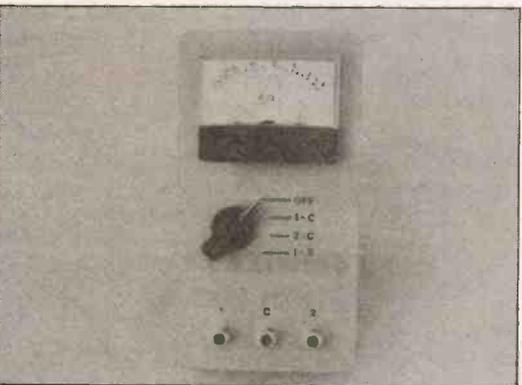
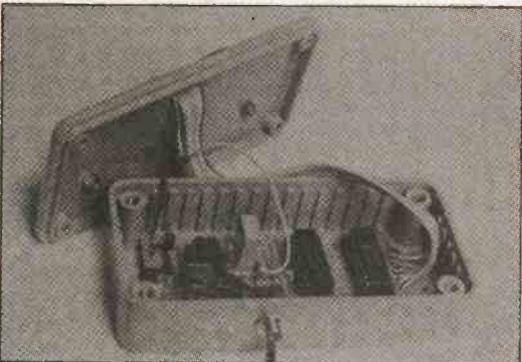
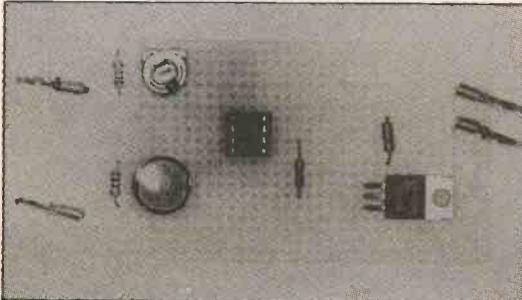
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PROJECTS ... THEORY ... NEWS ...
COMMENT ... POPULAR FEATURES ...



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Our January '90 Issue will be published on
Friday, 1 December 1989. See page 763 for details.
Everyday Electronics, December 1989

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Add intermittent wipe to your car — a Free Circuit Board project
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Allow the postman to leave your mail-order packages even when you're out
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THE RTC MONITOR II

100 WATT SPEAKER KIT £60.00 + £3.50 P&P (pair)
RESPONSE: 55Hz - 20kHz

BASS POLYMER CONE D: 22cm
DOME TWEETER: 14mm

OVERALL SIZE
(HWD): 382,252,204mm

RECOMMENDED AMP POWER:
10-100 watts per channel

The performance standard achieved in this compact design is distinctively superior to anything else available at the price. The drive units used are of sophisticated design and have been carefully integrated with a Complex Crossover. Stereo performance is exceptionally good with a well focussed sound stage and sharp resolution of detail. Distortion throughout the frequency range is low even at quite high power input and this gives a great sense of dynamic range and openness especially when used in bi-wired mode.

Supplied with:— 2 READY CUT BAFFLES, ALL CROSSOVER COMPONENTS, 2 BASS MID-RANGE, 2 DOME TWEETERS, HOOK UP WIRE, GRILLE CLOTH, SCREW TERMINALS AND SCREWS.

CROSSOVER KIT. To build 2 sets of crossovers £11+£1.75 post. (Featured in *Everyday Electronics* - May 1989 issue). Reprint Free with Kits



AMPHONIC 125+ 125 POWER AMPLIFIER



125 watt per channel stereo power amplifier with independent volume controls, professional 19" rack mount and silent running cooling fan for extra reliability.

Output power 125W RMS max. per channel
Output impedance 4 to 16 ohms
(max. power into 4 ohms)

Sensitivity 450V at 22K ohms
Protection Electronic short-circuit and fuses
Power 220-240V a.c. 50Hz
Chassis dim 435x125x280mm

£124.99 + £7.00 p&p

GOODMANS 60W CAR GRAPHIC EQUALIZER AMPLIFIER



As new condition but have been returned by customers or shops, so they may need some attention. Hence the price of only £8.00 each. Order six of these units and you get the seventh one free. Postage £2.90

ROSS DYNAMIC MICROPHONE BALL TYPE

General purpose in light weight case with wire mesh grill, and on/off switch fitted with lead and jack plug. These units have been returned and may need repairing. Price £2.50 each. Order ten of these units and you get one free. Postage 80p.

J.B.L. BOLIVAR COMPONENT SPEAKERS

4 1/2" 100W HI-FI MID RANGE 1" VOICE COIL, PAPER CONED AND DOPED CAMBRIC EDGE FITTED WITH A 3 1/2" MAGNET. 6Ω IMPEDANCE £5.33

4 1/2" HI-FI TWEETER 3/4" VOICE COIL, 1 3/4" CONE WITH FOAM EDGE, 2 3/4" MAGNET, 6Ω IMPEDANCE £6.33
POSTAGE £4.70 PER ORDER

52W 2-WAY COMPONENT SPEAKER SYSTEM £3.95

Comprises 8in rolled surround bass unit and 2 1/4in tweeter for In-Car or Hi-Fi use. 4 ohm. Made by Sanyo.

8 OHM HI-FI COMPONENT SPEAKER £4.95

6 1/2in. Audax 60W. Res freq. 45Hz bass-mid
8in SOUND LAB 60W £12.95
Res freq. 38Hz full range

12in DANTEX 100W £21.75

Res freq. 23Hz bass unit

Postage £3.20 each order

SPECIAL PURCHASES

Batteries C size NiCad 2.2 Ah EVERY-READY AN220 £1.98 each

Our most popular size of rechargeable battery: 4AA size Japanese made batteries — £3.90 for four.

HILLS KITS IN STOCK ★ SEND FOR CATALOGUE

£1 BARGAIN PACKS BUY 10 GET 1 FREE

Please state pack(s) required
No = Order No. Qty = Quantity per pack

No	Qty	Description
BP010	2	6 1/2" Speaker 80 10 watt
BP012	2	6 1/2" Speaker 40 10 watt
BP013	3	8" x 5" Speaker 40 6 watt made by E.M.I.
BP015B	1	30 watt, dome tweeter. Size 90x66mil JAPAN made
BP016	6	2200µf can type Electrolytic 25V d.c. computer grade made in UK by PHILIPS
BP017	3	33000µf 16V d.c. electrolytic high quality computer grade UK made
BP018	3	2000µf 50V d.c. electrolytic high quality computer grade made in USA
BP019	20	20 ceramic trimmers
BP020	4	Tuning capacitors, 2 gang dielectric a.m. type
BP021	10	3 position, 8 tag slide switch 3 amp rated 125V a.c. made in USA
BP022	5	Push-button switches, push on push off, 2 pole change over. PC mount JAPAN made
BP023	6	2 pole 2 way rotary switch
BP024	2	Right angle, PCB mounting rotary switch, 4 pole, 3 way rotary switch UK made by LORLIN
BP025	4	3 pole, 3 way miniature rotary switch with one extra position off (open frame YAXLEY type)
BP026	4	4 pole, 2 way rotary switch UK made by LORLIN
BP027	30	Mixed control knobs
BP028	10	Slide potentiometers (popular values)
BP029	6	Stereo rotary potentiometers
BP030	2	100k wire wound double precision potentiometers UK made
BP031	6	Single 100k multitune pots, ideal for varicap tuners UK made by PHILIPS
BP032	4	UHF varicap tuner heads, unboxed and untested UK made by PHILIPS
BP033	2	FM stereo decoder modules with diagram UK made by PHILIPS
BP033A	4	6"x3/8" High grade Ferrite rod. U.K. made.
BP034	3	AM IF modules with diagram UK made by PHILIPS
BP034A	2	AM-FM tuner head modules. UK made by MULLARD
BP034B	1	Hi-Fi stereo pre-amp module inputs for CD, tuner tape, magnetic cartridge with diagram. UK made by MULLARD
BP035	6	All metal co-axial aerial plugs
BP036	6	Fuse holders, panel mounting 20mm type JAPAN made
BP037	6	In line fuse holders 20mm type UK made by BULGIN
BP038	20	5 pin din, 180° chassis socket
BP039	6	Double phono sockets, Paxolin mounted
BP041	3	2.8m lengths of 3 core 5 amp mains flex
BP042	2	Large VU meters JAPAN made
BP043	30	4V miniature bulbs, wire ended, new untested
BP044	2	Sonotone stereo crystal cartridge with 78 and LP styli JAPAN made
BP045A	2	Mono Cassette Record and play heads. (Japan Made)
BP046	4	6-0-6 4VA mains transformers, P.C. mount UK made
BP047	1	24V 750mA mains power supply. Brand new boxed UK made by MULLARD
BP049	10	OC44 transistors. Remove paint from top and it becomes a photo-emitter cell (or P12) UK made by MULLARD
BP050	30	Low signal transistors n.p.n., p.n.p. types
BP051	6	14 watt output transistors. 3 complimentary pairs in T066 case (Ideal replacement for AD161 and 162s)
BP052A	1	Tape deck pre-amp IC with record/replay switching No LM1818 with diagram
BP053	5	5 watt audio ICs. No TBA800 (ATEZ)
BP054	10	Motor speed control ICs, as used with most cassette and record player motors
BP055	1	Digital DVM meter I.C. made by PLESSEY as used by THANDAR with diagram
BP056	4	7 segment 0.3 LED display (R.E.D.)
BP057	8	Bridge rectifiers, 1 amp, 24V
BP058	200	Assorted carbon resistors
BP059	1	Power supply PCB with 30V 4V/A transformer. MC7818CT IC & bridge rectifier. Size 4" x 2 3/4"
BP060	1	Transcription record player motor 1500rpm 240V a.c.
BP061	5	6.35mm Mono jack plugs
BP063	5	6.35mm stereo switched jack sockets
BP064	12	Coax chassis mount sockets
BP065	1	3mtr Euro-mains lead with a matching chassis socket

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■ 30W x 2 (DIN 4 ohm)
■ CD/Aux, tape I, tape II, tuner and phono inputs.

■ Separate treble and bass

■ Headphone jack

Size (H.W.D.) 75x400x195mm

Kit enclosed: case, P.C.B., all components, scale and knobs £36.80. post £3.50

(Featured project in *Everyday Electronics* April 1989 issue). Reprint Free with kit.

TV SOUND TUNER



In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are quite common and that really is quite sad, as the TV companies do their best to transmit the highest quality sound. Given this background a compact independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains operated. This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder.

£29.50 + £2.50 p&p

As above but with built-in stereo headphone amplifier for the hard of hearing

You can tune into the TV channel you want while still receiving the picture on your TV set. In fact it is rather like a second television, but without the screen. So that the ordinary TV can be placed for everyone to see, and the volume on it can be comfortable for others, while the sound tuner can be placed where you can control it. You will need to plug in one of your own listening aids such as headphones or an induction loop to hear the sound. The tuner is mains operated, has 5 pre-selected tuning controls and can be used in conjunction with a video recorder.

Size: 270x192x65mm. £35.90 + £2.50 p&p

TV SOUND TUNER KIT £11.50 + £1.30 P&P

All parts including Varicap tuner, mains transformer, PCB with IC's capacitors and coils etc., to build the unit illustrated above; without case and scale.

SHURE HIFI STEREO MAGNETIC CARTRIDGE

Fitted with an elliptical diamond stylus supplied with fitting kit and instructions. A good quality unit made to sell for well over twenty pounds due to scoop purchase, we are able to offer these at a fraction of the manufacturers price. All units are brand new and boxed. £7.20 each. If you order in multiples of five you get one free. Postage £1.30 (Made in U.S.A.)

KOSS MINI SPEAKERS Use instead of headphones on your personal stereo, just plug in instead of headphones. Koss sound cells can be mounted on top of your personal stereo with the holder supplied or simply detach for shelf mounting. This quality unit was made to sell for over seventeen pounds by the KOSS professional headphone company of the U.S.A. Due to a massive scoop purchase we can offer these units for £4.30 each or buy in multiples of ten and you get one free. Postage £1.50.

KOSS STEREO HEADPHONES

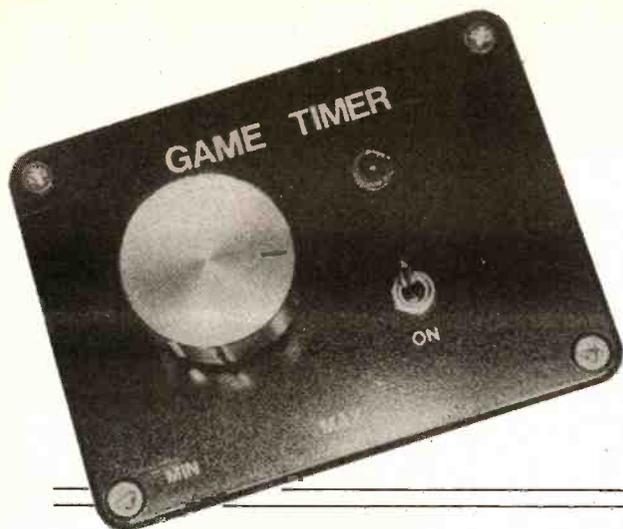
High quality light weight stereo headphones fitted 3.5mm jack with adaptor to 6.4mm jack. Ideal use HiFi or personal stereos made to sell for nine pounds. Our price for this unit £4.25. Postage 60p.

Hi-Fi stereo cassette deck transport mechanism, complete with 3 digit rev counter and tape heads, 12V d.c. operation. Unused manufacturers surplus JAPAN made

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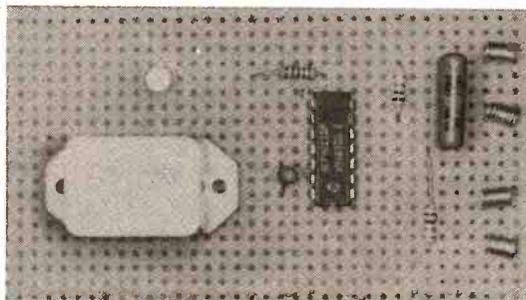


GAME TIMER

When playing a game where one person has to make a move at a time, disputes sometimes arise because one player seems to take very much longer to make their move than the other players. This timer has been designed to prevent strife in such circumstances by indicating that a set time has expired by sounding a buzzer. Designed to be built on our free circuit board presented with this issue.

POSSESSION ALARM

Another project for the *Free Easiwire Circuit Board* presented with this issue. This circuit is designed to operate in the same way as the alarms you will find in shops where valuable items are linked together by a wire which is passed through the items and which causes an alarm to go off if the continuity of the loop is broken.

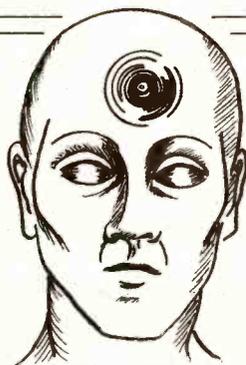


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BIOGEN

A problem for biofeedback enthusiasts, especially those working with EEG (Electroencephalograph) "brainwave" instruments, is the generation of suitable test signals. These should be sub-audio in frequency, from almost zero to about thirty Hertz, and of sinusoidal waveform. This project provides the right signals at the correct amplitude to enable EEG equipment to be tested.

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JANUARY '90 ISSUE ON SALE DECEMBER 1 1989

MICRO PANELS

Z4209 Panel 360x210mm covered in high quality chips; 8085AHC, 8255, 8257 8251A x2, 8253-5, 8275, 8202A, 2732, 2716, all in sockets; 18x4116-2 + other mainly LS chips + min switches, LED's, oscillator, large tants, 3x50 way double sided edge connectors. Amazing value at only **£16.95**

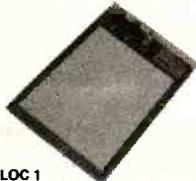
Z4210 Panel 260x210 which could plug into the above board. Lots of memory on this one: 36x4116-20. Also 8085AC, 8202 & 2716 in skts + 55 others mainly LS chips, DIL switch, large tants etc **£9.95**

Z4211 80186 Panel. 346x280mm 'Benchmark 186' panel packed with high class chips — all in sockets! Just look at what you get! 80186 16 bit 8MHz microprocessor: 16x4164-12 RAM's, 2x6116-3; 2x2732 EPROM's; 2x8255AP-5; 8259AC-2; 6845SP; 146818P; 7201C. Over 80 LS chips, 4 xtls, back up battery, 2x25 way 'D' sockets etc etcl Total chip value alone must exceed £150 — and remember, all the chips are in sockets. Price **£40.00**

Z4233 As above, but LS chips not socketed **£5.00**

Z4235 Superb panel 340x200 packed with high quality parts, giving outstanding value for money! 6809 microprocessor in skt 6840, 6850, 6844 support chips; 6x27128-25 EPROM's in sockets; 9x8264A-10 RAM's; over 50 other chips, linear, LS etc. **£20.00**

BREADBOARDS



PROTOBLOC 1

G708 Protobloc 1 has a total of 400 tie points consisting of two sets of 30 rows of 5 interconnected sockets plus 4 rows of interconnected sockets running alongside, suitable for use as power supply rails. All contact positions are clearly defined on an alphanumeric grid. ABS polymer board mounted on an adhesive foam base. Will accommodate up to three 16 pin devices. An ideal introduction to solderless circuit development systems. Size 80x60mm **£2.50**

PROTOBLOC 2

G711 Photobloc 2 has a total of 840 tie points consisting of two sets of 64 rows of 5 interconnected contact sockets plus 4 rows of 50 interconnected sockets running alongside, suitable for use as power supply rails. All contact positions are clearly defined on an alphanumeric grid. ABS polymer board mounted on an adhesive foam base. Will accommodate up to seven 16 pin devices. Size 172x64mm **£3.95**

PROTOBLOC 2A

G712 As above, but the ABS polymer board is mounted onto a rigid base plate complete with three 4mm terminals in red, black and green for power connections. A mounting bracket which clips into the base is also provided to accept a variety of components including switches and potentiometers, etc. Price **£6.95**

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A112 Variable stabilized power supply with overload protection. Meter reads voltage or current (switched). Two voltage ranges; 0-12V and 12-24Vd.c. Ideal for laboratory use.
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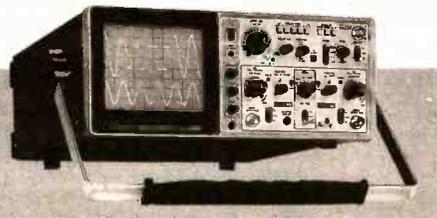
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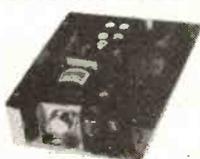
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O/P: V1 + 5v 5A
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Size: 160 x 104 x 45mm
Partially enclosed panel with fixing holes in steel case on 120 x 125mm centres.
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O/P: 50Watt max:
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V2 + 5v 6.0A
V3 12v 0.5A (+ or -)
V4 5v 0.5A (+ or -)
Size: 203 x 112 x 60mm
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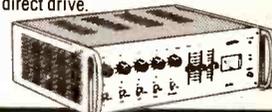


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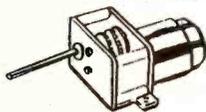
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EE JAN '86

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EE MARCH '86

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KIT REF 512

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EE OCT '88

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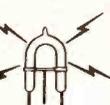
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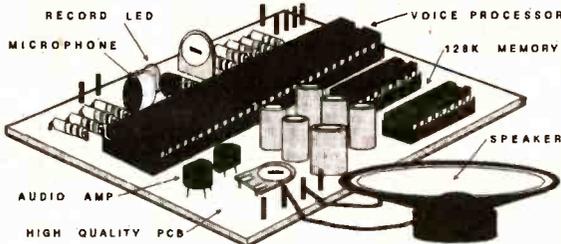
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Size..... 78x60x15 mm
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XK129..... £22.50

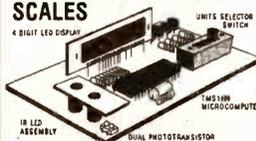
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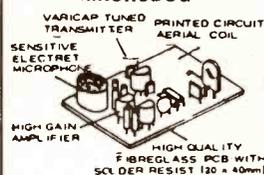
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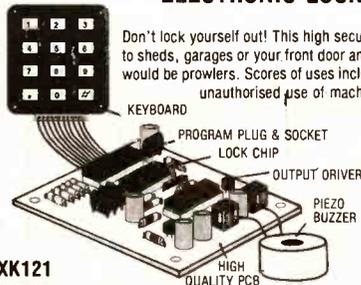
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CT6000K..... £49.50
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TK ELECTRONICS

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London W7 3SJ
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FREE

Over the next couple of months we will be publishing a few simple projects which can all be built on the Free Easiwire Circuit Board attached to the front of this issue. This board has been supplied by BICC-Vero who also supply the Easiwire wiring system — we reviewed this in our June 88 issue.

The board can be used to build up almost any small project so you are not limited to the ones we are publishing. The gift should therefore be of interest to most readers and we hope it will encourage those who have not built any projects before to "have a go".

BOOKS

While on the subject of project building please note that our first ever project book — *Electronic Projects Book 1*— is now on sale at your newsagents. This book contains 29 projects each backed with a kit of components.

There are now four special EE publications available and you can find details on all of them on page 811. They are all available by mail order through our *Direct Book Service*.

More books have been added to the D.B.S. pages this month — and another few new ones will appear next month. All the books listed are chosen because we believe they will be of special interest to our readers and the lists are updated every month.

P.C.B.s

In the past we have often had to ask readers to wait two or three weeks for p.c.b.s from our service. I'm pleased to say that virtually all of our listed p.c.b.s are now held in stock at our editorial office and are posted within seven days of receipt of your order. So — post willing — you should not have to wait too long before you can start the latest project.



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We advise readers to check that all parts are still available before commencing any project in a back-dated issue.

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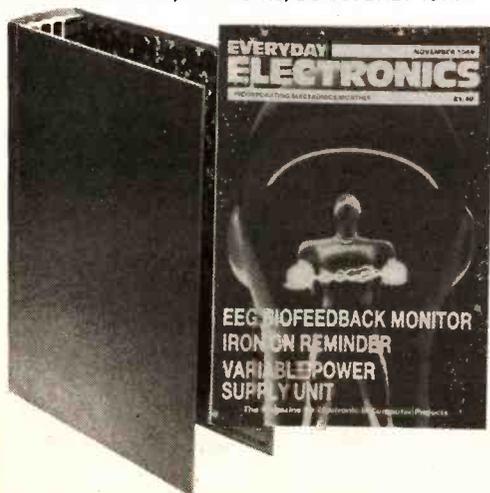
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Certain back issues of EVERYDAY ELECTRONICS are available price £1.50 (£2.00 overseas surface mail—**£ sterling only please**) inclusive of postage and packing per copy. Enquiries with remittance, made payable to Everyday Electronics, should be sent to Post Sales Department, Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH. In the event of non-availability remittance will be returned. *Please allow 28 days for delivery. We have sold out of Sept. Oct. & Dec. 85, April, May, Oct. & Dec. 86, Jan., April, May & Nov. 87, Jan., March, April, June & Oct. 88.*

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AUTOLIGHT

CHRIS BOWES



A simple unit that can be constructed on the Free Easiwire Circuit Board. It will provide emergency lighting or an automatic night light.

THIS MONTH'S Pocket Money project is designed to switch on a small, low voltage lamp automatically when the light level sensed by a Light Dependent Resistor (LDR) falls below a set level. It has been specially designed so that it can be built up on the **FREE**, cover mounted, piece of Easiwire board.

This is an interesting circuit in its own right and has a number of useful applications. These can include an automatic night light for use with a child or an emergency lighting system to take over illuminating a strategic area in the event of failure of a mains driven system.

The main active device in the project is the light dependent resistor. Light dependent resistors operate in the same way as variable resistors in so far that the actual resistance of the component can be made to vary.

In the case of a variable resistor or potentiometer you can manually alter the resistance by operating the rotating control of the component. With a light dependent resistor the amount of light falling upon the photo-sensitive area of the device governs the actual resistance of the component. In general when more light is shining on the LDR the resistance of the component is low and when very little light falls on it the resistance is high.

CIRCUIT DESCRIPTION

The circuit diagram for the Autolight project appears in Fig.1. Resistors R1 and R2 form a fixed (reference) voltage divider to produce a steady voltage of approximately 0.8V at the inverting input, pin 2 of IC1. Preset VR1 and LDR1 form a similar voltage dividing network which produces a variable voltage, dependent upon the amount of light falling upon the LDR, which is connected to the non-inverting input (pin 3) of IC1. The preset control is included so that the operating light level of the circuit may be accurately set.

IC1 is a CA3140 op. amp. which is configured in this circuit, as a comparator. An operational amplifier is designed to amplify the difference between the two inputs by a factor which is determined by the ratio of the resistance between the signal and the inverting input and a similar resistance connected between the output and the inverting input.

When the op. amp is set up as a comparator these two resistors are omitted and as a result the op. amp has virtually an infinite gain. This is, in practice, limited by being restricted to the power supply rail voltages.

Under these circumstances the output state is determined by the voltages present

at the two inputs. If the voltage at the non-inverting input (pin 3) is greater than the voltage present at the inverting input (pin 2) then the output at pin 6 will be the battery voltage.

If the conditions are reversed so that the voltage at pin 2 is greater than the voltage at pin 3 then the output at pin 6 will be 0 volts. The circuit is in fact very sensitive and a very small fluctuation of the input voltages will cause a complete swing of the output voltage at pin 6 from 0V to 9V.

TRANSISTOR POWER SWITCH

The operational amplifier has a very low current output. As a result it is not possible for this device to directly switch the lamp on and off so a simple, single stage, transistor output switching amplifier, consisting of resistor R3 and transistor TR1 is used to carry out this task.

In this sort of application the transistor is used as a simple switch so that a small current flowing through the base/emitter junction is used to control a much larger current flowing through the collector/emitter circuit. When a very small current flows through the base emitter circuit this allows a large current to flow through the collector/emitter circuit.

As soon as the current through the base/emitter ceases to flow then the current through the collector/emitter circuit is also prevented from flowing. The current will flow through the base/emitter as long as the voltage between the base and the emitter of the transistor exceeds 0.7V.

In actual fact, no matter what voltage is available at the base of the transistor the

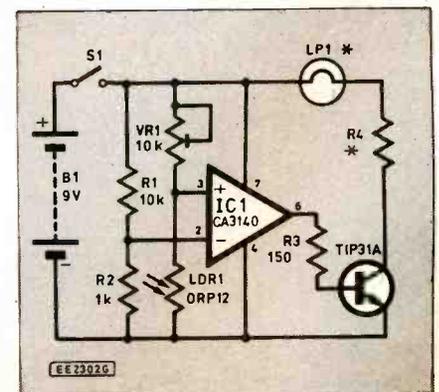
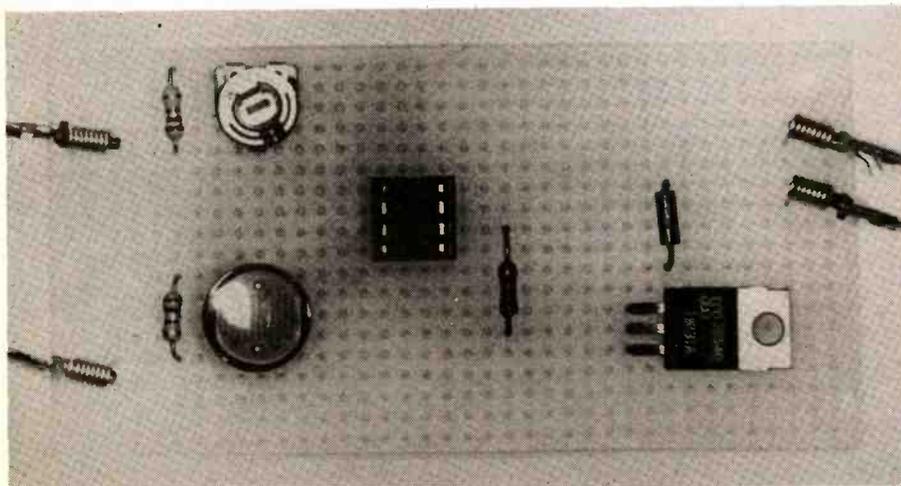


Fig.1. Circuit of the Autolight

transistor will actually prevent the voltage between the base and the emitter exceeding 0.7V. Any excess voltage is converted to heat by the transistor and could cause serious damage to the transistor. In order to restrict the current flowing through the base/emitter circuit of the transistor to a safe level resistor R3 has been included in the circuit as a base protection resistor.

LAMP

The selection of the lamp operated by this circuit (LP1) presents a difficulty, since it appears that no suppliers have 9V bulbs available in their catalogues. The solution is to therefore use a lower voltage bulb and to adjust the voltage flowing through it by means of a series resistor (R4).

Although the values given in the component list will work quite happily they are by no means the only suitable combination. There are such a large number of bulbs available that the best strategy is for you to select a bulb and then select the appropriate value for R4 to suit your bulb using the formula:

$$R4 = \frac{V_{ss} - V_{bulb}}{I_{bulb}}$$

Where V_{ss} = the battery voltage, V_{bulb} = the voltage of the bulb and I_{bulb} = the current taken by the bulb.)

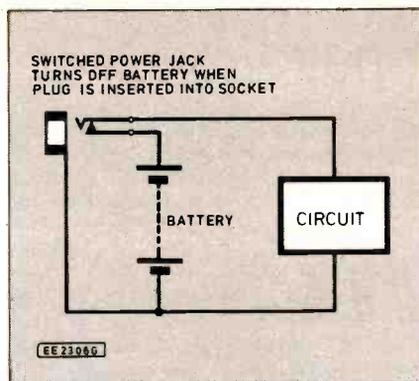


Fig.2. Using a battery eliminator

BATTERY ELIMINATOR

If you intend to operate this circuit as a child's night light, or in some similar situation where it must operate for a long period of time, you will probably find that normal 9V batteries are insufficient to keep the bulb burning for a prolonged period. However, it is possible to operate this circuit from a mains driven power pack of the type that is sold at component shops.

In order to connect a battery eliminator into the circuit you will need to use a low voltage input connector socket, of the type suitable for the output from your power supply, which switches off the internal battery when the external power supply is connected. This should be wired up as shown in Fig.2.

Switching within the input socket SK1 works so that without the power plug inserted the contacts allow current from the battery to flow to the circuit in the normal way. When the power plug is inserted the internal switch mechanism disconnects

the internal battery and powers the circuit from the current supplied by the power pack instead.

Under no circumstances should this project be connected to the mains EXCEPT through a SAFE low voltage power supply.

The on/off switch S1 is a simple, single pole, single throw switch which is included in the circuit so that it may be turned off when not required.

CONSTRUCTION

This project has been constructed using the BIC-VERO "Easiwire System". A suitable circuit board is included FREE (cover mounted) with this issue of Everyday Electronics. The board has 38 by 18 holes, on a 0.1in. matrix.

The layout of the components on the board together with the underside wiring is shown in Fig.3. The components are simply inserted into the appropriate hole in the board from the side with the wider holes. When all of the components have been inserted into it, the board is turned over and the protruding component tails trimmed to a length of 3mm using a pair of sidecutters.

At this stage it is important to ensure that any polarity sensitive components are inserted into the board the correct way round. This should be double checked thoroughly before wiring the board up, since moving components after they have been wired tends to require the complete replacement of all the connections made with that piece of wire.

The components can now be interwired, using the Easiwire pen, to produce the connections as shown in Fig.2. This process is a fairly simple task and should not cause too many problems.

At the start of a wiring run a short length of wire from the wiring tool is held on the board near to the first component pin with

COMPONENTS

Shop
Talk

Resistors

- R1 10k
- R2 1k
- R3 150
- R4 15 0.5W (see text)

See page 783

All 0.25W 5% carbon except where stated

Potentiometer

- VR1 10k skeleton preset, horiz

Semiconductors

- TR1 TIP31A npn power
- IC1 CA3140 op. amp

Miscellaneous

- LDR1 ORP12 light dependent resistor
- S1 s.p.s.t toggle switch
- LP1 6.5V, 0.15A bulb (see text)
- B1 9V battery (PP9 or similar)
- JK1 Min. "power" jack connector to suit power supply (optional)

Easiwire circuit board (Free with this issue), 38 holes x 18 holes; Easiwire connectors (4 off); Easiwire wire; bulb holder; 8-pin i.c. socket; battery connector; plastic case, to choice.

Approx. cost
Guidance only

£5

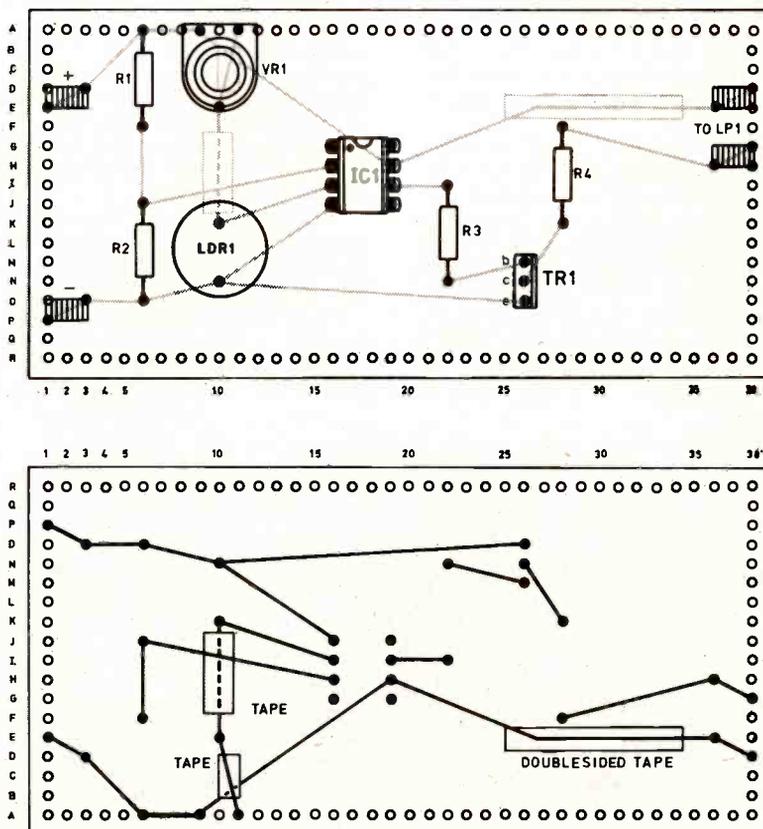


Fig.3. Wiring for the Autolight circuit board

the finger. The tool is then used to roll the wire up the pin, under light tension, for four or five turns and roll it back down again with another four or five turns around the component tail.

The wire should now be at the bottom of the component tail and should be in contact with the surface of the board. The wire is then pulled along to the next component by means of the wiring pen, keeping a small amount of tension on the wire, where the process is repeated again rolling the wire up and down the component tail before continuing to the next component.

At the end of the wiring run the wire is run up and down the last component as before and the wire is then cut, close to the pin, using the cutter on the tool. The extra piece of wire at the beginning of the wiring run can be similarly cut off using the cutter blade. Where the wiring chain has to break, as in the case of the negative connection to LDR1, this is simply achieved by wiring a further set of turns of wire around the component tail on top of those already sighted there at the junction point and then continue as before.

In this circuit there are two points at which wires have to cross. Because the wire used in this system is not insulated it is necessary to place a piece of insulating tape on top of the first wire installed before running the second wire on top of this. The points at which these occur are shown in Fig. 3.

The wire connecting the power rail from IC1 pin 7 to LP1 "spring" connector, if run in a straight line, would foul one of the component rails of resistor R4. In order to prevent this happening a curve must be introduced into the wiring run by using the double-sided adhesive supplied.

A small piece should be cut to the correct size required, the white film removed from the adhesive sheet and the sheet stuck to the back of the board. The brown film is then peeled off before the wiring run is made and the wire pressed onto the adhesive sheet to hold it firmly in place away from the tail of resistor R4.

ADJUSTING AND TESTING

Before inserting the battery and any attempt is made to use the circuit it should be thoroughly inspected to make sure all components are installed correctly, are the correct way round and that there are no 'accidental' short circuits. When this visual check has been completed then the battery may be inserted into its holder and switch S1 operated.

The first stage of the adjusting and testing procedure is to set the value of preset VR1 so that the lamp is turned on at the correct light level. To do this you should cover the LDR and adjust VR1 until the light comes on. If you then remove the covering and allow light to fall upon the LDR you should observe that the light is turned off. You can then adjust VR1 further until the bulb (LP1) switches on at the desired light level.

FAULT FINDING

Fault finding on this circuit can only really be accomplished by means of a multimeter. If the battery voltage is measured at the appropriate power points in the circuit and the circuit still fails to work then it will be necessary to check the individual sections of the circuit.

Assuming that the battery voltage is available between pins 4 and 7 of IC1. The next stage is to check the voltages, with respect to the negative input to the board, at pins 2 and 3 of IC1. A voltage of approximately 0.8V should be available at pin 2 and if this is not the case then the connections to the reference voltage divider, comprising resistors R1 and R2, should be checked.

With the meter, set to 'volts', connected to the negative battery input the positive probe should be connected to the wire of R1 nearest to the top of the board. The battery voltage should be measurable at this point and if this is not the case then the connection between the positive power supply input and this point should be investigated.

The voltage at the other end of R1, at the junction with R2, should be approximately 0.8V. The voltage present at pin 2 of IC1 should also be checked and found to be the same as the voltage found at the junctions of R1 and R2. If this is not the case then the connection between the junction of R1 and R2 and pin 2 of IC1 should be investigated.

