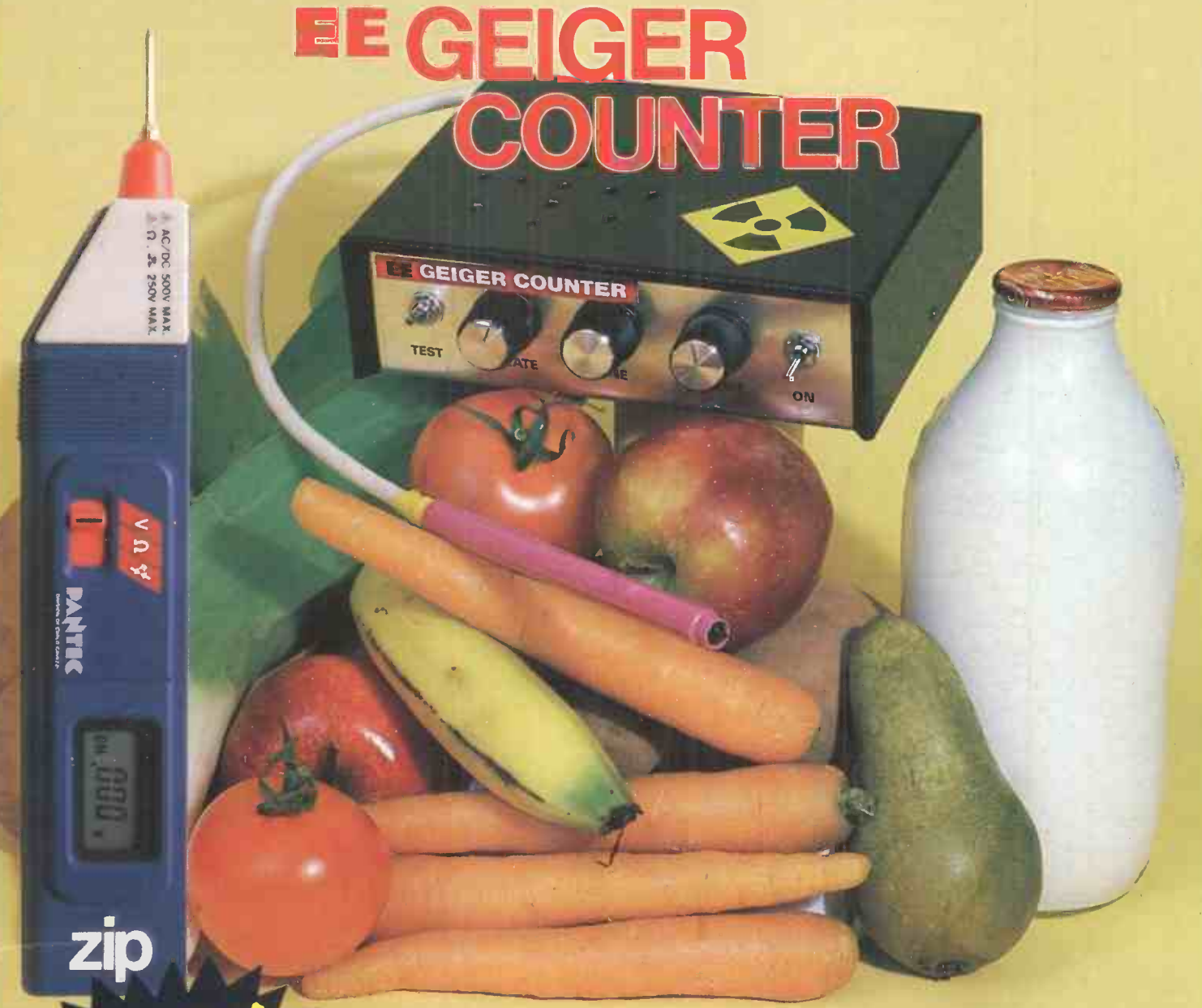
EVERYDAY ELECTRONICS and ELECTRONICS MONTHLY

AUGUST 1986 £1·10



EE GEIGER COUNTER

Special Offer!

MICRO MINI TUNER

zip MULTIMETER

Newcomers Magazine for Electronic & Computer Projects

£1 BAKERS DOZEN PACKS

Price per pack is £1.00.* Order 12 you may choose another free. Items marked (sh) are not new but guaranteed ok.

1. 5 – 13 amp ring main junction boxes
2. 5 – 13 amp ring main spur boxes
4. 5 – surface mounting switches suitably insulated for mains voltage
5. 3 – electrical switches intermediate type, will also replace 1 or 2 way switches, white flush mounting
7. 4 – in flex line switches with neons
9. 2 – mains transformers with 6V 1A secondaries
10. 2 – mains transformers with 12V ½A secondaries
11. 1 – extension speaker cabinet for 6½" speaker
13. 12 – glass reed switches
17. 2 – ultra transmitters and 2 receivers with circuit
19. 2 – light dependent resistors
25. 4 – wafer switches – 6p 2 way, 4p 3 way, 2p 6 way, 2p 5 way, 1p 12 way small one hold fixing and good length ¼" spindle your choice
28. 1 – 6 digit counter mains voltage
30. 2 – Nicad battery chargers
31. 1 – key switch with key
33. 2 – aerosol cans of ICI Dry Lubricant
34. 96 – 1 metre lengths colour-coded connecting wire
39. 1 – long and medium wave tuner kit
41. 8 – rocker switch 10 amp mains SPST
45. 1 – 24 hour time switch mains operated (s.h.)
48. 2 – 6V operated reed switch relays
49. 10 – neon valves – make good night lights
50. 2 – 12V DC or 24V AC, 3 CO relays
51. 1 – 12V 2 CO miniature relay very sensitive
52. 1 – 12V 4 CO miniature relay
53. 2 – mains operated relays 3 x 8 amp changeover (s.h.)
54. 10 – rows of 32 gold plated IC sockets (total 320 sockets)
55. 1 – locking mechanism with 2 keys
56. 1 – miniature uniselector with circuit for electric jigsaw puzzle
60. 5 – ferrite rods 4" x 5/16" diameter aerials
61. 4 – ferrite slab aerials with L & M wave coils
63. 1 – Mullard thyristor trigger module
64. 10 – assorted knobs ¼ spindles
65. 5 – different thermostats, mainly bi-metal types
66. 1 – magnetic brake – stops rotation instantly
67. 1 – low pressure 3 level switch can be mouth operated
69. 2 – 25 watt pots 8 ohm
70. 2 – 25 watt pots 1000 ohm
71. 4 – wire wound pots – 18, 33, 50 and 100 ohm your choice
72. 1 – 1250 watt dimmer Ultra ref SE20
77. 1 – time reminder adjustable 1-60 mins clockwork
81. 2 – 30A panel mounting slyslok fuses
85. 1 – mains shaded pole motor ¾" stack – ¼ shaft
89. 1 – mains motor with gear box 1 rev per 24 hours
91. 2 – mains motors with gear box 16 rpm
96. 1 – thermostat for fridge
98. 1 – motorised stud switch (s.h.)
101. 1 – 2½ hours delay switch
103. 1 – mains power supply unit – 6V DC
104. 1 – mains power supply unit – 4½V DC
105. 1 – 5 pin flex plug and panel socket
107. 1 – 5" speaker size radio cabinet with handle
110. 10 – slider type volume controls
111. 2 – musical boxes (less keys)
112. 1 – heating pad 200 watts mains
113. 1 – FM front end with tuning condenser and data
114. 1 – 1W amplifier Mullard 1172
115. 1 – wall mounting thermostat 24V
118. 1 – teak effect extension 5" speaker cabinet
120. 2 – p.c. boards with 2 amp full wave and 17 other recs
121. 4 – push push switches for table lamps etc.
122. 10 – mtrs twin screened flex white p.v.c. outer
123. 100 – staples for thin flex
124. 25 – clear plastic lenses 1¾ diameter
127. 4 – pilot bulb lamp metal clip on type
128. 10 – very fine drills for pcbs etc.
129. 4 – extra thin screw drivers for instruments
132. 2 – plastic boxes with windows, ideal for interrupted beam switch
134. 10 – model aircraft motor – require no on/off switch, just spin to start
136. 2 – car radio speakers 5" round 4 ohm made for Radiomobile
137. 1 – 6½" 4 ohm 10 watt speaker and 3" tweeter
142. 10 – 4 BA spanners 1 end open, other end closed
145. 2 – 4 reed relay kits 3V coil normally open or c/o if magnets added
146. 20 – pilot bulbs 6.5V.3A Philips
147. 1 – secret switch kit with data
149. 4 – socket covers (protect inquisitive little fingers) for twin 13A
152. 1 – air or gas shut off valve – clockwork operated
153. 1 – air or gas shut off valve – thermostat operated
154. 1 – 12V drip proof relay – ideal for car jobs
155. 3 – varicap push button tuners with knobs
158. 5 – 12 way connector blocks 2A 250V
159. 3 – 12 way connector blocks 25A 250V
162. 1 – 13A fused and switched spur for surface mounting or can be removed from box for flush mounting
163. 3 – 13A sockets good British make but brown
169. 4 – short wave air spaced trimmers 2-30f
171. 1 – shocking coil kit with data – have fun with this
172. 10 – 12V 6W bulbs Philips m.e.s.
178. 3 – oblong amber indicators with lilliputs 12V
180. 6 – round amber indicators with neons 240V
181. 100 – p.v.c. grommets ⅜ hole size
182. 1 – short wave tuning condenser 50 pf with ¼" spindle
184. 1 – three gang tuning condenser each section 500 pf with trimmers and good length ¼" spindle
188. 1 – plastic box sloping metal front, 16 x 95mm average depth 45mm
2 – double pole 20 amp 250V flush mounting switch – white
191. 6 – B.C. lamp holder adaptors white
193. 6 – 5 amp 3 pin flush sockets brown
195. 5 – B.C. lampholders brown bakelite threaded entry
196. 1 – in flex simmerstat for electric blanket soldering iron etc.
197. 2 – thermostats, spindle setting – adjustable range for ovens etc.
199. 1 – mains operated solenoid with plunger 1" travel
200. 1 – 10 digit switch pad for telephones etc.
201. 8 – computer keyboard switches with knobs, pcb or vero mounting
206. 20 – mtres 80 ohm, standard type co-ax off white
211. 1 – electric clock mains driven, always right time – not cased
216. 1 – stereo pre-amp Mullard EP9001
232. 2 – 12V solenoids, small with plunger
236. 1 – mains transformer 9V 1 amp secondary C core construction
241. 1 – car door speaker (very flat) 6½" 15 ohm made for Radiomobile
241. 2 – speakers 6" x 4" 4 ohm 5 watt made for Radiomobile
243. 2 – speakers 6" x 4" 16 ohm 5 watt made for Radiomobile
244. 1 – mains motor with gear-box very small, toothed output 1 rpm
245. 4 – standard size pots, ¼ mog with dp switch
249. 1 – 13A switched socket on double plate with fused spur for water heater
266. 2 – mains transformers 9V ½A secondary split primary so ok also for 115V
267. 1 – mains transformers 15V 1A secondary p.c.b. mounting
289. 50 3.5V torch bulbs
290. 3 7" reel to reel tape spools
291. 1 ten turns 3 watt pot ¼ spindle 100 ohm
292. 5 two plate brown bakelite ceiling roses
293. 50 silicon diodes mixed unmarked
294. 50 Germanium transistors mixed and unmarked
295. 10 round pointer knobs ¼ spindle
296. 3 car cigar lighter socket plugs
297. 1 cover for 24hr time switch ref BD45
298. 2 15 amp round pin plugs brown bakelite
300. 1 mains solenoid with plunger compact type
301. 10 ceramic magnets Mullard 1" x 3/8 x 5/16
303. 1 12 pole 3 way ceramic wave charge switch
304. 1 stereo amp 1 watt per channel
305. 1 tubular dynamic microphone with desk rest
306. 1 module, speaker & battery to make musical card
307. 5 thermal fuses 15 amp woods metal
308. 1 T.V. turret tuner (black & white T.V.)
309. 12 adaptable legended knobs ¼" spindle
310. 2 oven thermostats
311. 1 Clare Elliot sealed relay 12V
312. 1 pressure pad switch 24 x 18 (Trigger Mat)
313. 5 sub miniature micro switches
314. 1 12" 8 watt min fluorescent tube white
315. 1 6" 4 watt min fluorescent tube white
316. 1 round pin kettle plug with moulded on lead

MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules – i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for £6.00 plus £2 postage. For prices of modules bought separately see TWO POUNDERS.

CAR STARTER/CHARGER KIT

Flat Battery! Don't worry you will start your car in a few minutes with this unit – 250 watt transformer 20 amp rectifiers, case and all parts with data £16.50 or without case £15.00 post paid.

Ex-Electricity Board. Guaranteed 12 months.

VENNER TIME SWITCH

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

SOUND TO LIGHT UNIT

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

12 volt MOTOR BY SMITHS

Made for use in cars, etc. these are very powerful and easily reversible. Size 3½" long by 3" dia. They have a good length of ¼" spindle –
1/10 hp £3.45
1/8 hp £5.75. 1/6 hp £7.50

25A ELECTRICAL PROGRAMMER

Learn in your sleep. Have radio playing and kettle boiling as you wake – switch on lights to ward off intruders – have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. A beautiful unit at £2.50

THE AMSTRAD STEREO TUNER

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio – easy to carry about and which will give you superb reception. Other uses are a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.
Some of the features are: long wave band 115 – 170KHz, medium wave band 525 – 1650KHz, FM band 87 – 108 MHz, mono, stereo & AFC switchable, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or headphones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands). All made up on very compact board.
Offered at a fraction of its cost only £4.95

GOODS ARE ON APPROVAL

these notes are often hastily written and technical information sheets are seldom available about the items we have to describe, also advertisements sometimes go to press without our having a chance to correct any mistakes, however, everything we sell is supplied on the understanding that if it is not suitable for your project you may return it within 7 days for credit. If there was a definite error of description in our copy then we will pay postage. If not, then you pay the postage. Note this offer applies to kits, but only if construction is not started.

FANS & BLOWERS

Woods extractors
5" £5 + £1.25 post. 6" £6 + £1.50 post
4" x 4" Muffin equipment cooling fan 115V £2.00
4" x 4" Muffin equipment cooling fan 230/240V £5.95
5" Plannair extractor £5.50
9" Extractor or blower 115V supplied with 230 to 115V adaptor £9.50 + £2 post.
All above are ex computers but guaranteed 12 months.
10" x 3" Tangential Blower. New. Very quiet – supplied with 230 to 115V adaptor on use two in series to give long blow £2.00 + £1.50 post or £4.00 + £2.00 post for two.

IONISER KIT

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

TELEPHONE BITS

Master socket (has surge arrestor – ringing condenser etc) and takes B.T. plug..... £3.95
Extension socket..... £2.95
Dual adaptors (2 from one socket)..... £3.95
Cord terminating with B.T. plug 3 metres..... £2.95
Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 BT extension sockets..... £11.50

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
128 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QL

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. Brighton 0273 734648. Bulk orders: write for quote.

OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's dozen range and you become entitled to a free gift with each dozen pounds you spend on these packs. A classified list of these packs and our latest "News Letter" will be enclosed with your goods, and you will automatically receive our next news letters.

TWO POUNDERS*

2P2 –Wall mounting thermostat, high precision with mercury switch and thermometer
2P3 –Variable and reversible 8-12v psu for model control
2P4 –24 volt psu with separate channels for stereo made for Mullard UNILEX
2P6 –100W mains to 115V auto-transformer with voltage tappings
2P7 –Mini key, 16 button membrane keyboard, list price over £12
2P8 –Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
2P9 –Time and set switch. Boxed, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters
2P10 –12 volt 5 amp mains transformer – low volt winding on separate bobbin and easy to remove to convert to lower voltages for higher currents
2P11 –Power amp module Mullard Unilex EP9000 (note stereo pre-amp module Unilex 9001 is BD216
2P12 –Disk or Tape precision motor – has balanced rotor and is reversible 230v mains operated 1500 rpm
2P14 –Mug Stop kit – when thrown emits piercing squawk
2P15 –Interrupted Beam kit for burglar alarms, counters, etc.
2P17 –2 rev pr minute mains driven motor with gear box, ideal to operate mirror ball
2P18 –Liquid/gas shut off valve mains solenoid operated
2P19 –Disco switch-motor drives 6 or more 10 amp change over micro switches supplied ready for mains operation
2P20 –20 metres extension lead, 2 core – ideal most Black and Decker garden tools etc.
2P21 –10 watt amplifier, Mullard module reference 1173
2P22 –Motor driven switch 20 secs on or off after push
2P24 –Clockwork operated 12 hour switch 15A 250V with clutch
2P26 –Counter resettable mains operated 3 digit
2P27 –Goodmans Speaker 6 inch round 8ohm 12 watt
2P28 –Drill Pump – always useful couples to any make portable drill
2P29 –24 position Yaxley switch contacts rated 5A – ¼ spindle
2P31 –4 metres 98 way interconnecting wire easy to strip
2P32 –Hot Wire amp meter – 4½ round surface mounting 0–10A – old but working and definitely a bit of history
2P34 –Solenoid Air Valve mains operated
2P35 –Battery charger kit comprising mains transformer, full wave rectifier and meter, suitable for charging 6v or 12v
2P38 –200 R.P.M. Geared Mains Motor 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc.
2P42 –Tubular heater, 60 watts per ft, unsused but slightly storage soiled, made by G.E.C. Perfect order (must be collected by appointment as 12ft long)
2P43 –Small type blower or extractor fan, motor inset so very compact, 230V
2P46 –Our famous drill control kit complete and with prepared case.
2P47 –Joy switch kit complete as previously sold.
2P48 –Telephone ringing unit reduces mains to 50 volts and changes frequency from 50 hz to 25 hz to give right ringing tone.
2P49 –Fire Alarm break glass switch in heavy cast case
2P51 –Stereo Headphone amplifier, with pre-amp
2P55 –Mains motor, extra powerful has 1½" stack and good length of spindle
2P62 –1 pair Goodmans 15 ohm speakers for Unilox
2P63 –1 5Kv 20 mA mains transformer ex-equipment
2P64 –1 five bladed fan 6½" with mains motor
2P66 –1 2Kw tangential heater 115v easily convertible for 230V
2P67 –1 12v–0–12v 2 amp mains transformer
2P68 –1 15v–0–15v 2 amp mains transformer
2P69 –1 250v–0–250v 60 mA & 86.3v 5A mains transformer
2P70 –1 E.M.I. tape motor two speed and reversible
2P71 –1 PAPST 240 5 hz motor
2P72 –1 115v Muffin fan 4" x 4" approx.
2P75 –1 2 hour timer, plugs into 13A socket
2P76 –1 audax tweeter partner to 5P26 speaker
2P77 –1 instrument box with key size 12" x 4½" wide 6" deep
2P82 –9v–0–9v 2 amp mains transformer
2P84 –Modern board with press keys for telephone redialler
2P85 –20v–0–20v ½A Mains transformer
2P88 –Sangamo 24 hr time switch 20 amp S.H.
2P89 –120 min. time switch with knob
2P90 –90 min. time switch with edgewise engraved controller
2P92 –Bailey & Macky pressure switch 50 p.s.i.
2P94 –Telephone handset for EE home telephone circuit