If the voltages measured at these two points are considerably higher than 0.8V then the connection between the end of R2 nearest to the bottom of the board and the negative battery input connector should be investigated. If the connections between R1 and R2 and pin 2 of IC1 appear to be correct then the values of R1 and R2 should be checked using the resistance setting of the meter.

LIGHT LEVEL

The next stage is to check that the light detecting circuit, consisting of VR1 and R3 (LDR) is operating correctly. The first stage is to check the voltage between pin 3 of IC1 and the negative battery input to the circuit board whilst varying the amount of light falling on the LDR.

The voltage at this point should vary according to the amount of light falling on the LDR. When very little light falls on the LDR then the voltage at pin 3 of IC1 should be between two volts and the battery voltage.

As the amount of light falling on it is increased by removing the shading between the source of the light and the LDR so the voltage at pin 3 should reduce to below the voltage measured at pin 2. If this is not the case then the connections in the vicinity of pin 3 of IC1 should be checked. If the voltage measures 0 volts, with respect to the negative supply voltage, then a check should be made between pin 3 and the positive battery input on the board.

If the battery voltage is measured between these two points then this would indicate either a wiring short circuit between pins 3, 4 of IC1 or a fault within IC1 itself. If no voltage is measured between either of the battery input connections and pin 3 then this would indicate that the fault lies with the interconnection between pin 3 of IC1 and the light sensing resistance chain (VR1/LDR1).

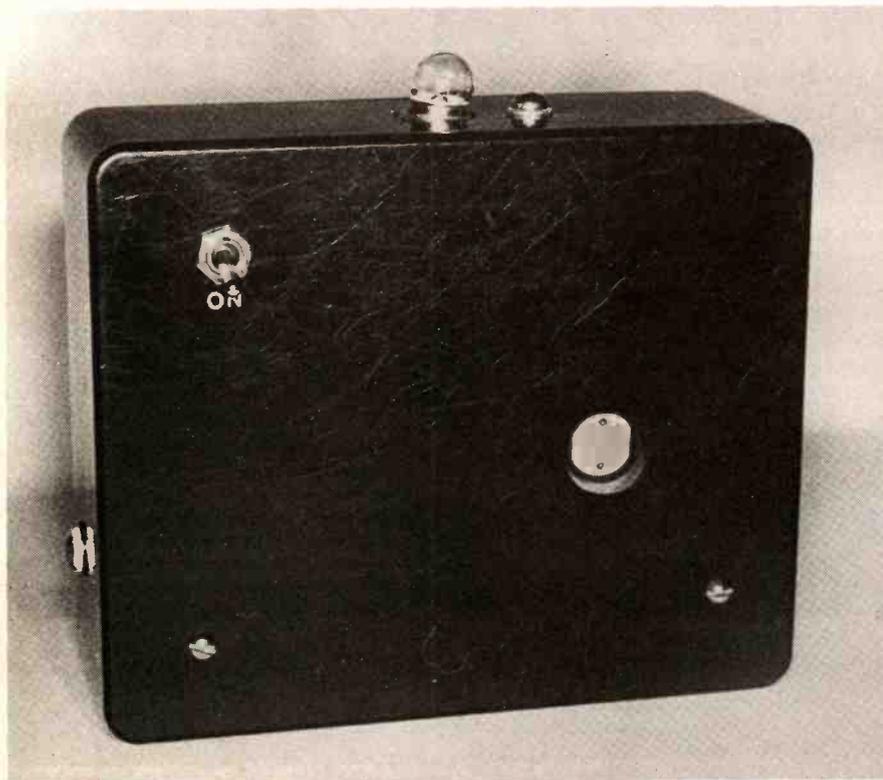
Another potential source of problems in the light sensing circuit is if VR1 is set so that there is very little resistance between the positive power supply rail and the connection of the wire of VR1 with the LDR then the variation of light levels on the LDR will have very little effect. A visual check should be made of the setting of VR1 and if necessary an adjustment of the setting VR1 made.

The potential divider circuit consisting of VR1 and LDR1 can be checked out in the same way as described for the checking of the fixed voltage potential divider made up of resistors R1 and R2. The major difference however is that the voltage present at the junction of VR1 and LDR1 which should be the same as the voltage present at pin 3 of IC1, should vary as the level of the light on the LDR varies.

Once a fluctuating voltage, which varies with the amount of light falling on LDR1, is obtained VR1 can be adjusted until the circuit switches over at the required light level.

OUTPUT VOLTAGE

The next stage is to check that the output voltage of pin 6 of IC1 switches as the amount of light falling on the LDR is



altered. With a voltmeter connected between the negative battery input to the board and pin 6 on IC1 the amount of light falling on the LDR should be varied by shading it with your hand.

When the amount of light falling on it is greater than the level at which you wish the circuit to switch then the output measured between pin 6 of IC1 and 0 volts should be virtually 0. As the light falling on the LDR is reduced, by shading it with your hand, so the voltage at pin 3 should rise above the voltage set at pin 2 and the output voltage at pin 6 should, at this stage rapidly switch from 0 volts to virtually the battery voltage.

If this does not happen and you have already checked that the voltage at pin 3 fluctuates above and below the voltage of pin 2 then you should check that there are no short circuits associated with pin 6 of IC1. If the voltage present at pin 6 of IC1 is permanently at the battery supply voltage then a check should also be made to ensure that there is not an accidental short circuit between pins 6 and 7 of IC1.

If this reveals no fault, or if the voltage at pin 6 remains locked at 0 volts, then a check should be made that the battery voltage is present across pins 7 and 4 of IC1. If all other checks reveal nothing to be wrong then it must be suspected that IC1 is faulty and it should be replaced with a new one.

OUTPUT CIRCUIT

Fault finding on the output circuit is relatively simple. The first stage is to check that bulb LP1 is firmly screwed into its lamp holder and that the connections are correctly made to the connectors on the board.

Once this has been done the next stage is to make a temporary short between the emitter and collector of transistor TR1. This should cause LP1 to light up. If LP1 does not illuminate when tested in this way then a careful check should be made of the lamp circuit from the battery positive con-

nection to the board, through the under-board wiring to the positive side of LP1 and from LP1 through resistor R5 and the collector and emitter of TR1 to the negative battery connection. A break of any description along this chain will cause the lamp not to illuminate.

If the lamp illuminates when tested in this way then the short circuit between the collector and emitter of TR1 should be removed and the voltage between the negative battery connector and the base of TR1 should be checked. When battery voltage is applied to the end of R4 which is connected to pin 6 of IC1 then approximately 0.7 volts should be measured between the base and emitter of TR1. This should cause LP1 to illuminate.

If no voltage is measurable between the base and emitter of TR1 when battery voltage is available at pin 6 of IC1 then the voltage present at the end of R3 nearest to the top of the board should also be measured. If the battery voltage is not present here but is present at pin 6 of IC1 then the connection between pin 6 of IC1 and R3 should be investigated. If battery voltage is measurable at both ends of R3 then the connection between R3 and the base of TR1 should be investigated.

If all of the foregoing checks prove that there is nothing wrong on the circuit board then the voltage present between the emitter and the base of TR1 should be measured. If 0.7V or more is present at this point and the transistor still fails to cause LP1 to illuminate then it must be suspected the TR1 is defective and should be replaced.

CASE

Before the project can be installed into a case a suitable sized case should be prepared. It is important to realise that the case layout should be designed so that the light from bulb LP1 does not shine onto the

LDR and that the circuit board can be installed with the LDR exposed to the ambient light through a hole in the case.

In the prototype it was decided that LP1 would be mounted so as to protrude through the top of the case with the LDR mounted in what is effectively the front of the case (which is in fact the bottom of the case) furthest away from the removable lid. When suitable positions for these components and also for S1 and, if used, the input power supply jack socket JK1 have been formed the case should be carefully drilled with holes of the appropriate sizes to accommodate these components.

Because it is potentially difficult to assess the correct position of the LDR by holding the circuit board up to the case it will be necessary to find a position for the LDR by careful measurement. Once the hole to accommodate the LDR has been drilled in the case then the circuit board may be offered up to the case wall and the LDR accurately positioned.

In order to allow the LDR to be mounted as close as possible to the body of the case it will be necessary to carefully bend the body of transistor TR1 over so as to make it as close to the component board as possible. The mounting holes for the circuit board can then be marked and drilled.

Once these holes have been drilled and their edges cleaned up any lettering you may wish to use on the case may be applied.

IN USE

This project is very simple to use. All that it is necessary to do is to set VR1 to give precisely the correct switching point and then turn the unit on.

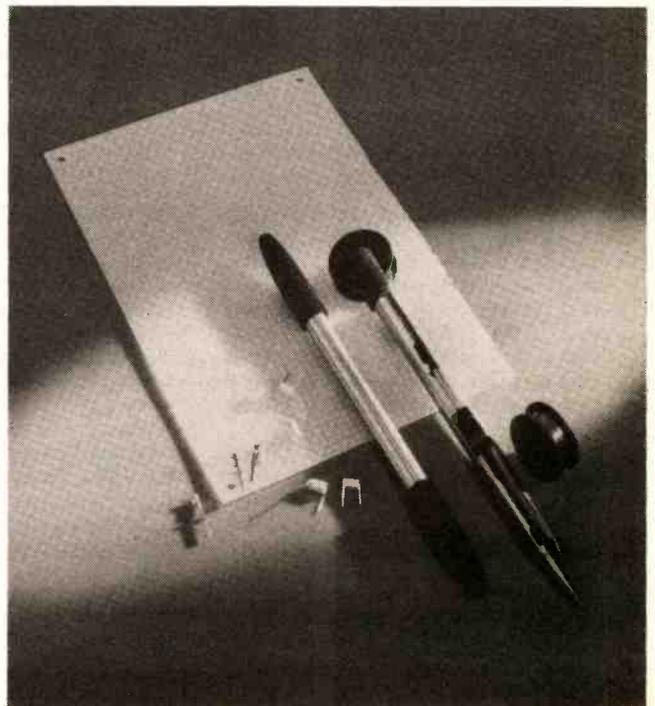
It must be remembered that even when the lamp is not illuminated a current is being drawn from the battery. So when the unit is not required to be in use it should be turned off to conserve battery life. □

USING YOUR FREE EASIWIRES CIRCUIT BOARD

The Easiwire circuit board attached to the front of this issue can be used to build almost any small circuit on. It is specially designed to be used with the BICC Vero Easiwire solderless wiring system — see their advertisement in this issue for more details.

The board has a matrix of tapered holes enabling component leads to be pushed through and firmly held while connections are made. Complete projects can be built using Easiwire without the need to solder joints.

This issue contains two projects specifically designed to be built on the board — more projects will follow over the next couple of months, they include a Games Timer and a Possession Alarm.



CAR IMPULSE WIPER

CHRIS BOWES



Use your Free (cover mounted) piece of Easiwire matrix board to give your car wipers a delayed sweep facility

A VERY useful facility incorporated in some, but not all, cars is the ability to have the windscreen wiper operate once every now and again. This facility is known as the "Impulse Wipe" facility. This project describes how a very simple circuit can be constructed to provide this facility.

HOW IT WORKS

A car wiper motor circuit is usually very similar to that shown in Fig.1a. It consists of a wiper on/off switch, which is wired to the motor by means of two circuits. One of these circuits is a direct connection to the

the motor start, accomplish one sweep and then park itself again on a timed basis. Such a relay can be operated by the standard 555 timer circuit which we have used before in this series of "Pocket Money" projects.

The 555 timer is a very useful circuit in that it produces, when configured as in Fig.2, an output wave form which is alternately on and off for time periods which are governed by the values of a small number of external components.

CIRCUIT DESCRIPTION

The full circuit diagram for the Car Impulse Wiper is shown in Fig.3. This cir-

Capacitor C2 is a decoupling capacitor which is used to set the voltage at pin 5 (control voltage input) at the optimum level for operation of the circuit. Relay RLA has been chosen so as to draw a relatively small current from IC1.

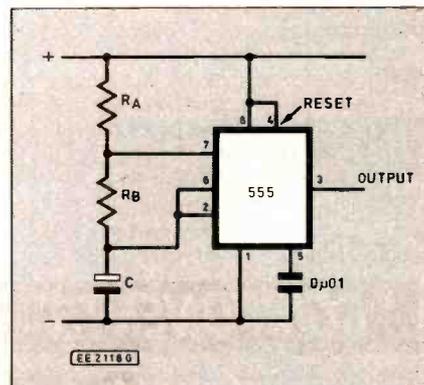


Fig. 2. Using the 555 timer i.c. in the astable mode.

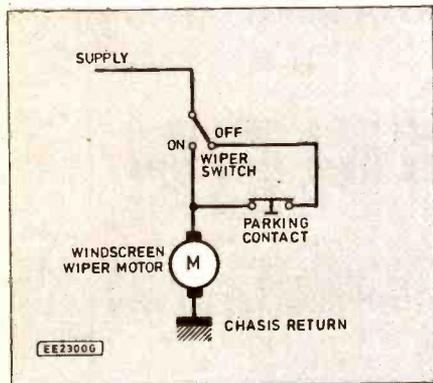


Fig. 1a Popular arrangement for a typical car windscreen wiper circuit.

motor which causes the motor to run constantly whilst the other circuit is wired so as to include a switch, usually in the motor assembly, which is closed except for a brief moment when the motor is in specific (parked) position. Another popular system places a short across the motor, to stop it quickly, when the wiper is turned off and the park switch operates. Dual speed wipers also have different wiring.

When the wiper motor switch is turned on the motor operates normally. When the motor switch is turned to the off position the current is connected to the motor through the parking switch so that the motor continues to operate until it reaches the parking position.

If a relay (which is really an electrically operated switch) is added to the circuit as shown in Fig.1b then this can be operated by a simple electronic circuit so as to make

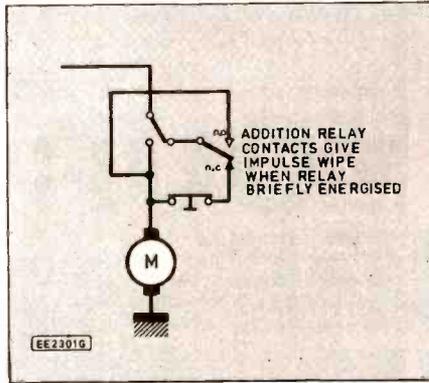


Fig. 1b. Windscreen wiper circuit modified to give "impulse" action.

cuit incorporates the relay coil of the relay shown in Fig.1b.

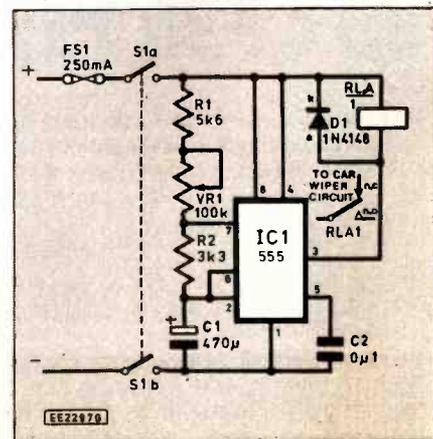
The heart of the impulse wiper circuit is a standard Astable 555 timer circuit with resistor R1 and potentiometer VR1 combining together to form the equivalent of RA of Fig.2. Resistor R1 has been chosen to set the minimum acceptable period between pulses of the impulse wiper, whilst VR1 has been chosen so that it is adjustable to give the intervals between the sweeps of the wiper. These values have been chosen, together with that of capacitor C1 to produce the time delays which are considered to be appropriate for this project.

Potentiometer VR1 and R1 set the time period that the relay RLA is not energised. The values of resistor R2 and capacitor C1 determine the fixed time period, which is not affected by any adjustment of VR1, for which RLA is energised in each cycle.

Because the standard bipolar 555 timer version of IC1 has been chosen for use with this circuit, sufficient power is available from the integrated circuit to directly drive the relay. Also, because the timer output is governed by the values of the resistors and capacitor the relay has been placed between the positive power supply rail and the output of IC1.

This causes the relay to be energised when the output of IC1 is at 0 volts. This arrangement ensures that the relay is energised for a time period which is determined

Fig. 3. Circuit diagram for the Car Impulse Wiper.



by the fixed values of R2 and C1, and is de-energised for the time period which can be varied by operation of VR1.

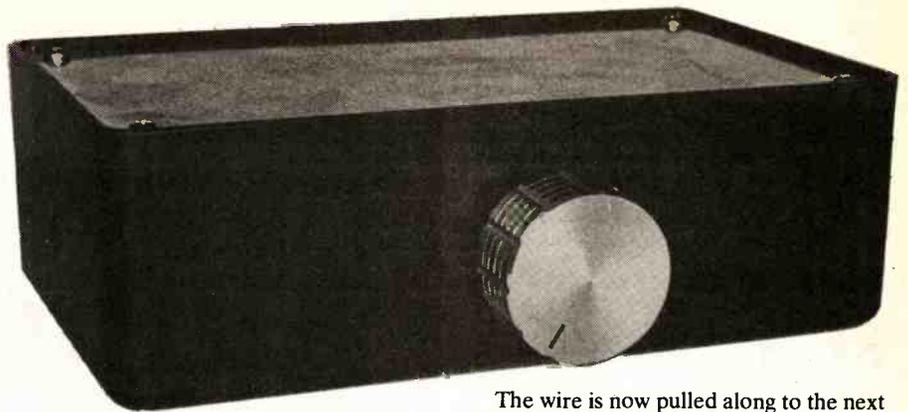
The diode D1 across the relay coil is included in the circuit to prevent the voltage surge which is produced when the relay de-energises from destroying IC1. Switch S1 is the standard two pole switch, incorporated into the potentiometer VR1, which is used to turn off the unit when not required.

Although this circuit can be operated from a 9V battery, as are all of the circuits in the "pocket money" series, it does seem rather unnecessary to include a battery when a suitable source of power is available within the car. It is therefore suggested that the power required to drive this project is obtained from the car and, for that reason, the fuse FS1 has been incorporated into the circuit to provide protection in the event of problems occurring within the circuit.

CONSTRUCTION

This project has been designed to be constructed on the FREE, cover mounted, piece of Easiwire matrix board and using the "Easiwire system". This board has a matrix of 38 by 18 holes or can be obtained by cutting down a larger board to suit.

The layout of the components on the board together with the underside wiring is shown in Fig. 4. The components are simply inserted into the appropriate hole in the board from the side with the wider holes. When all of the components have been inserted into it the board is turned over and the protruding component tails trimmed to a length of 3mm using cutters.



It is important to ensure that any polarity sensitive components are inserted into the board the correct way round. This should be checked thoroughly before wiring the board up, since moving components after they have been wired tends to require the complete replacement of all the connections made with that piece of wire. The components are then connected, using the Easiwire pen, to produce the connections as shown in the underside diagram (Fig. 4).

This process is fairly simple. At the start of a wiring run a short length of wire from the wiring tool is held in the board near to the first component pin with the finger. The tool is then used to roll the wire up the pin, under light tension, for four or five turns and roll it back down again with another four or five turns around the component tail. The wire should now be at the bottom of the component tail and should be now in contact with the surface of the board.

The wire is now pulled along to the next component by means of the wiring pen, keeping a small amount of tension on the wire, where the process is repeated again rolling the wire up and down the component tail before continuing to the next component. At the end of the wiring run the wire is run up and down the last component as before and the wire is then cut, close to the pin, using the cutter on the tool. The extra piece of wire at the beginning of the wiring run can be similarly cut off using the cutter blade.

In this circuit there are two points at which wires have to cross. Because the wire used in this system is not insulated it is necessary to place a piece of insulating tape on top of the first sets of wire installed before running the second sets of wire on top of this. The points at which these crossovers occur are both under the i.c. and one piece of insulation tape can be used to provide insulation for both of the sets of crossing wires as shown on Fig. 4.

COMPONENTS

Resistors

R1 5k6
R2 3k3
All 0.25W 5% carbon

Potentiometer

VR1 100k lin. rotary, with d.p.s.t. switch

Capacitors

C1 470µ elec. 16V
C2 0µ1 Mylar 16V

Semiconductors

D1 1N4148 signal diode
IC1 555 bipolar timer

Miscellaneous

RLA 12V p.c.b. mounting relay, with heavy duty contacts (16A)
S1 See VR1
FS1 250mA fuse with carrier

Easiwire board, 38 x 18 holes (FREE with this issue); connectors for Easiwire board (7 pairs); plastic case to choice; control knob; self-adhesive standoffs (3 off); 8-pin i.c. socket; barrier strip, 5-way with right angle connectors (see text); connecting wire; heavy duty automotive wire; solder etc.

**Shop
Talk**
see page 783

WIPER SWITCH CONNECTIONS

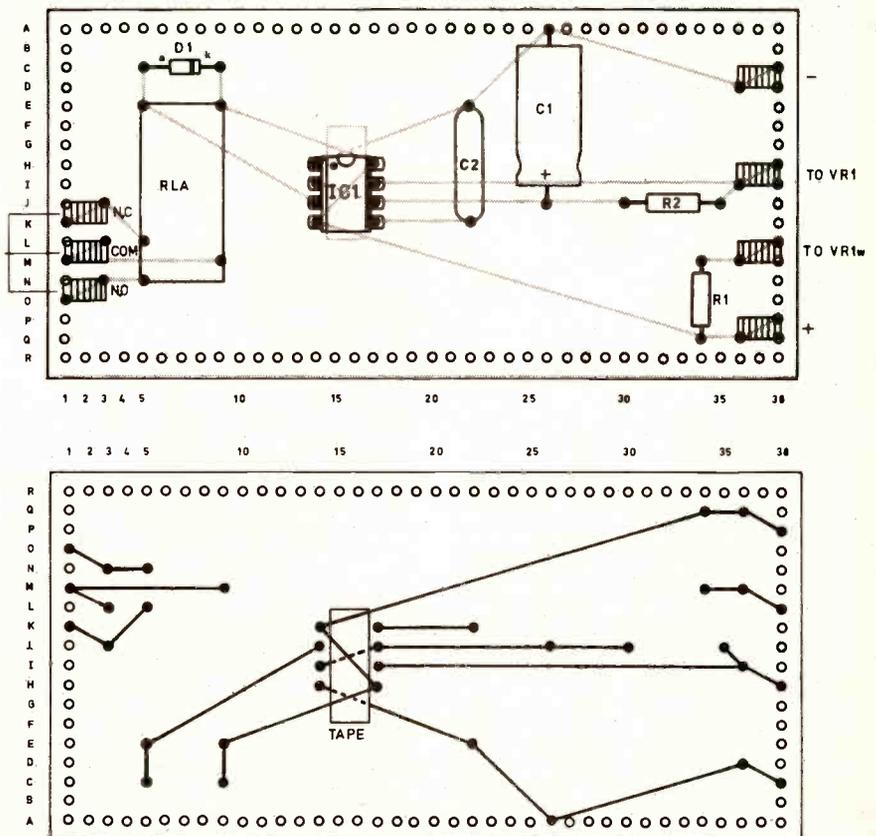


Fig. 4. Easiwire board component layout and details of the underside wiring. Wires connecting the relay contacts should be rated at least 10A.

Approx. cost
Guidance only

£12

After completion the circuit should be carefully tested, using an external 12V supply if necessary, to ensure that it operates correctly before finally isolation varnish is brushed over all of the connections to make the circuit permanent. Varnishing also helps to protect the circuit against moisture.

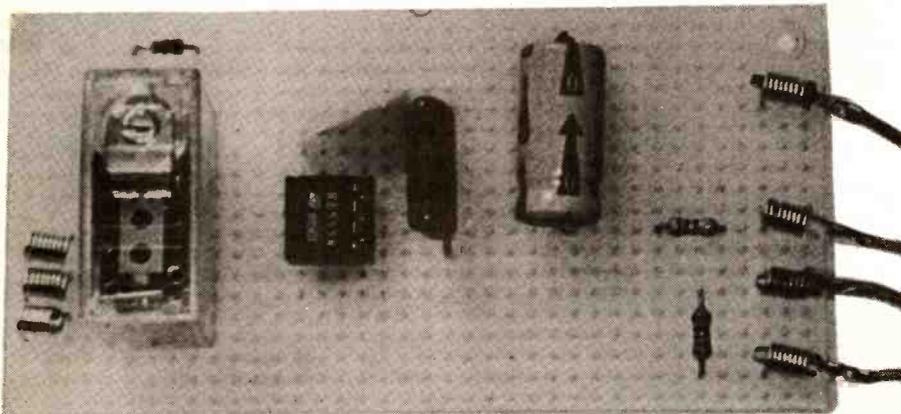
FAULT FINDING

Fault finding of the circuit board prior to inserting into a suitable case is relatively simple. The first stage is to check that the circuit is receiving power and that the power "rails" on the board are doing their job.

You should be able to measure the battery voltage between any 0V connection and both pins 8 and 4 of IC1 as well as between the battery positive connection to the board and pin 1. If these voltages are not present this will indicate faulty wiring up of the component board.

The next step is to check the voltage at the output (pin 3) of IC1. If the circuit is working correctly this voltage should be regularly switching between 0 volts and the battery voltage.

If this does not occur and the output is locked permanently at a fixed voltage then



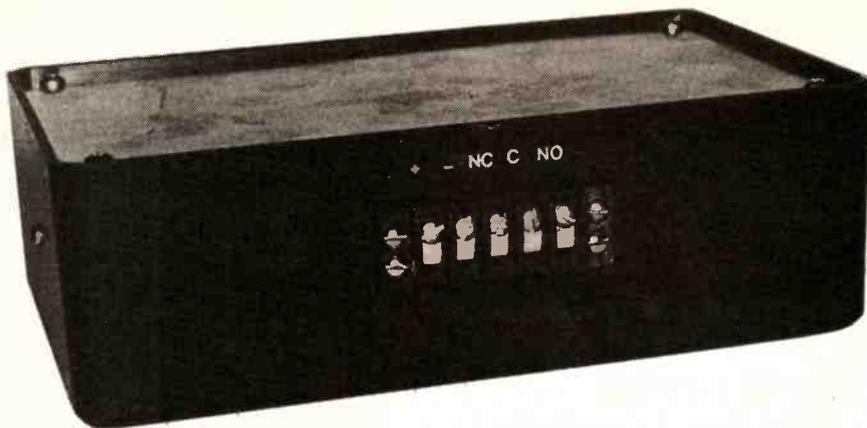
Completed circuit board showing component layout. The timer i.c. should be mounted in an 8-pin i.c. holder.

you should remove the i.c. from its socket and check the voltage at the pin 3 connection again. If the voltage persists with IC1 removed then the fault does not lie with IC1 but most possibly with the wiring associated with the connections from IC1 to the relay and D1.

A particularly likely problem is that diode D1 may be connected the wrong way round or may have gone short-circuit. This can easily be checked by using the resistance scale on your test meter.

The diode should exhibit a very low resistance with the test probes one way round and a higher resistance with the test meter probes the other way round. Remember however that the resistance of the relay coil (which is itself fairly low) will be in parallel with the resistance of the diode.

The next step is to replace the i.c. and check the voltages at pins 2, 6 and 7. The voltage at pin 7 should be fluctuating around a value which is roughly $\frac{2}{3}$ of the battery voltage. The voltages at pins 2 and 6 should be identical (because these two pins are connected together by a wire link) and these should also be fluctuating but at a voltage slightly less than that found at pin 7.



Rear of the control unit showing the five-way connecting strip.

If both of these voltages are not present then the most likely cause is that the circuit from the positive voltage rail, through VR1, R1 and R2 is not correctly made. This is best checked by measuring the voltage present between 0 volts and each of the points in the component chain through VR1, R1, R2 and C1 and investigating at the point where no voltage is measured.

If a voltage is present between 0 volts and pin 7 but no voltage, or only a very

under these conditions then it must be assumed that the relay is faulty and it should be replaced.

CASE

This type of project really must be mounted in a plastic case, in order to protect it from the rigors of being installed into an automotive environment. The precise details of how the case is to be laid out will really depend upon the space and arrangement available within the vehicle.

The main point to consider in designing the layout for the case is that ideally the live connections to the vehicle's wiring loom need to come out of the opposite side of the case to where the on/off switch/speed control is mounted. The barrier strip, to which the output connections are terminated, is fitted with right-angled connectors so that the only connections visible are those made to the car's wiring loom. The other connections to the barrier strip are inside the box and pass through the case wall and are then connected to the circuit board by means of wires fitted with the appropriate connecting clips.

The type of barrier strip which is specified in the components list can usually only be obtained as a 12-way connection strip. It will therefore be necessary to cut it down carefully to give six connections and then carefully drill out one of the connector fixing bushes to provide a five way barrier strip with fixing holes at each end.

Once the layout for the case has been decided and the components modified, where necessary, then the appropriate hole for all of the components should be drilled into the case. If it is desired to letter the case then the lettering should be applied and carefully protected with spray on varnish before finally installing the case mounted components and the circuit board.

The board is best accommodated by means of self-adhesive standoffs fitted inside the case. It will therefore be necessary to drill 3mm x 4mm holes at convenient points on the circuit board before fitting them with the standoffs and offering them to the inside of the case and firmly sticking them into position.

WIRING

The wires required to connect the case mounted components with the circuit board will need to be soldered to the appropriate connections on the case mounted components. The wires passing between the connectors to which the car wiring is connected and fuse FS1 and the switch on VR1 will need to be soldered at both ends and cannot be terminated with

small voltage, is measured between the 0 volts rail and pins 2 or 6 of IC1 then you should check that the resistance between pins 7 and 6 of IC1 is roughly equal to that of resistor R2. If this is correct then check the "resistance" of capacitor C1 with the resistance range of your meter. If the resistance is very low (less than about 500 ohms) then you should replace C1.

If voltage is present at pins 2 and 6 of IC1 but it does not fluctuate then the likely causes are that capacitor C1 is not correctly connected, is faulty or that IC1 is faulty. To check C1 you should touch connect another capacitor of similar value across the connections to see if this cures the fault. If this does not cure the fault check that the connection between the positive connection of C1 and pins 2 and 6 of the i.c. is correctly made.

If this voltage switching is taking place then the i.c. is working correctly and the fault must lie with the relay and its associated connections. If all is correct here then the connections between pin 3 of IC1 and the relay should be carefully inspected. If this connection is correctly made the output voltage from IC1 should be present at the coil connections of the relay which should work. If the relay is not working

FOR YOUR ENTERTAINMENT

BY BARRY FOX

Toothless BVA

In the early days of video, the software industry had a terrible reputation. Piracy was rampant, initially because the film and TV companies would not legitimately release any worthwhile material. Entrepreneurs simply got hold of unauthorised masters, made copies and pulled in a fortune.

Then, when the film and TV companies got wise and authorised release, the pirates used their existing duplication and distribution networks to make large numbers of back-to-back copies from authorised releases. FACT, the Federation Against Copyright Theft, was formed and the laws tightened, to clamp down on this scam. The Macrovision system, which alters the synchronization pulses on a video tape, to make it difficult to copy, has also helped. But there is still a hard core of persistent pirates, as the monthly list of FACT prosecutions shows.

The video software industry also got a bad name for selling hard core pornography, and films that exploited violence. Young children were able to watch films at home which no cinema would be allowed to screen, even to adults. The name "video nasty" was coined, and the popular press campaigned.

There is now a tight certification scheme for all video releases, enforced by the Video Recordings Act. A dealer was recently fined over £13,000 for renting adult movies to children.

The video industry has its own trade body, the British Videogram Association, which is supposed to cast a watchful eye over the industry and keep its image clean. But, sometimes, the software companies show signs of slipping back into their old, bad ways and the BVA comes across as a pretty toothless watchdog.

It happened recently, when the popular press, quite rightly, sounded the alarm on a thoroughly nasty publicity gimmick dreamed up by a film company that should have known better, CIC.

Snakes Alive!

The CIC film company's Marketing Department hit on a bizarre idea for publicising a new video release about Voodoo. The company sent out 500 large live Chinese Rat Snakes to shops stocking the video. The innocent reptiles were accompanied by a card which said they would be collected again in four weeks and until then needed only water. "He does not need feeding.. (and) is completely harmless" advised CIC.

Not surprisingly there was an outcry, not just from terrified shop assistants who opened the box without knowing what to expect, but from members of the public who objected to the use of live animals for a publicity gimmick.

The RSPCA moved in, branded the stunt "pathetic and deplorable" and collected the snakes.

But what has really got under the RSPCA's skin was CIC's claim that it talked to the RSPCA ahead of the stunt, and was given the go-ahead. This claim was widely reported in the video press, shifting the blame from CIC.

So I talked to the RSPCA. Definitely not true, said they, CIC never contacted us.

You must talk to CIC, said the BVA. So I did. I asked CIC the obvious simple question. Who at the RSPCA approved the idea?

After three days, a dozen calls and a wonderful crop of excuses CIC still had not come up with a name.

A series of CIC staff variously told me it was "none of my business", "we have nothing to add to our press release" (which blandly said the stunt was meant to be "a straightforward in-store promotion") and Paul Brett the CIC man who master-minded the sick stunt was variously on the phone, in a meeting, out to lunch, not in yet, not back yet, at a seminar, and — finally — off sick.

The last ten days, CIC staff whined to me, have been "horrendous". As an animal lover and reptile respecter I found it hard to feel too much sympathy for CIC.

This kind of behaviour brings the whole trade into disrepute. Significantly the BVA issued no statement. What, I was left wondering, is the point of the BVA.

DAT Dump

For reasons that will soon become obvious I am not going to identify, and thereby embarrass, the engineer who has been closely involved with DAT development and told me recently how Japanese shops are starting to dump unsold stocks of DAT recorders at giveaway prices.

I said: "Perhaps I'll buy one when I'm next in Japan".

"Don't" he warned. "As you know, the recorders on sale won't record digitally at 44.1kHz and can't easily be converted. Wait for the new SCMS machines which dub digitally from CDs".

Why not buy one of the current models if they are that cheap, I persisted. I can use it to make analogue compilation dubs from my CDs and probably never hear the slight loss of quality.

"Once you have recorded digitally" the engineer told me, "you will never again want to record with an analogue system. Believe me, I've been doing it and I know. It's the convenience of the system that gets you. You need never again bother with manual gain settings or rely on automatic gain control which compresses the dynamic range. You just connect the CD player to the DAT recorder, press 'record' and forget about it".

I'd never heard anyone put it that simply before, probably because the only people able to describe digital dubbing first hand are the hardware engineers who have worked on DAT and been told not to discuss such things on pain of death. The

Thief Foil

I am all for deterring shoplifters, even if it means that we have to pay more for pocket size products, like cassettes and CDs, in artificially large packaging. Hopefully we pay less for the extra packaging than we would for subsidizing the pilferage it is designed to prevent.

In American book and record shops things are now so bad that customers have to leave bags or briefcases at the shop entrance. So I was surprised to see a shop in Chicago relying on what looks like a surprisingly clumsy anti-theft system.

All their records and tapes are shrink wrapped in plastic, with a bar code label stuck on the front. The bar code covers, and thus disguises, a flat metal coil which modifies the field created by a low frequency radio transmitter at a security check point near the Exit. Any change in the field sounds an alarm if anyone tried to leave the shop with a labelled product.

Similar systems are used in UK shops, e.g. with large tags on clothing. Usually the check-out staff remove these labels, or tags, when the customer pays. But not in this case. Instead the shop staff stick on an extra label which says "Paid — thank you". Although these "paid" labels look like ordinary paper, they include a thin sheet of metal foil. So when stuck over the invisible coil, the paid label blocks, or attenuates, pick up and re-radiation of the tell-tale alarm signal.

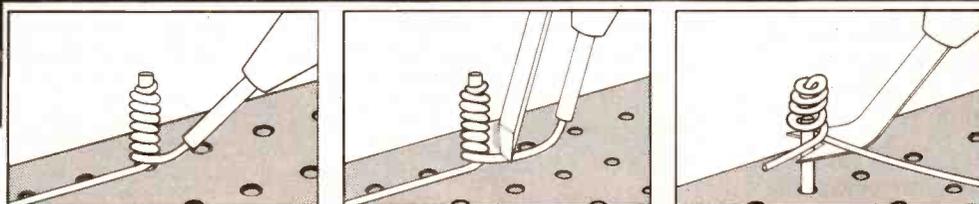
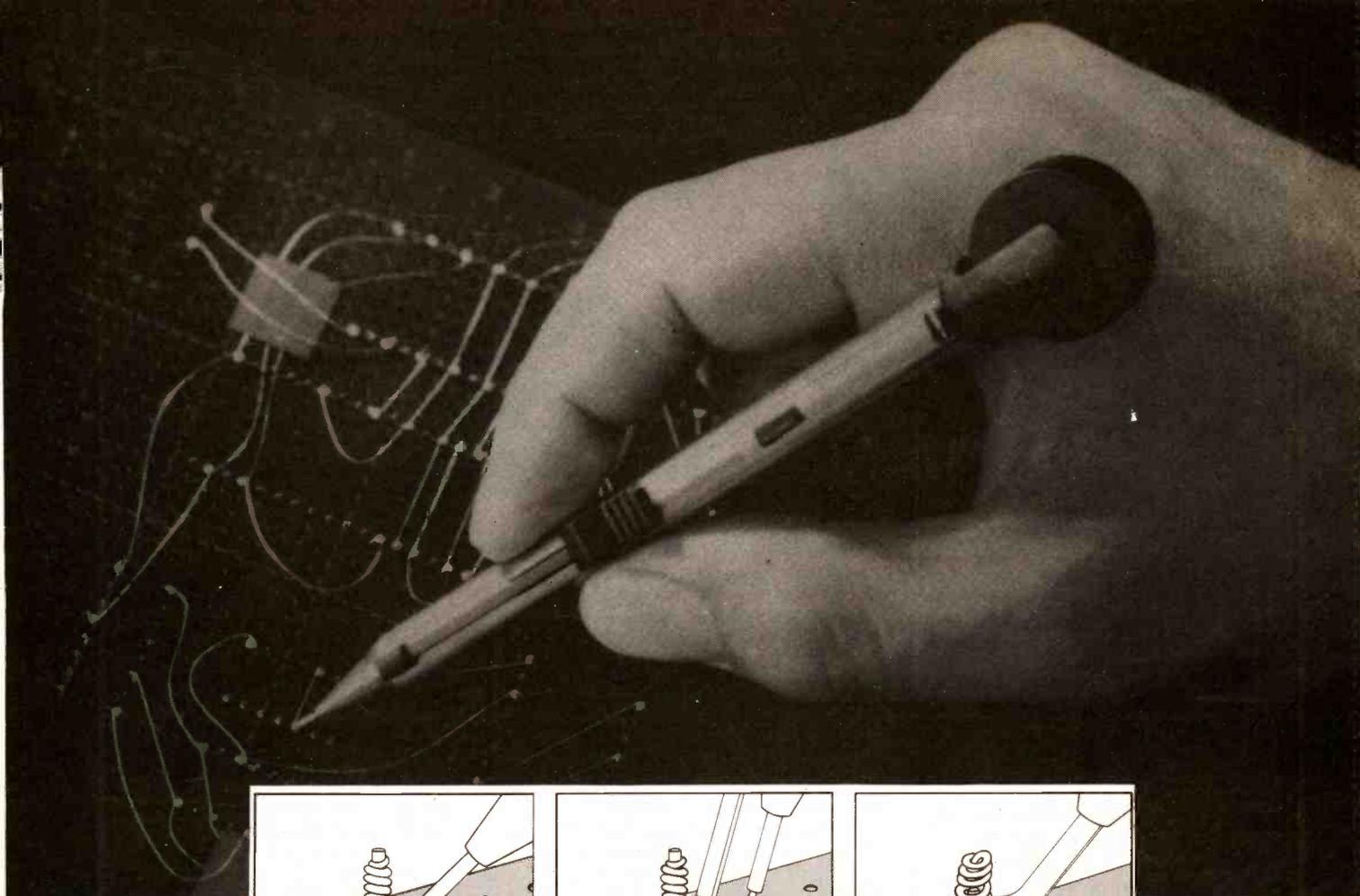
It's all very neat, but I would have thought it would not take the average thief long to work out that all it takes to disable the system is a few thin strips of metal foil stuck over the coil labels.

people running the record industry have been so busy bleating about "perfect copies" and "clones" and the "inaudibility of Copycode", and are generally so ignorant of the technology of recording, that they have missed the chance to warn of the single most important — and dangerous — benefit of DAT and recordable CD. *Convenience*.

The dynamic range of a 16 bit digital tape or disc recorder matches the dynamic range of a 16 bit CD. There is no risk of overloading the tape or under-recording quiet sounds. You just copy the code without any gain control at all. It's like copying a computer program from one floppy disc to another. Computers don't have gain controls because they don't need them.

This is what makes digital recording such a powerful tool. It is all plainly obvious, once the point has been made. The real message won't get through until people have had the chance to get their hands on a DAT deck with SCMS and actually tried dubbing a CD digitally. Just as with CD, which was originally hyped for sound quality, it will be the convenience factor that sells DAT.

I was grateful to that engineer's advice and now fear that anyone who has bought an expensive grey import DAT recorder which doesn't record at 44.1kHz is soon going to feel sick as a parrot. Bear this in mind if the grey importers now start dumping their stocks in the UK at what look like irresistible prices.



EASIWIRES

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MICRO IN CONTROL

JOHN HUGHES



Part One

Starting from very basic principles this series quickly builds through logic to simple microprocessor control. It is based on the experiences gained through teaching courses on the subject.

INTEREST in electronic control, especially using the flexibility of the microprocessor, continues to grow. The dialogue in this series is based closely upon that which has taken place regularly during a series of courses on the topic, directed to enthusiastic beginners.

It is hoped that those who are starting up in this field will find it helpful, revealing perhaps some slight but deadly misconceptions which can bedevil the learner's progress. More experienced readers may find the approach of interest. Comments and suggestions are, of course, welcome.

Equipment and Materials

It should be borne in mind that electronic component values, in simple circuits, are rarely very critical, so sensible substitutions can usually be made. In most cases, similar items can replace those described. These are specified as a guide, and advice can be obtained from manufacturers or from local suppliers.

Power Supplies

Batteries, though safe and easy to use, become expensive for long-term work, and a regulated (stabilised) d.c. supply unit capable of giving at least 250mA at 5V is recommended. Rechargeable batteries may be worth considering. No a.c. supplies are initially envisaged.

Breadboards

Prototyping boards (breadboards); there are many suitable types and sizes available. The diagrams illustrate a popular pattern, but any board, except the very small or early types with totally different socket spacing, should prove ideal. It is also possible to obtain breadboards mounted as part of a "training kit", with appropriate and useful additional units, such as power supplies and those for input and output needs, attached.

Manual Controls

Switches, potentiometers and such items can be large or small, and, as usual,

TABLE 1

Items needed for "starter" kit:

Power supply unit as described above (5V 250mA (or more) d.c.)

Breadboard suitable for integrated circuit mounting. Supply of suitable **single core wire**, 0.6mm dia. in red, black and two or three other colours.

Resistors: inexpensive, fractional-wattage types. A range of "preferred values" is ideal, but the following is plenty:
4 each 330 or 390 ohms.
2 each 1k, 2k2, 3k3, 4k7, 10k, 100k.
1 each 100 ohms, 470 ohms, 6k8, 22k, 47k, 330k.

Potentiometers (preferably manually operated, even without a knob, rather than "pre-set"). Single-core leads to be attached:
1 each 1k, 10k, 100k.

Capacitors: most types are suitable, as available. If new ones are being purchased, low-voltage polyethylene or polyester are cheaper up to about one microfarad (1 μ). For higher values, electrolytic types score (6V working or more).
2 each 0.022, 0.1, 1, 10, 100 (or 50) microfarad (μ F).

Semiconductors: those specified are among many suitable general-purpose types.
4 each red l.e.d.s (miniature or standard types).

2 each min. silicon diodes e.g. 1N914.

2 each *n*p*n* transistors, e.g. BC108, 2N3704.

1 each photoresistor, e.g. ORP12 (to be mounted with leads attached).

Integrated Circuits, TTL 74 or 74LS series (it's best not to mix them, except for 7406).

2 each 7400, 7404.

1 each 7402, 7406 (or 7405), 7408, 7432 (later 7475), 7476, 7420, 7493.

Other items: add leads of single-core wire where needed, and mount onto suitable bases as indicated later in the text and photographs.

2 each 6V 0.06A m.e.s. lamps (torch bulb types).

4 each slide switches, single pole, two way (toggle switches are fine, but dearer).

1 each miniature relay 5V (or 6V) d.c. working, 2 pole, 2 way contacts.

1 each small d.c. permanent magnet motor, to run on about 1.5V (this is just for demonstration, and a motor-driven toy might be a more attractive or more useful substitute).

1 each 1.5V cell, e.g. U2 type, in suitable holder (or with leads attached by clips).

quality and convenience have to be paid for. Miniature or inexpensive items are often suitable, if one can accept a certain "fiddliness" in their operation. It is also possible to salvage items from old equipment, provided their values are marked or can be measured.

It is very desirable to mount such items onto a base, and some of the later photographs may suggest ideas. Much of the equipment used was made up as simply as possible. It was augmented with professionally made items when this was essential. Table 1 indicates the main items needed. The advertisement pages of this journal will provide sources for materials.

Just before we start in earnest **T** can be Teacher, Tom, Teller or anything else while **S** is Student, Sam, Speedy, Sloth, etc. Now read on!

MICRO IN CONTROL

T This is the kind of circuit board we shall use (Fig 1). It allows us to use "raw" components instead of having to buy expensively-mounted ones, and cuts out the need for soldering or for elaborate terminals.

It has a large number of tiny sockets in it (just under the plastic surface), so that we can plug in the leads of our bits and pieces to build up our circuits. Easy to alter it too (shows a resistor being plugged in and removed).

Mind, we must be careful not to damage the sockets by using wires which are too thick, or covered in solder blobs, or "kinky"! This single core connecting wire is 0.6 millimetres in diameter, and it's ideal (shows a piece).

S Can stranded wire be used?

T No, it's best to stick to "single-core" type like this.

We shall also need a power supply for our circuits. We COULD use batteries (4.5 volt is OK) but a mains power supply unit (p.s.u.) is preferable, because it doesn't run down, and, more importantly, because it's MUCH cheaper to run (though it's dearer to buy, of course).

It has to be a D.C. STABILISED (regulated) unit and of course it must be SAFE!

S Any danger of electric shock?

T An important point, especially if youngsters are to use the gear. No, a

properly made unit is perfectly safe, but should be tested regularly. Many schools nowadays use a special mains supply which is passed through an "earth leakage cut-out" device to make sure. One can be installed in any mains circuit.

A 5 volt supply is much too low to give a shock to anyone. In fact, any pressure less than about 40 volts is pretty harmless because of the relatively high resistance of our skin (at least, when dry). But remember, the MAINS pressure is two or three HUNDRED volts, and can be LETHAL! But be reassured, 5 volts cannot be felt (unless you do what some kids used to do, and touch the battery terminals to your tongue!)

S I've done that! It tingles a bit, that's all.

T All the other items we need are listed in Table 1.

Let's make a start by actually connecting up a very simple circuit. Apologies to those of you who find all this very trivial. There may be others who'd prefer to start at square one.

S Or even square zero. Me, for a start.

T OK. We'll go quickly, however, so as not to bore the pants off the high fliers. Now look at the way the sockets on the board are linked together (Fig 1).

Notice, first, that if we hold the board this way, ALL the sockets along the TOP are linked together, and ALL the BOTTOM ones are also linked together. We can use these two rows to connect to our POWER SUPPLY, thus (Fig 1).

It's sensible to stick to the universal colour standards where we can, so let's always use a RED lead for the POSITIVE supply (the top one), and a BLACK lead for the other.

S Does the colour really matter?

T Not as far as the current is concerned, but it makes life much easier for us if we stick to this standard, especially when our circuits get more complicated, or when we have to trace a fault.

Notice now, the way the OTHER sockets are linked. They're in COLUMNS of five together, so any component we plug into THIS socket, for example, can be connected to anything else that we plug into any of the other four sockets above or below it, in the same line up and down. There's NO link to the sockets on either side.

EXERCISE 1 Light the lamp!

Now look in your box of bits for a small lamp. It's a "torch bulb" type, with a couple of leads soldered to it. We've been busy getting ready for you, you see. No expense spared!

Will you plug it in EXACTLY as shown here. (Fig 1). And will you tell me, would you expect it to light up?

S (chorus) NO! (a few voices). There's no circuit there.

T Agreed. There's a GAP in the CIRCUIT; there's no complete CONDUCTING path, so nothing much can happen. No CURRENT can FLOW, as you said, because there isn't a complete circuit. Could we "bridge that gap"?

S Yes, but not with chocolate biscuits!

T OK... What with, then? Yes, there are some short lengths of wire in the box. One of those could be tried. We'd better do it just to make sure everything is working as we expect it to.

What we've made is really a lamp and switch of sorts, isn't it?

Let's draw a CIRCUIT DIAGRAM of it (Fig 2). Easier to look at than the real thing, but we MUST be able to see how the two really match each other.

This is really "landmark number one" for those of you who are beginners. It's worth noting it, and some of the concepts implicit in what we've done so far. (These are areas where many learners trip up simply through not having a good grip on these basic points):

1 No CURRENT can FLOW without, firstly, a BATTERY or other POWER SUPPLY to "push" it, and, secondly a COMPLETE CONDUCTING CIRCUIT all the way round.

2 The battery exerts an ELECTRICAL PRESSURE all the time, "trying" to push a current round, but ONLY succeeding when a complete circuit is connected up.

3 A SWITCH is just a means of CLOSING or OPENING a GAP in the circuit, so turning the current ON or OFF. (Have a look at a real switch).

S What's the difference between "VOLTAGE" and "ELECTRICAL PRESSURE"?

T None at all. We measure electrical PRESSURE in UNITS called VOLTS. Electric CURRENT, if any is flowing, is measured in...?

S (several voices) AMPS.

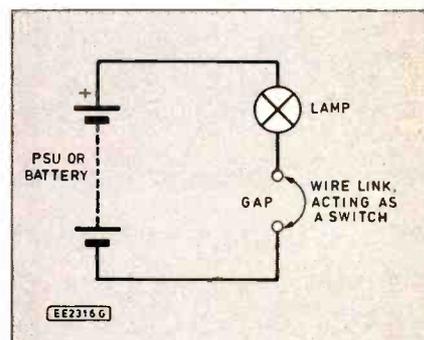
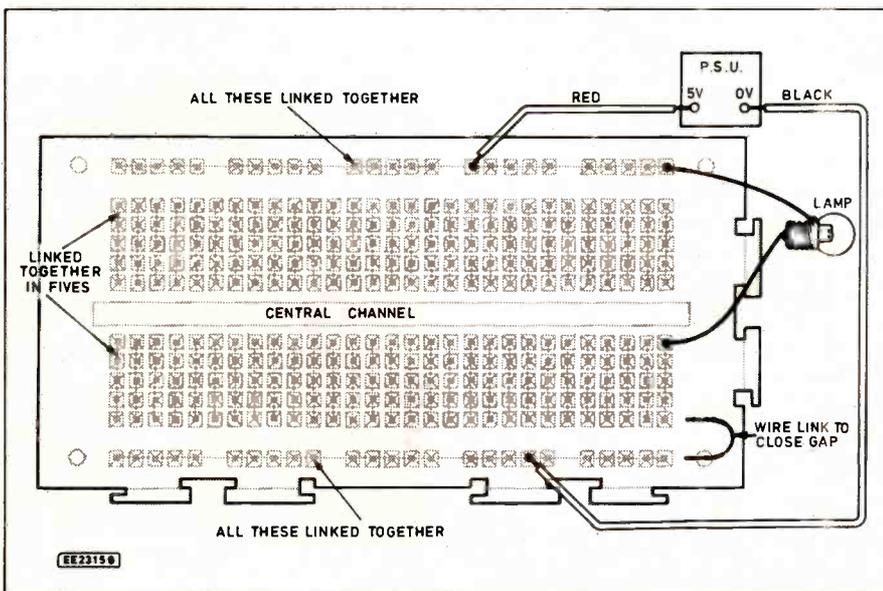
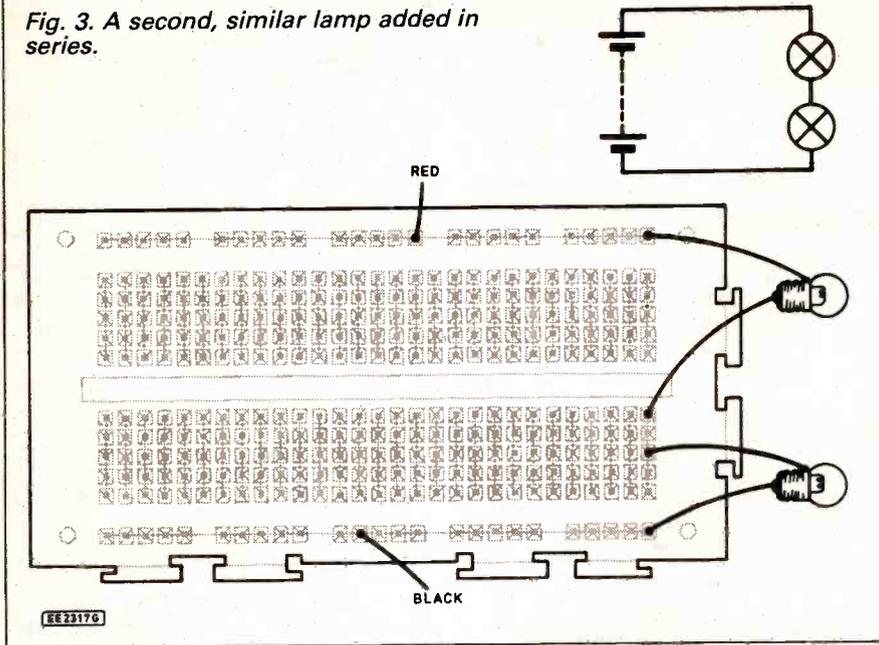


Fig. 2. The circuit diagram (so far).

Fig. 1 (left). Typical breadboard showing internal links. The red (+5V) and black (0V) single core leads are connected to the power supply. Then the lamp with leads already soldered to it, is plugged in as shown.

Fig. 3. A second, similar lamp added in series.



T Yes, short for Amperes. VOLTA was an Italian, AMPERE a Frenchman. They both contributed to our understanding of electricity. Most electrical units are named after people. We shall meet more of them later.

EXERCISE 2 Ohm on the ... breadboard.

T Now remove the wire link. The lamp goes out, and we're left with just the gap in the circuit. This can be a useful arrangement for testing various things to see whether they can or cannot conduct electric current, and could form a very simple "continuity tester".

Now, I'd like you to bridge the gap, not with a bit of wire, but with ANOTHER LAMP, similar to the first one, but BEFORE you do so, can you try to PREDICT the outcome?

- S** The light will be shared.
- S** (another) Nothing will happen.
- S** (another) Less current, etc.

T Well, let's try it and see (Fig 3). Most of you were on the right track, but we must make sure of our ideas. We can see that the first lamp isn't as bright as it was, so presumably there's less current flowing through it. Could this be because the current is being "shared" with the other lamp?

- S** (uncertainly) Yes, half each?
- S** (others) No, because there's only ONE path.

T I prefer this second argument. There IS only a single path, or CIRCUIT.

S But BOTH lamps are the same, so it must be shared in some way.

T SOMETHING seems to be shared, but, as we've just agreed, it can't be the current.

Looking at the FIRST lamp alone, do we agree that the current through this lamp is now less than before?

- S** (most) Yes, it's definitely dimmer.
- T** And where does the current flow AFTER it's passed through the first lamp?
- S** (pleased) Through the SECOND one.

T Yes, it's the SAME current con-

tinuing on its way, for there's nowhere else for it to go, is there? Why, then, is it a SMALLER current flow than before? Is the battery exerting less pressure?

- S** No, it's the same "battery"/PSU.
- T** That's right, the PRESSURE is still 5 volts. So what has changed when we stuck the extra lamp in the circuit?

S (some) The resistance of the circuit.
T Spot on! The extra lamp, with its addition of another fine "filament" offers more RESISTANCE to the current flow, so we can add "landmark two" to our first one, and sum up:

- 1 A circuit RESISTS the flow of current.
- 2 The CURRENT flow depends upon TWO things:
 - (i) the PRESSURE exerted by the supply.
 - (ii) the RESISTANCE of the circuit.

Does anyone know what UNITS we use to measure RESISTANCE?

- S** (several) Ohms.
- T** Yes, after the German, Ohm. We also talk of "Ohm's Law", don't we? We've seen an Italian, a Frenchman, and now a German, whose names have been used for important units. What about us Brits? Don't we have one?
- S** (some) Watts?

- T** Yes, James Watt has his name for what?
- S** What watt? what what! etc.
- S** (eventually) power.
- T** OK, OK. Yes, our unit of POWER (and not just electrical power, but ALL forms of power).

Now we'd better move on rapidly, past these simple but very fundamental ideas, and try to build some real circuits. But first, a couple more simple exercises to clinch it. (Holds up a resistor).

This is called a RESISTOR. It's the type used in most electronic circuits, and its value is shown by the coloured stripes on it (Fig 4).

Now find a ONE HUNDRED OHM RESISTOR, and use it to REPLACE the second lamp across the "gap" in our circuit. FIRST, try another PREDICTION.

- S** No light/less light/etc.
- T** Well, try it. Yes, less light. Why?
- S** More resistance.
- T** Exactly. What would happen if we used a 1k resistor instead (remember what this means)?
- S** Less still/none at all?
- T** Did you try? Yes, no light at all. But, now listen. Does this mean NO CURRENT? Careful!
- S** Yes/No. There must be SOME current, surely?

T Then why no light at all?
S (after a pause) Not enough to heat the lamp filament. Not enough to glow, anyway.

T Exactly right. We have enough faith in our understanding to believe that a current is flowing ALTHOUGH WE CAN'T SEE IT. This is part of the problem some people have with electric circuits. They can't SEE the flow. What a "breakthrough"!

S Could we use a meter to detect it?
T Yes, we could, if we HAD to do so, for the sake of the "doubting Thomases". But our "act of faith" is an important step forward for us, don't you think?

EXERCISE 3. One-way traffic
 Now we could try other resistors, or even a "variable" resistor, but we'll introduce instead, our first "semiconductor" device ("real" electronics at last).

In your box you'll find a miniature DIODE. Those who haven't a clue what it looks like, see this one here. It's really tiny with a lead at each end. Try not to bend the leads too close to the glass, then plug it in to the usual "gap" (instead of whatever's there, yes) and see whether it conducts. Does it?

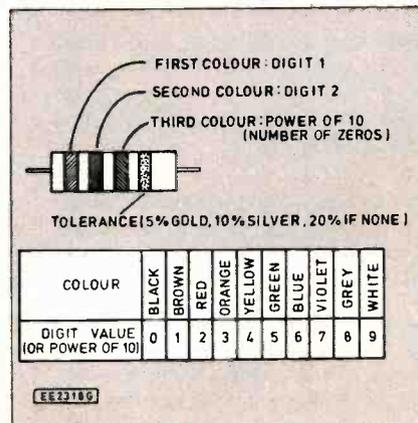
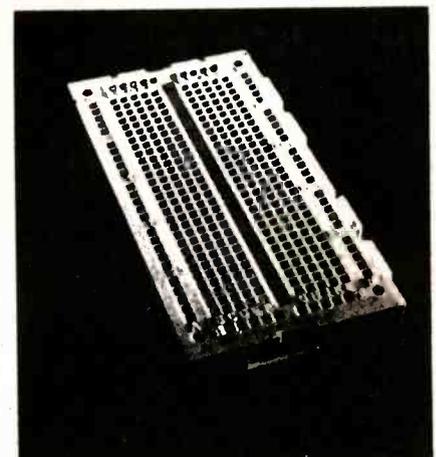


Fig. 4. Colour code for resistors.



The type of breadboard used in this series.

S Yes/No
T Try turning it round the other way.
S No/Yes
T Fine, so a DIODE conducts one way only. We can say it has a low forward resistance, and a high reverse resistance, OK? (Fig 5). Some of you may already know why this can make it very useful in many circuits.

Now remove the diode, and look for another type of diode. It's a red blob, with both leads at one end. Try it as before across the gap.

S (several) Ooh.
T Yes! Make sure it IS a diode, by trying it both ways. It's called a Light-Emitting Diode, or l.e.d. for short, in fact this one is a RED LED. If it doesn't work it's a DED RED LED. Sorry.

It's used mainly, you'll realise, as an indicator light in all sorts of devices.

L.e.d.s come in other colours, such as green or amber (yes, traffic light project), but they DO need a resistor in series with them. Why?

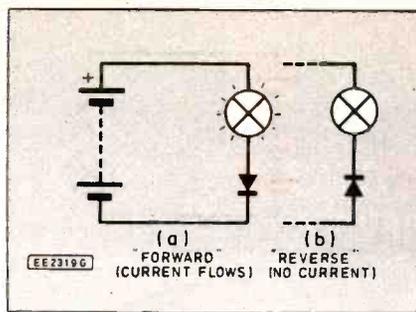


Fig. 5. Diode in series (across the "gap") (a) "forward" - current flows, (b) "reverse" - no current.

S To control the current.
T Yes, to limit the current, because the l.e.d., like other diodes, has a LOW forward resistance, and could be damaged by too much current unless some extra is added in the circuit. Why didn't we add any here, then?

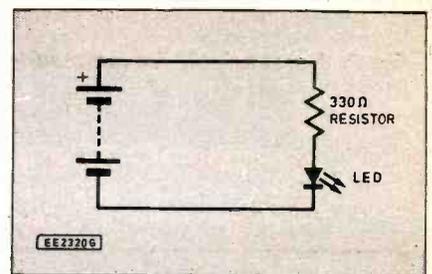
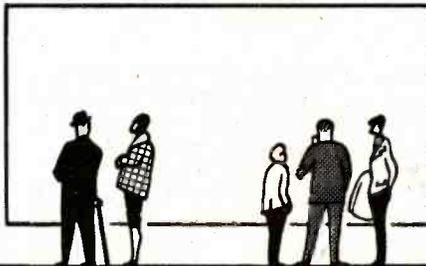


Fig. 6. L.E.D. with "ballast" resistor. Note the symbols (the l.e.d. has "light" arrows from it!).

S (after brief thought) The lamp.
T Right. The lamp provides the necessary "ballast" resistance in this case, but a resistor of a few hundred ohms is generally used (Fig 6).

Next month: The Transistor

SHOP TALK



BY DAVID BARRINGTON

Children's Christmas Lights

We do not expect any component buying problems for the *Children's Christmas Lights* project. The Darlington driver i.c. certainly appears to be listed by most of our advertisers and should not cause any local sourcing problems.

The screw terminal block is most commonly sold as a 12-way item and will need to be cut to size with a junior hacksaw. It may prove a little difficult to solder the supply leads to the battery spring terminals and it might be better to use miniature crocodile clips, with their bodies covered with insulating material to avoid any possibility of shorting out the battery terminals. The use of clips also makes it easier to change batteries.

It is important to remember that when purchasing the "display" lamps they should be the 6V types normally used as replacements for the 40 lamp mains sets. Bulbs from the 20 lamp sets will, of course, have a higher operating voltage and be too dim for this application.

Car Lamp Charger

The only component called for in the *Car Lamp Charger* circuit that we feel readers will have some difficulty locating is the L200, adjustable voltage and current regulator i.c. It is currently listed by Cirkit, Cricklewood, Maplin and Omni Electronics. The price ranges from about £1.30 to £2.

Suitable "power-in" plugs and sockets are listed in the Maplin catalogue, order codes HH60Q (Std Power Plug 2.1) and HH85G (Power Skt 2.1) for the 2.1mm version; HH62S (Std Power Plug 2.5) and HH86T (Power Skt 2.5) for the 2.5mm version.

Autolight

Most of the mains driven battery eliminators on the market are quite safe and it should be possible to find one to suit the Autolight for prolonged use. Some of these units have multiple "spider" plugs, one of which should match the Autolight switched power input socket.

The rest of the components should be standard lines carried by most local suppliers. The Easiwire matrix board is attached to the front cover of this issue of EE and any readers having difficulty sourcing the wiring connectors or pen should contact BICC-Vero direct for nearest stockists.

Car Impulse Wiper

Readers intending to build the *Car Impulse Wiper* should pay particular care when installing the unit in the car and the car battery **must** be disconnected during connecting up. Do not underestimate the power from the car battery and it is vital that all wiring from the unit to the car be double checked before reconnecting the battery.

It is most important that heavy duty auto-wire be used where specified, par-

ticularly right up to the relay contacts. The relay used must also have heavy duty contacts and a suitable one is stocked by Maplin, code YX99H (12V 16A Relay). This relay is rated at 16A. Also, most car spares specialists stock relays specially for installation in vehicles. Again, make sure that the contacts are heavy duty (10A plus) before purchasing.

The right-angled barrier strip, used in the prototype model is an RS type and was purchased through Electromart (☎ 0536 204555), order code 423-374. An alternative would be plastic screw terminal strip, cut to size, which is more widely available. It must be rated at 15A minimum.

The rest of the components for this "pocket money" project are standard 555 timer circuit components and should be stocked by most of our advertisers. The Easiwire board is attached to the front cover of this issue of EE.

EEG Electrode Impedance Meter

All the components required to build the *EEG Electrode Impedance Meter* are standard "off-the-shelf" items and should not cause any buying problems. Most of our advertisers stock excellent ranges of panel meters and should be able to recommend a suitable model.

The small printed circuit board is available from the EE PCB Service, code EE665.

Parcel Post Storage Box

Suitable 12V solenoids for use in the *Parcel Post Storage Box* should be available from advertisers, such as TK Electronics, Marco, Greenweld and J.N. Bull Electrical. A 12V solenoid which may be suitable for this project, but not tried, is available from Maplin, code YR88V (£7.95).

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Robot Roundup



NIGEL CLARK

DOMESTIC

The search for the mobile, all-purpose domestic robot is still on. It is only a question of time and getting the technology right before it comes knocking at the door, demanding to be let in to release us from the drudgery that is housework.

That was the overall impression gained from the first Workshop on Domestic Robots given recently at Newcastle University. It was the view of Joe Engelberger who gave the keynote speech and of the four papers given to about 40 people from 10 countries.

However, it appears that the definition of domestic may have been taken a little wider than intended. One of the papers was presented by the Technology Action Group of Alnwick, Northumberland, which, while confident of being able to produce low-cost (£2,000 to £3,000) mobile robots for cleaning, grass cutting and security, does not see them as being for use in the home.

The workshop in September was organised by the Department of Trade and Industry under the framework of the International Advanced Robotics Programme. Britain is the lead country under IARP for medical and healthcare robotics and the domestic workshop was organised at the same time as the second workshop on medical and healthcare subjects.

Following the success of the first domestic workshop it is hoped that another will be organised next year. A decision is likely in the near future.

OPTIMISTIC

The tone of the three days was set by Engelberger who was said to be very optimistic and positive about the future for robotics. He took the view that it was only technology which prevented lots of little mobiles helping to deal with all those unpleasant tasks in the home.

Other speakers included a former employee of Personal Robotics Ltd. (the research company doing the feasibility study for the DTI's collaborative group for domestic robots, which went into voluntary liquidation in July) and a member of the Shadow Robot Project, which is also represented on the domestic group. Both reinforced the optimistic tone.

It is expected that their views will be supported when the final results of the feasibility study and the group's comments are known. As revealed last month there are likely to be three areas considered worthy of further interest, an all-purpose mobile domestic robot for the home, a similar device for commercial areas such as hotels and a mobile designed to allow further research to be undertaken.

SPOOF

As part of the study a spoof review of a domestic robot appeared in *Good Housekeeping*. The response was said to be better than for most of the magazine's articles with some people,

convinced that such a machine was available, wanting to know where to obtain it.

There was an element of self-fulfilling prophesy in the article. It described a robot which was expected to be attractive and efficient and so it proved. It was attractive and created a market for such a device. Whether it was possible to create such a device in the near future was not considered.

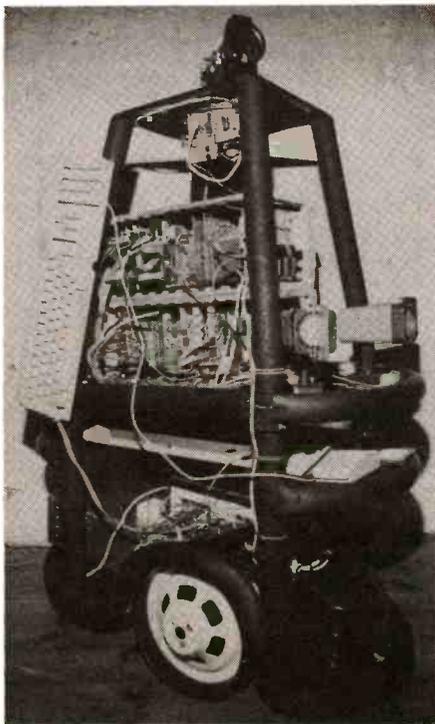
Possibly more interesting and more important are the results of the work of a market researcher, done as part of the study. She has found that there is a widespread aversion to the word "robot" and the most common question asked in connection with robots is "How easily can you turn it off?". It would appear from that that the general public does not have the greatest confidence in the reliability of robots.

TAG

The Technology Applications Group (TAG) was set up in 1986 by five people straight out of university who wanted to work in research. It is split into two almost equal sections, computer consultancy, which provides most of the income at the moment, and research.

Simon Smith, the marketing partner, said that they chose to work on mobile robots because it was an area which interested them. Over the years they have created a variety of robots but all have had the same information handling system using neural strands. This system is based on research done in the States and is said to provide a cheaper and faster way for robots to find their way around, rather than taking in a

Hilda 2 autonomous mobile robot from TAG (Circa 1989).



great deal of information from sensors of all kinds and processing it to work out the path.

Like all research companies TAG is seeking commercial backing. By default, following the liquidation of Personal Robots, TAG has the lead in this type of work in the UK, but while plenty of companies had expressed interest they had not been willing to put up any money. Smith added that he thought there was a market for the products they were developing but appliance companies were waiting to see properly-engineered working models before taking action.

"They are likely to wait until someone steps out of line and then interest will explode," he said. However he emphasised that they were concentrating on low-cost items for industry and commerce, not the home.

Until the mobiles begin to be considered viable TAG is looking at ways of adapting its technology for stationary devices such as vision systems and high-speed pattern recognition.

EXTENSION

TAG's views on the suitability of mobile robots for the home are shared by Dr John Billingsley, professor of robotics at Portsmouth Polytechnic, though for different reasons. He argues that a general purpose mobile domestic robot would not be the best way of achieving release from much of the domestic work done in the home. And he quotes the result of the market research, mentioned above, as showing people's nervousness of apparently self-controlled robots wandering about the house.

He considers an extension of what has already been developed in the domestic appliance market as the best way forward. Define a robot as a "machine designed to perform, unsupervised, a useful task which required the use of sensory data for its execution" and we suddenly find ourselves surrounded by "robots".

As Billingsley said in his inaugural lecture as robotics professor, given earlier this year: "Nowadays we turn on the dishwasher, while the central heating controller maintains our chosen room temperature. Morning tea is brewed by a bedside teamaker and the toast pops up under the direction of an integrated circuit. Not only does light appear at the flick of switch but movement sensors can automatically cause the pathway to be flooded with light at the approach of a visitor, welcome or otherwise.

"The roast switches on at an appointed time to be heated to a thermostatically-controlled temperature while a few feet away the indispensable washing machine fills with water to a metered depth, heats it to a selected temperature, tumbles, drains and spins all under microcomputer control."

Perhaps we could do with more useful stationary robots on the same lines.

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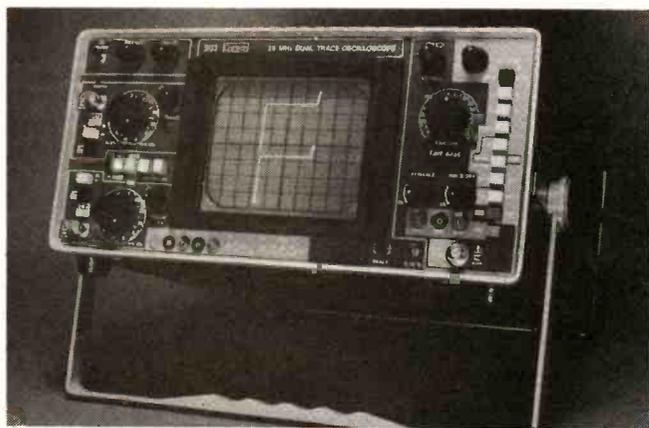
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PARCEL POST STORAGE BOX

M. P. HORSEY



Simple unit that will allow the postman to leave your mail-order packages even when you are out.

MANY constructors will have faced the problem of being out of the house when parcels are delivered. The situation is equally frustrating for the postman.

The project to be described here overcomes this problem by means of a secure box into which a parcel can be placed. The postman has only to press a push button to unlock the box. However, once a parcel is inside, the box cannot be unlocked except by pressing a button inside the house.

In both cases, the box unlocks for a preset time, enabling the postman to open the box with just one hand. A buzzer indicates that the lock has opened, and a small l.e.d. inside the house indicates that a parcel has been delivered.

It will be apparent that only ONE delivery of one or several parcels can be accommodated before the parcel(s) is removed. This should cover most people's needs. A multiple delivery system could be devised, but this would involve the postman in a more complex operation than pressing just one button.

The project is ideal for busy electronics constructors who order their parts by mail, but are nearly always out when they arrive!

HOW IT WORKS

The principle behind the Parcel Post Storage Box circuit is shown in Fig. 1. Normally both switches S1 and S2 are open and (a) and (b) are at logic 0. The NOT gate (inverter) causes output (c) to be at the opposite logic level to (a). The NOR gate combines inputs (b) and (c) to produce a logic 1 at (d) only if both inputs are at logic 0.

A glance at Truth Table 1 shows all the combinations of (a) and (b) with their results. Notice that (c) is the exact inverse of (a), and that (d) is the result of a NOR gate combining (b) and (c). The overall result is that (d) is only at logic 1 if (a) is at logic 1 and (b) is at logic 0.

In other words, a logic 1 is fed to the monostable only if S1 is pressed, and S2 is open. If a parcel causes S2 to close, (d) will not switch to logic 1 even if S1 is pressed.