£5 POUNDERS*

1. 12 volt submersible pump complete with a tap which when brought over the basin switches on the pump and when pushed back switches off, an ideal caravan unit.
2. Sound to light kit complete in case suitable for up to 750 watts.
3. Silent sentinel ultra sonic transmitter and receive kit, complete.
4. Dial indicator, measures accurately down to .01mm, "John Bull" or equally first-class make, a must for toolmaker or lathe worker.
5. 250 watt isolating transformer to make your service bench safe, has voltage adj. taps, also as it has a 115V tapping it can be used to safely operate American or other 115V equipment which is often only insulated to 115V. Please add £3 postage if you can't collect as this is a heavy item.
6. 12V alarm bell with heavy 6" gong, suitable for outside if protected from direct rainfall. Ex GPO but in perfect order and guaranteed.
7. Tape punch and matching tape reader, not new but believed in perfect working order if not so we would repair or replace within 12 months. Please add £2.50 postage.
8. Sensitive voltmeter relay, this consists of a 4½" dia moving coil meter with electronics (we will supply cct. dig.) over £120 each, they are new and still in maker's boxes.
9. Box of 25 fluorescent tubes 40 watt daylight or warm white ideal window pelmets, signs, etc. Please collect or add £2 postage.
10. Box of 25 18" fluorescent tubes assorted colours, please collect or add £2 postage.
11. 24 x 8 ft 85-120 watt warm white tubes. Ideal plant growing. Collect or send open cheque to cover carriage.
12. Equipment cooling fan – minin snail type mains operated.
13. Ping pong ball blower – or for any job that requires a powerful stream of air – ex computer. Collect or add £2 post.
14. Uniselector 360 degrees rotation, 5 poles, 50 ways, 50V coil.
15. Washing machine water pump, main motor driven so suitable for many applications.
16. Control panel case, conventional design with hinged front and finished metallic silver, easily arranged as lockable size approx. 15" x 10" x 5½", wall mounting.
17. Two kits: surveillance transmitter and FM receiver.
18. Washing machine pump with motor.
24. ½ hp motor ex computer. Add £2 if not collecting.
25. Mood lighting switch. 6 plus changes hourly.
26. Audax 35 watt 8" 8 ohm speaker.
34. 24 volts 5 amp Torroidial mains transformer.
35. Modern board with 12 contact pad switch.
37. 24 hr. time switch with clockwork reserve 2 on/off. Plus £1 if not collected.
94. Prestel unit. New, complete except for some i.c.s.

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EVERYDAY ELECTRONICS and ELECTRONICS MONTHLY

ISSN 0262–3617

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

exploring electronics

OWEN BISHOP

SEE PAGE 420

Projects

Series

Features

Our September 1986 issue will be published on Friday, 15 August. See page 417 for details.

Readers' Services ● Editorial and Advertisement Departments 399

The CMC Components

42 Clifton Industrial Estate, Cherry Hinton Rd, Cambridge CB1 4ZZ
Telephone: (0223) 213374

Ordering: All components are brand new and to full specification. Please add 65p postage/packing (unless otherwise specified) to all orders and then add 15% VAT to the total. Minimum order £5.00. Either send cheque/cash/postal order or send/telephone your credit card number. Official orders from schools, universities, colleges etc most welcome.

Credit Cards welcome
Trade counter open: Mon to Sat 9.00 - 5.00

TTL74

7400	20	7432	28
7401	20	7437	28
7402	20	7440	24
7403	24	7451	30
7404	24	7470	45
7405	24	7473	40
7406	37	7474	35
7407	24	7483	80
7408	24	7485	95
7410	24	7486	34
7412	24	74121	44
7416	34	74123	72
7417	34	74147	125
7420	24	74164	100
7423	30	74176	75
7428	30	74192	100
7430	22	74198	185

74LS

LS00	15	LS154	90
LS01	15	LS155	41
LS02	15	LS156	48
LS03	18	LS157	30
LS04	15	LS158	32
LS05	15	LS160	48
LS08	15	LS161	50
LS09	18	LS163	46
LS10	15	LS164	44
LS11	15	LS165	65
LS12	18	LS166	74
LS13	22	LS168	90
LS14	28	LS169	65
LS15	15	LS170	80
LS20	15	LS173	80
LS21	15	LS174	40
LS22	18	LS175	40
LS26	15	LS190	55
LS27	15	LS191	52
LS28	15	LS192	52
LS30	15	LS193	50
LS32	17	LS195	52
LS33	18	LS196	62
LS37	16	LS197	55
LS38	17	LS221	55
LS40	16	LS240	55
LS42	32	LS241	55
LS48	55	LS242	55
LS54	16	LS243	60
LS73	30	LS244	50
LS74	24	LS245	50
LS75	28	LS247	50
LS76	28	LS249	90
LS78	28	LS251	30
LS83	42	LS253	50
LS85	45	LS257	42
LS86	30	LS260	40
LS90	32	LS266	30
LS92	38	LS273	52
LS93	30	LS279	40
LS95	48	LS280	140
LS96	60	LS283	70
LS107	32	LS290	30
LS109	34	LS293	30
LS112	36	LS295	125
LS114	35	LS298	100
LS123	42	LS299	200
LS124	84	LS348	135
LS125	36	LS353	84
LS126	36	LS363	135
LS132	40	LS366	36
LS133	34	LS367	36
LS136	36	LS373	55
LS138	36	LS374	55
LS139	36	LS375	60
LS145	82	LS378	84
LS151	82	LS393	50
LS153	40	LS395	98

VOLTAGE REGULATOR

7805	35	7912	40
7812	35	7915	40
7815	35	7918	40
7818	35	7924	40
7824	35	LM323K	400
7905	40		

DIL SOCKETS

low profile

8 pin	5
14 pin	8
16 pin	9
18 pin	10
20 pin	12
22 pin	14
24 pin	16
28 pin	18
40 pin	20

SWITCHES

DIL 4 way	65
6 way	75
8 way	80
10 way	95
Sub-min Toggle 240v 2A	
SPST (2 tag)	55
SPDT (3 tag)	60
DPDT (6 tag)	55
240V 1A	
SPST (2 tag)	55
SPDT (3 tag)	60
SPDT (3 tag centre off)	65
DPDT (6 tag)	65
DPDT (6 tag centre off)	80
Rockers	
10A/250v SPST	25
10A/250v SPDT	35
10A/250v SPST (neon)	80

CRYSTALS

100kHz	360
200kHz	350
1.0MHz	260
1.008MHz	260
1.8432MHz	175
2.0MHz	180
2.4576MHz	85
3.278MHz	100
4.0MHz	90
5.0MHz	120
6.0MHz	80
6.114MHz	105
8.0MHz	80
10.0MHz	80
12.0MHz	80
16.0MHz	80
18.0MHz	90
20.0MHz	120

RIBBON CABLES

	price/ foot	100ft
10way	14	700
16way	24	1100
20way	28	1400
24way	36	1700
26way	38	1800
28way	50	2000
34way	58	2100
40way	67	2700
50way	84	3400

COMPUTER IC's

ET41116-3	75
UPD41256-15	400
HM4864-15	200
HM6116-3	150
R6532	500
R6551	525
F6800	200
MC6802	250
MC6809	550
F6821	150
MC6840	350
MC6845	600
DP8216	150
Z80A SIO	650
Z80A CTC	250
Z80 PIO	250
Z80A DART	660
Z80 CPU	180
2764-25	200
27128-25	240

LINEAR

LM 301	25	LM388	100
LM310	60	LM389	160
LM311	35	LM556	90
LM318	130	LM557	90
LM319	160	LM709	35
LM324	35	LM723	40
LM339	40	LM747	60
LM348	60	MC1488	70
LM387	100	MC1489	70

CMOS

4000	13	4050	20
4002	13	4051	38
4006	35	4052	37
4007	37	4053	37
4009	20	4060	40
4011	13	4066	20
4012	13	4068	15
4013	20	4069	15
4015	34	4070	15
4016	18	4071	15
4017	32	4072	15
4018	33	4073	15
4019	28	4075	15
4020	35	4076	45
4021	36	4077	15
4022	36	4078	15
4023	15	4081	15
4024	25	4082	13
4025	13	4085	40
4027	18	4089	80
4028	30	4093	20
4029	35	4099	45
4031	90	40106	40
4034	80	40107	55
4035	45	4501	30
4038	50	4510	38
4040	35	4511	40
4042	30	4516	40
4043	36	4517	120
4044	38	4518	38
4046	45	4519	30
4047	45	4520	36
4049	20		

DISC DRIVES (uncased)

400k 5.25 TEAC Slimline	£99
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ACY22	110	BC208	10	BC549	10
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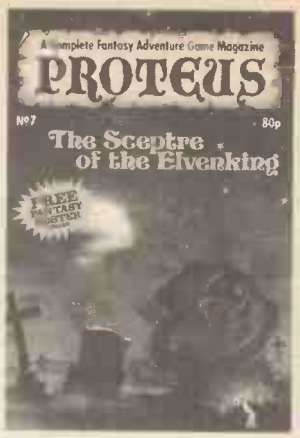

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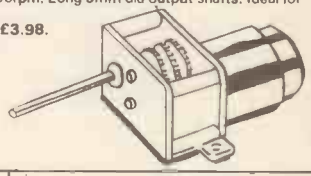

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EVERYDAY ELECTRONICS and ELECTRONICS MONTHLY

VOL 15 Nº8 AUGUST '86

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BRITISH SCHOOLS TECHNOLOGY

IN APRIL 1984 British Schools Technology (BST) was set up with funding from the Department of Trade and Industry and the Manpower Services Commission. BST is charged with taking all practical steps to promote and develop technological education in schools and colleges throughout the UK. The aim of the DTI was that BST should be self-funding within approximately three years of its life—something which is perhaps a little surprising for an "educational" body to have to achieve. However, it seems that BST is well on the way to self financing; it now generates a large proportion of its own funds and hopes to become independent next year.