Switch S3 can be used to trigger the monostable, irrespective of the states of S1 and S2. The monostable multivibrator (to give its full title) is used as a simple timer. The output (e) stays at logic 1 for a preset time after a logic 1 pulse is received. The amplifier increases the current available to enable the solenoid to operate.

Transferring the above analogy to our

"post box", when the postman operates the "Box", an electronic circuit (inside the house) causes the solenoid to unlock the lid for about 50 seconds. The buzzer indicates that the box is unlocked. The lid is then opened and a parcel placed inside.

The weight of the parcel causes a false bottom in the box to activate a micro switch S2. This causes an l.e.d. in the house to glow, and also prevents S1 operating again. The postman closes the lid, and after the preset time mentioned above, the solenoid switches off, causing the lid to be locked in place.

Since the Box switch S1 is now inoperative, the box can only be opened by the householder pressing push switch S3, located inside the house. This switch and l.e.d. D1 are housed in a plastic case, together with the electronic circuit and batteries.

CIRCUIT DESCRIPTION

The full circuit diagram for the Parcel Post Storage Box is shown in Fig. 2. A quad 2-input CMOS NOR gate i.c. is used (IC1), since NOR gates can be easily converted to NOT gates, and can be wired as monostables. The NOT gate in the block diagram (Fig. 1) is achieved by joining together input pins 1 and 2 of IC1a.

When S1 is pressed, these inputs are connected to 12 volts (logic 1). When S1 is released, resistor R1 causes the potential at these inputs to fall to 0V (logic 0). Capacitor C1 removes any a.c. interference at the inputs.

In a similar way, resistor R2 causes a logic 0 at the input pin 6 of IC1b unless microswitch S2 is closed. Resistor R3 limits the current through l.e.d. D1 to about 7mA when S2 is closed.

Resistor R2 may not be strictly necessary, since R3 and D1 will maintain logic 0 at pin 6 when S2 is open. However, the voltage difference across D1 could otherwise cause a problem. As with capacitor C1, capacitors C2 and C3 remove a.c. interference.

MONOSTABLE

The output from IC1b (pin 4), the NOR gate, is used to trigger the monostable created from the last two NOR gates, IC1c and IC1d. Normally the input of IC1c pin 8 is low (logic 0), the other input pin 9 is low and output pin 10 high. The inputs to IC1d pins 12 and 13 are high, and the output pin 11 low.

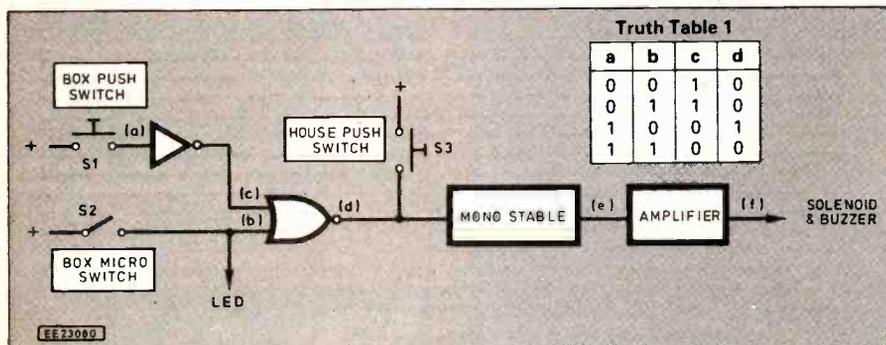


Fig. 1. Block diagram and truth table of the Parcel Storage Box

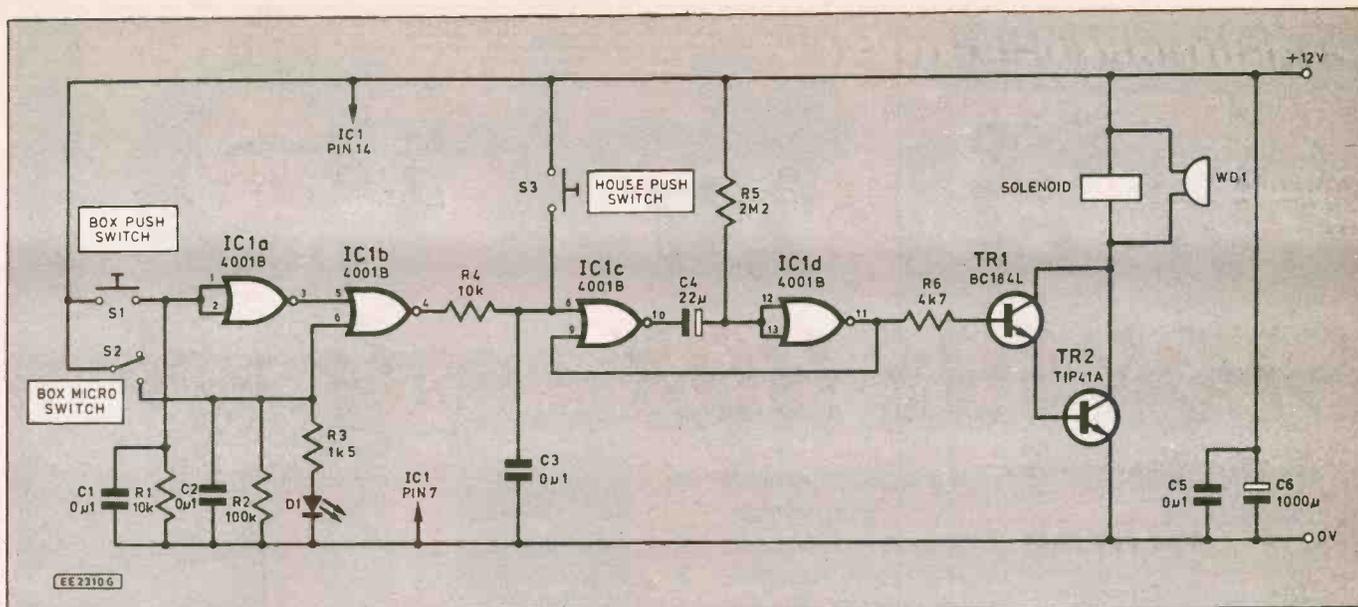


Fig. 2. Circuit diagram of the Parcel Post Storage Box

When a logic 1 is fed to IC1c pin 8, the output pin 10 switches to logic 0. This sudden change of potential at capacitor C4 causes a similar change at IC1d inputs pins 12 and 13. With inputs 12 and 13 low, the output (pin 11) switches to high. This turns on transistors TR1 and TR2 (wired as a Darlington pair), and is also fed back to IC1c pin 9 thus maintaining the monostable in its present state.

With inputs 12 and 13 low, a potential difference exists across resistor R5. A current therefore flows through R5, slowly charging capacitor C4. Eventually the voltage at pins 12 and 13 is sufficient to cause IC1d gate to change state again. Output pin 11 now switches to logic 0, and the situation reverts to the "normal state" described earlier.

TIME PERIOD

The time for which IC1d output is at logic 1 depends upon the values of resistor R5 and capacitor C4. An approximate guide is to multiply the value of R5 (in M ohms) by the value of C4 (in micro F).

The values chosen provide a time of nearly 50 seconds, but this may be changed if desired.

AMPLIFIER

Resistor R6 limits the current flowing from the output of IC1d. When the voltage at pin 11 switches to nearly 12V, TR1 and TR2 are turned on, allowing current to flow through the solenoid and buzzer.

The prototype solenoid required a current of 250mA. Even with a buzzer in parallel, the current is not sufficient to require the fitting of a heatsink on TR2. A higher current solenoid is *not* recommended if the project is to be powered by batteries.

Capacitors C5 and C6 decouple the supply, providing a fairly steady 12V for the i.c.

CONSTRUCTION

The circuit is constructed on Veroboard measuring about 42 holes by 20 tracks. The component layout and details of breaks required in the underside copper tracks is shown in Fig. 3. The breaks can be made using a stripboard cutter or a small twist drill bit.

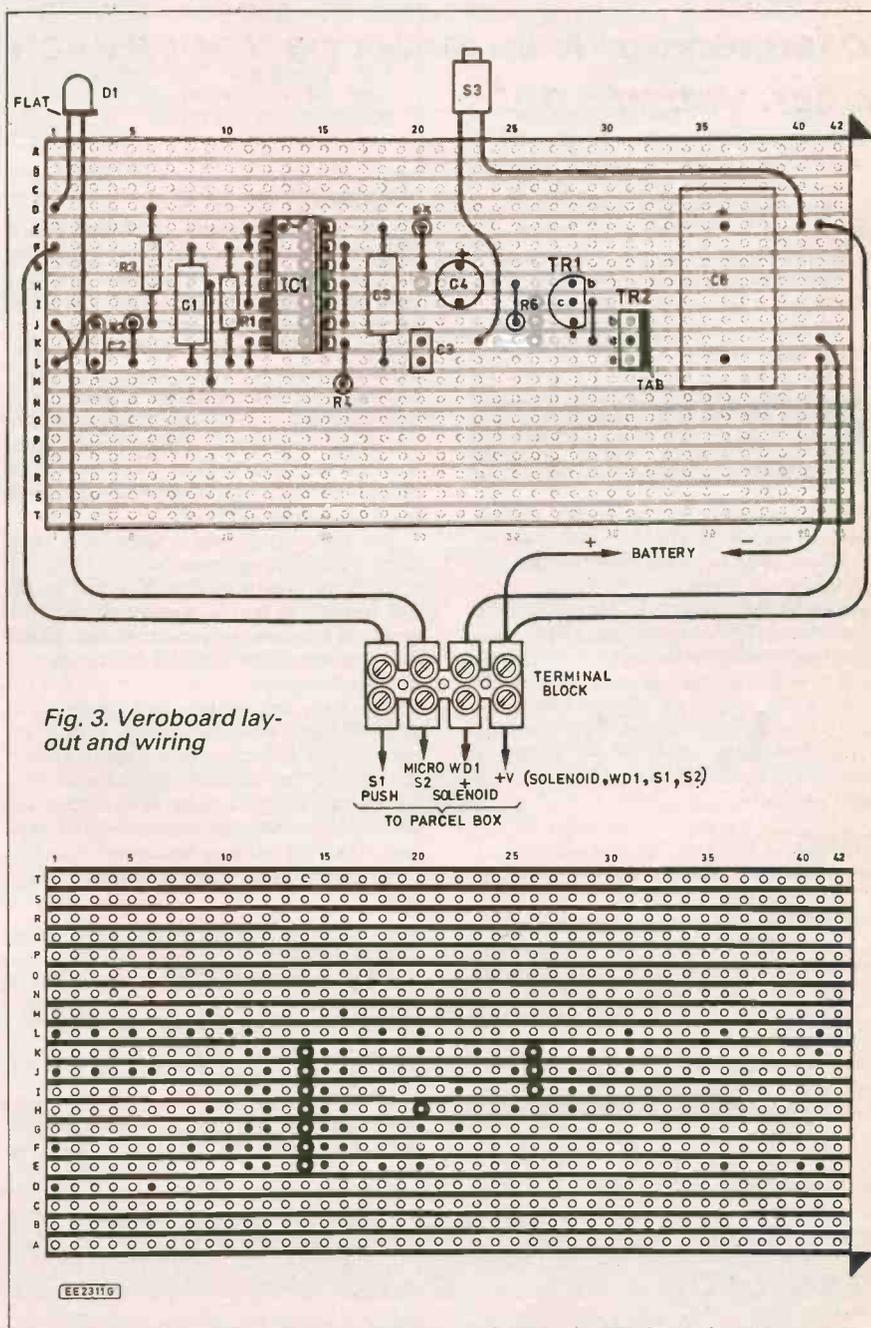


Fig. 3. Veroboard layout and wiring

COMPONENTS

Shop Talk

see page 783

Resistors

R1, R4	10k (2 off)
R2	100k
R3	1k5
R5	2M2
R6	4k7

All 0.6W 1% metal film

Capacitors

C1, C2,	0 μ 1 polyester layer (4 off)
C3, C5	
C4	22 μ radial elec. 25V
C6	1000 μ axial elec. 35V

Semiconductors

D1	5mm red l.e.d.
TR1	BC184L <i>npn</i> silicon
TR2	TIP41A <i>npn</i> silicon
IC1	4001B Quad 2-input NOR gate

Miscellaneous

S1	Push-to-make switch
S2	Lever operated microswitch
S3	Push-to-make switch
WD1	12V solid state buzzer

Veroboard, 0.1in matrix 20 strips by 42 holes; 4-way screw terminal block; plastic case, 150mm x 100mm x 55mm; 14-pin i.c. socket; 12V solenoid; small spring for false floor; medium spring for latch; self-adhesive p.c.b. mount; battery holder and 12V battery (8xAA); chipboard; strips of metal for lock mechanism; connecting wire, solder etc.

Approx. cost guidance only **£13 plus box**

Begin by carefully making the eleven breaks in the tracks where shown. Next fit and solder the i.c. socket, followed by the wire links.

Solder in the resistors noting that several are fitted upright. Fit the capacitors, not forgetting to observe the polarity of C4 and C6 (i.e. fit them the correct way round).

The transistors must also be fitted the correct way round as shown. Finally solder in the connecting leads for the terminal block TB1, i.e.d. D1, switch S3 and the battery holder.

CASE

A plastic case measuring 15cm by 10cm by 5.5cm was used for the prototype. Four holes are required, one for the l.e.d. indicator, one for the push-to-make switch, one for the leads connecting the circuit with the parcel box and a hole to enable the case to be fixed to a suitable surface near the front door.

The stripboard was fastened with one p.c.b. self-adhesive mount. There is room on the board for up to four mounting points, but one was sufficient as the lid of the case held the stripboard very firmly. The battery holder was wedged in with self-adhesive mounts, and the terminal block fastened with self adhesive pads.

PARCEL BOX

The construction of the parcel storage box is shown in Fig. 4. The box was con-

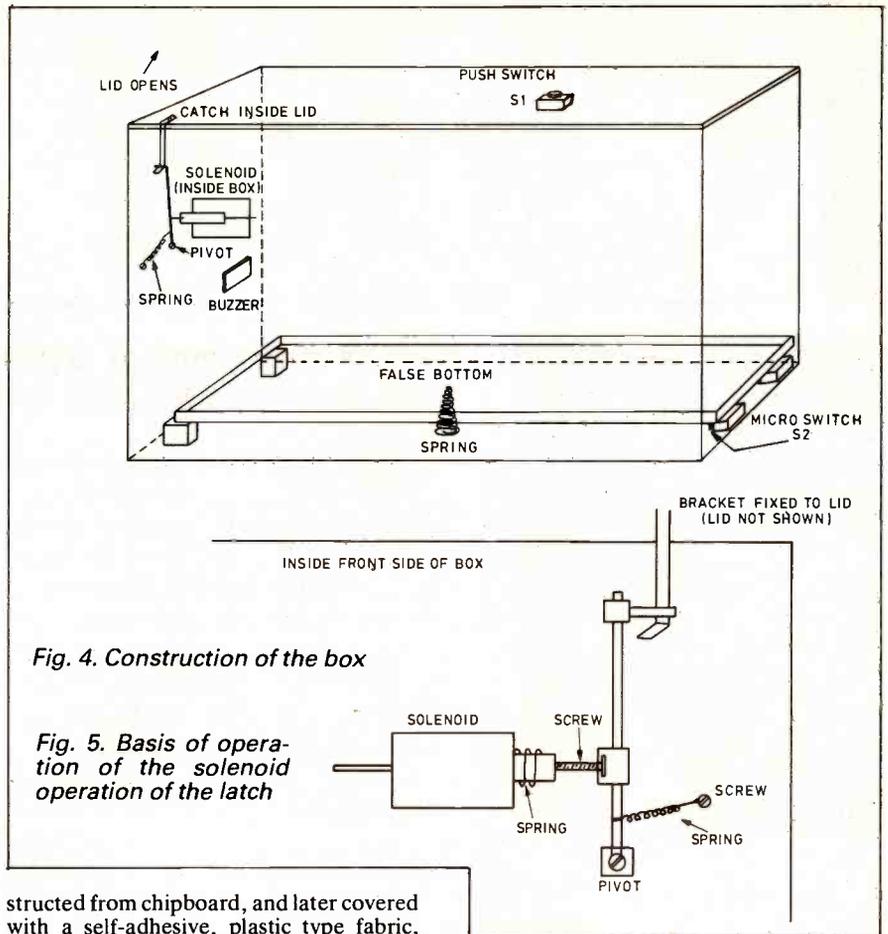


Fig. 4. Construction of the box

Fig. 5. Basis of operation of the solenoid operation of the latch

structed from chipboard, and later covered with a self-adhesive, plastic type fabric, such as Fablon. The size depends upon the type of parcels expected. The prototype measured 46cm by 27cm by 40cm high.

One hole is required in the lid for the wires connecting to the "bell push" S1, another hole for the screw fastening the solenoid, and a third hole in the base for the leads. Four small wooden blocks were used for the false bottom to rest on. The microswitch S2 was screwed to one of these blocks as shown in Fig. 4.

The false bottom was made from very thick card, strengthened with a wooden strip. Hardboard would be a good alternative to card. A spring was mounted at the centre of the base, to prevent the weight of the false bottom holding the microswitch in its closed position.

The lock mechanism was made from strips of metal as shown in Fig. 5. In practice it is likely that the lid would be closed during the 50 seconds period allowed. However, in case the lid is closed after this period the mechanism was made 'self latching'. Thus the lid may be closed after the mechanism has returned to its locked position.

TESTING

When the battery is first connected the monostable may latch on. After about a minute the output (buzzer and solenoid) should switch off. Press the "house" switch S3. The output should switch on for another timed period.

Next check that the microswitch S2 is open (no parcel), and press S1. The output should switch on again. Now close S2, either by hand, or by placing an object in the parcel box. Pressing S1 should NOT cause the output to switch on. However, S3 should still be operative. Finally check that the l.e.d. D1 lights when the microswitch is closed.

If any of these tests fail, carry out the

usual visual checks, particularly looking for copper tracks bridged with solder or fragments of copper. Check also that the tracks are broken properly in the places shown.

A few readings taken with a voltmeter should establish which part of the circuit is causing trouble. Check the voltage across pins 14 (positive) and 7 (negative) of IC1. This should read about 12V.

Connect the negative side of the voltmeter to the negative of the battery, and check the action of S1 by connecting the positive lead of the voltmeter to pins 1 and 2 of the i.c. Check the voltage at pin 3, noting that it should be the inverse of the voltage at pins 1 and 2. Check the action of S2 by measuring the voltage at pin 6, and the action of S3 by measuring the voltage at pin 8.

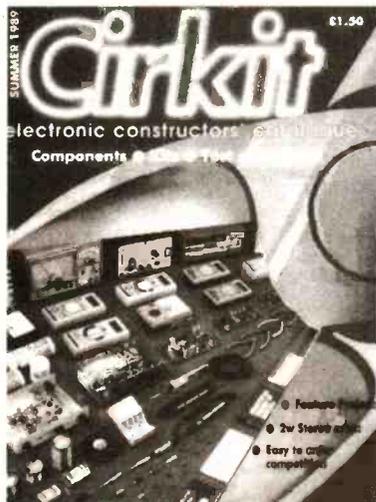
The monostable may be checked by measuring the voltage at output pin 11. If the "house" switch S3 is pressed, this voltage should approach 12V, returning to 0V after about 50 seconds.

If this is working, but the buzzer and solenoid are failing, the problem is likely to be around resistor R6 or transistors TR1, TR2. Check that the transistors are the correct way round, and that a BC184L has been used (not a BC184 by mistake).

Further checks can be made by referring to the circuit description and the circuit diagram.

FINAL INSTALLATION

The Parcel Post Storage Box may be screwed into position outside the house, and the connecting leads fed through to a suitable place inside the house. A brief set of instructions should be provided on the top of the box for the benefit of the postman. After his initial surprise, he should be as delighted with the project as the householder, as it will save him a great deal of time. □



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ac volts: 200mV-750V
dc current: 200uA-10A
ac current: 200uA-10A

Resistance: 200Ω-20MΩ
Frequency: 2kHz-20MHz
Continuity, diode and HFE test
Basic dc accuracy ±0.5%

TM5365

- 30 ranges
- Frequency and capacitance measurement
- Compact size

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ac volts: 200mV-750V
dc current: 200uA-10A
ac current: 200uA-10A

Resistance: 200Ω-2000MΩ
Frequency: 2kHz-200kHz
Capacitance: 2nF-20uF
Logic, continuity, diode and HFE test

TM175

- Frequency measurement to 10MHz
- Capacitance measurement from 1pF to 20uF
- 39 ranges

Price **£57.49**

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ac volts: 200mV-750V
dc current: 200uA-10A
ac current: 200mA-10A
Resistance: 200Ω-2000MΩ

Capacitance: 2nF-20uF
Frequency: 2kHz-10MHz
Continuity, diode, HFE, logic & LED test.

TM135

- Temperature measurement
- Capacitance measurement
- 40 ranges

Price **£45.95**

dc volts: 200mV-1kV
ac volts: 200mV-750V
dc current: 200uA-10A
ac current: 200uA-10A

Resistance: 200Ω-2000MΩ
Temperature: 200°-750°C
Capacitance: 2nF-20uF
Diode, HFE and continuity test

TM115

- 0.5% accuracy
- Transistor HFE test
- 26 ranges

Price **£33.60**

dc volts: 200mV-1kV
ac volts: 200mV-750V
dc current: 200uA-10A

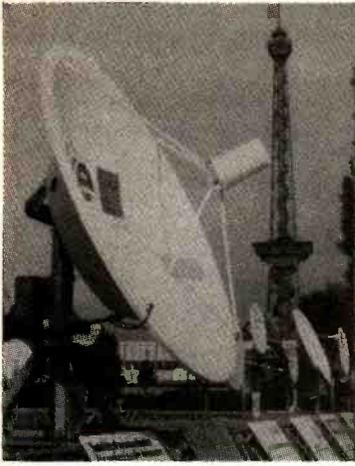
Resistance: 200Ω-2000MΩ
Continuity, diode and HFE test
Basic dc accuracy ±0.5%

Prices inc VAT. Please add 90p for p&p.

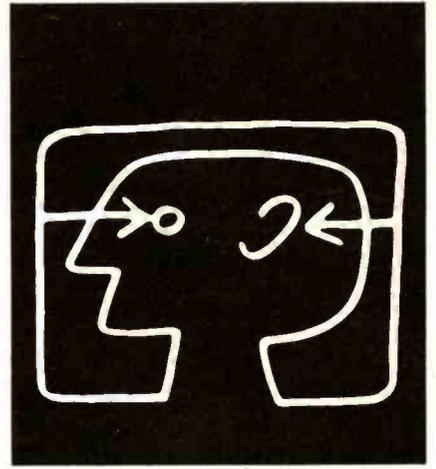


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EUROPEAN INTERNATIONAL AUDIO and VIDEO FAIR



Berlin has hosted an electronics exhibition since 1924. Originally it was the Funkausstellung, or Radio Show. Times change. It is now the International Audio and Video Fair.

This year four hundred exhibitors were spread over 25 halls and our international reporter Barry Fox was there to prowl behind the scenes and eavesdrop on some of tomorrow's developments.

ONCE EVERY two years nearly half a million people stream into West Berlin from all round Europe to pay the £5 a day entry price for a first sight of all that is new in electronics.

The title "international" remains, as always, a joke. Most of the exhibitors, often subsidiaries of Japanese companies, provide only German language information.

All the exhibitors are in the same cleft stick. They want to show off their strength in innovation but fear the public will stop buying today's products if they know too much about what is coming tomorrow. So some novelties are kept in back rooms, out of sight of the public, and shown only to the trade — and sometimes the press. But in Berlin, walls have ears so secrets do not last long.

WHO WANTS A MAC

Consumer research in the US recently proved what has long been glaringly obvious to anyone with a grain of commonsense — that the general public has no interest in slight improvements in picture quality, as for instance the barely visible difference between MAC and PAL on a domestic set. Neither is the public interested in the vague promise of an upgrade path to High Definition MAC in the mid 90s.

Few homes now, and even fewer in the future, will have the space to install large screen sets and projectors. The perceived and saleable benefit of MAC comes from changing the aspect ratio of the screen from today's boxy 4:3 to tomorrow's widescreen 16:9.

Both the D2-MAC standard adopted on the Continent and Britain's D-MAC variant, to be used by British Satellite Broadcasting (BSB), are designed to cope with either aspect ratio. A digital code word (transmitted like teletext) tells the MAC receiver whether the incoming pictures were shot in 4:3 or 16:9 aspect ratio.

The receiver then displays the pictures with the correct relationship between height and width, irrespective of whether the screen is narrow or wide. This creates all manner of logistic problems which began to surface at Berlin.

On a 4:3 screen, a wide picture must either be displayed in letter-box format (with blank strips at the top and bottom of the screen) or the sides of the picture must be sacrificed. So either the viewer pays for screen area that is not used, or the programme producer must keep all action at the centre of the screen — which defeats the object of wide screen production.

Then there is the question of how future wide screen sets will cope with programmes made in 4:3 aspect ratio. One option (favoured at Berlin by Thomson and Ferguson) is to sacrifice a little of the top and bottom of the picture i.e. heads and feet, while displaying a fuller width of picture than is normally seen on domestic TV sets which currently electronically blank out the extreme screen edges.

Another idea is to display a 4:3 picture on a wide screen set, and put three vertically stacked, picture-in-picture frames, down one side of the screen. Again programme producers must know how receivers will work, to avoid losing vital action off the screen on some sets.

MAC-CHIPS

The first prototype MAC TV sets were shown at the last Berlin show two years ago. This year there was no sign, or even mention, of D-MAC. Most major manufacturers had D2-MAC receivers on display, but many would admit that they had received only small quantities of the D2 chip sets from ITT by courier or taxi a week before the show.

The vital issue of chip testing has apparently still not been resolved; and automated testing is the key factor in mass production. ITT is believed now to be on the 39th generation of chip sets. And even these are not yet perfect.

Philips was demonstrating a 4:3 MAC set, fed with 16:9 wide screen pictures. Although the pictures filled the screen, the image was squashed, like a Cinemascope film shown without the correct lens.

"The chip set is not right", admitted the Philips demonstrator.

This does not bode well for the D-MAC chips, on which BSB's life depends. At Berlin Thomson engineers said they had "seen a working D-MAC chip set" but had no news on the bulk supplies needed for a spring launch.

The only sign of the Scotch mist Squarial (special receiver dish for BSB transmissions), was a dejected dummy on a Tatung stand. "We don't even know what it is", admitted the staff on duty at the company's information booth.

EUREKA BACKFIRES ON HDTV

All the major European electronics companies have banded together in a "Eureka" research project to develop a High Definition TV system. The first prototypes were unveiled at Berlin two years ago and progress continues.

But there are already worrying signs of political squabbling from the Eureka camp. The HD MAC pictures shown at Berlin were being bounced from the French TDF satellite. The connection added noise and even broke down completely because the German Bundespost (Post Office) would not licence an uplink to send the signals up to TDF. So the signals had to go on a double hop, first to the German satellite *Kopernikus* and then to the French satellite. Although ostensibly enthusiastic about satellite broadcasting and HDTV, the Bundespost is actually far more interested in making money from its cable TV interests.

To keep all the Eureka contributors happy, the Eureka demonstration room used a bank of wide screen sets from Barco, Thomson, Philips and Nokia. This soon backfired. The Nokia set failed and the Thomson set gave very poor pictures in comparison with the Barco.

Worse still, whereas HDTV shots of football and tennis sources from the BBC looked good, HDTV material sources from France looked very poor. One sequence looked like dirty film. Sheepishly, the Eureka exhibitors admitted that they had been forced ("for political reasons") to include French material which had been shot on film and then transferred to video, with serious quality loss!

Berlin revealed a wide divergence of opinion over when wide screen and HD-MAC sets and services will be ready, and at what price. The official Eureka line is that there will be "regular HDTV broadcasts by 1992". The head of Philips consumer electronics division, Jan Timmer has a more realistic attitude which is shared by Grundig. They believe test transmissions will begin in 1992, in time for the Barcelona Olympics. From then until 1995 there will be a gradual increase in service.

"It's wrong to give the impression that HDTV is just around the corner", says Timmer.

Only Thomson will talk about set prices. Peter Weber of Thomson says there will be wide screen 1250 line HDTV sets ready for sale, at £3,000 each, by autumn 1990.

"Wide screen tubes are cheaper to make than conventional tubes", says Weber. But Grundig estimates that even conventional 625 line wide screen sets will cost five times as much as 4:3 sets for the next five years. And there were surprisingly few prototype wide screen sets on working display at Berlin.

Whoever is right, the outcome is the same. The public wonders whether it might be better to wait a year or so before buying a new TV set.

BITSTREAM MASHINATIONS

Specialist hi fi dealers are already feeling, and complaining about, the effect of confusion over the new single-bit digital decoding techniques, Bitstream from Philips and Mash from Panasonic.

In simple terms, whereas conventional digital-to-analogue converters process the 16-bit digital code words from a CD in their entirety, Bitstream and Mash break the words down into their individual bits and process them one by one.

Says Jan Timmer, Bitstream is an "important step".

In technical literature describing the advantages of Bitstream and the disadvantages of existing CD decoding systems, Philips says it will use Bitstream first in a new high end player, the CD-840, later this year and later spin the system off and down into the entire range of CD players, including low end and medium priced models. Grundig is using Bitstream for its new high end "Fine Arts" DAT recorder. But Marantz, now controlled by Philips and being used by Philips as the premium brand name in Japan and Europe, will not be using Bitstream.

"We don't think the system is yet good enough", says Eric Kingdon of Marantz. "Adoption would be premature. The DACs we've got are better. The key is in matching the analogue circuitry. That's why players with the same DACs, but different analogue circuitry, sound different.

"We shan't use Bitstream until we are convinced that there is an audible benefit. We are not interested in technology in its own right. We will not use Bitstream until it sounds right. And that probably will not be until 1990 or 1991."

Meanwhile Matsushita (Panasonic and Technics) took Berlin as the opportunity to claim superiority for its own single-bit system, Mash.

Who can blame any member of the public who decides to postpone purchase of a CD player until the DAC versus Bitstream-versus-Mash dispute is resolved?

ALL DAT TALK

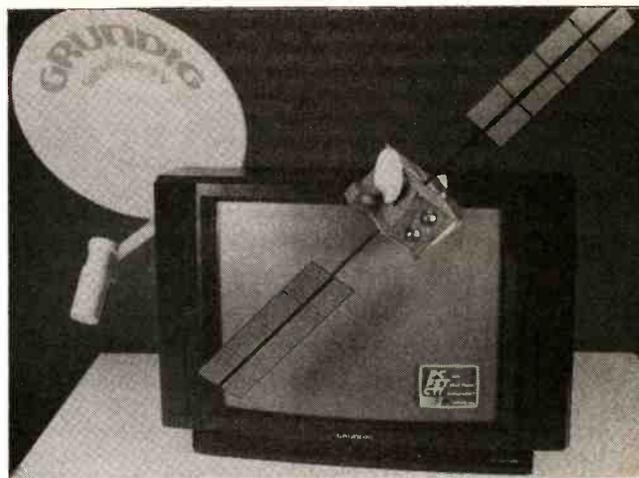
The popular press has predicted that DAT recorders, and pre-recorded DAT software, will be in the shops by Christmas. Berlin made clear that this is a nonsense. If (and it's a big if) there is a consolidated launch on DAT, it will be for Christmas 1990, most definitely not Christmas 1989.

The hardware and software industries agreed on the technical formula to limit digital copying or "cloning" (Serial Copy Management System) in June. Their formal announcement came at the end of July. Now the hardware has to be re-designed to meet the SCMS specification and the software industry has to lobby for legislation to prevent hardware companies (eg from Taiwan and Korea) who have not signed the agreement from ignoring it.

At Berlin, Philips engineers and lawyers confirmed the state of play. The SCMS system (developed by Philips, and initially called Copycode) will be filed with the IEC standards body in October and the DAT standard subsequently amended to include SCMS. At the same time hardware manufacturers will have to modify the computer software inside their DAT recorders to work to the SCMS specifications.

Three changes are necessary. The recorder must be able to dub digitally from compact disc at 44.1kHz, as well as 48kHz. When dubbing the recorder must automatically put an anti-copy "flag" on the tape. And it must also look for any such flag in the signal being copied, and refuse to copy any flagged signal.

There are four or five computer microprocessors in each DAT recorder, and all will now require modification. Manufacturers



The Grundig ST70-564 Satellite TV Receiver

will not have the product ready for bulk sale until spring 1990 or later.

To support the hardware launch with pre-recorded software, the record industry needs high speed duplicating equipment, which Sony promises, but has not yet delivered. Some record companies (e.g. Polygram) do not want to release software until laws have been passed to make SCMS a compulsory feature of all DAT hardware. Philips admits that it will take between two and four years for the EEC to deliver a directive which individual countries in Europe can enshrine in law.

Jan Timmer of Philips talked at Berlin of "waiting for legislation" before launching Philips DAT hardware. Later the same day others in Philips talked of releasing DAT recorders by "mid 1990 ahead of legislation". Grundig promises a DAT recorder early next year.



CD60 Compact Disc player from Marantz



Portable DAT recorder with A/D converter from Aiwa

PORTABLE DAT

At Berlin Aiwa and Casio both showed portable DAT decks but without any promise of price or launch date. Sony was significantly silent. The company recently signed a deal with Taiyo Yuden on the joint development of Taiyo's low cost recordable CD system. But CD-12 was not on show. In fact only Thomson showed a recordable CD at Berlin. Significantly it used magneto-optical technology, which is both expensive and incompatible with conventional CD players, and thus not viable as a domestic product.

Aiwa's prototype pointed the way to possible success for DAT; a versatile portable unit, which can be used either to record sound or still pictures in digital code.

STILL PICTURE VIDEO

Canon took Berlin as the opportunity to preview the still picture video camera which the company is launching in Europe this autumn for around £500. Sony is also planning to launch its Mavica camera early next year.

Both cameras comply with the same technical standard. A 2in magnetic disc, like a miniature computer floppy disc, records up to 50 still pictures for replay through a TV set. The camera has a solid state CCD image sensor, and is remarkably small. But inevitably it relies on a complex mechanical drive for the disc, which keeps the price high.

At Berlin (as in June at the *Consumer Electronics Show* in Chicago) Toshiba took the opportunity to show the public that still picture disc technology is already potentially obsolete! Toshiba's i.c. card camera has no moving parts. Instead of a spinning magnetic disc it uses a 20 megabit computer memory in a "credit card". This card can record 13 pictures of high quality. Toshiba promises to increase memory capacity and use signal processing tricks, to put 50 pictures on a single card.

They also demonstrated a system for storing up to 1,600 DAT pictures on a modified DAT recorder. Toshiba's card camera will not be ready for sale at competitive prices until the 1990s, so the company's technique of demonstrating the system strategically opposite Canon's demonstration of the disc camera is clearly a spoiler tactic designed and guaranteed to confuse the public.

3D VISION

With every cuckoo in spring, comes some new 3D video or TV system. Toshiba has developed a VHS camcorder, with two lenses, that records in 3D.

Left and right eye images are recorded alternately on tape. When the tape is replayed, the left and right images are displayed alternately on a TV screen.

The viewer wears a hat, with liquid crystal spectacles connected by wire or infra-red link to the TV set. The left and right eye l.c.d.'s alternately switch from dark to clear in synchronism with the images on screen. When the left eye image is on screen, the left eye l.c.d. is clear and the right eye l.c.d. is dark, and vice-versa.

The effect is a rather odd 3D image. The price of the camera, the need to wear an l.c.d. hat, and fatigue brought on by watching left and right eye flicker make the idea little more than a gimmick. Most important, the system is not compatible. Viewers without l.c.d. hats see unwatchable pictures, a rapid sequence of flickering left and right eye perspectives. The real value of the system is for industry, education or medicine, for instance training surgeons.

SUPER MAC

Expect yet more confusion, this time over the launch of video recorders claimed to record MAC and HD-MAC. A clear distinction needs to be drawn here.

The I.C. Card Camera from Toshiba uses a 20 megabit "credit card" to produce 13 pictures. Future cards will, it is hoped, produce 50 pictures.



HD-MAC recorders (as for instance developed by Philips) capture the full bandwidth (over 10MHz) 1250 line high definition MAC TV signal on a VHS cassette, by completely altering the VHS standard. The head drum rotates at twice normal speed (3000r.p.m.) and metal powder tape is used instead of conventional oxide. The signal is split into two channels and recorded with two pairs of video heads.

Although shown at Berlin this is very much a future product. More immediate, is the idea from Grundig of using a Super VHS recorder to tape 625-line D or D2-MAC signals with minimal loss of quality. The system takes advantage of the fact that MAC is a natural source of the separate Y (black and white or luminance) and C (colour or chrominance) signals on which the S-VHS format relies for its superior picture quality. The MAC system keeps Y and C separate and an S-VHS recorder handles them separately.

Combining a MAC decoder with S-VHS recorder is a natural and sensible approach which will let both MAC and S-VHS ride on the back of any commercial success which the other may enjoy.



The Toshiba 3K-3D7 VHS camcorder has two lenses and is claimed to record in 3D.

HOME VIDEO DEVELOPMENTS

As expected, after hints at the company's annual general meeting, Grundig has now decided to back the 8mm video format as well as VHS. Grundig is sourcing 8mm and High Band 8mm camcorders from Sony, as well as the new Sony personal Video Walkman. Although Philips acknowledges that 8mm now has 40 per cent of the camcorder market in Europe, the company still sticks loyally to VHS.