BST now operates from two centres, one in Carlton, Bedfordshire, which was recently opened, and the other at Trent Polytechnic. The new centre at Carlton is said to be one of the most advanced in the world with training facilities, laboratories and residential blocks for teachers. The centre also converts buses to mobile high technology centres for local authorities. Already 85 per cent of local education authorities have used BST's services and BST is in the process of retraining 7,000 teachers by the end of this year; teachers who will be capable of teaching technology in our schools. In addition to this, BST trains technicians, offers a consultancy service on equipment for schools and assists with curriculum development.

BST WHO?

Personally I find this all very pleasing and interesting—what perhaps is amazing is that most people have never heard of BST or are even vaguely aware of its work. My children are at the age where technology is beginning to be part of their education and I suppose I am more aware of technology in education than most parents, but BST had escaped me. Surprisingly, teachers I have spoken to are also unaware of BST or its work. I am sure many parents would be pleased to know what is being done to educate children in technology, that teachers are being retrained and that mobile technology units are becoming available. I feel that there may be areas where smaller companies and even parents would be willing to help with loan of equipment, gifts of components or donations etc., if only a little publicity and public relations were put behind such schemes. So come on BST, let us know of your good work—even some information which could be duplicated in schools and sent to parents would spread the word at very little cost.

Children and parents were disturbed by industrial action in the teaching profession last year. The effort and work of dedicated teachers in this and other areas needs underlining to regain good relationships and develop the standing, and perhaps financial support, of education in the UK.

Mike Kenward

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All reasonable precautions are taken to ensure that the advice and data given to readers is reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it.

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JOHN BECKER

The nature of radiation and a means to detect it. Check your surroundings and food, etc.

THE problems of nuclear radiation have been greatly emphasised since the disaster at Chernobyl. Although this is the most serious accident in the history of atomic power stations, it follows numerous other reported incidents. Previously the worst accident was at the American Three Mile Island in 1981. Frequent minor incidents though, have been reported about nuclear establishments in other areas, including Britain. The authorities concerned deny that we in this country have anything to fear, but both media and public statements affirm the disquiet widely felt.

In researching for this article, it was found that enquiries about Geiger counters were high. Some distributors reported rapid stock depletion of commercial counters, and the tubes that drive them. It is understood that even in the U.S.A, Geiger counter sales rose following the announcement from Chernobyl, even though it seems improbable that the effects could be apparent at such distances.

With public concern at its present level, this is an opportune moment to briefly summarise the nature of radiation, and to describe a simple detection method. It is emphasised though, that although it is a practical working unit, it is not a precision instrument. Where it is vital to know accurate radiation data, calibrated commerical instruments should be used by experienced personnel.

The essential purpose of this project is to check for unusual levels of radiation and to show that radiation can be detected from the natural sources all around us. These range from emissions from ancient rocks of various types, some luminous clock faces, and even high voltage TV tubes. The ethics of nuclear power will not be discussed, though the author's belief is that a technological society relying heavily on power via a plug, needs satisfactorily controlled atomic energy.

NUCLEAR ACTIVITY

The commercial use of nuclear power is a recent situation, but atomic radiation from natural sources has always existed, and will until the end of time. The very existence of ourselves and the entire universe depends on the forces responsible for the creation of radiation.

Any matter, whether it is part of an animal, plant, rock, liquid or gas, is made up of elements. There are over one hundred of these basic building blocks, ranging from hydrogen which is the smallest, to uranium and beyond. The smallest part that defines an element is the atom. This consists of three basic forms, protons, neutrons, and electrons. Although capable of further subdivision, the nature of a substance depends on the various quantities of these defined parts.

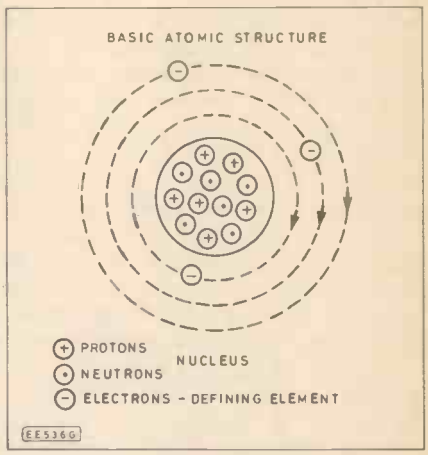


Fig. 1. Basic atomic structure.

The centre of an atom is called the nucleus. It consists of varying quantities of positively charged protons, plus neutrons without any electrical charge (Fig. 1). Spinning around the nucleus, like a planet round the sun, are negatively charged electrons. The definition of an atom's type is determined by the quantity of electrons held in orbit. Hydrogen has one, helium has 2, uranium has 92. The full table consists of all elements known, not only those occuring naturally, but also some that can be created scientifically, such as plutonium.

Normally, the naturally occuring elements have atoms that are stable. The only one that does not, is uranium. Should a free neutron collide with a uranium atom with sufficient impact, the forces holding it together will be disrupted. It will break apart, typically into two nearly equal sections, and release two or more neutrons from its nucleus. They fly out at vast speeds, and if they collide with another unstable atom, that likewise will disintegrate, and a chain reaction develops. The total mass of the remaining and dispersed particles is less than the original total. The difference between the two is contained in the energy released at heat. In the sun, different nuclear reactions, called fusion reactions, involving hydrogen rather than uranium are occuring all the time. Our planet is warmed by the radiated heat by-product, and our lives depend on it. In nuclear power stations, the chain reaction is controlled by sophisticated processes, and the heat is harnessed to power steam turbines for electricity production.

Although elements are defined by the number of electrons around the atom, their nature also depends on the make up of the

nucleus. This can consist of protons and neutrons in quantities varying from the norm, resulting in elemental structures known as isotopes. Such substances have identical chemical properties, but their physical attributes are different. Throughout nature they occur in most elements. Hydrogen, for example, usually has a nucleus comprising one proton, but frequently can have a neutron as well when it becomes known as Deuterium. Occasionally it can have two neutrons extra, and is then known as Tritium. Many others are simply known by their numbers, such as the three isotopes of potassium, numbered 39, 40 and 41.

MUTATIONS

Some isotopes are inherently unstable, being created spontaneously by impact from free travelling atomic particles. Such isotopes may only hold their new form for short periods, eventually radiating off their excess mass. Instruments can detect the course of these events, hence the use of isotopes in medical applications.

However, some forms may be harmful since life depends on the stability of its elements. Disruption to the make up of essential atoms can cause adverse behaviour in an organism. Random cosmic events may create new isotopes at various times throughout its life, and probably the rarity of the changes may have no significant effect. But if sufficient changes occur from exposure to large quantities of radiation, disastrous consequences can result through cell tolerances being exceeded.

In intense radioactive situations, the changes can rapidly cause death. In other cases, the changes may not show until many years later, depending on the nature of the disruption. Leukaemia and other cancers are notorious consequences of excess radiation. Alternatively, the changes may not affect the individual directly, but instead cause changes to its reproductive system, modifying the gene structure. Offspring may then become the mutant inheritors of the consequences.

Not all mutations are bad though, some may well be evolutionarily beneficial. Assuming the correctness of the theories first summarised by Darwin, all life forms have progressed in response to genetic change. But despite this, it is undeniable that some mutations are inherently hostile, resulting in malformation of body shape, brain tissue, resistance to disease and so on. Although a few mutant forms may be incapable of reproduction, so allowing the strain to become extinct, other adverse characteristics could be passed down many generations. Consequently the use of nuclear power must be tightly controlled to eliminate the risk of change from excessive radiation.

At present there is disagreement about safe radiation levels, but possibly information from Chernobyl, and re-examination of the 1945 Hiroshima data may well yield revised safety tables.

EMISSION TYPES

Fortunately, most particles and radiations from radioactive isotopes lose their energy quite quickly as they pass through the atmosphere. The three primary emission types from nuclear activity are known as alpha, beta particles, and gamma radiation (Fig.2). Of the three, alpha has the least penetrating power, being readily stopped by paper or skin, but it causes the most damage if it comes from radioactivity which has somehow got into the body for instance by breathing it in or eating contaminated food. It consists of streams of small particles containing two protons and two neutrons. Even in air it can only travel a few centimetres.

Beta particles are streams of free electrons, losing their power within several metres in air, and can be easily blocked by 6mm thick aluminium. Gamma rays are electromagnetic radiation with frequencies in the 10^{18}Hz to 10^{20}Hz region. They are more penetrating, but still can be stopped by thick concrete or lead.

The ability to radiate is determined not only by the source type, but also by its intensity and age. Whenever radioactive materials decay they try and turn into something more stable. The rate at which this occurs is defined in half-lives. This term is the measure by which a given level of radioactivity will decay to half the original level. For some materials the rate is rapid; others have half lives spread over billions of years.

The isotope argon 41 has a half life of 1·8 hours, iodine 131 has 8·1 days and carbon 14 is quoted at 5736 years. Uranium 238 though takes 4·5 billion years to reach half

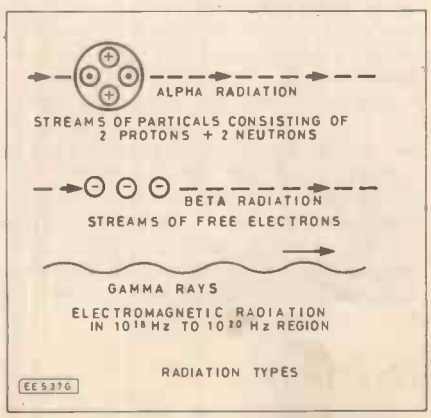


Fig. 2. Radiation types.

level. This coincides with the estimated age of the earth. Given sufficient time to decay by many half lives, radiation will practically disappear from a particular source.