"The consumer will decide" says Jan Timmer.

Both JVC and Panasonic have now shown an F/C mechanism for a table-top VHS recorder. A single loading tray accepts either a Full size or Compact VHS-C cassette, without the need to use an adaptor. "It solves a problem none of us knew we had", said one American observer when the concept was first unveiled at the *Chicago Consumer Electronics Show*.

It would surely make far more sense to offer a single recorder with separate F and C mechanisms. This would let users edit tape easily by dubbing from a camcorder C cassette onto a full size blank cassette.

BASF has now decided to defy JVC, and launch its E300 VHS cassette throughout Europe. The E300 cassette gives five hours recording time at normal speed, and ten hours at half speed, compared with four and eight hours from the longest play cassette so far available, the E240.

The extra playing time is gained by making the tape thinner, and longer. Standard VHS tape is made from a polyester base film 14 micrometres thick with a 5 micrometre coating of magnetic oxide, E240 tape has a 12 micrometre base film and BASF's E300 base is 9 micrometres.

The E300 cassette was first shown at Berlin two years ago. JVC objected that it fell outside the terms of the VHS licence, and warned that some VCRs might chew the thin tape.

BASF has now test marketed the E300 in Austria and claims that the failure and complaint rate is no higher than for E180s or E240s. The new cassettes will now become a standard BASF line throughout Europe, at twice the price of an E180. Expect them in the UK before Christmas.

"JVC says that if there are problems it will damage the VHS name" says Bernd Rothfuss of BASF. "We say we would not sell something with our name on unless we were sure it would work. They say they don't like it. We say we do like it".

The advantage of an E300 is that it lets the owner of VCR set it to record several programmes during a holiday period.

CROSSTALK

The same advantage accrues from an astonishing new VHS recorder developed by ITT Nokia's laboratory at Pforzheim in West Germany. Although hidden behind the scenes and still only in prototype form, this could prove to be the most significant development unveiled at Berlin.

The Nokia recorder runs VHS tape at one-third normal speed, 0.78 cm/second instead of 2.34 cm/s for a conventional recorder and 1.17 cm/s for a half speed machine. Reducing the speed reduces the width of each magnetic track to 16 micrometres instead of 49 microns.

Normally this would cause intolerable "crosstalk" between adjacent tracks, with the signal from one track interfering with the signal from the one alongside it on the tape. But Nokia has succeeded in cancelling crosstalk by a clever electronic trick.

The phase of the electrical signal for each adjacent line of the picture is reversed so that any breakthrough from one line to the next is cancelled out. This simple technique, which costs only a few pounds in circuitry to implement, lets a VHS recorder running at one-third normal speed produce pictures which are almost as clear as from tape running at full speed. When used with a BASF E300, the Nokia recorder can give a staggering fifteen hours continuous recording time — enough to record at least seven full length films from TV while the owner is away on holiday.

JVC is however not amused. Tapes recorded on third speed machines will not play back on existing single speed, or half speed machines.

"We saw the system at Berlin" said a spokesman. "It is outside the VHS standard. There must be strict direction or the public will be confused".

BALANCED VIEW

Nokia may however still be able to use its system, although not with third-speed recorders. Potentially even more significant, the Nokia line phase reversal technique can be used to let a conventional VHS recorder with conventional heads, give good results at half speed.

Normally, half speed recording needs an extra set of heads on the drum, finely dimensioned to match the narrower tracks and avoid crosstalk interference. With Nokia's new system, full sized heads can give good results from half size tracks. This could make VHS machines with two speed recording almost as cheap as VHS machines with single speed recording.

For good measure, Nokia has developed a clever remote control for TV sets and video recorders. This has far fewer buttons than usual. The controller handset contains a miniature light source and light sensitive diode, with a ball bearing free to move between them.

As the control is tipped, the ball moves under gravity and the beam shape varies. The controller circuitry senses this change in beam shape and varies the control signal. So just tipping the handset in one direction can switch a recorder from play to fast forward and tilting the hand-set in the opposite direction can reverse the tape wind direction.

CD VIDEO

Behind the scenes at Berlin, fingers sizzled as a red hot potato was frantically passed around. The hot potato is a multi-standard CD Video player.

Jan Timmer of Philips, has virtually staked his reputation on selling CD Video to Europe. So far CDV has been a commercial disaster, because there is pitifully little PAL format software.

"I am still convinced there will be a breakthrough in Europe", said Timmer at Berlin, pointing to the Japanese and American experience. "There are 7,000 titles in Japan, 4,000 in the USA, but only around 300 in Europe. I am convinced Europe will catch up. At least four companies, including Sony, Grundig, Panasonic and Pioneer, are joining in with products on display at Berlin. I am absolutely convinced in years to come shops will have a section for films on disc".

He acknowledged that there had been a major problem with the production of PAL discs at the Philips-Du Pont plant at Blackburn. Bertlesmann (RCA) is now pressing a few discs for Europe, but it is still a pinprick compared to the NTSC catalogue.

For a while it looked as if he was going to announce what everyone had been waiting for — a CD Video Combi player which can play back NTSC discs through a PAL TV set, using similar technology to the Panasonic NVL-28 video recorder.

But no. The Philips CD video player still handles only PAL discs.

DOUBLE STANDARD

Sony was showing a multi-standard CD Video player but it worked only with a multi-standard TV set. Panasonic was showing only an NTSC video disc player. "We are not supporting CDV in Europe", said Panasonic later.

This put all eyes on Pioneer.

The trade had known for at least a month in advance that Pioneer plans to launch the CDV-1450 player in Britain this November and that this player plays NTSC discs through a PAL TV set. But the prospect appalled the film companies, which have built up a careful schedule of staggered releasing, with films available in the US long before Europe. And most of the films available on video disc are licensed to Pioneer.

Seeing its relationship with the film industry in jeopardy, Pioneer's Head Office in Japan issued a carefully worded statement ahead of the Berlin Show: "Pioneer will not show a PAL/NTSC compatible player at the Berlin Show and we have no plans to bring this type of player to market in any country".

Sure enough, at Berlin, Pioneer showed only the CDV-1400 player which will be launched on the Continent of Europe this autumn. The 1400 plays only PAL discs, because the NTSC software is all English-language material and thus of limited value on the Continent.

Pioneer staff at Berlin had been warned in advance to emphasise that the 1400 plays only PAL discs and this they dutifully did.

But none of this alters the fact that a batch of 1450 dual standard players is already ear-marked for pre-Christmas sale in the UK. Some disc outlets are already looking at distribution channels for NTSC discs from Japan and the US.

The big question now is what will happen to the dual standard model 1450 machines?

Before Berlin, Pioneer's plan had been to compromise by selling the 1450 in the UK without any reference to NTSC capability, leaving it to cognoscenti in the trade and public to discover the bonus for themselves. But at Berlin Pioneer was clearly so worried about the political problems, that sales of the 1450 may even now be blocked, or the machine modified to disable NTSC playback.

Without NTSC playback, CD Video in Europe seems doomed to failure; with NTSC playback, Pioneer faces rows with the film industry comparable to the record industry rows on DAT. In short, the company is between a rock and a hard place. □

A view into the future offers the Panasonic video recorder which can play both VHS and VHS-C tapes, without a special adaptor.



b...Beeb...Beeb...Beeb...Beeb...Beeb

...Add-on Keyboard...Sound Generator...Making Music...

IN ITS day the sound generator of the BBC model B computer was quite highly regarded. It has three tone channels plus a noise generator, an envelope shaping facility, and can cover a wide frequency range.

The computer world progresses though, and the BBC computer's sound generator has what now seems a relatively poor specification. Currently there are several computers having sound generators which offer a variety of waveforms, extra channels, better envelope control, and even sampled sounds (although usually with only eight bit quality).

While the sound of the BBC machine might not rival some of the more recent 16-bit computers, and is certainly not in the same league as modern electronic musical instruments, it can still provide some useful sound effects and reasonably musical results.

Making Notes

Many 8-bit computers use the AY-3-8910 sound generator chip or one of its derivatives. The BBC computer's sound generator is based on a rival device from Texas Instruments, the SN76489AN. The basic specifications of the two chips are broadly similar, as are the sounds they make.

Most BBC computer users will not need to get deeply involved with the sound generator at the hardware level. BBC BASIC provides good support for the sound generator, and there is usually no difficulty in obtaining the required sounds via a BASIC program.

It is not too difficult to produce a program that enables the sound generator to be played as a musical instrument via the computer's QWERTY keyboard. This is an easy solution, but not a very good one in that a QWERTY keyboard is not particularly well suited to playing music.

Playing a computer's sound generator via an external plug-in keyboard is not exactly a new idea, but it is an interesting one to pursue with the BBC computer. To be entirely honest about it, I rather doubt that the cost of adding an expensive multi-octave keyboard to the BBC machine would be justified by the results. On the other hand, adding a small inexpensive type, or a stylus operated keyboard, need not cost a great deal. Results will not rival the Yamaha DX7 series, but they should more than justify the relatively low cost involved.

There are several possibilities when it comes to interfacing the add-on keyboard to the BBC computer. The two obvious approaches are a digital solution via the user port, or an analogue one via the analogue port. We will take the second option as it would seem to be the cheaper and more simple of the two.

Basically all that is required is something similar to an analogue synthesiser keyboard circuit. These are based on a series of equal value resistors connected as a potential divider fed from a highly stable reference voltage generator. In a synthesiser the voltages from the keyboard are used to directly control a voltage controlled oscillator (VCO).

In this case things are less straightforward, and the system must be set up so that the keyboard circuit gives a series of readings from the analogue port that increment by one from each key to the next. Some mathematical manipulation can be used in the computer if necessary, and due to the analogue port's noise problems and unusual basic scaling, a bit of mathematics is unavoidable. A look-up table is used to convert values read from the analogue port into the appropriate pitch values for a SOUND instruction.

Keyboard Circuits

The circuit diagram for a simple stylus operated add-on keyboard is shown in Fig. 1. The equivalent circuit using a simple switch-type keyboard is shown in Fig. 2. A series of resistors are connected as a potential divider and are fed from the reference voltage output of the analogue port.

Only six resistors are shown in Fig. 1, but in practice there would be substantially more than this (typically 25 resistors giving a two octave range). Resistor R7 normally takes the channel 0 input to 0 volts, but touching the stylus onto one of the keypads will take the input positive by the appropriate amount.

As the analogue to digital converter used in the BBC computers is a 12-bit type it is theoretically possible to accommodate up to 4096 notes. The realities of the situation are very different, and apart from the fact that the sound generator and human hearing do not justify such a wide range, the analogue port's noise problems mean that in order to get the right note every time the returned values must be divided by a substantial amount in order to reduce the effective resolution to a point where noise is no longer a problem.

Using DIV 1024 on returned values gives a 0 to 63 range, which should be sufficient for most purposes. It certainly eliminates any noise problems, and this range of five octaves is as much as the Beeb's sound generator can handle anyway (see page 181 of the User Manual).

It is likely that most users will not wish to go beyond about two octaves. Adjusting preset VR1 enables the circuit to be set up so that the appropriate value is produced when each key pad is operated. To set up VR1 first run this simple program.

```

10 CLS
20 PRINTTAB(10,10) ADVAL 1
   DIV 1024
30 GOTO 10

```

This will print returned (and divided) values on the screen. Touch the stylus on the highest key pad and then adjust VR1 for stable readings at a value equal to the number of fixed resistors used in the keyboard divider circuit. The unit should then function properly, with the correct values being produced by the other key pads.

Fig. 1. The stylus operated keyboard circuit.

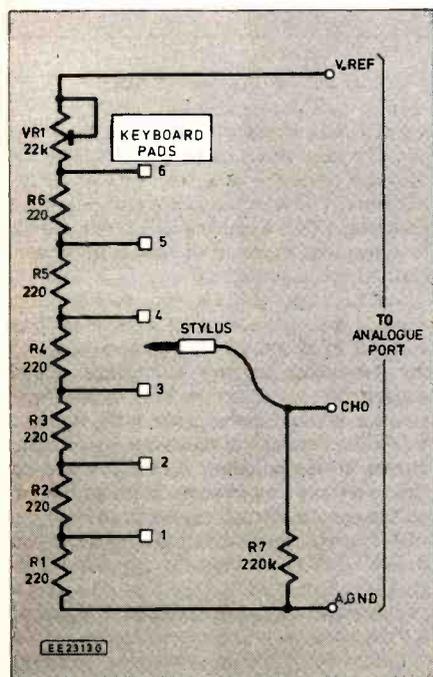
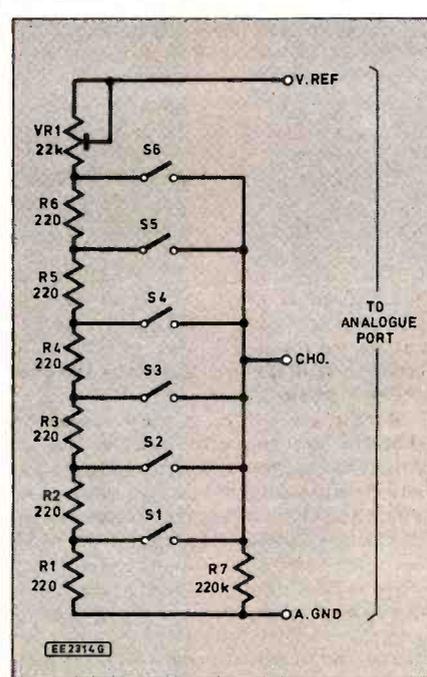


Fig. 2. The switch keyboard equivalent to Fig. 1.



Software

The simple sound generator listing (Listing 1) enables the system to act as a basic stylus organ covering two octaves (twenty five notes — C to C). This just reads in values from the analogue port, does the mathematics on them, and uses a look-up table to convert them into pitch values which are used in a SOUND instruction.

This process is repeated over and over again, with the program looping indefinitely, and a short duration being used in the SOUND instruction. This ensures that the program quickly responds to changes in note. A value of 0 is returned if no note is played on the keyboard. If a value of 0 is detected, the program repeatedly reads the analogue port until a proper note value is read from the port.

The improved version of the program, Listing 2, operates in a broadly similar fashion. However, it provides somewhat more musical results by making use of the ENVELOPE command to give some simple envelope shaping on each note. The envelope shape is something close to the classic ADSR (attack, decay, sustain, release) type, but this can obviously be changed by altering line 130 if desired.

from 128 to 137, which are useful with the mode 7 Teletext display, and in conjunction with the control key they produce codes from 144 to 153, useful with Teletext graphics. The codes generated by the shift/function keys combination can be changed with *FX 226, and by the control/function keys combination with *FX 227.

A further range of codes can be produced by using the function keys with shift and control together. The default is that these combinations have no effect, but codes can be assigned to them by *FX 228. Remember, however, that pressing the control and shift keys together on the BBC micros stops output to the screen temporarily.

Within a BASIC program, it is easy enough to check for the function key codes with INKEY\$ or GET in conjunction with the ASC() or CHR\$() functions. The results of such tests can be used to divert program flow.

Versatile Input Routine

This is perhaps most elegantly done with a Versatile Input Routine, or VIR, usually written for the BBC machines as a user-defined function (though it can be done as a

and pass them to a procedure called PROCedit (line 540):

```
500 DEF FNvir(length,valid$)
510 LOCAL in,out$
520 in=GET:*FX 15,1
530 IF in=13 THEN
540   VDU10,13:=out$
550 IF in=128 THEN
560   PROCedit(in):GOTO 520
570 IF in=127 AND out$=""
580 THEN 620
590 IF in=127 THEN
600   out$=LEFT$(out$,LEN(out$)
610   -1):VDU127:GOTO 620
620 IF LEN(out$)=length
630 VDU7:GOTO 620
640 IF valid$<>"" AND
650 INSTR(valid$,CHR$
660 (in))=0 VDU7:GOTO 620
670 PRINT CHR$(in);out$=out$+
680 CHR$(in):GOTO 620
```

This routine does not terminate a string automatically when the maximum length is reached. One extra feature it does have is to allow any character to be included in the string if a null string is passed as the string of valid characters (line 580).

Listing 1: Simple Sound

Generator Program

```
10 REM SIMPLE SOUND GENERATOR PROG
20 REM J.W.P 9/89
30 CLS
40 PRINT "Press ESC to end program."
50
60 DIM TABLE(25)
70
80 FOR NV= 1 TO 25
90   READ TABLE(NV)
100  NEXT NV
110
120 REPEAT
130   note=ADVAL 1 DIV 1024
140   pitchparm=TABLE(note)
150   IF note<>0 SOUND 1,-15,pitchparm,1
160   IF note=0 THEN *FX21,5
170   UNTIL FALSE
180
190 DATA 53,57,61,65,69,73,77,81,85,89,93,97
200 DATA 101,105,109,113,117,121,125,129,133,137,141,145,149
```

Listing 2: Improved Sound

Generator Program

```
R
10 REM IMPROVED SOUND GEN PROG
20 REM J.W.P 9/89
30 *FX16,1
40 CLS
50 PRINT "Press ESC to end program."
60
70 DIM TABLE(25)
80
90 FOR NV= 1 TO 25
100  READ TABLE(NV)
110  NEXT NV
120
130 ENVELOPE 1,1,0,0,0,0,0,0,126,-2,0,-1,126,80
140 REPEAT
150   REPEAT
160     note=ADVAL 1 DIV 1024
170     UNTIL note<>0
180     T=TIME:REPEAT UNTIL TIME>T+1
190     note=ADVAL 1 DIV 1024
200     pitchparm=TABLE(note)
210     SOUND 1,1,pitchparm,10
220     REPEAT UNTIL ADVAL 1 DIV 1024=0:*FX21,5
230     UNTIL FALSE
240
250 DATA 53,57,61,65,69,73,77,81,85,89,93,97
260 DATA 101,105,109,113,117,121,125,129,133,137,141,145,149
```

Function Keys

Last month we looked at the normal way of using function keys, by programming strings into them. The alternative way of using the function keys is to cause them to generate ASCII codes. In fact, any single code could be assigned to any key as a string, either from the keyboard or using OSCLI as described above.

However, there is a single command which can be used to make the keys generate a contiguous sequence of codes. This command is *FX 225, followed by the code to be assigned to key 0. For example, to start the sequence at ASCII code 160, you would use:

```
*FX 225,160
```

Key 0 will then generate ASCII 160, key 1 ASCII 161, and so on to key 9, ASCII 169.

In fact using the function keys in conjunction with the control and shift keys produce ASCII codes by default. In conjunction with shift, the keys produce codes

procedure). A VIR is used instead of INPUT statements, and can be used to check each character as it is entered.

In essence, each character is entered, usually with a GET statement. It is checked against a string of acceptable characters, and if valid, is added to a string.

The maximum length for the string can also be specified, and characters are only accepted up to this limit. Input is terminated if the return key is pressed, or can be terminated if the string reaches the pre-defined length.

Within the VIR, it is easy enough to check if the character entered has an ASCII code within the range programmed into the function keys, and if it has, to send the character to a procedure which will perform some function, depending on which key was pressed. In this way, editing or other functions can be made to happen at any time, even in the middle of entering a string.

Here is an example of a VIR function which will check for ASCII codes over 128,

For an example of how this can be used, if entering values into a table, the function keys can be used to scroll through the table, and different keys can be used to move up or down one entry at a time, or a screenful at a time. The scrolling is not always easy to program, but is worth the effort as it allows insertion and deletion of entries to be performed in a very natural way.

When doing this, it is important to keep control of the cursor position. This is done with the POS and VPOS functions, used at the beginning of the procedure which implements the function keys to store the position of the cursor in the VIR, and the VDU 31 command at the end to replace the cursor in this position. As long as you do this, you can, in between, print anywhere on the screen to your heart's content.

A further interesting fact is that if you use the *FX commands to cause the function keys to generate ASCII codes within a program, when the program terminates, if you had put strings into the keys before running the program, the keys revert to producing those strings.

CONSTRUCTION

This has been designed as a battery-powered circuit. It should not be modified to operate from a mains-derived supply.

Construction is based on a circuit panel made from 0.1in matrix stripboard, size 11 strips x 29 holes. The board component layout and details of breaks required in the underside copper tracks is shown in Fig. 2.

Make all track breaks and inter-strip links as indicated and follow with the on-board components. Do not insert the i.c.'s themselves into their holders, however, until the end of construction.

After a careful check for errors, connect 10cm pieces of light-duty stranded connecting wire to each of copper strips C to J along the right-hand side of the panel as indicated — ribbon cable is convenient here. Connect similar wires to strips B and D at the left-hand side for the power supply, red for positive and black for negative.

Fig. 3. Interwiring from the circuit board to the terminal block TB1 and switch S1.

The terminal block is mounted on the top of the case and wiring from the lamps and battery are wired up as shown.

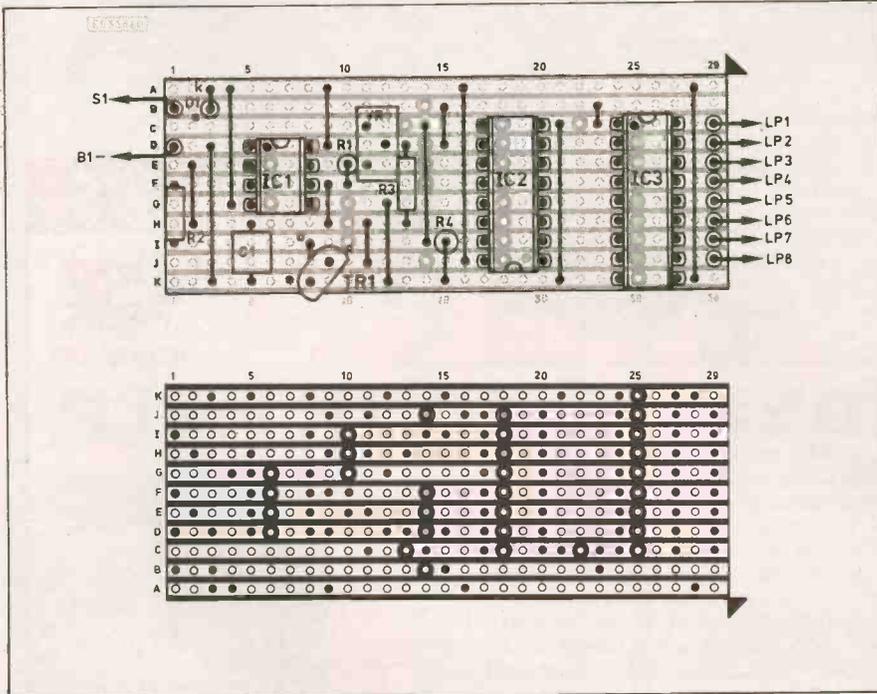
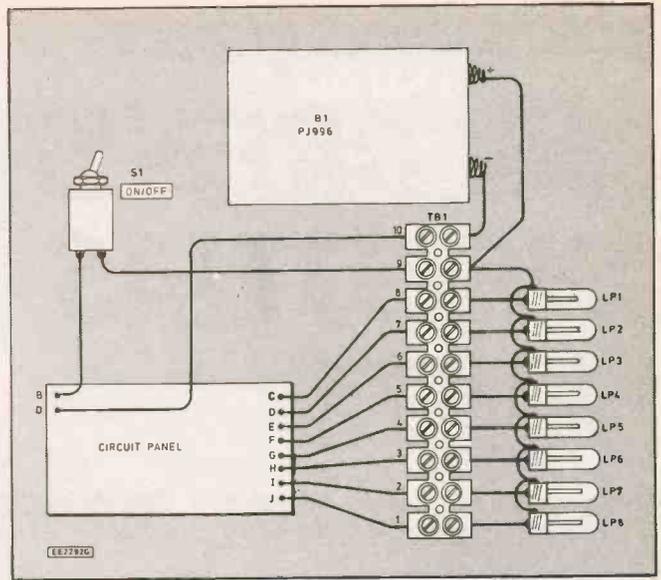


Fig. 2. Circuit board component layout and details of breaks required in the underside copper strips.

INTERWIRING

Prepare the box for the circuit by drilling a hole for the On/Off switch S1, for terminal TB1 mounting and for the wires passing through the case to TB1. Mount S1 and TB1 and complete S1 wiring (see Fig. 3).

Attach the circuit panel to the base of the case using adhesive fixing pads. Pass the wires leading from the circuit panel and switch S1 through the hole made for the purpose and make the TB1 connections.

Make the decoration and cut holes in it for the bulbs. Make the holes slightly smaller than the bulbs so that these are a tight push fit.

Using light-duty stranded wire, interconnect the metal caps of all bulbs and run the end of the wire to TB1/9. Solder individual wires to the bottom connection of each bulb taking great care to avoid short-circuits. Connect these wires to TB1/1 to TB1/8 as shown in Fig. 3. Connect the battery positive and negative wires to TB1/9 and 10 respectively.

One suggested method of display is to make a small decorative tree and mount the coloured lamps on its "branches". The battery could form the base.

Finally insert the three i.c.'s into their sockets and adjust VR1 sliding contact to approximately mid-track position. Note that the i.c.'s are CMOS devices which can be damaged by static charge on the body. They should therefore be unpacked and inserted without touching the pins. Note also that IC2 is inserted upside down compared with the others.

CHILDREN IN NEED

The author has requested that the payment for this project be paid to the "BBC Children In Need Appeal". This we are pleased to do and have doubled the payment to the Appeal.



The completed control unit showing the screw terminal block mounted on top of the case.

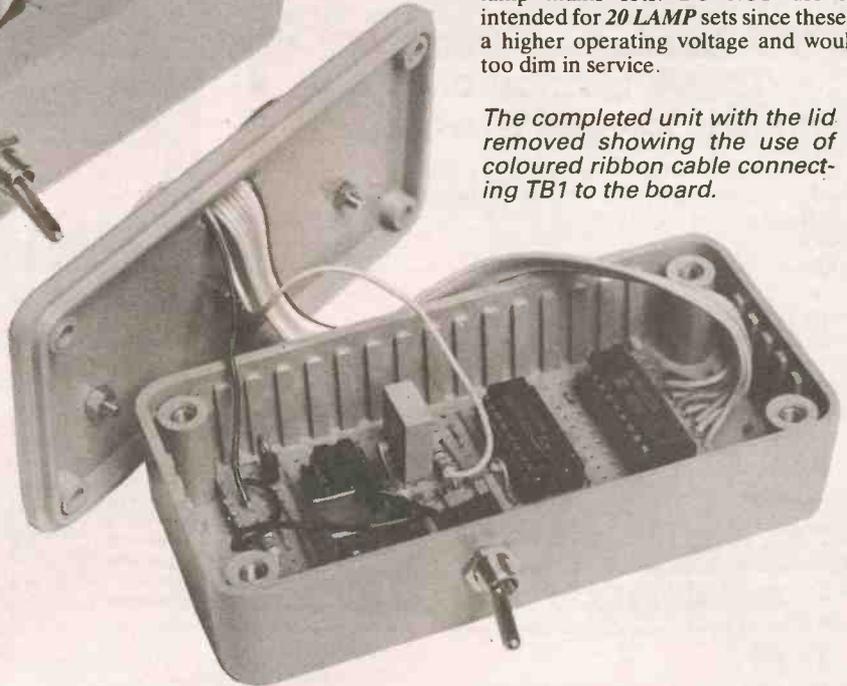


pulse rate and vice-versa. A rapid rate gives a beautiful twinkling effect.

The battery is fairly heavy and may be used as a base for the display providing this is not too large. The box containing the circuit may then be taped into position.

The bulbs used are standard 6V screw-fitting Christmas Tree lamps obtainable from Woolworth's and elsewhere. These are normally used as replacement for 40 lamp mains sets. **DO NOT** use lamps intended for 20 LAMP sets since these have a higher operating voltage and would be too dim in service. □

The completed unit with the lid removed showing the use of coloured ribbon cable connecting TB1 to the board.



PULSE RATE

Connect the battery leads (observing polarity) using small plastic sleeved crocodile clips or by soldering. If using crocodile clips, make certain that the metal parts cannot touch and cause a short circuit.

Switch on S1 and note the effect. Each bulb should come on in turn and the rate may be adjusted by careful rotation of pre-set VR1 sliding contact — clockwise rotation (as viewed from IC1) increases the

DIXON MURDERS — YOUR HELP REQUESTED

Dear Editor,

On the 5th July, 1989 the bodies of Peter and Gwenda Dixon were discovered having been brutally murdered on the Pembrokeshire Coastal Path.

Peter Dixon was a keen radio amateur, call sign G0HFQ, and sometime C.B. enthusiast.

The police are anxious to talk to any person who had contact with or heard, the above named person, whilst he was operating in Pembrokeshire as GW0HFQ/M, on 2 metres FM, 20 metres SSB, 40 metres SSB, or 10 metres FM/SSB, between the 19th and 29th June, 1989.

It is believed that Peter Dixon had a contact with another mobile station operating in the area on 10 metres FM on the morning of Wednesday, 28th June, and another contact with a station, operator 'Tom', on Sunday, 25th June, band unknown. The police are particularly anxious to trace the other stations involved.

I wonder, therefore, if you could include a short appeal to your readers asking for their co-operation in your next issue. If they have any information, could they be asked to contact the Murder Incident Room, Haverfordwest Police Station, telephone 0437 763355, or their local Police Station.

I thank you for your assistance in this matter.

Yours sincerely,

G.J. Lewis, P.C. 569
pp Inspector D.T. Davies
Press Officer, Dyfed-Powys Police.

Information has come to light that at about 2-p.m. on Sunday, 25th June, 1989, two men in a boat fishing on the Hellwick Bank off Worms Head on the Gower Coast overheard a conversation on the boat's C.B. radio. The set was tuned to Channel 33 and a man was transmitting, who, from the personal details he gave over the radio could well have been Mr. Peter Dixon. This person speaking on Channel 33 said he was middle aged, from the Oxford area and had been holidaying in Pembrokeshire for the last sixteen years or so. These details and the fact that he was using a complicated call sign, such as a radio ham would use, indicated he was an experienced amateur radio enthusiast like Mr. Dixon as opposed to being a C.B. radio user.

The conversation he was conducting was with a second unknown man believed to have been called Tom and who was also in a fishing boat but off the Pembrokeshire coast. This second man had a broad Pembrokeshire accent and during the conversation agreed to meet the man believed to be Mr. Dixon somewhere at a later date. It is not known whether or not this meeting did actually take place as the second man appeared slightly disinterested in any future rendezvous.

The police however, are very interested in speaking to the second man; as he may be able to furnish them with further information as to the movements of Mr. and Mrs. Dixon in the days immediately prior to their murders on the 29th June, 1989. They ask therefore that he contact them as soon as possible at Haverfordwest Police Station, Tel. No. 0437/763355.

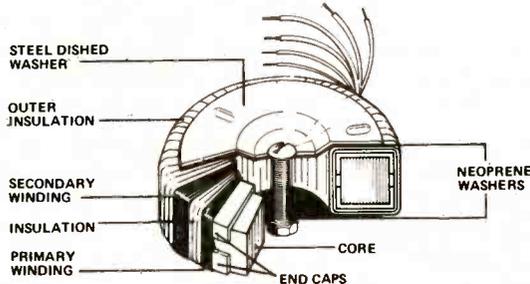


Mr. & Mrs. Dixon

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	43016	25+25	2.40	83028	110	4.54	
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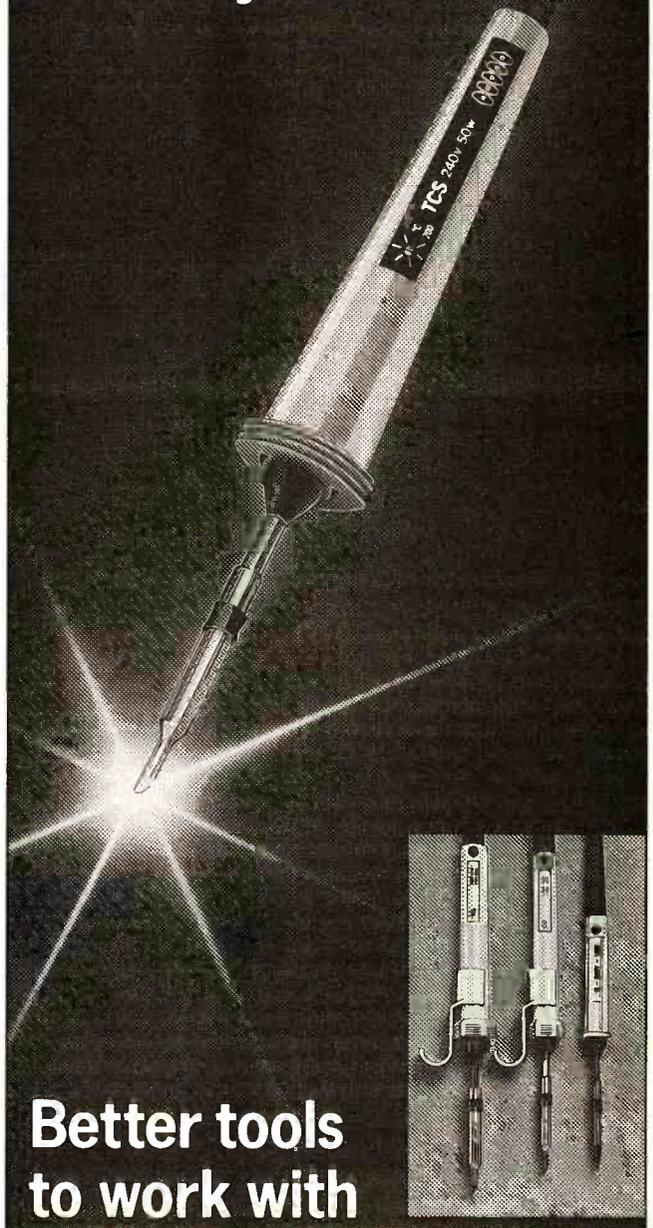
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ELECTRONIC CIRCUITS REVIEW

By Mike Tooley BA

SOME time ago, I had the opportunity of reviewing the excellent Open Learning package on Digital Electronics published by the National College of Technology (NCT Ltd). I was rather impressed by this particular Open Learning offering (*Digital Circuits — Volume 1*) and was, therefore, particularly pleased to be asked to take a look at another package from the same stable. This course, entitled *Electronic Circuits — Volume 1*, provides students with approximately 45 hours of study and the learning process is based upon a number of student centred assignments.

The ability to study when and where a student wishes is fundamental to Open Learning and, unlike conventional Business and Technician Education Council (BTEC) and City and Guilds (C&G) courses, the NCT programme is designed to be studied whenever and wherever it is needed. It may be equally well applied in the workplace or in the comfort of the student's own home and thus provides a flexible solution to the problem of keeping abreast of technology in the rapidly changing world of electronics.

OPEN LEARNING

Open Learning is increasing in prominence and demands a radically different approach from that associated with conventional study programmes and success depends primarily on two factors; commitment on the part of the student and the overall quality of the Open Learning package. The first of these is a matter for the individual student but the second relies largely on the professionalism of the provider of the Open Learning package and, more particularly, on the extent of any back-up which he or she can provide the student with. In this respect, NCT courses score very highly as they are not only well thought out but they are very well presented and fully supported with tutorial assistance, assessment and certification.

The *Electronic Circuits* course also contains three "open-book" assessments

which students can use to check their progress. On satisfactory completion of the programme (including assessments and workbook assignments) students are eligible for the award of a Business and Technician Education Council Certificate of Achievement. The NCT tutorial support (via a telephone "hot-line") is available at a small additional charge.

Open Learning courses require a good deal of self-discipline on the part of the student. A regular weekly study plan makes a good starting point and this cannot be stressed too strongly. "Your very first task is to sit down and work out your weekly timetable" advises Sylvia Merrett, one of the two audio tutors.

HARDWARE

NCT courses are designed to teach practical as well as theoretical skills and *Electronic Circuits* is no exception. The kit supplied with the course comprises three spiral-bound workbooks, a breadboard (together with a pack of links and components), a digital multimeter, and an audio cassette. The only additional items required are a 9V PP9 battery and an audio cassette recorder.

The circuit board supplied with the NCT *Electronic Circuits* package is of very high quality. Approximately 40 percent of the area is devoted to a 0.1 inch matrix breadboard which is capable of accommodating a large number of components (including up to seven 14-pin dual-in-line integrated circuits). The remaining area is devoted to a bank of eight l.e.d.s and associated drivers, a d.i.l. package containing eight s.p.s.t. switches, a +5V regulator, and an on-off toggle switch.

Sockets are fitted to accommodate two daughter boards (for use with more advanced courses) and two BNC sockets are available for linking to external equipment such as an oscilloscope. NCT can provide a special adapter to convert a standard TV into a dual-channel oscilloscope but this item of equipment is not required for this particular course.

The circuit breadboard is undoubtedly one of the more costly items included within the *Electronic Circuits* package. It should, however, be regarded as something of an investment since not only can it be used as the basis for further NCT programmes but it makes an excellent breadboarding aid in its own right.

MULTIMETER

The *Electronic Circuits* course involves students in making numerous measurements on simple electronic circuits. There is no better way of doing this than with a modern digital multimeter and NCT provide such an instrument as part of the package. The meter employs a 3½ digit l.c.d. display and offers d.c. voltage, d.c. current, a.c. voltage, and current ranges. Accuracy on the d.c. ranges is ± 0.5 percent with a maximum resolution of 1mV and 1 μ A on the d.c. voltage and current ranges respectively. The multimeter will undoubtedly prove to be extremely useful to students long after successful completion of the NCT study programme!