In archaeology this fact is used for assessing the age of excavated remains. Since the decay rate of each isotopic element is known, the prevailing level in materials can be determined, and their age calculated. Carbon 14 dating is the commonest technique used. This isotope has six protons and eight neutrons, compared with six of each in normal carbon. Cosmic rays form carbon 14 constantly in the atmosphere and so a background level is absorbed by various organisms. Knowing its half life, the level acquired at formation can be compared against its current level to establish its age. Calculations can be complex though, since the excavated sample may also contain carbon that was irradiated in an earlier cycle.

GEIGER COUNTERS

Many types of detector are available for measuring different radiation types and intensities. Commercially available units can cost from more than a hundred pounds and well beyond. Generally known as Geiger counters, after Hans Geiger who lived from 1882 to 1947, their fuller name is actually Geiger-Muller counters. Although they may frequently be used as counters in the usual sense, a count in Geiger terms simply means that an event has been registered. Often count monitoring is not done by a digital display, but more likely is shown as a meter deflection or just an audio output of clicks.

The EE Geiger Counter to be illustrated here falls into the latter category, though it does have a secondary output suitable for feeding to a metering or conventional counting device, including a computer. It contains its own internal speaker, but may also be used with headphones. It is a portable unit, drawing about 30mA from a nine volt battery. The exact current drawn will depend on the setting up and could rise to 40mA if the adjustment is imprecise, making a PP6 or PP7 preferable. The latter just fits in with a tight squeeze.

In addition to the essential detection and monitoring sections, it has been designed to include a simple pre-test circuit. This permits easy testing to be carried out before the Geiger-Muller tube is connected. Ideally, a voltmeter will also be needed to set the voltage multiplier driving the tube, though it is not essential. The box used measures 15·5 × 11·2 × 5cm.

G-M tubes are very simple in principle. They consist of an anode wire held at a high potential, and a cathode shield surrounding the wire (Fig. 3). These are enclosed in a glass and mica envelope filled with one or more rare gases. A resistor is used in series

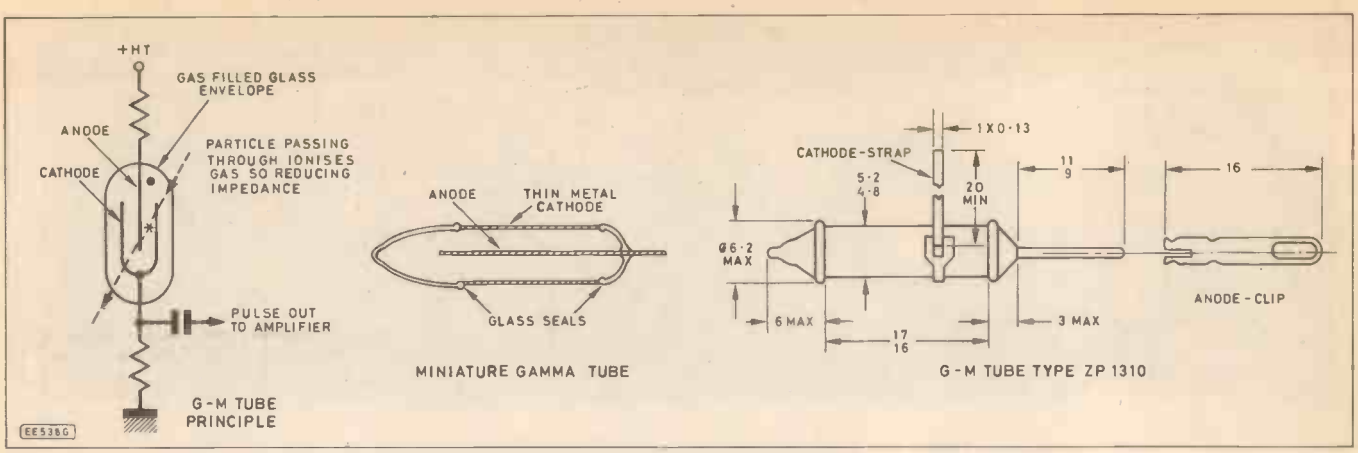


Fig. 3. The Geiger Muller tube principle and construction.

with the anode, and when incoming atomic particles and radiations pass through the tube the gas is briefly ionised. The impedance between the anode and cathode is reduced during ionisation, and the potential seen at the anode resistor falls. One of the gases contained is usually a quenching agent that restores the ionised gas to its original state once the particle has passed through. The anode potential then rises again. The resulting pulse can be amplified and fed to the chosen monitoring circuit.

Typically the anode potential needed is between 450V and over a 1000V, depending on the tube type. The unit here is designed for either of two tubes, the Mullard ZP1300 or ZP1310. Respectively, they have a working voltage requirement of 550V and 575V. There is little price difference, but the ZP1310 is recommended as it is more sensitive.

In a simple unit, precise voltage control is not essential, and the tubes have a wide range within which they can operate. Anode potentials below about 400V are insufficient to allow the gas to ionise. The level at which this begins is known as the starting voltage (Fig. 4). As the voltage is increased, sensitivity to incoming particles increases sharply. Then at a level known as the Geiger point, the detection sensitivity rises only slowly on a plateau set against increasing voltage. This extends for a hundred volts or so. Beyond that higher voltages will increase the sensitivity, but will shorten tube life. The usual voltage setting is at the middle of the plateau range.

Sensitivity and tube life also depend on the anode resistor value. The above two tubes need a minimum of 2M2, but to extend tube life, a higher value may be preferable. Under normal conditions a tube will remain useful for over 500 billion counts.

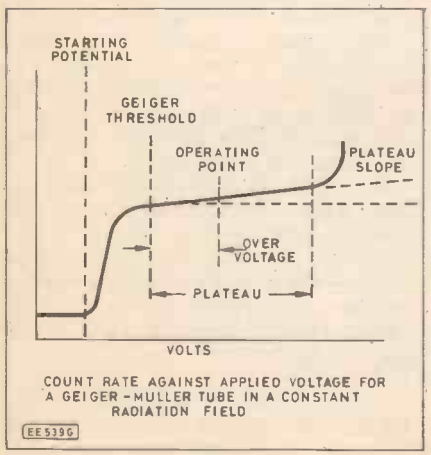


Fig. 4. Graph showing count rate against applied voltage.

POWER SUPPLY

Since tube operation is determined by the anode potential, the power supply is the first consideration. Although the unit is run from a nine volt battery, higher voltages can readily be generated by using an inverter circuit. Instead of employing an expensive high voltage step-up transformer to produce the needed level, a voltage multiplier is used in conjuntion with a reverse-connected mains transformer. These are normally used with frequencies of 50Hz, but they will still transfer current when driven by frequencies of several kilohertz.

The two secondary windings are used in series with two transistors, TR1 and TR2, as shown in Fig. 5. Their intercoupling via R1, R2 and C1 forms a tuned circuit that oscillates at around 5kHz, with a level set by the current through VR1, VR2 and R3. The a.c. waveform is stepped up by the reversed transformer, and about 130V a.c. appears at the primary winding (now being used as a secondary winding). The exact level will vary with the load applied. The capacitor and diode network following, is the multiplier. Diodes D1 to D3 rectify the waveform to a positive d.c. voltage. Bypass capacitor C20 adds the a.c. level to the d.c. and then D4 rectifies the final voltage and stores it at C5 to C7. Depending on the setting of the emitter loads of TR1 and TR2, the voltage here can be around 600V.

This voltage is not dangerous since the current that can be drawn is very low, but it is still preferable not to touch any unprotected part of the multiplier circuit. If it is touched, the effect may be a bit startling, but no more so than receiving a kick from static electricity.

Switch S1b following R4 ensures capacitive discharge when the unit is switched off so that the board can be worked on in comfort. Although three capacitors are shown in series at D4, this is only because those available had a maximum working voltage of 250V. A single capacitor of around 700V is equally suited. The same reasoning applies to C3 and C4, but at a lower voltage.

PSU TESTING

When assembling the unit, it is best to have the high voltage supply working before connecting the G-M tube. This is where a voltmeter is really needed, though setting up without one is described later. The voltmeter should have an impedance, of at least twenty kilohms per volt, and preferably as high as possible since probing the h.t. will load it, and pull the voltage down a bit. First set VR1 and VR2 at maximum resistance. With the meter on an a.c. range suitable for about 9V, check that an a.c. voltage appears at both sides of the transformer secondary windings connected to TR1 and TR2. Adjusting either VR1 or VR2 should vary this up and down, with a maximum of 9V. Switch the meter to an a.c. range above 150V. Probe the connection of the primary winding and C2. Vary VR1 or VR2 and check that around 120V a.c. can be produced. Switch now to the d.c. range for at least 600V. Probe the junction of D4 and C5 and adjust VR1 for roughly the voltage needed by the G-M tube (500V for the ZP1300 and 575V for the ZP1310). Now set this a little more accurately by fine tuning VR2. If a 20k/V meter is being used set the level about 10V below the exact value since it will rise once the meter is removed. If an electronic meter or d.v.m. of much higher impedance is used the voltage can be set to much nearer the correct level with the meter connected. During battery life, the voltage will fall, and it is worthwhile checking it periodically. Once satisifed the rest of the circuit can be assembled.

EVENT DETECTION

On the cathode side of the G-M tube is R5. As particle events cause a discharge through the tube, a small proportion of the conducted voltage will appear on this resistor, probably at about 0·5V in level. This passes through S2a to the pulse amplifier around IC1a, which pulls up the level to about 8V maximum. The amplifier gain can be adjusted by VR3 if full output swing is not needed. If final output level is unimportant, set VR3 at maximum resistance and ignore it.

The pulse length at R5 will have a very short duration, and will probably only be seen on an expensive oscilloscope. (A scope is not needed though to build this project). The pulse length is extended after IC1a. The immediate rise in level caused by the pulse is passed via D5 to C9 which charges rapidly. As the original pulse dies, the charge will decay from C9 at a slower rate, as set by the current flowing back through R9. The effective pulse length is thus extended to several milliseconds, which is long enough for monitoring.

External equipment, such as counters,

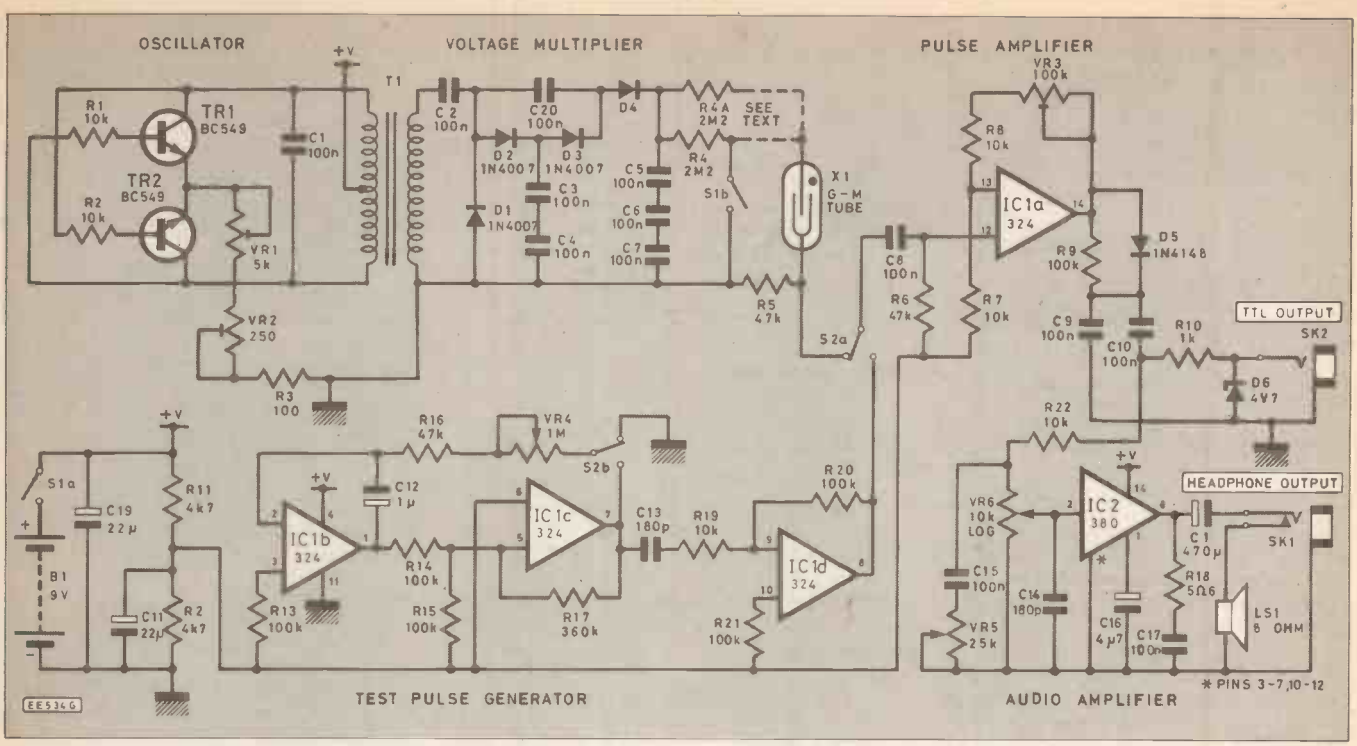


Fig. 5. Circuit diagram of the EE Geiger Counter.

COMPONENTS

Approx. cost Guidance only **£50**

See Shop Talk page 436

Resistors

R1,R2,R7,R8,R19,R22	10k (6 off)
R3	100
R4,R4A	2M2 (2 off, see text)
R5,R6,R16	47k (3 off)
R9,R13 to R15,R20,R21	100k (6 off)
R10	1k
R11,R12	4k7 (2 off)
R17	360k
R18	5Ω6

All ¼W ±5%

Potentiometers

VR1	5k skeleton preset
VR2	250 skeleton preset
VR3	100k skeleton preset
VR4	1M
VR5	25k
VR6	10k log.

Capacitors

C1 to C10,C15,C17,C20	100n polyester (13 off)
C11,C19	22µ elect. 16V (2 off)
C12	1µ elect. 63V
C13,C14	180p polystyrene (2 off)
C16	4µ7 elect. 63V
C18	470µ elect. 10V

Semiconductors

D1 to D4	1N4007 (4 off)
D5	1N4148
D6	4V7 400mW Zener
TR1,TR2	BC549 (2 off)
IC1	324
IC2	380

Switches

S1,S2	min d.p.d.t. toggle (2 off)

Miscellaneous

SK1,SK2	mono jack socket (2 off)
T1	6V transformer (2 x 3VA secondaries) with 240V primary (see text)
X1	G-M tube (see text)

Knobs (3 off); p.c.b.; 14-pin i.c. socket (2 off); battery clip; p.c.b. mounting clips; connecting wire; battery and battery clip; case (15·5 x 11·2 x 5cm).

frequency to voltage converters and computers can register the particle count via the TTL output. Between them R10 and D6 restrict the level to less than 5V, suitable for triggering TTL equipment and other circuits. The maximum current that can be drawn is limited by R10. Should more be needed the resistance value can be lowered, though at the expense of reducing the pulse duration.

AUDIO OUTPUT

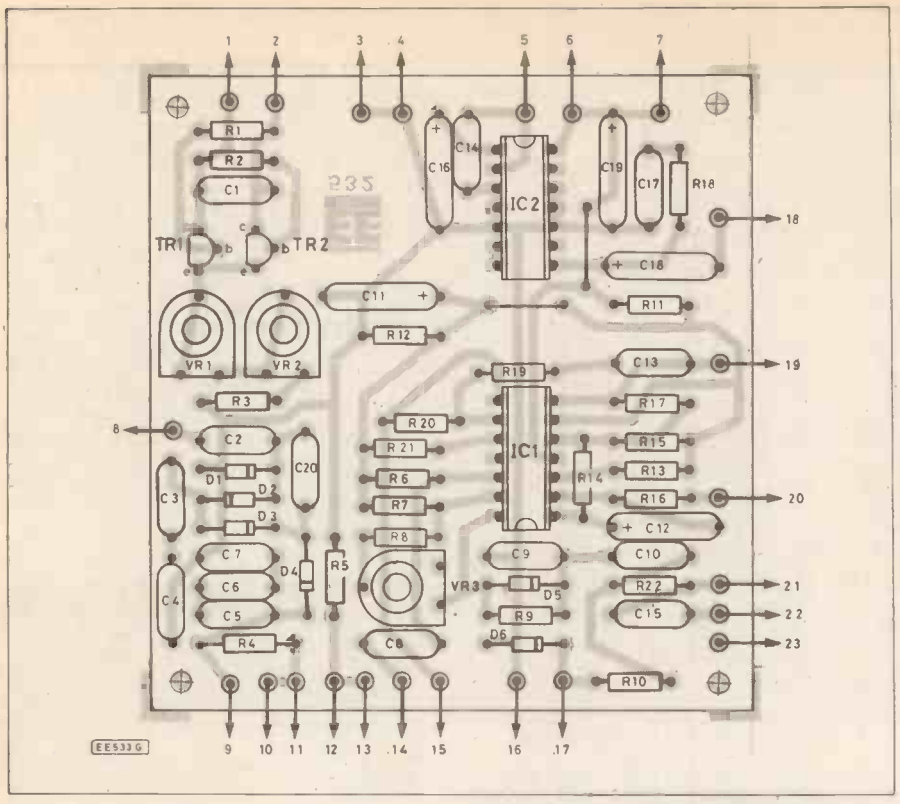
For audio monitoring, the pulse from C10 is sent to the audio amplifier IC2. This has an output capable of supplying up to two watts into eight ohms. It is suited to driving most loudspeakers and headphones. The output level is controlled by VR6, and the tone can be varied by VR5. The latter mutes the pulse, making it more comfortable to the ear when monitoring on headphones. Normally IC2 drives the little internal speaker mounted on the lid of the box, but when a jack plug from headphones or other equipment is inserted, it is automatically switched off.

A small amount of oscillator crosstalk can be expected. This may be minimised by careful routing of oscillator leads away from signal leads and in particular the input to IC2. A certain amount though is beneficial since it is a low level reminder that the unit is on. Fig. 6 shows the p.c.b. layout and construction and Fig. 7 the wiring of the remaining components.

The correct functioning of both the pulse amplifier and the audio amp can be checked by connecting C8 to the collectors of either TR1 or TR2. A spiky note of about 5kHz will be heard.