COURSE CONTENT

Electronic Circuits — Volume 1 provides a comprehensive introduction to electronic circuits and assumes no previous knowledge of the subject on the part of the student. The course is pitched at about BTEC First Certificate/City and Guilds Part 1 levels and covers the following topics:

- ★ Know your circuit board
- ★ P.C.B. tests
- ★ Cells and switches
- ★ Current measurements
- ★ Resistors
- ★ Use of the Ohmmeter, potentiometer, and l.d.r.
- ★ Ohm's Law
- ★ Series circuits
- ★ Parallel circuits
- ★ Capacitance
- ★ Charge and Discharge
- ★ Electronic Circuit Workshop

As with *Digital Circuits*, tuition moves backwards and forwards between the

workbooks and audio cassette and this provides some useful variety in the study programme. Self-test questions are provided within the workbooks and students are encouraged to attempt these before referring to the answers provided. Such questions are designed so that students can evaluate their own progress through the course and assess their comprehension of each of the major topics.

It is also important to realise that *Electronic Circuits — Volume 1* provides an introduction to electronic circuits. The course does not, for example, deal with semiconductor devices such as diodes and transistors. Nor does it deal with important concepts such as current, voltage, or power gain which are essential to developing an understanding of such topics as amplifiers and oscillators.

Volume 1 undoubtedly represents a very effective starting point to developing a sound understanding of electronics. Students will undoubtedly wish to go further and should be prepared to devote the necessary time, effort, and expense in going further along this road. *Electronic Circuits — Volume 2* should be available by the time you read this, whilst *Volume 3* is scheduled for publication in February 1990.

WORKBOOKS

The three workbooks incorporate text regularly interspersed with details of the student-centred assignments. Each workbook should be regarded more as personal reference of progress through the course rather than as a conventional textbook. Furthermore, since the course is highly structured, the workbooks should be followed in exact sequence. Each workbook

The standard of the workbooks is generally good, with "chatty" text and neatly presented computer-generated diagrams. The division of the course into three separate modules (each with its own text) is both logical and helps to make the material a little more manageable than if it had all been presented in one book. The satisfactory completion of each of the workbooks represents a goal in its own right. Students can, therefore, build on their successes and steadily gain in confidence as they progress through the *Electronic Circuits* course.

The numerous "student centred assignments" present students with a series of tasks to carry out. Representative tasks include measuring the current supplied to a number of light emitting diodes (l.e.d.s), measuring the resistance of series and parallel connected resistors, and plotting graphs showing charge and discharge characteristics of simple C-R circuits.

One of the most ingenious assignments involves the construction of a primary cell using nothing more than an apple, a steel nail, and a penny coin! Each student centred assignment is supplied with a solution. Hence students are not left completely in the dark when things don't work out as planned.

COST

Electronic Circuits — Volume 1 is priced at £199 (excluding VAT) and must thus be outside the budget of many E.E. readers. Packages like *Electronic Circuits* will, however, become increasingly available from contains between 83 and 101 pages and the workbook for part 3 contains an index of topic references for all three parts of the course.

agencies who are prepared to invest in Open Learning packages and make these available "off the shelf" to students when required.

Many company training departments and Further Education Colleges are investing in Open Learning and *Electronic Circuits* is bound to become very popular. Hence it would be well worth contacting your Training Officer or the Open Learning Co-ordinator of your local college to see whether this package is available. If it is, you can be assured of making an excellent start!

IN CONCLUSION

Open Learning packages continue to appear from a variety of sources. At the present time there are a number of packages which are aimed at the complete beginner to electronics and cover much the same ground as the NCT *Electronic Circuits* package. The NCT offering is, however, one of the best that I have seen. The package is well thought out and fits well with other courses offered by the same provider. I have little doubt that this particular Open Learning course will find its own particular niche in the market place and will be instrumental in providing its students with a good basic grounding in the principles and practice of electronic circuits.

In conclusion, *Electronic Circuits — Volume 1* can be highly recommended. It is thorough, comprehensive, very professionally presented, and ideally suited to those with no previous knowledge of electronics.

NCT Ltd are at Bicester Hall, 5 London Rd., Bicester, Oxon, OX6 7BU. Tel. (0296) 613067 Ext. 202. □

EE/MAPLIN ROAD WINNER COMPETITION RESULTS

We would like to thank the hundreds of readers who sent in entry coupons for our joint EE/Maplin competition featured in the September '89 issue.

The results have now been decided and the following readers have won prizes.

1ST PRIZE — The Maplin Road Winner Radio Control Car, Controller, Batteries and mains charger.
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2ND TO 5TH PRIZES — Maplin Road Winner Radio Control Cars and Controllers.
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CONSOLATION PRIZES — EE subscriptions and binders.
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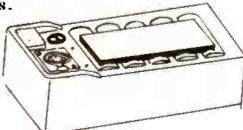
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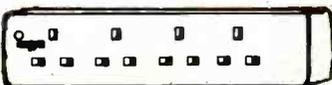
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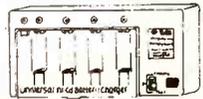
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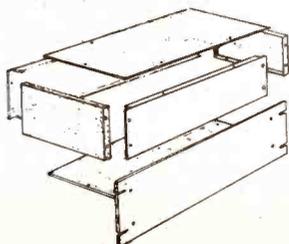
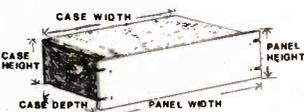
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19.0	5.25	16.75	12.0	4.875	BOX/U312	£23.60
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EEG ELECTRODE IMPEDANCE METER



ANDY FLIND

Check the condition of your Biofeedback electrodes with this safe to use meter and increase your chances of picking up your "brainwaves".

FOLLOWING completion of the EEG Biofeedback Monitor featured in last month's issue, it was quickly discovered that some means of measuring impedance between the electrodes was essential for serious use. Whilst a quick wipe with the surgical spirit often produces an excellent contact, no amount of careful preparation guarantees one, so an electrical check before use is vital.

Although the EEG monitor has a high impedance input, the resistance between the electrodes must be as low as possible to keep induced noise to a minimum and ensure best possible pickup of the minute signals from the brain. In practice, it has been found that the measured resistance

between any pair of electrodes can be as low as 2k, but for successful operation of the EEG monitor it must be less than 10k.

SAFETY

Whilst the trusty workshop multimeter could be pressed into service for electrode checking, this practice is to be discouraged for several reasons. Foremost among these is, of course, safety.

The current flow between the test leads of a meter depends upon the particular model in use, but may reach unsafe levels. To obtain sufficient current flow for measurement, many meters use 15V batteries for their higher resistance ranges.

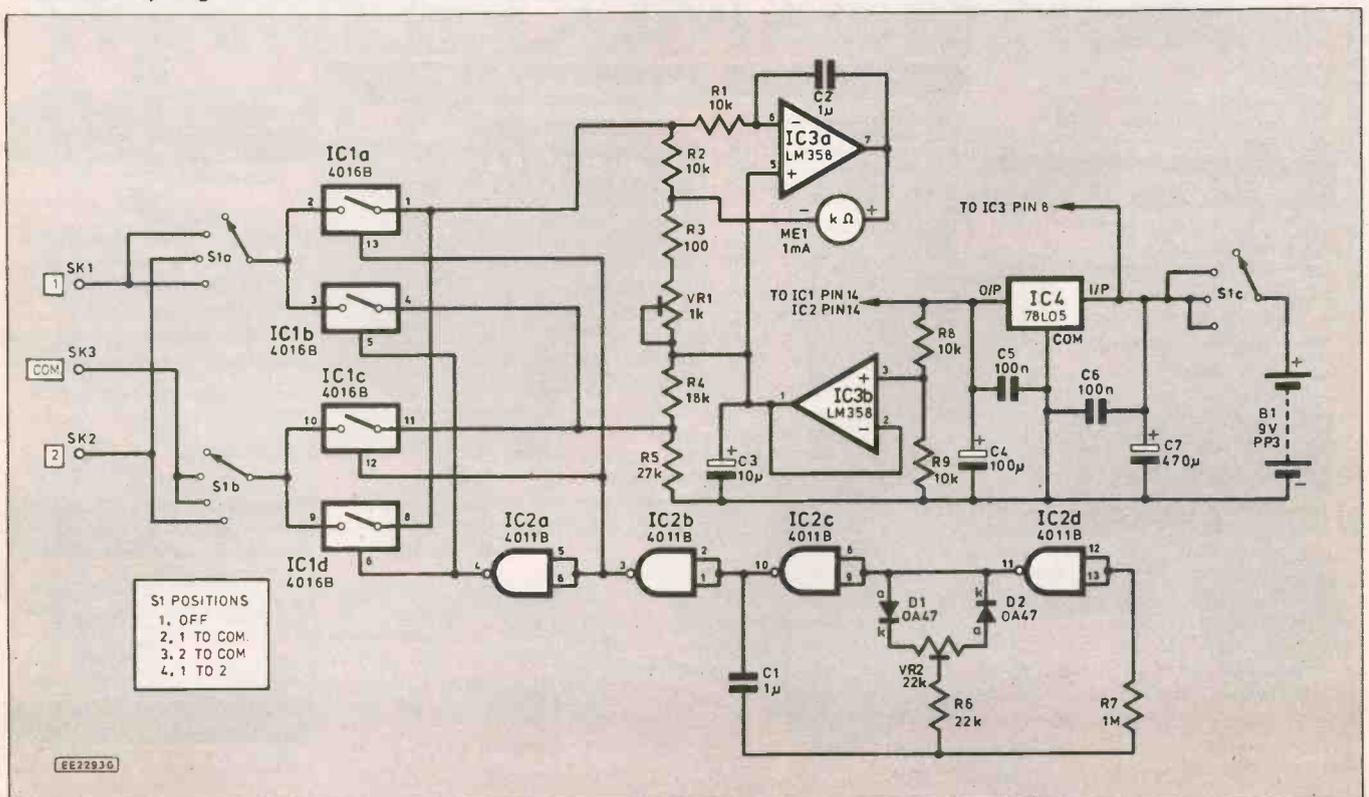
Enthusiasts who have experimented with EEG circuits before may have experienced such delights as the apparent "flashes of light" when checking electrodes placed over the eyes; the effect of similar currents passing through the brain can be imagined. Not to be recommended!

A further problem which may occur if a multimeter is used for impedance checking is "polarisation", where d.c. current passed between the electrodes causes ion migration between them, resulting in a residual potential when the meter is removed. This effect may also interfere with the impedance reading obtained.

ELECTRODE IMPEDANCE METER

To overcome the above problems, this dedicated EEG Electrode Impedance Meter was designed. It applies a maxi-

Fig. 1. Complete circuit diagram for the EEG Electrode Impedance Meter. Pins 7 of IC1, IC2 and pin 4 of IC3 are connected to the battery negative (0V) line.



imum potential of one volt between the electrodes on test whilst limiting the test current to no more than 100 microamps, values which should guarantee complete safety.

To avoid the risk of polarisation, the polarity of the test current is reversed about fifteen times a second by electronic switches. These factors should make it totally safe to use whilst giving sufficiently accurate readings and avoiding any chance of electrode performance being impaired by polarisation.

The complete circuit diagram of the EEG Electrode Impedance Meter is shown in Fig. 1. As it proved a time-consuming nuisance swapping electrode connections between sockets whilst trying to place them, three sockets (SK1-SK3) are provided so that they can all be plugged in together.

The required combination of any two out of the three is selected by switch S1, sections S1a and S1b. Through these, the selected sockets are then connected to the four switches in IC1, a CMOS 4016 device arranged to operate as two electronic single-pole, two-way switches. These change the polarity of the test voltage applied to the electrodes about fifteen times a second, driven by a low frequency oscillator built with IC2c and IC2d.

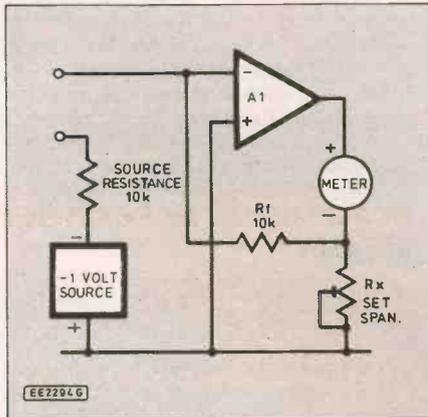


Fig. 2. Simplified circuit diagram for the meter circuit.

Two drives, of opposite polarity, are required by IC1; these are provided by IC2a and IC2b which buffer and invert the output from the oscillator. CMOS oscillators of this type often have rather poorly balanced mark-space ratios, which in this circuit would cause a net voltage to appear across the electrodes.

To avoid this, a mark-space ratio adjustment is provided by trimmer VR2. The diodes, D1 and D2, are germanium types, which have a lower forward voltage drop than the more common silicon variety.

METER CIRCUIT

The measuring part of the circuit is constructed around the dual op-amp IC3. As shown in Fig. 1, the operation of this is a little difficult to follow, so it has been redrawn in simplified form in Fig. 2.

From this it can be seen that the meter is driven by a simple inverting amplifier arrangement. A negative source of one volt is applied to the electrodes on test, the resulting current flow between them passing to the op-amp's inverting input.

COMPONENTS

Resistors

R1, R2, R8, R9 10k (4 off)
R3 100
R4 18k
R5 27k
R6 22k
R7 1M
All 0.6W 1% metal film.

**Shop
Talk**

See page 783

Potentiometers

VR1 1k sub-min horizontal preset.
VR2 22k sub-min horizontal preset.

Capacitors

C1, C2 1 μ min. polyester layer (2 off)
C3 10 μ axial lead elec. 25V
C4 100 μ axial lead elec 10V
C5, C6 100n min. polyester layer (2 off)
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D1, D2 0A47 germanium diode (2 off)
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IC2 4011B CMOS quad NAND gate
IC3 LM358 dual op-amp
IC4 μ A78L05 5V 100mA positive regulator

Miscellaneous

SK1-SK3 Phono chassis sockets (3 off)
S1 3-pole 4-way rotary, break-before-make
ME1 1mA moving coil meter

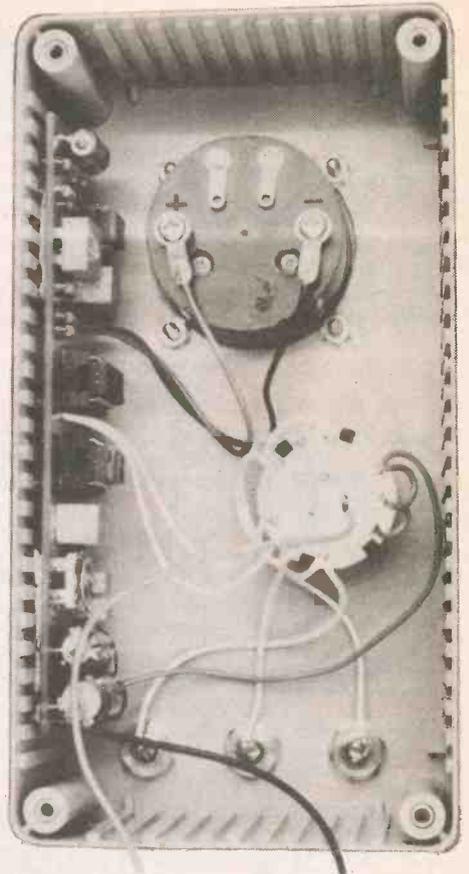
Printed circuit board, available from the *EE PCB Service* order code EE665; case, ABS plastic 150mm \times 80mm \times 50mm; 8-pin d.i.l. socket; 14-pin d.i.l. socket (2 off); battery connector (PP3); pointer knob; connecting wire; solder etc.

Approx. cost **£18.50**
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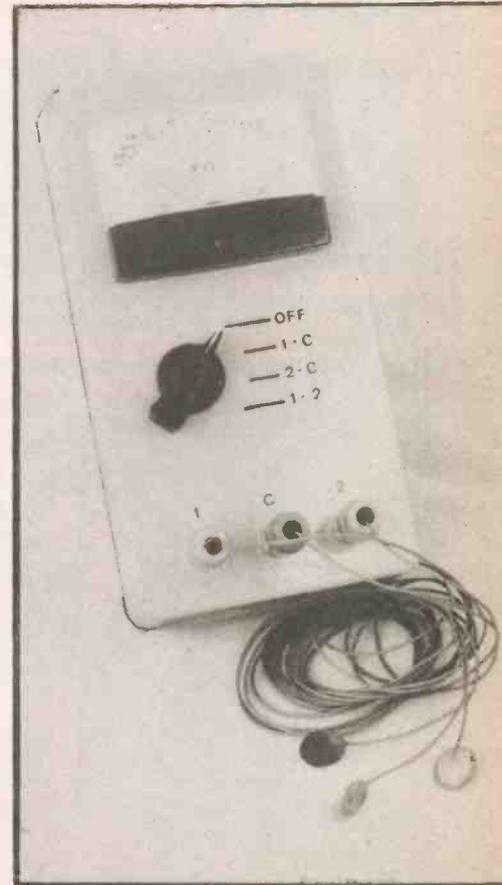
The amplifier will attempt to balance the voltage at its inputs by raising its output voltage until an equal but opposite current flows through R_f . This will also cause current to flow through the meter and trimmer R_x , which is adjusted so that the meter reads full-scale when the electrode connections are shorted together. As the one volt source is in series with a 10k resistor, the maximum current that can be drawn from it is 100 microamps.

Returning to the full circuit of Fig. 1, it will be seen that IC3a is the meter amplifier, but there are some additions. To begin with, a five volt reference supply is generated by IC4, a 5V 100mA regulator. From this a 2.5V reference is obtained with the divider resistors R8 and R9 and buffer amplifier IC3b, and this is used as the "ground" for the meter amplifier.

The one volt negative voltage for application to the electrodes is produced by divider resistors R4 and R5, the effective



source impedance of these two resistors in parallel being sufficiently close to 10k. Preset potentiometer VR1 and resistor R3 control meter current and allow adjustment of the full-scale reading. Resistor R1 and capacitor C2 suppress any tendency for the output to "jitter" because of the input's electronic switching arrangements.



CONSTRUCTION

Apart from the meter, input sockets and selection switch S1, all components are mounted on a single-sided printed circuit board. This board is available from the *EE PCB Service*, code EE665.

The component layout and full size copper foil master pattern is shown in Fig. 3. There are no special points to note regarding construction, save that the three electrolytics and two diodes must of course be fitted the correct way round. There are two plain wire links. DIL

sockets are recommended for IC1 to IC3, which should not be inserted at this stage.

If the completed printed circuit board is powered up without these i.c.s, the supply current can be checked. Following a surge as the electrolytics charge, it should settle to about 2.5mA. The five volt regulated supply should be present across capacitor C4.

Next, IC3 can be inserted. This will add about half a milliamp to the supply current. The 2.5V rail should now be present across the 10 μ F capacitor C3, and 2.5V should also be present at the output of

IC3a, pin 7. The easy place to measure this is from the top of capacitor C2.

Following these checks, IC2 can be inserted and the voltage at pin 3 and pin 4 checked. This should, in each case, be somewhere between 1.5V and 3.5V, indicating that oscillation is taking place. If an analogue meter is used for this, a slight tremor will probably be apparent on the needle.

If these checks are successful IC1 can be inserted and the two trimmers VR1 and VR2 adjusted. The first step is to monitor the voltage between the test input connection points, that's the two wires that will go to switch S1, and adjust VR2 for an average of zero volts. This effectively adjusts the oscillator output to an even mark-space ratio.

Next, the project's own meter should be temporarily connected, the inputs shorted together and preset VR1 adjusted for a full-scale reading. This completes the adjustments on the board so the project can be assembled into the case and connected to the switch and input sockets.

As there is plenty of room in the suggested case and the layout is by no means critical, precise details of this are not included. The general arrangement should be clear enough from the photographs. Connections between the various items are given in Fig. 4. Take care with the switch wiring, which is slightly complex.

Calibration of the completed project is achieved by removing the meter cover - it unclips - placing appropriate resistors across the input and marking the resulting indications on the meter scale. Suitable calibration points are 500ohms, 1k, 2k, 5k, 10k, 20k, 50k, and 100k.

IN USE

In use, all three electrodes should be plugged in and the pair required for testing selected by switch S1. As it helps to have a good reference electrode to begin with, the best course is to start by placing the common electrode, which is attached to easily accessible bare skin. (The positions and application procedures for the EEG electrodes were described last month). Then one of the others can be placed and the impedance between them measured.

For successful operation of last month's *EEG Biofeedback Monitor*, this should be less than 10k. With care figures of less than 2k can be quite easily obtained, ensuring that even with unscreened electrode leads the signals displayed are indeed "brainwaves", not interference!

If the impedance is too high, the likely cause is insufficient cleaning of the skin surface, so another good scrub with a cotton-wool pad moistened with surgical spirit will usually clear the problem. Occasionally a discernible tremor may be seen on the meter needle, indicative of a slight d.c. potential, probably caused by skin acids reacting with the electrode material. So long as the impedance is low this doesn't appear to cause any difficulty, though if it occurs a lot the electrodes should be checked carefully for faults such as damage to the chloride layer or a leaking araldite seal over the soldered lead connection.

Next month we present a low-cost Bio Gen unit for checking the *EEG Biofeedback Monitor* described in the November 1989 issue. \square

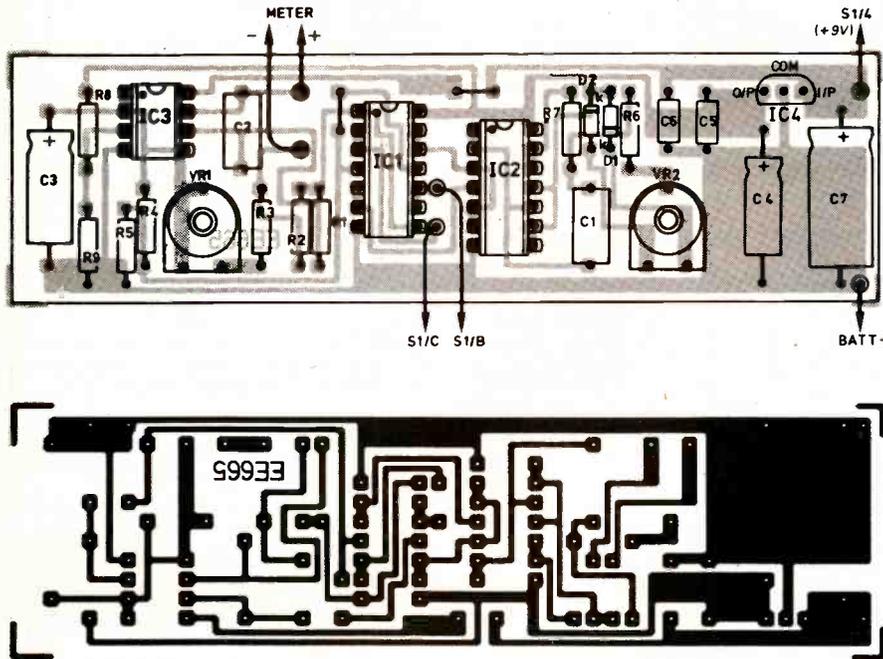
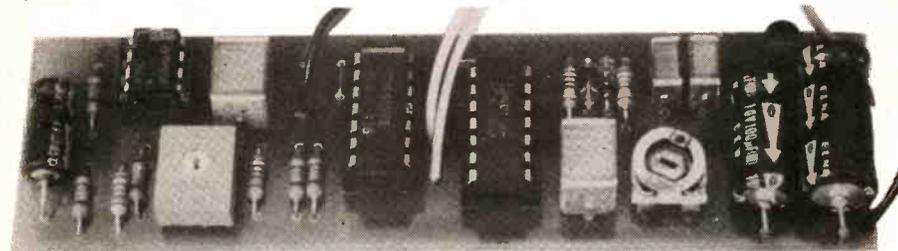
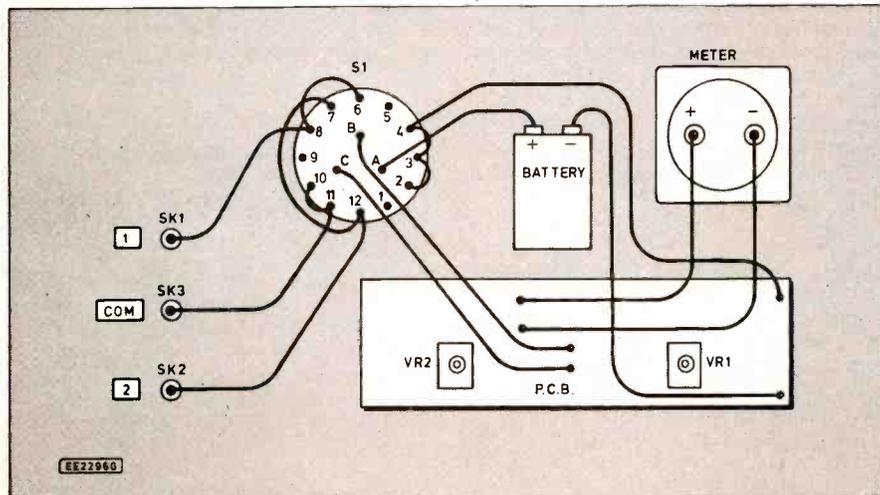


Fig. 3. Printed circuit board component layout and full size copper foil master pattern. The i.c.s should be mounted in d.i.l. sockets.



The completed printed circuit board showing the use of i.c. sockets.

Fig. 4. Interwiring from the circuit board to case mounted components.



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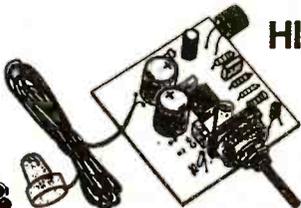
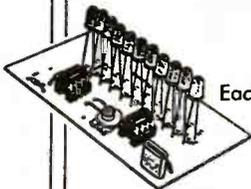
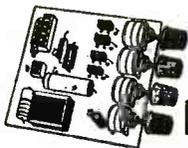
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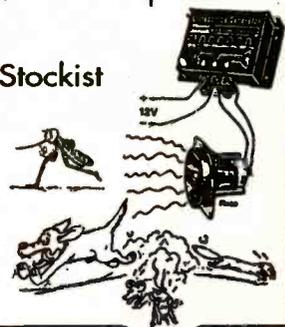
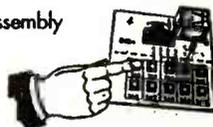
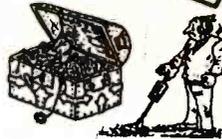
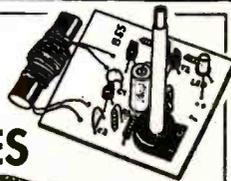
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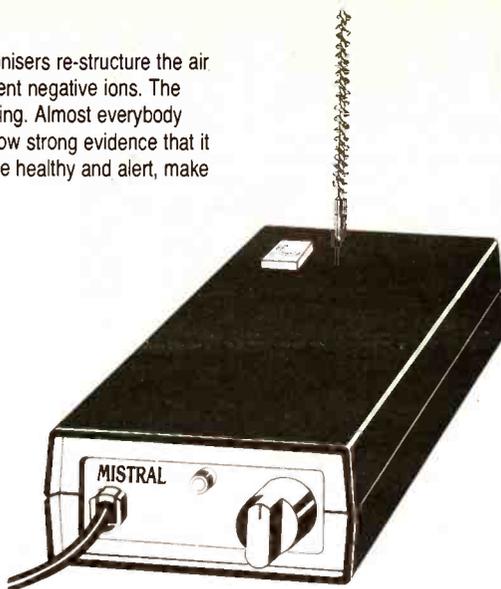
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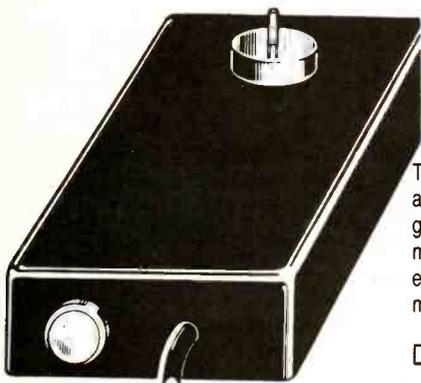
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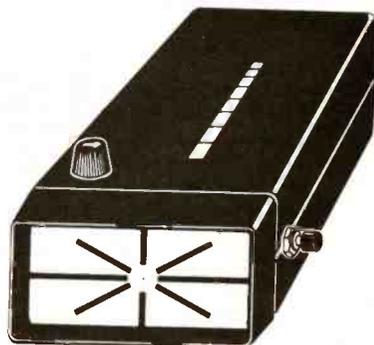
The ideal bedside ioniser. If you're keen to see what all the fuss is about, and to experience the ion effect for yourself, this is the one to go for. The Direct-Ion parts set contains PCB, 66 components, case, mains lead, and even the components for the tester. Don't forget the experiments: there's the smoke trick, triffids, the living emitter, and more. And full constructional details too, of course.

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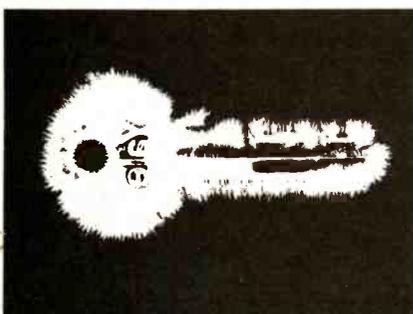
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IONISER EXPERIMENTS

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* Triffids

Connect a length of wire from the ioniser emitter to the soil in the pot of a houseplant. One with sharp, pointy leaves is best. Hold your hand close to the plant and the leaves will reach out to touch you! In the dark you may see a faint blue glow around the leaf tips – this works better with some plants than with others, so try several different types. The plants don't object to this treatment at all, by the way, and often seem to thrive on it.

* The Electric Handshake

Wear rubber soled shoes. Touch the ioniser emitter for a few seconds until your body is thoroughly charged up. When your hair stands on end, that's just about enough. Then give everyone you meet a jolly electric handshake. Just think, you could lose all your friends in a single evening! (A meaner trick still is to charge up a glass of water or a pint of beer. Even your family won't speak to you after that!)

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ACTUALLY DOING IT!

by Robert Penfold

THE STANDARD methods of preparing and lettering front panels were discussed in last month's article, and this month we will consider some alternative methods of tackling the problem. I suppose that virtually any method of producing neat lettering is potentially useful as means of making front panels.

Few people can produce neat lettering by hand, but stencils are readily available in a variety of letter sizes. The choice of styles is likely to be a bit limited, but you should be able to find something suitable.

You are not likely to find a pen that will mark nicely direct onto the front panel. A fibre-tipped pen having a spirit based ink might do so, but these mostly have "nibs" that are too large for all but the largest of stencils.

If the panel is covered with paper or card, any pen should then be able to mark it properly. Alternatively, you can mark the words onto a sheet of paper, and then cut out the words and stick them onto the panel.

An advantage of this method is that it does not matter too much if a mistake is made. You can simply start again on the word that is wrong, and will soon produce a replacement. If you mark directly onto a paper covering on the panel, correcting mistakes might not be possible. Even a fairly minor error could result in the panel having to be covered with a fresh sheet of paper, and a fresh start being made!

LABELLERS

A popular method of making panel labels some years ago was to use a special gadget and tape which enabled self-adhesive plastic labels to be produced quickly and easily. These labelers were certainly available until a short time ago, but my recent attempts to obtain one drew a blank. Anyway, this is certainly a good way of doing things if you can track down the necessary equipment.

The only problem is that some labelers produce labels that are slightly on the large size for today's mostly diminutive projects. The labels can tend to become unstuck and damaged at the corners after a period of time, but replacements are easily produced and installed if necessary.

There are relatively simple methods for producing entire front panel designs or individual labels photographically. This basically involves first producing the design on translucent material using ink or rub-on transfers, and then producing the panel from this

using an ultra-violet light box and special photographic materials/chemicals. For those who are interested in this method, it was described in some detail in a previous "Actually Doing It" article (see the September 1987 issue).

The main difficulty with this system is that the materials required seem to be difficult to obtain these days. Be warned that even if you can obtain suitable supplies, the cost is likely to be very high indeed. The results are usually outstanding, and the panels are extremely hard wearing, but they could cost more than the projects themselves!

COMPUTER LABELS

Moving on to slightly higher tech methods of producing labels, any reasonably good typewriter can produce neat lettering at about the right size for marking legends on controls etc. A well worn machine fitted with an equally well used ribbon is not likely to give good results, but a well maintained typewriter and a new ribbon (or better still, a carbon type) can give extremely neat results indeed.

Some very impressive results can be obtained using computers to produce panels and labels. Being realistic about things, it is not going to be worth your while buying expensive equipment and software in order to produce a few labels for projects. On the other hand, many electronic hobbyists have an interest in computing and already have suitable equipment and programs. Many more have access to sophisticated computer systems at work, school, college, etc.

At a most basic level, you can simply print out the required words onto a sheet of paper, cut them up into neat individual labels, and then stick them in position on the front panel. Obviously the printer should be used in its highest quality printing mode. Even a low cost nine pin dot-matrix printer should be able to produce lettering of reasonable quality.

Most dot-matrix printers these days seem to have more than one built-in font, and some offer a range of type sizes and styles. Many take add-on font cartridges, and (or) can take downloadable fonts. Obviously the greater the range of fonts, styles, and letter sizes your printer can handle, the better your chances of finding a combination that is well suited to project panel labels.

Taking things a stage further, there are plenty of programs that can produce lettering from printers in a wide

variety of fonts, styles and sizes. These are mainly desk top publishing (DTP) programs, and simple graphics programs of the paint type.

Both types of software are very popular, and paint programs often seem to be given away with computers, or with add-ons such as mice. For some computers there are "public domain" paint programs and a few simple DTP type programs which cost very little to obtain.

These programs get around the limitations of the printer's built-in type styles by driving it in its graphics mode. This enables any size and style of lettering to be produced, but obviously you must have a printer with graphics capability, and one that is compatible with the software. If you have one of the many Epson compatible machines there should be no difficulty.

The output quality of these programs varies substantially from one to another, and is sometimes not particularly good. Some programs give a print quality that is the same as the screen quality (i.e. pretty terrible) whereas others introduce some smoothing to give improved print quality. In general, DTP programs give better quality hard-copy than do paint programs.

Producing individual labels should be perfectly straightforward with either type of program. Some paint and DTP programs have on-screen rulers or grids and can print accurately to scale. With a program that has these facilities there should be no difficulty in producing entire panel designs.

Using paint programs, or DTP types that have some graphics capability (most have at least some simple line drawing functions) you can add embellishments to panel designs. This could be something as simple as 'go faster' stripes, to something more complex such as using a headphone circuit symbol as the legend for a headphone socket.

VECTOR GRAPHICS

Another form of software that is well suited to the production of labels or complete panels is the CAD (computer aided drawing) type. These differ from paint programs in that they are object oriented and use vector graphics. In other words, the drawing is not stored in the form of a bit-map of pixels. Instead, it is stored as lines, circles etc., with a co-ordinate system to define the positions of ends of lines, centres of circles etc.

The co-ordinate system is usually able to handle very large quantities together with a large number of decimal places, giving extremely high resolution. The drawing is produced on the monitor, printer, or whatever, using the full resolution of the device concerned. Any true CAD program can output accurately to scale.

For the production of labels and panels you do not need a sophisticated CAD program costing thousands of pounds. The most simple of CAD software running on a home computer should be perfectly adequate. The range of fonts available is strictly limited with most CAD programs, since they are primarily intended for technical drawings. They mostly provide

quite neat results though, and with text any size you like.

For the ultimate in front panel designs you need one of the illustration programs. Unfortunately, these are something of a rarity at present, are not very cheap, and only run on the more powerful 16-bit computers.

They combine paint program and CAD features, plus some of their own. They are ideal for producing panel designs, since they are designed specifically for commercial art applications of this type (and the panels for many pieces of commercial electronics are now designed using software of this type).

Text can be in virtually any size, there are numerous fonts to choose from, and you can manipulate the text in a variety of ways. This includes such things as shadow effects, outline text, various fill patterns including fountain fills (shading that varies from light to dark), and fitting text to a curve or other shape.

The panel design for Fig.1 was produced by playing with an illustration program for a couple of hours. The fact that I had never used this program before probably shows, but it shows the type of thing that can be achieved. If you can get access to a program of this type it is well worthwhile giving it a try-out. The only problem is likely to be

Fig. 1. A computerised front panel design produced using an illustration program called "Corel Draw".

difficulty in keeping your imagination in check.

COLOUR

Printers with the ability to print in colour have been something of a rarity in the past. It seems to be a standard feature on a number of recent printers though, and is an optional extra on several others.

Using colour can certainly give much more impressive results, and it might be possible to do so even if you do not have a colour printer. Some of the larger computer supplies companies can supply ribbons in various colours for some of the more popular dot matrix printers.

This limits you to one colour for the whole panel design, but this is probably all you will want anyway. In fact, you can probably produce multi-coloured designs by printing one colour, then putting the sheet of paper back into the printer and printing the second colour, and so on. Provided you produce a design where a very slight lack of registration accuracy between one colour and the next will not show up too clearly, this method can produce some excellent results.