TEST GENERATOR

The test generator is formed around IC1b to IC1d, with the first two sections connected as a variable squarewave oscillator. The



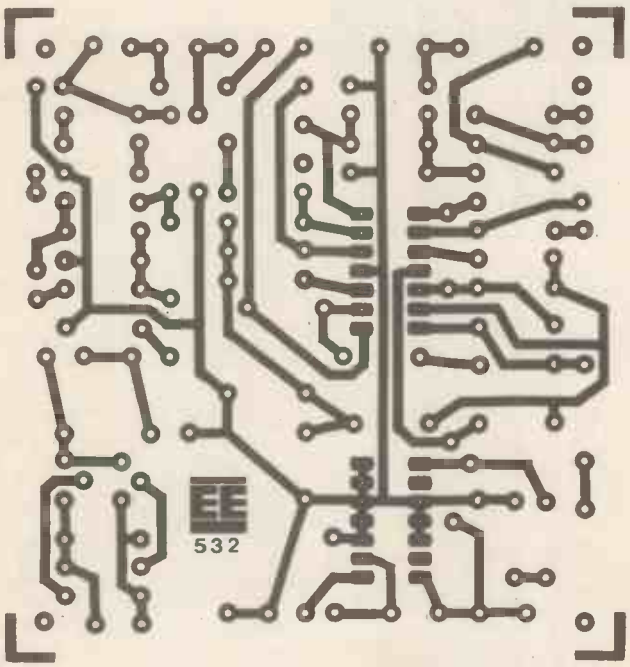


Fig. 6. P.c.b. layout and wiring. Note that C18 is carefully laid flat across the board towards C12.

frequency range is determined by C12, and can be varied by VR4, The squarewave output at IC1c is coupled to C13. Since C13 has a low value it will only pass the output at the edges of the squarewave, and so a short duration pulse is generated. This is amplified to a respectable level by IC1d. With the G-M tube switched out by S2a, S2b completes the oscillator feedback circuit allowing it to generate.

The output pulses are taken by IC1a and the subsequent circuits can treat them as though they had come from the tube. VR4 can set the rate from a few pulses per minute to several hertz. Rates greater than this are not needed since particle counts of greater frequency could imply hostile conditions.

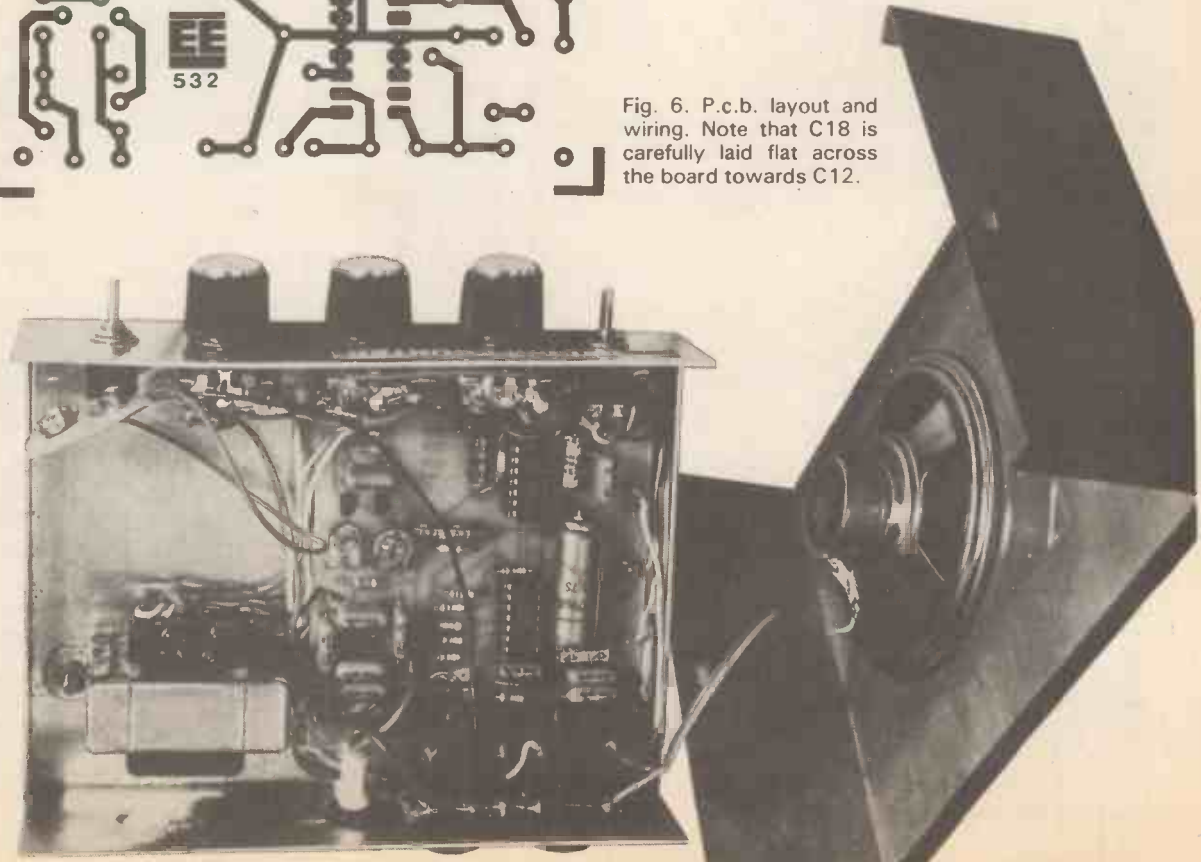
Before connecting the tube, run through the testing of the amplifier circuits, and double check the h.t. voltage on C5. Then switch off, allow a few seconds for C5 to discharge, and connect the tube as shown in the drawing.

TUBE MOUNTING

The tube is connected by means of a strap round the cathode, and a clip pushed on the anode, both supplied with it. **Only hold it by these connectors, and solder to them, not to the tube directly.** Be wary if tightening them as this could break the glass. Also *avoid touching the envelope if possible as the mica area can be damaged by fingertip perspiration.*

Conveniently, a felt tip pen provides the right size holder in which to mount the tube. The ink cartridge is removed and, if necessary, the tapering interior should be carefully drilled out to 6mm diameter. Resistor R4 is then soldered to the anode pin. The connecting lead should have insulating capabilities suited to the h.t. supply. First solder the positive lead to R4, and cover in insulating tape. Then connect the return lead, also insulating this join.

Push the assembly gently up the holder until the tube tip just protrudes from the end. Pass the free end of the lead through a hole drilled in the small end cap, and push home to secure the lead in the holder. The fit should be tight enough to prevent accidental extraction, though a sloppy fit can be



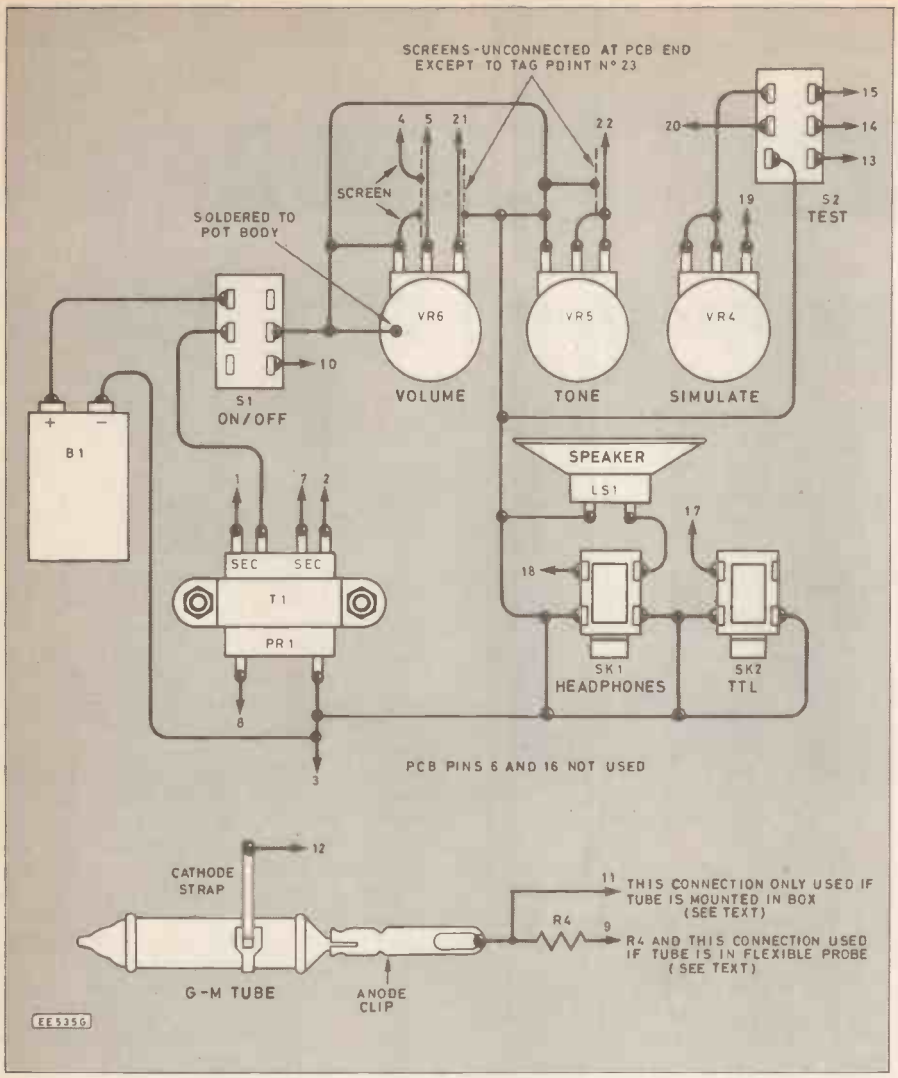
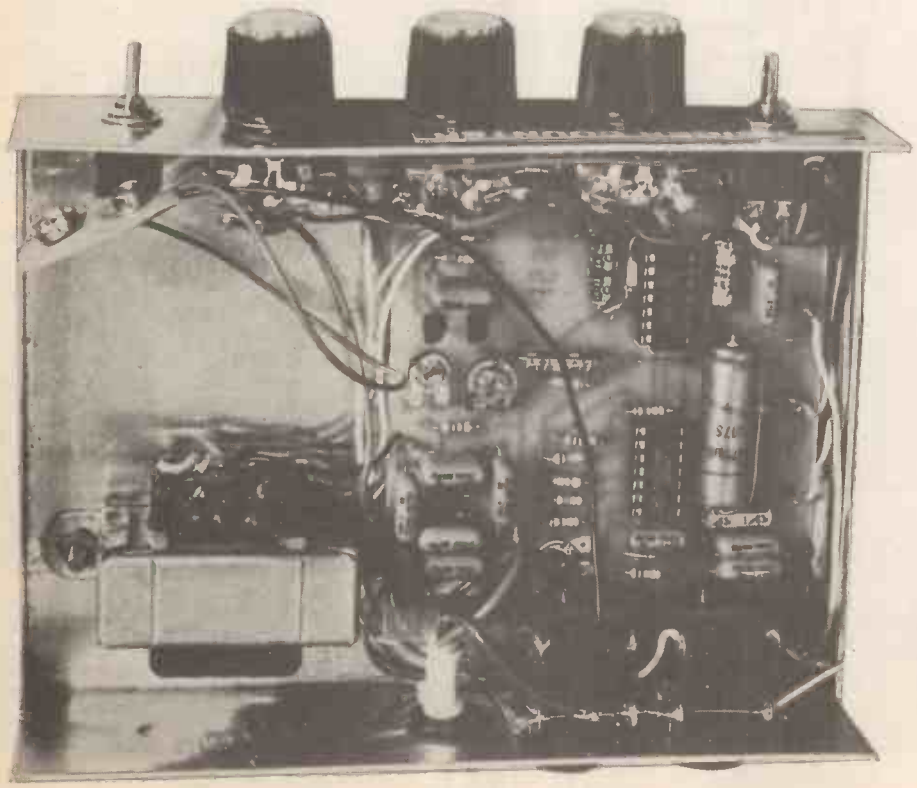