One problem with a computer designed front panel is that you will probably only be able to print it onto ordinary paper. This will not give a particularly impressive finish, and will probably soon become dirty and discoloured. Spraying the paper with a clear lacquer can give a good and quite hard wearing finish.

One slight problem is that some combinations of lacquer and paper do not seem to mix well. You can find that the paper tends to go translucent and a bit blotchy looking, and you will almost certainly have to put up with a certain amount of discolouration.

My preferred method is to cover the paper with transparent self-adhesive plastic. As already explained, this is a little risky in that it is easy to end up with wrinkles in the covering.

Peeling it back so that it can be repositioned is almost certain to damage the lettering. This is not so important with a computer printed panel, since it takes little time to print out another one and try again. The cost of wasted materials is not going to be very great, and this method can produce some very professional looking and long lasting results.

FINALLY

If you are not very skilled with rub-on transfers, and perhaps do not bother to label the panels of your projects at all, bear in mind that there are alternative methods of labelling. These will often give good results, and do not require a high level of expertise.

Even if you are skilled at using transfers, it would still be a good idea to give some thought to the alternatives instead of automatically reaching for the transfer sheets next time you come to label a panel. These alternative systems of labelling should make an interesting change if nothing else.



BOOK REVIEWS

ELECTRONICS Build and Learn 2nd Edition by Robert Penfold

The electronics enthusiast may well be able to undertake many projects without a great deal of theoretical knowledge but there is no doubt that, sooner or later, a bit of basic theory will make all the difference between being able to solve, say a fault finding problem and coming to a dead stop. *ELECTRONICS Build & Learn* is intended to guide the electronics enthusiast through enough basic theory to avoid this sort of frustration.

As the title suggests, it is practical as well as theoretical. The first chapter deals with the construction of a circuit demonstrator unit which is used in subsequent chapters to illustrate the characteristics of electronic components so that one learns by doing.

ELECTRONICS Build & Learn was originally published in 1980. In this new, second edition, the author, R. A. Penfold (a name that must be familiar to *Everyday Electronics* readers), has updated the circuit demonstrator board which now includes i.c. holders and included a new chapter on logic circuitry and its relevance to computer binary code. Published by PCP it costs £5.95 — see *Direct Book Service* pages for more details. Paul Gabriel

SENSORS AND TRANSDUCERS by Keith Brindley

Although the word SENSORS dominates the cover of this book, it is really all about transducers, where sensors are one

application of these. Unlike *transistor*, *transducer* is not a word that is so easily recognised. And yet there are a lot of them about. Familiar examples are microphones and loudspeakers. Solar powered devices such as in calculators is another. However, the book is mainly concerned with the sensing and measuring use of transducers. And therefore, in the chapter on acoustics, it is the use of microphones in the *measurement* of sound levels rather than sound *quality* that is discussed.

A transducer is generally accepted to be a device that converts a non electrical physical quantity into an electrical signal or vice versa. Using the term "measurand" which is the physical quantity to be measured, such as acceleration, displacement, force, flow level, position, pressure, strain, temperature, velocity etc., the book divides them into five types: thermal, solid, fluid, acoustic and optical (grouped together), and chemical measurands, with one chapter devoted to each type.

In addition, because transducers are at heart analogue devices, there is a final chapter which discusses ways that transducers can be interfaced for digital conversion.

This is certainly a very useful reference book for designers and engineers and although, as the author points out, it is not intended as an encyclopaedia or even a guide as to which transducer to use in a particular application, it does compare one type with another and so allow the designer to make an informed choice.

Sensors and Transducers is published by Heinemann Newnes and is priced at £12.95 — see *Direct Book Service* pages for more details.

Paul Gabriel

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ON SPEC

a regular feature for the Spectrum Owner...

by Mike Tooley BA

THIS month, as promised, we shall show how, with minimal software and hardware, the humble Spectrum can be used as a versatile clock/timer. We begin by attempting to provide an answer to a plea from a reader with a defective Spectrum.

Mr S. Duruin of Burnley describes a fairly common problem; that of a non-initialising Series Two Spectrum. Unfortunately, failure to initialise (and produce the normal copyright message) can be caused by a number of faults. The prime suspect in an early Spectrum (Issue Three or before) is the power supply, however almost any device which produces a fault on the bus lines will cause this symptom. Hence failure of a RAM device, ROM, CPU or ULA could be the problem.

If the screen clears to a random display of flashing squares, this symptom is often associated with a failed RAM. If, on the other hand, the display comprises a series of thick vertical black and white stripes, the fault could be within the ULA. If nothing at all happens (completely black or white screen), then I would suspect the CPU or ROM.

Some years ago I was involved with providing a course specifically for Spectrum service engineers. I recall spending many hours producing a dossier of screen displays and likely faults. Unfortunately, I cannot trace the paperwork but suspect that other people may have also attempted this exercise. If you have any information on the screen displays produced by dud Spectrums (should this be Spectra?) then please get in touch. Between us, we should be able to provide something worth publishing here in *On Spec!*

In any event, the procedure for dealing with a defunct Spectrum (Issue Six, or earlier) should broadly follow these guidelines:

1. Disconnect the power supply and TV.
2. Invert the Spectrum so that the keyboard is face downwards (a plastic or rubber mat should be used to protect the keyboard from damage against the work surface).
3. Remove the five cross-point fixing screws for the case which are accessible on the underside of the case. Note that the rearmost screw is approximately 50 per cent longer than the other screws. Care-

fully retain the screws so that they can be used to re-assemble the case halves.

4. Do not separate the case halves but carefully turn the Spectrum the correct way up. Now remove the upper case half by gently lifting and then moving it to the rear. The upper case half contains the keyboard assembly and is attached to the lower half by means of two lengths of printed wiring. This wiring can be easily damaged by over-stretching or bending!

5. Disconnect the printed wiring from the two connectors fitted to the p.c.b. This can be done by firmly grasping the printed wiring between the thumb and forefinger and gently pulling upwards. Do not pull sideways or strain the printed wiring to the keyboard matrix.

6. Having freed the upper half, put this safely aside storing it with the keyboard downwards.

7. Now re-connect the power supply and TV.

8. Check each of the power rails (+12V, +5V, and -5V). This can most easily be done using any one of the eight RAM chips (IC6 to IC13) fitted at the front left-hand side of the p.c.b. These RAM chips are 16K-bit 4116 devices and the supplies are connected as follows:

Pin number	Supply rail
1	-5V
8	+12V
9	+5V

A ground (0V) connection to the multimeter can be obtained by simply clipping the negative test lead to the aluminium heatsink at the rear of the p.c.b. The pin connections for the RAM chips are shown in Fig. 1.

If any of these supplies is low or missing, it will indicate that the fault is either attributable to failure of an integrated circuit device or that the power supply is at fault. The power supply in the Issue Two Spectrum was notoriously unreliable. (I can remember endless faults involving the infamous "TR4" and "TR5"!)

9. If the power supply rails are normal (i.e. within 10 per cent of their nominal voltages);- the next stage involves checking the signal at the clock input to the Z80. If this signal is absent the system will be completely dead. The clock signal can be easily checked using a logic probe or an oscilloscope which should be connected to pin-6 of the Z80 (IC2). The clock signal should comprise a square wave of 3.5MHz (note that this waveform will not be a

perfect square as it is periodically stopped by the ULA). If the clock signal is absent, this will usually indicate that the ULA (IC1) is faulty.

10. The next stage involves checking the read (RD) and write (WR) lines (pin-21 and pin-22 of IC2 respectively). If the Z80 is fetching and executing instructions, these lines should be pulsing continuously. If these lines are static, and provided the clock is present, this will usually point to failure of the Z80 itself.

11. If the problem area can still not be pinpointed, the logic probe (or oscilloscope) should be connected to each of the data and address lines in turn. The signal present on each line should be examined and, if any line is permanently low (logic 0) or high (logic 1) or permanently tri-state (i.e. floating and neither logic 0 nor logic 1) this may indicate failure of an integrated circuit connected to the bus or the fault may be attributable to the failure of one of the Z80's internal buffer/drivers. In the latter case it will, of course, be necessary to desolder and replace the Z80.

12. Finally, and if all else fails to pinpoint the faulty component, the following (unscientific yet effective!) procedure can be tried:

- (a) Leave the system running for some time. Then touch the centre of each chip in turn in order to ascertain its working temperature. If a chip is running distinctly hot (i.e. very warm or too hot to comfortably touch) it should be considered a prime suspect. (If possible compare with the heat produced by a similar chip fitted in another Spectrum).

In particular, where a RAM chip is running noticeably hotter than its neighbours, this usually indicates that the device has failed. Such a failure will also normally be associated with a reduction in one, or more, of the supply rail voltages due to relatively high current demand.

- (b) The 6C001 or 6C002 ULA fitted to the Spectrum is invariably socketed. This complex device is prone to failure (particularly by improper connection to the expansion bus) and it is thus worth substituting a known device (which *must* be from a Spectrum of similar issue number).

Take care when removing and replacing the ULA as the pins can be easily damaged and the device is static sensitive. Don't forget to disconnect the power supply *and* the TV when handling the device. A replacement ULA will usually cost in the region of £6 to £10!

13. Finally, if you do have to desolder an integrated circuit device which you suspect to be faulty, it is always worth fitting a low-profile d.i.l. socket before replacing the device with a new component. This can save much aggravation in the event of subsequent failure and will also allow you to test a device (by substitution) if the need ever arises.

14. The procedure for re-assembling the Spectrum is simply the reverse of disassembly. Again, it is important to avoid straining the printed wiring to the keyboard membrane and, in order to ensure an effective connection, it is important to push the printed wiring fully home into each of the p.c.b mounted connectors. Also, don't forget that the longer of the case screws is fitted at the rear. Good luck!

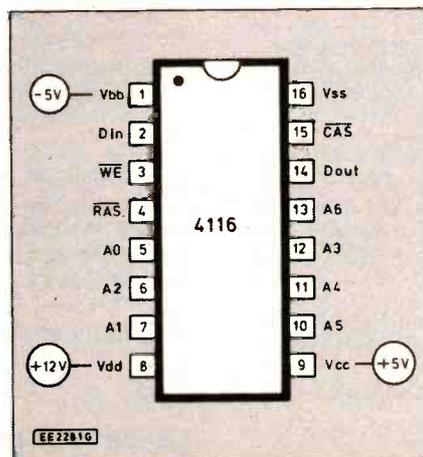


Fig. 1 4116 pin connections

Clock/timer

Several years ago (July 1986, to be precise) I devoted an instalment of *On Spec* to explaining how one can make use of the FRAMES system variable in order to make the Spectrum function as a reasonably accurate clock. I also included a simple program which could provide an on-screen clock display in hours, minutes, and seconds. More recently, I realised the need for a programmable timer which would be capable of driving a mains connected load. Rather than go to the extreme length of purchasing a ready made mains timer unit or designing a circuit from scratch, I decided, once again, to press my trusty workshop Spectrum into service.

The problem with all this, of course, lies rather more with the hardware than the software; if at all possible, I wanted to avoid having to build a complex interface circuit which would require connection to the Spectrum's expansion bus!

Since I was only concerned with a single channel, I decided that it would be worth exploring the use of the cassette recorder EAR connector as a means of deriving an output signal (a signal at the EAR connector can very easily be produced by including a BEEP statement within a program). The BEEP signal can be used to trigger an external bistable latch and hence the problem can be readily solved!

Fig. 2 shows the complete circuit diagram of the timer relay interface. The interface is connected to the Spectrum by means of a standard cassette cable fitted with two 3.5mm jack plugs. D1 and D2 provide a means of detecting the BEEP signal whilst TR1 and TR2 provide the necessary rising edge pulse to clock the J-K bistable element (IC1) at the end of a burst of BEEP signal. A push-button switch, S1, provides a means of resetting the bistable latch (causing the relay to drop-out).

Power for the timer/relay interface may be derived from the Spectrum (+5V rail and GROUND) or alternatively may be taken from any bench supply capable of delivering a well-regulated +5V at about 50mA. Where d.c. (rather than a.c.) connected loads are to be switched, a miniature relay with a coil rated at 5V and having a resistance of 300 ohms (or greater) may be used.

It is vitally important to note that, when using a solid-state relay with a mains connected load, great care must be taken to avoid contact with the mains supply and to ensure adequate insulation at the mains contacts of the relay. It is always better to be safe than to be sorry!

Demonstration software

A complete clock/timer demonstration program is shown in Fig. 3. This program provides the user with three options, including using the Spectrum as an elapsed timer (in conjunction with the timer relay interface) and using the Spectrum as a clock. In the former case, the user is prompted to enter the time required (in hours, minutes, and seconds) and then invited to press the space bar to start the timing period. During the timing period, elapsed time is displayed on the screen. At the end of the time previously set by the user, the Spectrum issues a BEEP and the relay will become energised.

In the latter case, the user is prompted to enter the current time (also in hours, minutes and seconds) and thereafter the time is displayed on the screen. Pressing the Q key will return the user to the main options menu.

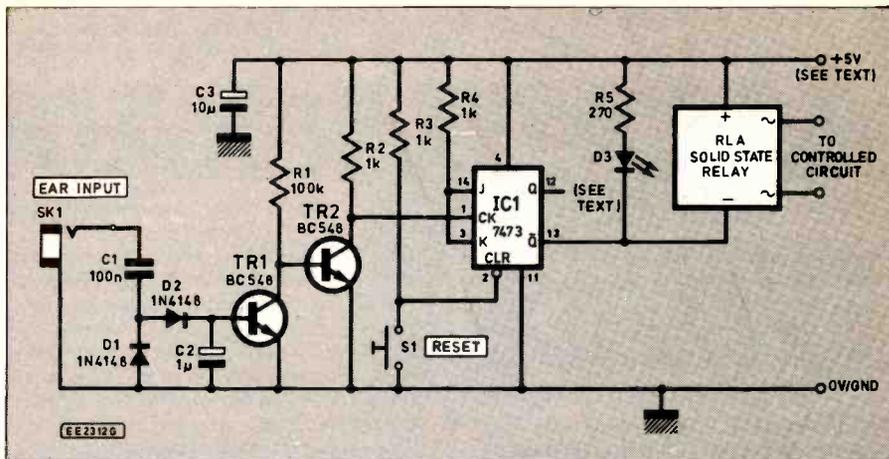


Fig. 2 Circuit diagram of the timer interface

There is some considerable scope for experimentation with both the hardware and software of this little project. If the relay is to be energised throughout the timing period (rather than at the end) it may, for example, be connected to the Q output of IC1 (pin-12) rather than the Q-bar output (pin-13). Alternatively, if the reset button is not operated at the end of an initial timing period, the load will be maintained until the end of the next period of elapsed time.

Software may be written to provide several consecutive on/off periods, each being initiated by a BEEP statement. As an example, it would be eminently possible to control a central heating system or domestic water heater (via appropriately rated relays) with a pre-selected 24-hour cycle for each day of the week.

Next month we hope to have some details of Andy Wright's SAM BASIC (Andy will be well known to many readers as the author of Beta BASIC). In the meantime, if you would like a set of the latest Up-date sheets, please drop me a line enclosing a large (250mm x 300mm) and adequately stamped (currently 42p for UK postage) and addressed envelope. Please note that I am unable to provide individual replies to queries. Instead, I will do my best to pro-

vide answers in future instalments of *On Spec*.

Mike Tooley, Faculty of Technology, Brooklands College, Heath Road, Weybridge, Surrey, KT13 8TT.

COMPONENTS

Resistors

R1	100k
R2,R3,R4	1k (3 off)
R5	270

(All resistors are 0.25W 5%)

Capacitors

C1	100n
C2	1µ elect. 12V
C3	10µ elect. 12V

Semiconductors

D1, D2	1N4148 (2 off)
D3	red l.e.d.
TR1, TR2	BC548 (2 off)
IC1	7473

Miscellaneous

RLA	solid-state relay (see text)
S1	miniature push-button switch (push to make)
SK1	3.5mm jack socket

```

5 REM *****
10 REM **
15 REM ** Clock/Timer Demonstration **
20 REM ** Everyday Electronics December 1989 **
25 REM **
30 REM
40 REM
50 REM *** Initialise ***
60 PAPER 1: INK 7: BORDER 1
70 POKE 23658,8: REM Caps lock
80 POKE 23609,0: REM Disable keyclick
90 REM
100 REM *** Main Menu Options ***
102 CLS
105 PRINT AT 4,8;"E.E. CLOCK/TIMER"
110 PRINT AT 8,8;"Options"
120 PRINT AT 10,8;"1. Timer"
130 PRINT AT 11,8;"2. Clock"
135 PRINT AT 12,8;"3. Quit"
140 PRINT AT 14,8;"Select option..."
150 LET rs=INKEY$
160 IF r$="" THEN GO TO 150
165 IF r$="Q" THEN GO TO 150
170 LET r=VAL r$
180 IF r=1 THEN GO SUB 1000
190 IF r=2 THEN GO SUB 2000
200 IF r=3 THEN NEW
210 GO TO 100
1000 REM *** Timer Subroutine ***
1010 CLS
1020 PRINT AT 21,0;"Set alarm time:"
1030 GO SUB 3000
1050 CLS
1060 PRINT AT 8,10;"Alarm set for:"
1062 PRINT AT 10,10;"HOUR MIN SEC"
1064 PRINT AT 12,12;hours;" ";mins;" ";secs;" "
1070 PRINT AT 14,6;"Press <SPACE> to start."
1080 LET r$=INKEY$
1090 IF r$<>" " THEN GO TO 1080
1095 CLS
1100 PRINT AT 8,10;"Elapsed time:"
1110 PRINT AT 10,10;"HOUR MIN SEC"
1120 POKE 23672,0: POKE 23673,0: POKE 23674,0
1130 GO SUB 4000
1190 PRINT AT 12,12;hour;" ";min;" ";sec;" "
1200 IF hour=hours AND min=mins AND sec=secs THEN BEEP 1,10: RETURN
1210 GO TO 1130
2000 REM *** Clock Subroutine ***
2010 CLS
2020 PRINT AT 21,0;"Enter correct time:"
2030 GO SUB 3000
2035 CLS
2040 PRINT AT 19,2;"Press <Q> for menu options."
2050 PRINT AT 8,10;"Time now ..."
2060 PRINT AT 10,10;"HOUR MIN SEC"
2070 LET st=(40&60*hours+60*mins+secs)*50
2080 LET sta=INT (st/65536): LET rem=st-(sta*65536)
2090 LET stb=INT (rem/256): LET rem=rem-(stb*256)
2100 POKE 23672,rem: POKE 23673,sta: POKE 23674,stb
2110 GO SUB 4000
2120 PRINT AT 12,12;hour;" ";min;" ";sec;" "
2130 IF INKEY$="Q" THEN RETURN
2140 GO TO 2110
3000 REM *** Subroutine to set clock parameters ***
3020 INPUT "Hours >";hours
3030 INPUT "Minutes >";mins
3040 INPUT "Seconds >";secs
3050 RETURN
4000 REM *** Subroutine to calculate time ***
4010 LET t=PEEK 23672+256*PEEK 23673+65536*PEEK 23674
4020 LET dt=INT (t/50)
4030 LET hour=INT (dt/3600): LET rem=dt-(hour*3600)
4040 LET min=INT (rem/60): LET rem=rem-(min*60)
4050 LET sec=rem
4060 RETURN

```

Fig. 3 Listing of the clock/timer program

REPORTING AMATEUR RADIO

TONY SMITH G4FAI

RADIOCOMMUNICATION DIVISION'S ANNUAL REPORT

In his introduction to the DTI Radiocommunications Division's recently published Annual Report for 1988/89, Robert Atkins, Parliamentary Under Secretary of State for Industry, notes the continuing growing demand for use of the radio spectrum. The government, he says, has been examining a wide range of options to ensure the most effective use of the spectrum.

Referring to the CSPI report *Deregulation of the Radio Spectrum in the UK* (see this column, August 1987), the Annual Report (AR) records that Touche Ross Management Consultants were commissioned in October 1988 to study the commercial viability of a trial of Frequency Planning Organisations (FPOs) to implement spectrum pricing. The DTI is now re-examining the options in the light of the Touche Ross report and other recent studies. "When proposals are finalised, there will be a full opportunity for interested parties to submit their views."

The original CSPI report recommended that because of its potential commercial value the amateur share of the spectrum should be reduced. Despite the feeling of the Radio Society of Great Britain at the time that it was of little significance, there are some who still believe there is a danger of this recommendation slipping through as "accepted in principle" somewhere in the small print.

YEAR IN REVIEW

In its comments on amateur radio, the AR recalls that during the year in review HRH The Duke of Edinburgh presented the DTI's Young Amateur of the Year award to Andrew Keeble, aged 15, of Norwich at the RSGB's 75th anniversary convention in 1988. The Radiocommunications Division (RD) has agreed to continue this award for a further two years, and lends its broad support to the RSGB's Project YEAR (Youth into Electronics via Amateur Radio). For the second year in succession the Division manned a stand at the RSGB Convention "which proved very popular with licensees".

The review continues, "After lengthy discussions between RD and the RSGB, a licence amendment was made in September 1988 which provided a legal framework for digital communications (including packet radio). The provisions are included in the revised Amateur Radio Licence which came into effect in January 1989. Another highlight of the licence is provision to allow UK amateurs to operate under their UK licence in a growing number of CEPT countries".

"This major revision required the setting up of a new computer system and the complete re-design of all licence stationery. A new Radio Amateurs' Examination syllabus more closely in

tune with current needs, for example through the inclusion of topics such as electromagnetic compatibility, has also been introduced. Four new information sheets have been written to help licensees with the new licence. The ever-popular booklet *How to become a Radio Amateur* has been substantially enlarged and brought up to date.

RAYNET AT LOCKERBIE

The review also refers to the public service aspect of amateur radio: "RAYNET, the radio amateur emergency service, is often to be found providing radiocommunications in support of the emergency services at disaster scenes. A case in point was at Lockerbie where, within 30 minutes of the fatal air crash on 21 December, three RAYNET members were deployed within Lockerbie. Shortly after midnight communications links were established with each ambulance in the area and during 22 December teams were deployed with Police and Accident Investigators and remained on site until 31 December."

"The number of RAYNET personnel in service ranged from 30 just after the crash to 100 at the peak of search activity. Almost all the equipment used was the members' personal property. Service was provided 24 hours a day thus allowing night searches with the security of radiocommunications. Members from as far south as the midlands provided support. The speed and scale of the RAYNET response to this disaster is a fitting testimony to the organisation and its members".

RADIO INVESTIGATION SERVICE

The overall objective of the Radio Investigation Service (RIS) is to reduce interference to the radio spectrum. Its work covers a wide range of services ranging from licensing and inspecting private mobile radio (PMR) installations to prosecuting pirate radio stations.

According to the AR the RIS received 522 requests during the year, accompanied by the standard fee of £21, from householders to visit them to diagnose the cause of reception difficulties. In order to underline the responsibility of the trade in resolving reception problems, however, the RIS will now only carry out detailed investigations after dealers or aerial contractors have confirmed that they have checked the domestic apparatus concerned.

The Service also received 4,242 reports of possible illegal transmitters and other interference sources. Such reports, says the DTI, have assisted the RIS in taking action against, unlicensed broadcasters and people who misuse CB and amateur radio.

NEW BOOK

An Introduction to Amateur Radio, by I. D. Poole, G3YWX, (paperback, Bernard Babani [Publishing] Ltd, £3.50) is

intended to be "a comprehensive and easy to understand guide to the subject" for newcomers, "remaining an essential reference volume to be used time and time again".

For its size, Ian Poole's new book performs well as claimed, and includes a useful chapter on "Getting Started". Basic aspects of the hobby, including practical operating, are explained clearly and theoretical subjects are covered with a minimum of (albeit well-explained) technical terms.

This approach does not provide in-depth explanations, but that is not the purpose of the book. For anyone interested in taking up amateur radio many, but not all, aspects of the hobby are covered or referred to, and the book could be very useful in providing initial explanations/outlines for those studying for the Radio Amateurs' Examination before going deeper into particular aspects.

Once licensed an amateur could well find it useful when coming across some new aspect of the hobby. Thinking back to my own early days on the amateur bands such a book would have been invaluable as fellow-operators on the air, or at my club, expounded on a variety of subjects making me feel very much "at the back of the class". A quick peek in its pages would have prompted my memory from earlier studies, primed me on overall principles, or put me on the road to learn more.

I still need such a prompter from time to time and shall be keeping my copy handy as a quick-reference source. As a good overall guide to what amateur radio is about, this small volume packs a lot into its 150 pages. (It is available from our *Direct Book Service* — see the book pages in this issue. Ed.)

USA BANDS UPDATE

In my September column I reported on the proceedings of the Congressional House Sub-Committee looking into charges that the Federal Communications Commission (FCC) may not have acted properly in dealing with protests about the allocation of part of the 220MHz amateur band to commercial interests.

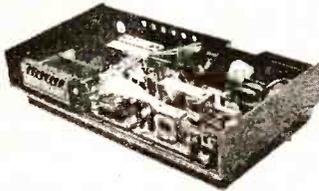
The FCC has now rejected all petitions received asking for reconsideration of its frequency re-allocation and the American Radio Relay League (ARRL) is to ask a Federal Court of Appeals to review the FCC decision.

In a surprise move the FCC, apparently under pressure from the chairman of the Congressional Sub-Committee, has grudgingly agreed that ARRL might apply for secondary access to the 216-220MHz band by way of compensation for loss of part of the 220MHz band. The broadcasting establishment, however, is expected to oppose any such allocation because of the possibility of interference to TV transmissions in the adjacent 210-216MHz band.

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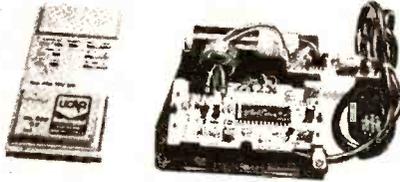
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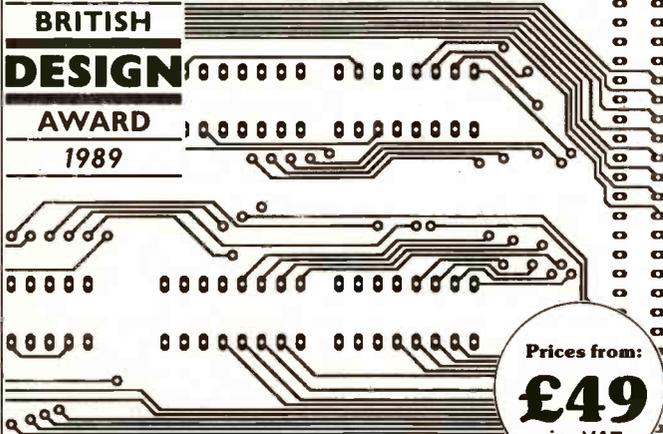
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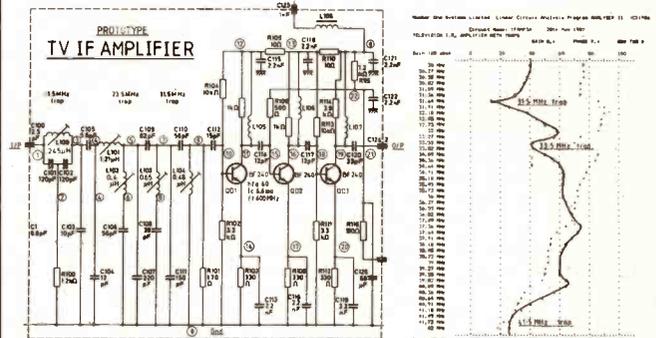
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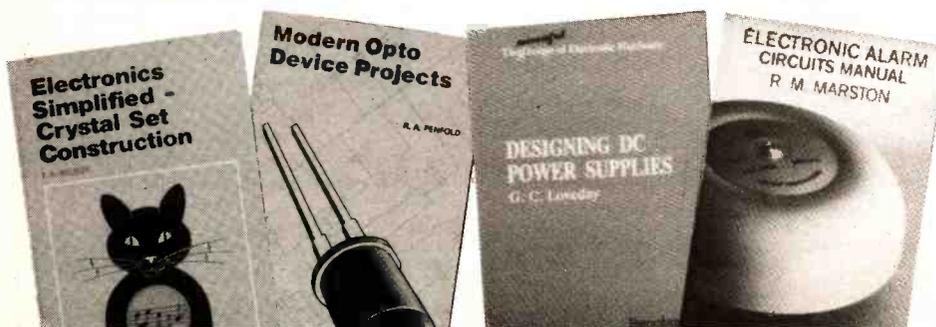
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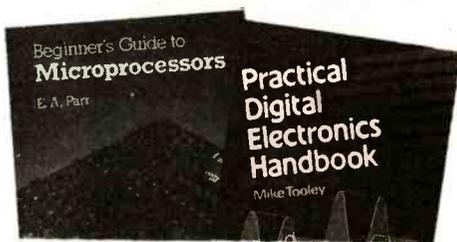
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CAR LAMP CHARGER

T. R. de VAUX-BALBIRNIE



Convert your 3-in-1 car safety lantern to automatic charging.

CAR LANTERNS of the 3-in-1 type are very popular and inexpensive. These lamps are so called because they provide three different light sources — a conventional narrow-beam torch; a flashing yellow light for emergencies and a fluorescent tube for general illumination. They usually use four "D" size cells and it is for this type of lamp that the present project was designed.

Although these lamps are extremely useful, over a period of use the batteries will need to be replaced. This is expensive, a set of four alkaline "D" cells costs approximately £4. Weak batteries will cause poor operation of the lights and, in the case of fluorescent tubes, permanent blackening may occur.

The best solution is to use a set of nickel-cadmium (rechargeable) batteries in place of the standard ones. Although these will cost about £9, savings are soon made even when the constructional costs of the charger are taken into account. In this way, the lamp will always operate at peak efficiency.

HOW IT WORKS

This project is a charging circuit powered by the car electrical system and can be placed in the glove compartment or elsewhere. It appears as a small plastic box with an on-off switch and terminal block for the external connections. A short lead with a plug on the end connects the charger to a matching socket on the lamp.

Operation of the circuit is automatic and while the lamp is not being used it is connected to the charger continuously. Thus, when the batteries are in a low state of charge, the current delivered by the circuit will be high but, over a period of time, it reduces to a small value.

This low current may be passed continuously without damage and maintains the cells in a fully-charged state ready for immediate use. Such "trickle" charging is necessary since without it, this type of cell tends to self-discharge fairly quickly.

While the engine is not running, the current drawn by the charger imposes negligible load on a well-charged car battery. The circuit will be found particularly useful to caravanner's and boat owner's who can use the on-board 12V supply for charging.

OPERATING VOLTAGE

The operating voltage of a nickel-cadmium cell is nominally 1.2 volts so four of these provide 4.8V. This contrasts with the 6V (4 x 1.5V) of conventional cells.

At first sight this would seem insufficient and lead to dim operation of the lamp but this is not true in practice. The reason is that the spotlight and flashing bulbs are of 0.5A rating and when this rather large current is drawn, there is a significant voltage drop across the internal resistance of the battery. This leaves less terminal voltage to operate the bulb.

To overcome this, the bulbs are rated at only 4.8V. Nickel-cadmium cells have a

much lower internal resistance and can provide the required current with negligible voltage drop. The lamps therefore operate at full brightness.

A milliammeter (multimeter switched to a d.c. current range) is needed for adjustment of the output current at the end of construction. An inexpensive meter is sufficient for the purpose since a high degree of accuracy is not required.

CIRCUIT DESCRIPTION

The entire circuit for the Car Lamp Charger is shown in Fig. 1. The design centres around IC1 which is a combined voltage regulator and current limiting i.c. It is a robust device fully protected against most forms of mis-use.

With the on-off switch S1 on, current flows through fuse FS1 and diode D1 into IC1 input (pin 1). Resistor R2 connected between IC1 pins 2 and 5 sets the output current limit and with the value specified this will be 100mA approximately. This is appropriate for "D" size batteries.

Resistors R1 and R3, in conjunction with preset VR1, set the output voltage delivered by IC1 pin 2. Potentiometer VR1 allows this to be adjusted between 6V and 7.5V approximately.

At full charge, the terminal voltage of each cell rises to 1.4V approximately — that is, 5.8V for the set. The unit therefore delivers sufficient output voltage taking into account 0.7V approximately which appears across diode, D2, in forward bias.

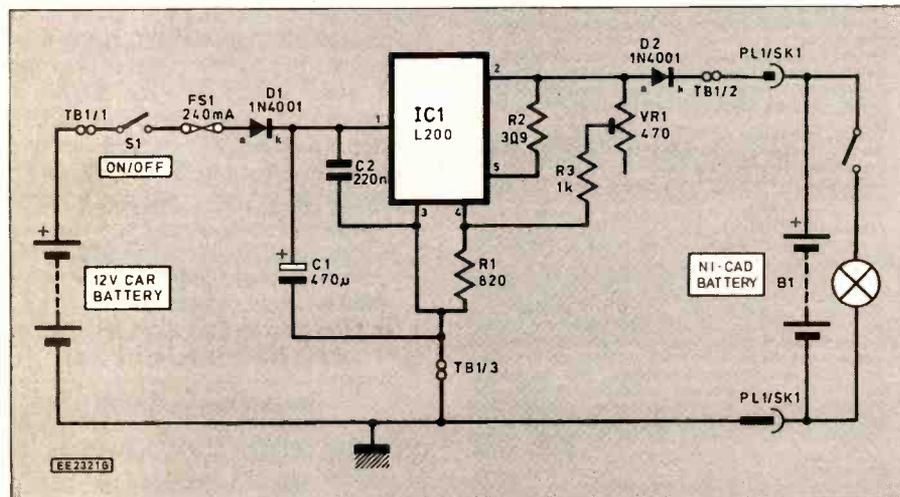
Charge regulation operates in the following way. With a poorly-charged set of cells, B1, their combined terminal voltage will be less than 4.8V. The voltage output from the unit will exceed this considerably and a high current will be driven through the cells so charging them. This will be limited to a nominal 100mA by the action of resistor R2 as described earlier.

Later in the charging cycle, the cell terminal voltage rises. The charger output voltage will be adjusted, using VR1, to exceed this figure with only a small margin. A low current is therefore obtained which may be passed continuously without damage to the cells.

Diode D1, together with capacitor C1, provide smoothing of the car generator output. Diode D2 allows current to flow into the battery but prevents it from passing back into the system if S1 is switched off with the lamp connected.

Fuse FS1 provides protection in the event of overload. A further fuse is built into the lamp itself — this provides protection from possible short-circuits at the plug and socket or inter-connecting wires.

Fig. 1. Complete circuit diagram for the Car Lamp Charger



CONSTRUCTION

It is usually a simple matter to dismantle the lamp sufficiently to find a free space in which to fit the input socket SK1 and 20mm fuse FS2. However, it would be wise to check this point before starting construction work.

This project is easily made up using a piece of 0.1in. matrix stripboard, size 10 strips x 29 holes. Begin by cutting this slightly too large then file it to fit the slots of the plastic box. The component layout and details of breaks required in the underside copper tracks is shown in Fig. 2.

Drill the mounting hole in the board for FS1 and mount this component (but do not insert the fuse itself at this stage). Make all track breaks and solder the link wire between FS1 fuse holder tag and strip J as shown.

Gently bend the five pins of IC1 to allow them to pass through the circuit panel in

COMPONENTS

Resistors

R1	820
R2	3Ω9
R3	1k

**Shop
Talk**

see page 783

All 0.25W 5% carbon

Potentiometer

VR1	470 sub-min. preset, vertical
-----	-------------------------------

Capacitors

C1	470μ elec. 16V
C2	220n polyester.

Semiconductors

D1, D2	1N4001 rec. diode (2 off)
IC1	L200 adjustable voltage and current regulator

Miscellaneous

S1	Miniature s.p.s.t. rocker or toggle switch, 1A rating.
TB1	3A 3-way screw terminal block.
PL1/SK1	2.1mm or 2.5mm standard "power-in" plug and matching chassis socket. Small fixings for SK1.
FS1	20mm chassis fuseholder.
FS2	20mm 250mA quick-blow fuses (2 off). Plastic tubing for fuse — see text.

Stripboard, 0.1in. matrix 10 strips x 29 holes; ABS plastic case, 76mm x 58mm x 38.5mm; 3A auto-type wire; solder etc.

Approx. cost
Guidance only

£6

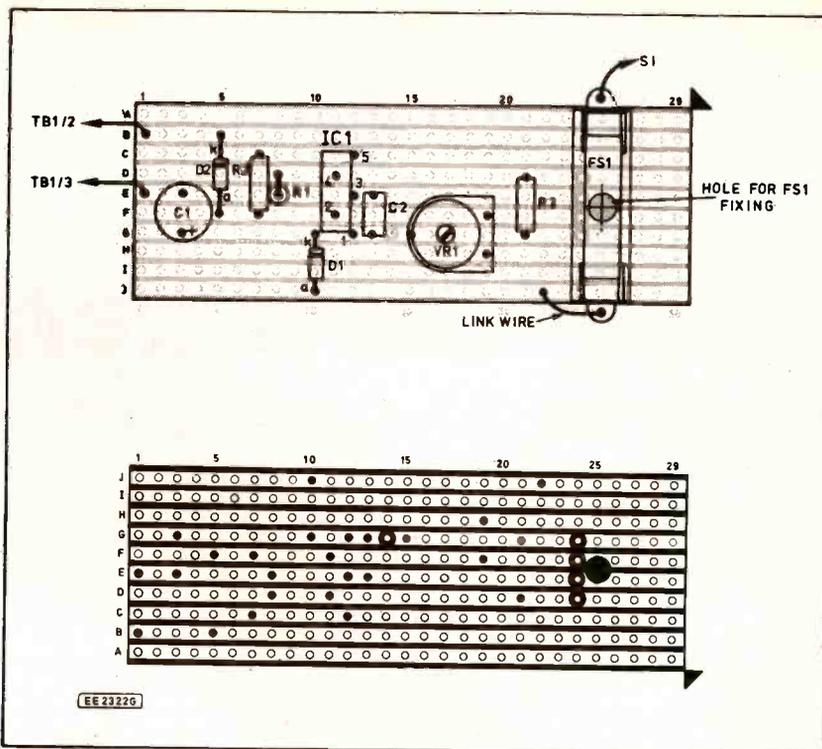


Fig. 2. Stripboard component layout and details of breaks required in the underside copper tracks

the positions shown in Fig. 2 — use the full length of the pins and take care when soldering them to the copper tracks to prevent heat damage. Note that no heatsink is needed for IC1 since it is used well below its maximum power rating.

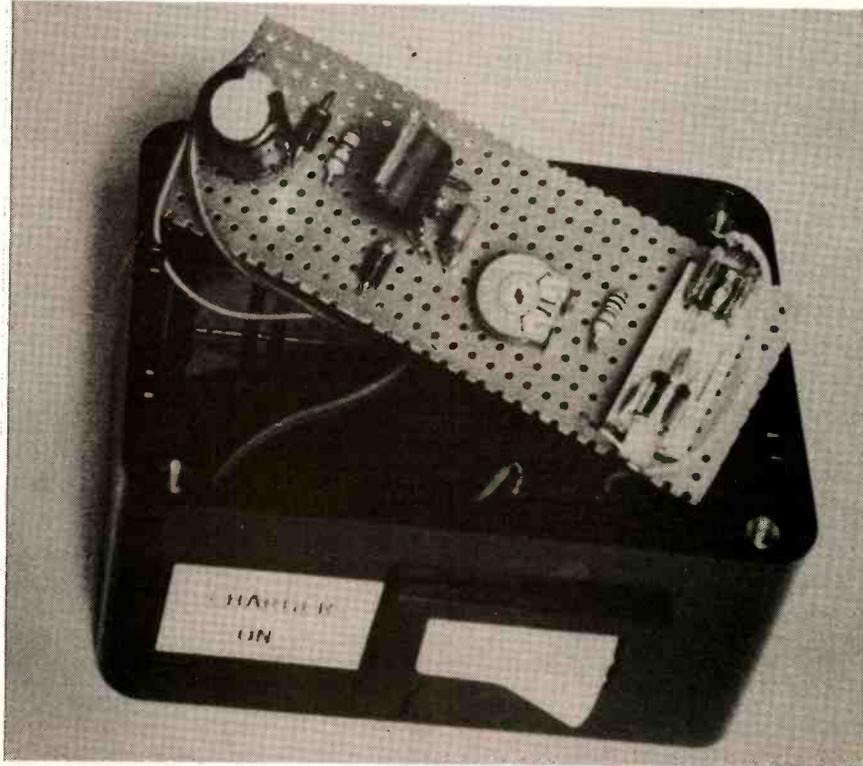
Solder all remaining on-board components into position noting the polarity of diodes D1, D2 and capacitor C1. Solder 15cm pieces of light-duty stranded connecting wire to copper strips B and E at the left-hand edge of the panel and to the remaining unconnected fuseholder tag as indicated. Make a careful check for errors,

insert the fuse and adjust preset VR1 sliding contact to approximately mid-track position.

Prepare the case by drilling holes for the on-off switch, S1, and terminal block, TB1 mounting. Drill a few small ventilation holes in the lid above IC1 position. Drill a small hole next to TB1 position for the three wires passing through from the circuit panel.

Referring to Fig.3, mount remaining components and complete all wiring. Switch S1 off. Note that the circuit panel should *not* be inserted at this stage.

The completed charger with the circuit board removed showing the fuseholder at one end



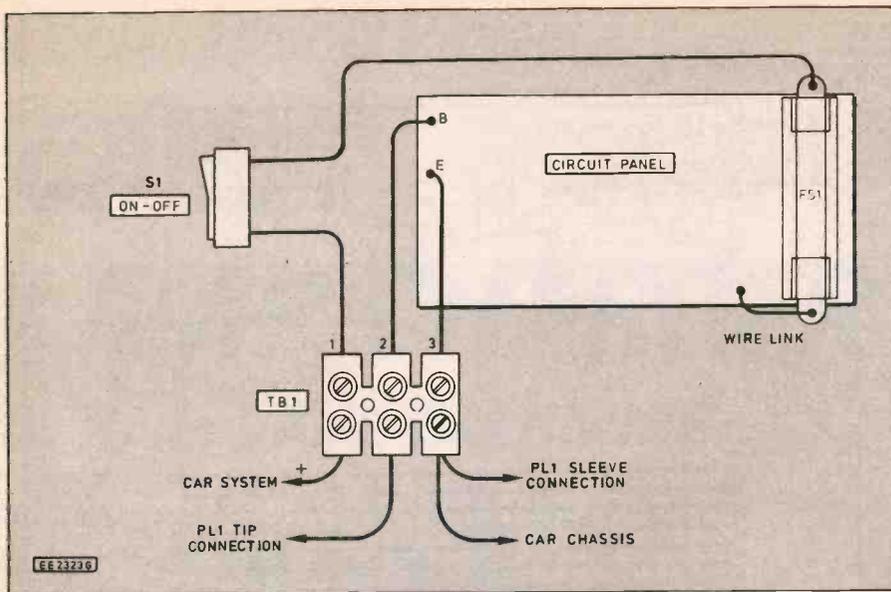


Fig. 3. Interwiring from the circuit board to the terminal block

Make the output lead by soldering "power-in" plug, PL1, to a piece of light-duty twin stranded wire (see Fig.4). Use the tip of PL1 for the positive connection and the sleeve for the negative one. Make certain that short-circuits are avoided in the plug — make an insulating sleeve if necessary to keep the wires apart. Connect the negative wire (sleeve connection) to terminal block TB1/3 but leave the positive (tip) one unconnected for the moment.

PREPARING THE LAMP

Precise details for lamp preparation cannot be given since this will depend on the exact type of lamp being used. Careful dismantling should reveal a free space in which to accommodate the 20mm fuse and socket, SK1.

Space may be saved by avoiding an actual fuse holder here. The fuse may be slid tightly into a short piece of plastic tubing and direct soldered connections used.

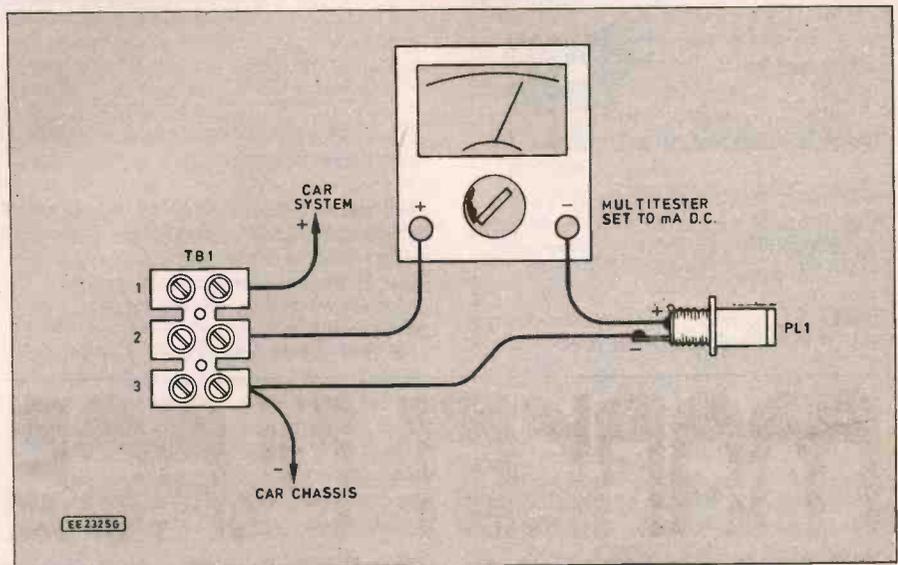


Fig. 5. Test set-up, using a multimeter, for adjusting the charging rate

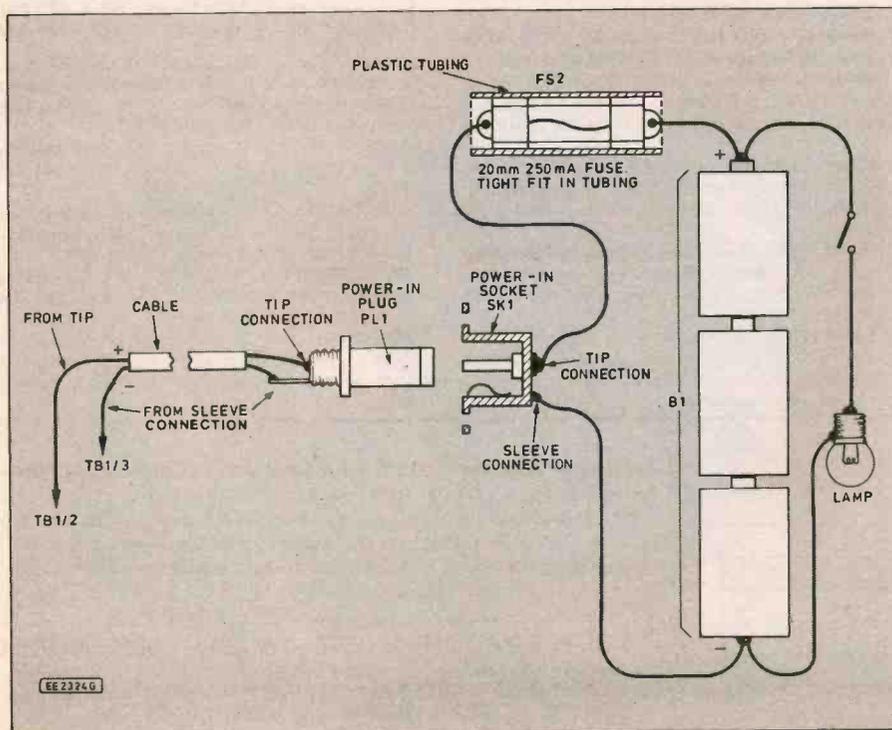


Fig.4. Wiring to the power-in plug and to the "torch" socket and fuse

This is acceptable practice since it is unlikely that the fuse will ever need to be replaced.

Use the specified "power-in" socket, not a type having exposed metal parts such as a jack socket. This could cause short-circuits.

The socket SK1 is arranged with the centre pin (tip) connected to the fuse and hence to the positive battery connector terminal. SK1 sleeve connection is made to the negative battery connector terminal. Note that power-in sockets usually have a pair of switch contacts which part when the plug is inserted — take care not to make connections here in error.

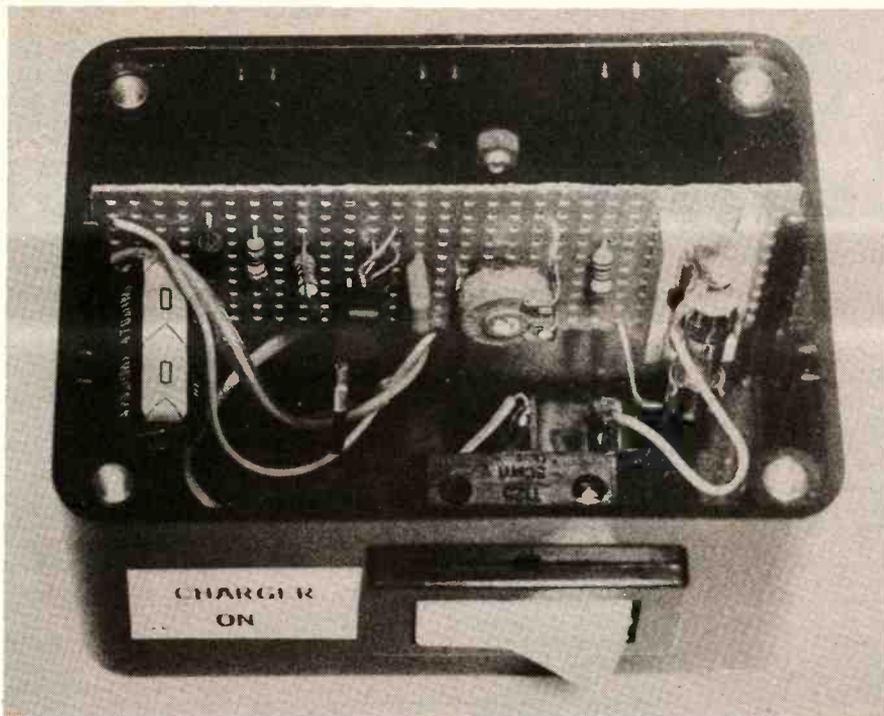
TESTING AND ADJUSTMENT

Before making connections to the electrical system, disconnect the car battery. Using light-duty auto-type wire of 3A rating minimum, connect terminal point TB1/1 to a fuse which is live all the time and TB1/3 to an earth point (car chassis). If wire passes through a hole drilled in metal use a rubber grommet.

Tests assume that the batteries are discharged — if not, operate the lamp until they are. Set the multimeter to a d.c. current range of at least 150mA. Connect TB1/2 to the positive meter probe lead and the free positive wire (leading to PL1 tip connection) to the negative one (see Fig.5). Take care to prevent bare wires touching any part of the car bodywork as this would cause short-circuits.

Plug in the lamp and switch on S1. The meter should indicate a current in the range 80 to 130mA. This will probably fall a little during the first few minutes then remain steady. Watch the reading at intervals — if the current falls by more than 20 per cent approximately before 4 hours have elapsed, adjust VR1 anti-clockwise to raise it again. Note that it is normal for IC1 to feel quite hot while a high current is flowing.

Towards the end of the charging cycle, the current will fall and the meter will eventually indicate the end-point; somewhere in the region 10mA to 50mA. Disconnect the lamp and switch it on to discharge the batteries completely again. Connect the charger and observe the meter reading at hourly intervals. Small adjustments to VR1



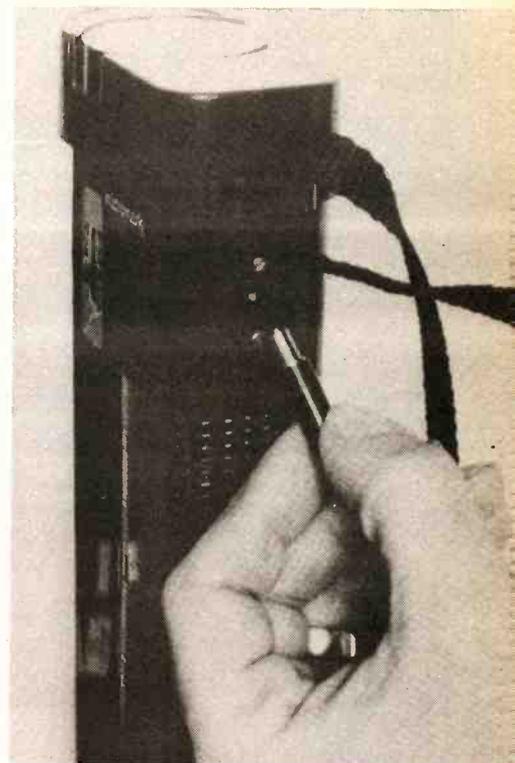
Completed charger showing the circuit board slotted in position. The terminal block is mounted on the outside rear panel

will ensure that a high charge rate is maintained for as long as possible while giving an end-point current less than 50mA.

If the charging current is too low even with preset VR1 adjusted fully anti-clockwise, increase the value of resistor R3. If the charging current is consistently

too high, reduce R3. None of this should be necessary, however, since VR1 provides a good range of adjustment.

With VR1 correctly adjusted, the meter may be removed and the positive output wire connected to terminal TB1/2. The circuit panel may then be slid into position.



The modified car lantern showing the power-in socket and plug

Before fitting the lid, make sure no wires are touching IC1 to avoid heat damage.

Now it only remains to label S1 and leave the charger to do its job. You will never be left in the dark with the Car Lamp Charger! □

MARKET PLACE

MARCONI alignment oscilloscope 10MHz complete with instructions and circuit diagram — good working order (valve model) £40. Tel: Watford 36362.

TEKTRONIX scope 585A £10, 581 for spares, ES1 audio generator £5, Tautron £10. Tel: 0491 575216 (Henley).

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WANTED AVO Valve Data Manual or photocopy. Borrow, buy. M. Tollett, 81 Godston Road, Wolvercote, Oxford OX2 8PE.

MALE PEN PAL about 21. University student. My interests include digital and communications. Shahryar Pasyar, P.O. Box 71365-1664, Shiraz, Iran.

WANTED information on weather station kits/circuit diagrams. If possible on atmospheric pressure in digital form. Richard C. Davies, 16 Dingle Lane, Crundale, Haverfordwest, Dyfed, SA62 4DJ.

AVO METER £80, tuner amplifier £30, LCR bridge £30. D.E. Jones 01 249 4829.

PCB Ultra Violet Light Box by Radio Spares cost £150 sell £80. Tel: 0268 417775.

WANTED HERO Junior Robot, as sold by Maplins. Call Andrew on 0603 871598 after 4pm.

WANTED Ferranti i.c. ZN401E-2 for Sinclair pocket TV FTVC. Tel: Stroud 763914 or write: J. Jordan, 36 Hillcrest Road, Cashes Green, Stroud, Glos.

HELP! Does anyone know of a company or can you make drilled printed front panels contact D. Rees, 14 Bank Buildings, Llandeilo, Dyfed SA19 6BU.

PRACTICAL Electronics collection complete 1964-1986. Very good condition. Vols 1-9 in binders. Sensible offers only please. Tel: 0735 412756.

COULTANT GPT-500 regulated power supply unit 2 x 15 + 15, 5 amp working order £15. plus £4 p.p. Mr. J.T. Hill, County High School, Gramlington, Northumberland.

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SCOPEX 4D10B dual trace 10MHz oscilloscope v.g.c. £100 o.n.o. Avo 8 £30 o.n.o. Tel: 01 756 0237.

WANTED for vintage Philips EL3516G tape recorder. Drive belt or suitable equivalent. Can anyone help. Please phone 09278 2078.

TANDBERG series 12, 7 inch reel to reel stereo tape recorder 1967 model. Exc. condition for year £65. Tel: 0904 84406.

MAPLIN Electronics 61 note keyboard only, as new, list price £50, selling for £30. Mr. F. Lucas, 6 West Fryerne, Yateley, Nr. Camberley, Surrey GU17 7SU.

Name & Address:			

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PCB SERVICE

Printed circuit boards for certain constructional projects are available from the PCB Service, see list. These are fabricated in glass fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Add £1 per board for overseas airmail. Remittances should be sent to **The PCB Service Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH**. Cheques should be crossed and made payable to **Everyday Electronics (Payment in £ sterling only)**.

Boards for some older projects – not listed here – can often be obtained from Magenta Electronics, 135 Hunter St., Burton-on-Trent, Staffs DE14 2ST. Tel: 0283 65435 or Lake Electronics, 7 Middleton Close, Nuthall, Nottingham NG16 1BX. Tel: 0602 382509.

NOTE: While 90% of our boards are now held in stock and are dispatched within seven days of receipt of order, please allow a maximum of 28 days for delivery – overseas readers allow extra if ordered by surface mail. Please check price and availability in the latest issue before ordering. We can only supply boards listed in the latest issue. Boards can only be supplied on a payment with order basis.

PROJECT TITLE	Order Code	Cost
Automatic Car Alarm	DEC '86 550	£3.00
BBC 16K Sideways RAM (Software Cassette)	551 551S	£3.00 £3.88
Mini Amp	FEB '87 554 & 555	£5.68
Video Guard	556	£3.80
Spectrum I/O	557	£5.35
Spectrum Speech Synthesiser	558	£4.86
Computer Buffer/Interface	MAR '87 560	£3.32
Infra-Red Alarm: Sensor Head	561	£4.19
PSU/Relay Driver	562	£4.50
Experimental Speech Recognition	APR '87 563	£4.75
Bulb Life Extender	564	£3.00
Fridge Alarm	MAY '87 565	£3.00
EE Equaliser-Ioniser	566	£4.10
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Noise Gate	SEPT '87 577	£4.41
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Electronic Analogue/Digital Multimeter	579	£6.40
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Accented Metronome	NOV '87 582	£3.77
Acoustic Probe	584	£3.00
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Bench Amplifier	591	£5.51
Transistor Curve Tracer	592	£3.00
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Game Timer	583	£3.55
Semiconductor Tester	MAR '88 594	£3.19
SOS Alert	595	£3.00
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Stereo Noise Gate	APR '88 597	£6.65
Pipe & Cable Locator	598	£3.00
Inductive Proximity Detector	574	£3.00
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Transmitter	600	£3.07
Receiver	605	£3.00
Door Sentinel	606	£5.91
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Function Generator – Power Supply		
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Relay/Decoder	602	£3.07
Dimmer Board	603	£3.00
Power Supply	604	£7.76
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Tea Tune	AUG '88 609	£3.00
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– Processor	662	£4.56
Power Supplies – 1.5V–25V 2A	663	£4.78
Logo/Logo & Spectrum Interface	664	£5.60
EEG Electrode Impedance Meter	DEC '89 655	£3.98

Please note that when ordering it is important to give project title as well as order code. Please print name and address in Block Caps. Do not send any other correspondence with your order.

EE PRINTED CIRCUIT BOARD SERVICE

Please send me the following p.c.b.s.
Make cheques/PO payable to: **Everyday Electronics**
(payment in £ sterling only)

Order Code Project Quantity Price

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I enclose cheque/PO for £

Name

Address

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 REED BUZZER PCB/LEADS 3, 6, 9, 12, 24v
 PIEZO DISC PCB/LEADS 3-28v
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 COIL AND DIAPHRAGM PCB 6, 12v

WITHOUT INTERNAL DRIVE
 PIEZO CERAMIC PCB/LEADS
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FOR T3 1/4 (10mm) WEDGE BASE BULBS
 PANEL MOUNT (20mm CUTOUT) SPADE TERMS.
 PCB MOUNT
 BULBS FOR THE ABOVE 6.5/12/24/28v

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 50v 22/27/150/470/2000/5000pF PACK 50 £1.25
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 ELECTROLYTIC RADIAL 35v 2200µF 40p
 50v 2200µF 40p
 25v 10µF PACK 10 50p
 16v 220µF PACK 10 50p
 16v 4700µF 40p
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 32.768KHZ TO 116.00MHZ P.O.A.
 TTL CLOCK OSCILLATORS
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 PLEASE SPECIFY PACKAGE SIZE AND TOLERANCE
 VERY LOW PRICES - PLEASE ENQUIRE

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PIANO DIP 2 POLE 46p SLIDE DIP 2 POLE 38p
 4 POLE 62p 4 POLE 48p
 6 POLE 72p 6 POLE 53p
 8 POLE 80p 8 POLE 62p

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5.25" 80 TRACK DS 1/2 HEIGHT
 TOSHIBA ND04DT 0.5MB £85.15
 NEC FC1057 1MB £76.00
 SWITCHABLE
 TOSHIBA ND08DE 1MB-1.6MB £93.75
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40 x 40 x 10mm 12vdc * £7.00
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 VERY QUIET
 BIG DISCOUNTS FOR LARGER QUANTITIES - POA.

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GLASS QUICK BLOW
 50mA-6.3A (5x20) 10p
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POLISHED CHROME-PLATED MILD STEEL
 W.111.1, H.33.5, DIA.9.5, FC.101.6 £2.69

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LOW COST 3 or 5mm
 RED, GREEN, AMBER, YELLOW PACK 20 £1.00
 BICOLOUR 5mm RED/GREEN 3 LEADS 45p
 SUPERBRIGHT 3 OR 5mm
 RED, GREEN, AMBER, YELLOW 10p
 8mm RED, GREEN, AMBER, YELLOW 38p

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FOR 3 OR 5mm LEADS PACK 10 50p
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LED INDICATORS

3mm LED IN 6mm CHROME PROMINENT HOUSING
 RED, GREEN, YELLOW 73p
 3mm LED IN 6mm CHROME RECESSED HOUSING
 RED, GREEN, YELLOW 73p
 5mm LED IN 8mm CHROME PROMINENT HOUSING
 RED, GREEN, YELLOW 55p
 5mm LED IN 8mm CHROME RECESSED HOUSING 55p

7-SEGMENT DISPLAYS AND DOT MATRIX

8mm SINGLE DIGIT
 14.22mm SINGLE AND DOUBLE DIGIT
 6.4mm DOUBLE DIGIT
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 20 x 14 DOT MATRIX
 SPECIFY COMMON ANODE/CATHODE
 SPECIFY BLACK/GREY FACE
 SPECIFY COLOUR

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 TAXAN SUPERVISION 760 14" EGA £451.00
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NEON INDICATORS

ROUND, SQUARE, 9, 12mm, 110v, 240v.
 RED, GREEN, AMBER, CLEAR 50p

RELAYS

4PDT 24VDC 3A 14 PIN PLUG-IN £3.36
 48VDC 3A 14 PIN PLUG-IN £3.59
 240VAC 3A 14 PIN PLUG-IN £3.98
 SCREW TERMINAL BASE FOR ABOVE £2.78

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 48VDC 10A ROUND 11 PIN PLUG-IN £4.49
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 48VAC 10A ROUND 11 PIN PLUG-IN £4.49
 110VAC 10A ROUND 11 PIN PLUG-IN £4.61
 220VAC 10A ROUND 11 PIN PLUG-IN £4.68
 240VAC 10A ROUND 11 PIN PLUG-IN £4.68
 SCREW TERMINAL BASE FOR ABOVE £2.24

PCB SPDT 8A 24VDC FLATPACK £2.00
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RESISTORS

CARBON FILM
 1/4 WATT 5% 1R1/10M SINGLE VAL. PACK 50 50p

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DPST SUBMINATURE (15.9 x 13.3 CUTOUT) 43p
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Send £1.50 for our full catalogue which includes discount vouchers - 50p off £5.00+ order, £1.00 off £10.00+ order, £5.00 off £50.00+ order.
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New components, lots of new packs, and a better selection than ever in the old favourites. If you haven't yet sampled these delicious component assortments, you just don't know what you're missing! All the packs are **£1 (+VAT)** each, but if you order five packs you can select an extra one FREE. Order ten packs and you can have three extra packs FREE. Go for it!

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PACK 1 - 200 RESISTORS. Finest carbon film, with lots of E12 values and a few precision.
PACK 2 - 100 CAPACITORS. Polystyrene, ceramics, metallised film. A fine selection!
PACK 3 - 30 ELECTROLYTICS. Values to 470µF.
PACK 4 - 15 LARGE ELECTROLYTICS. Values to 4,700µF.
PACK 5 - 10 TANTALUM CAPACITORS. Values from 0.1µF to 68µF!
PACK 6 - 20 HIGH VALUE POLYESTER CAPACITORS. Values to at least 3µ3.
PACK 7 - 15 DIL RESISTOR NETWORKS. Lots of values.
PACK 8 - 50 POWER RESISTORS. 1W and above.
PACK 9 - 30. SUB-MINIATURE CAPACITORS. Look like diodes!

OPTO ELECTRONICS & DISPLAYS

PACK 11 - 10 5mm LEDs: 4 red, 2 yellow, 2 orange, 2 green.
PACK 12 - 10 3mm LEDs: 4 red, 2 yellow, 2 orange, 2 green.
PACK 13 - 10 Rectangular LEDs. Mixed red and green.
PACK 14 - 10 Mixed LEDs. All shapes, sizes, colours.
PACK 15 - 2 DUAL 0.3" CA 7-seg displays (panel type).
PACK 16 - 1 DUAL 0.5" CC 7-seg display (panel type).
PACK 17 - 1 QUAD 0.3" CA 7-seg display (panel type).
PACK 18 - 2 INFRA-RED COMPONENTS. Emitter and receiver.
PACK 20 - 1 CALCULATOR DISPLAY, eight digits.
PACK 23 - 2 PHOTOTRANSISTORS. Respond to visible and IR light.

SEMICONDUCTORS

PACK 26 - 3 TAG136D MAINS TRIACS (400V, 4A).
PACK 27 - 30 IN4000-SERIES RECTIFIERS.
PACK 28 - 30 MIXED SEMICONDUCTORS. Diodes, transistors, ICs, triacs, all sorts.
PACK 29 - 20 ASSORTED ICs. CMOS, TTL, linear, memory, as available. Changes daily!
PACK 30 - 20 TRANSISTORS. High grade general purpose NPN.
PACK 31 - 12 BC212 TRANSISTORS. High grade general purpose PNP.
PACK 32 - 12 BC213 TRANSISTORS. High grade general purpose PNP.
PACK 33 - 3 DUAL OP-AMPS MC1458. With data.
PACK 35 - 20 RECTIFIERS. Studs, high current, glass bead, top hat, IN4000, etc.
PACK 36 - 50 DIODES 1N4148. The most popular type for projects!
PACK 39 - 10 SURFACE MOUNT AND LCC ICs. Special hi-tech pack!

MISCELLANEOUS

PACK 41 - 4 POWER MICROSWITCHES. Push to break.
PACK 42 - 8 SPST STANDARD MICROSWITCHES (V3).
PACK 43 - 5 SPST ROLLER-OPERATED MICROSWITCHES (V3).
PACK 44 - 1 MINI BIO-FEEDBACK KIT. With PCB, components and instructions.
PACK 45 - 1 MINI DREAM-MACHINE KIT. With PCB, components and instructions.
PACK 46 - 1 MINI BURGLAR ALARM KIT. With PCB, components and instructions.
PACK 47 - 6 AUDIO TRANSFORMERS.
PACK 48 - 200 CABLE CLIPS to attach alarm or doorbell wires to wall.
PACK 51 - 1 CRYSTAL OSCILLATOR MODULE, 19.6608MHz.
PACK 52 - 12 PP3 BATTERY CLIPS.
PACK 53 - 2 PIEZO TRANSDUCERS. Use as microphone or speaker.
PACK 60 - 100 MYSTERY PACK of at least 100 components. The most popular pack of all!

AUTUMN COLLECTION

Buzz like a butterfly, hoot like a bee; the computer you pay for, but the switches are free! Match this famous quotation with our equally famous sound effects computer, and you could be on your way to a fortnight's holiday in the Canary Islands. On the other hand, you're much more likely to be sitting in your front room. But you never can tell where people read their electronics mags, can you?



SOUND EFFECTS COMPUTER

Take a powerful PIC655A single chip computer, mask program it to produce the most outrageously realistic sound effects, add an audio amplifier to bring them up to loudspeaker level, and you have the Highgrade Sound Effects Computer. How about a motor rally, complete with gear changes? Or a ship hooting its mournful way through the fog? Or a fly so realistic it'll have you running for the swat! Sirens, helicopters, steam trains, aliens - you name it, it's in there. The

computer is easily programmed with the thirteen switches supplied. In one mode you can even play it like a synthesizer! I have to admit, it's my favourite project of the moment. With your computer we also give you: a battery connector, a loudspeaker, thirteen switches, and a wiring diagram and programming instructions. You add a PP3 battery, a length of connecting wire and ten minutes of your time to connect it all together.

SOUND EFFECTS COMPUTER KIT **£12.80!** (+VAT)



LCD DISPLAY MODULES

On one side of the PCB is an LCD which displays two lines of text and symbols. On the back there's a powerful surface-mount drive IC to take in data, store it, and drive the display. Interface is through an eight-way connector for the power supply and data signals. We supply full data on the IC, which should be enough for you to get it up and running!
LCD DISPLAY MODULE **£6.60** (+VAT) 10 DISPLAYS **£54!** (+VAT)

LED DISPLAYS

TYPE 1: DUAL 0.56" COMMON ANODE

Large, high brightness digits for displays that have to be visible at some distance. Each display has two digits, but the connections to each are entirely separate. They can be butted up to each other to make a display as long as you choose! And just look at the price:

10 0.56" DUAL CA DISPLAYS **£4.80!** (+VAT) 50 DISPLAYS FOR **£22!** (+VAT)



TYPE 2: 1 1/2 DIGIT 0.5" COMMON CATHODE

Another two digit display, with the left-hand one lighting up as ±1. Once again, connections to the two digits are entirely separate.

PACK OF 10 1 1/2 DIGIT 0.5" CC DISPLAYS **£3.80!** (+VAT) 50 DISPLAYS FOR **£17!** (+VAT)

BAR-GRAPH LED MODULE

Eleven rectangular green LEDs assembled as a bar graph display. The central LED is turned edge-on to indicate the 'normal' position, or for centre-zero or tuning indicator displays. All LED leads are individually available at the rear of the assembly.
BAR GRAPH MODULE **£1.40** (+VAT) 10 MODULES **£11.80!** (+VAT)



LEDs

Rectangular LEDs in a tasteful shade of green, or a violent primary red. Bring some colour into your life! The prices ARE genuine.

PACK OF 100 RED, GREEN OR MIXED (you choose) RECTANGULAR LEDs **£3!** (+VAT)

PACK OF 500 RED, GREEN OR MIXED LED'S **£14!** (+VAT)



BUFFER AMP

Elantec EL2033 damn fast (100MHz) buffer amplifiers. Equivalent to National LH0033C. Current list price is **£28.50** each, I kid you not. With data.
EL2033 100MHZ BUFFER AMP **£2.80!** (+VAT)

KEYBOARDS

Full size QWERTY keyboard units with separate numeric pad and function keys. Exactly 100 keys in all. Must be good value just for the switches!

COMPUTER KEYBOARD **£4.80!** (+VAT)

POWER METERS

Meter movement scaled 0-10 with red pointer against a green scale which can be back lit for glowing effect. Full scale approx. 1mA.

POWER METER **£1.80!** (+VAT) 5 METERS **£7.80** (+VAT)

MONSTER PARCELS

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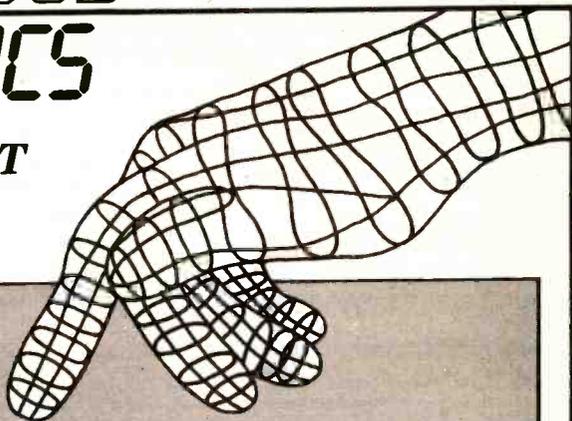
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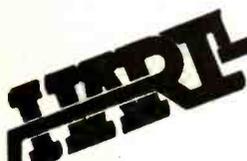
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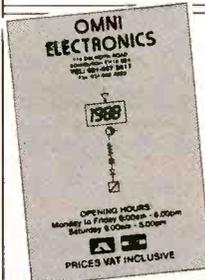
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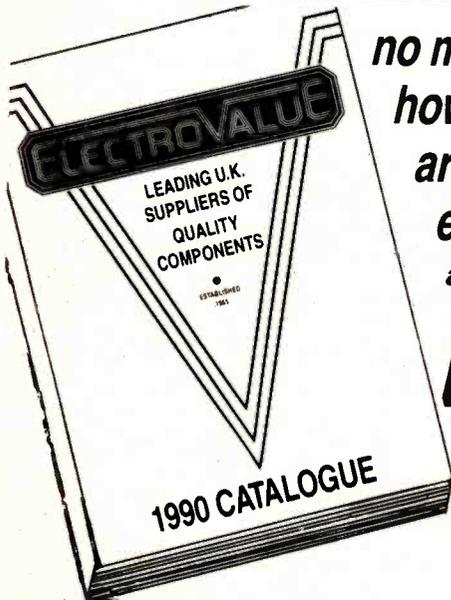
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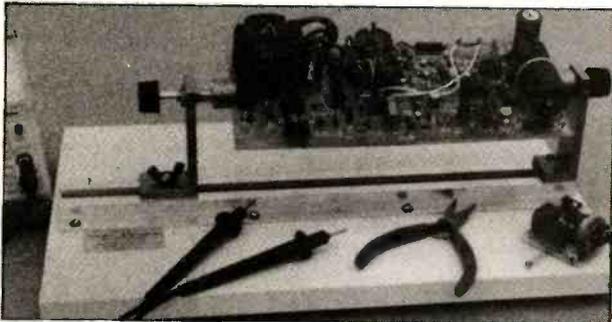
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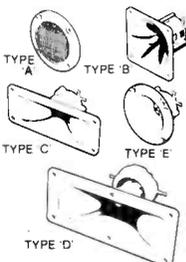
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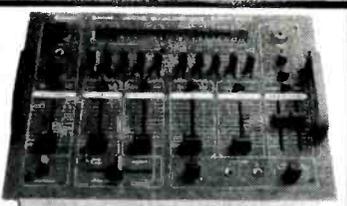
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