Fig. 7. Component interwiring and connections to the G-M tube.

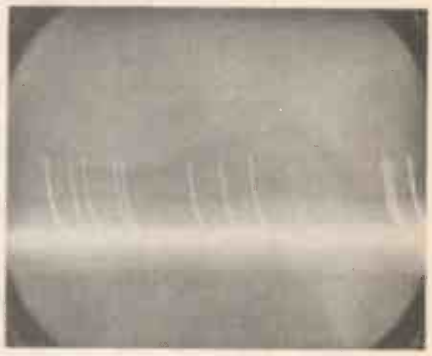


improved with more tape around the tube joins. The pen cap then fits over the tube end for protection. It can be temporarily removed to increase detection sensitivity.

The p.c.b. also has holes for R4 to be mounted on the board, this position can be used if the detector tube is to be mounted directly to the rear of the box by some means. Narrow gauge plastic plumbing fittings could be used for this. If the tube is in a probe a second R4 should be put in this space so that S1b functions correctly.

READY FOR USE

Once the tube has been installed, switch on again and with S2 in detector mode, just recheck that the h.t. is correct. There should be no significant change as the tube is a high impedance device except when under particle bombardment. The unit is now ready for immediate use.



The pulse length at R5 has a very short duration and can only be detected on an expensive oscilloscope—a 'scope is not required to build the unit.

If a voltmeter has not been used for p.s.u. setting, the h.t. level can be adjusted with the tube close to a known radiating source. Set VR1 and VR2 to minimum resistance. Switch on and slowly adjust them in turn until particle clicks just start, then increase VR2 a fraction more. This should put the h.t. voltage at the plateau level.

In view of government declarations that we have nothing to fear in Britain from radiating farm produce, it is unlikely that close examination of vegetable baskets or milk bottles will yield results, Indeed, instead of being disappointed that a hail of machine-gun sounds is not forthcoming, be thankful!

The largest readily found response is likely to come from certain types of active luminescence as found on some older watches. Not all use this material, but those that do should be emitting particles detectable when held right up close to the G-M detector. Some high voltage TV sets may produce results close to the screen. Normal electrical safety precautions should be observed. Otherwise follow in the areas favoured by geologists. Many ancient rocks around the country are slightly radioactive.

Geologists actually use Geiger counters to determine the age and make up of some types. However, much of nature around us exhibits some form of radiation at a very low level. Even beach sands, peat bogs and house bricks may have some. The interest to be found with this unit is not so much in checking up on Chernobyl or Sellafield, but in finding and learning about natural radiation sources around us. □

BATTERY TESTER

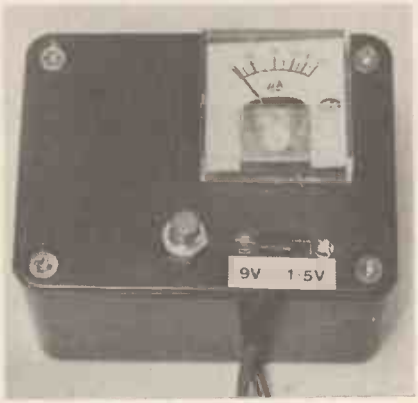
T.R. de Vaux Balbirnie

Basic condition check for 1·5V and 9V batteries

THE MODERN home has a surprising amount of battery-operated equipment ranging from torches and radios to personal stereos and video games. This tester identifies good batteries and finds "rogue" cells in a set. Although suitable for most 1·5V and 9V batteries, it is most useful and effective in checking *non-rechargeable* types. Testing of a kind may be performed by simple substitution but a meter gives a precise indication of the state of the battery and whether it could find a new lease of life in a light-duty situation.

As a battery ages, its internal resistance rises. When current flows, a voltage is developed across this resistance which is effectively lost to the external circuit. Eventually, the voltage drop becomes so large that the battery fails to deliver sufficient current for the purpose. A simple voltmeter does not provide a good test since negligible current is drawn by the meter so there is virtually no voltage drop across the internal resistance. A better method is to apply a voltmeter with an appropriate load connected to the battery. The higher the reading, the less voltage is being dropped across the internal resistance and the better is the condition of the battery.

The Battery Tester provides such a test and has the added advantage of modifying the scale of the meter so only the useful range of readings are recorded. Thus, in checking 1·5V cells, there is no point in



preserving readings below 1V approximately since any such cell would be "dead". Similarly, with 9V batteries, the section of scale below 6V is not needed. This maximises the useful part of the scale and leads to more accurate readings. A slide switch selects a basic load according to whether a 1·5V or a 9V battery is being tested and a push-button switch increases the load by a factor of five for larger types of battery.

CIRCUIT

The circuit for the Battery Tester is shown in Fig. 1; S1 is a four-pole three-way switch—the individual poles are labelled S1a, b, c and d. The centre position is "off". S1a directs battery current through either the diode pair D1/D2 (for 1·5V cells) or through D3 (for 9V batteries). With a 1·5V cell on test, there will be 0·7V approximately dropped across the *silicon* diode, D1, and 0·2V approximately across the *germanium* diode, D2. This gives a total of 0·9V leaving a maximum of 0·6V across R1 (assuming 1·5V at the battery terminals). As the battery terminal voltage falls, less voltage is developed across R1 until this falls below 0·9V whereupon D1/D2 fail to conduct and the meter will read zero. With a 9V battery on test, a similar situation arises with S1a directing current through the 6·2V *Zener* diode, D3. Thus a maximum of 2·8V will exist across R1. As the battery voltage falls, the voltage across R1 will also fall until at 6·2V D3 will fail to conduct and the meter will read zero.

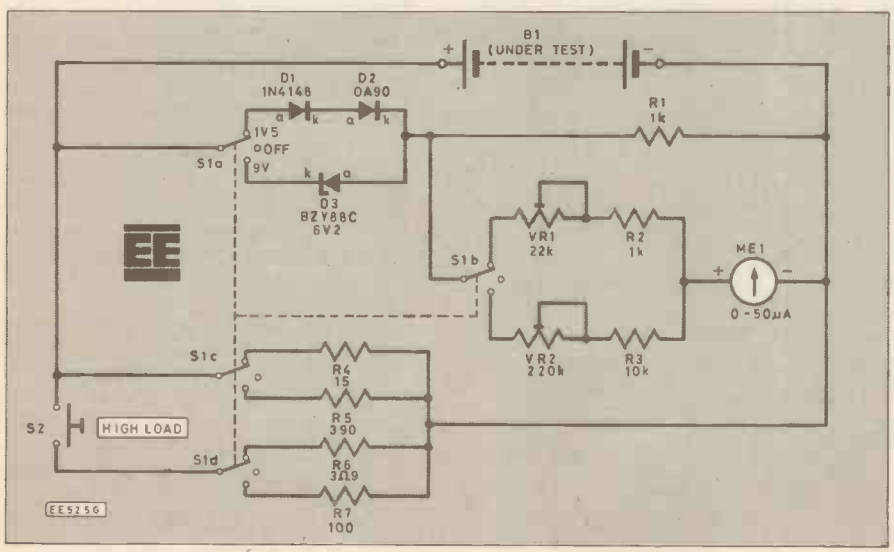
The voltage across R1 is measured by the voltmeter consisting of microammeter, ME1, connected in series with VR1 and R2 (for 1·5V cells) or VR2 and R3 (for 9V batteries), as selected by S1b. Preset potentiometers VR1/2 are adjusted at the end of construction for accurate full-scale deflections of ME1. The rest of the circuit applies the preset loads to the battery under test (see Table 1). Switch S1c selects R4 (for 1·5V cells) of R5 (for 9V batteries). With S2 pressed, S1d directs battery current through R6 or R7 as appropriate to increase the load. Note that the scale of ME1 is marked 0–50 *microamps* but this is no disadvantage since only comparative readings are needed.

TABLE 1

Battery voltage	1·5V	9V
S2 released	100mA	20mA
S2 pressed	500mA	100mA

(All figures are approximate)

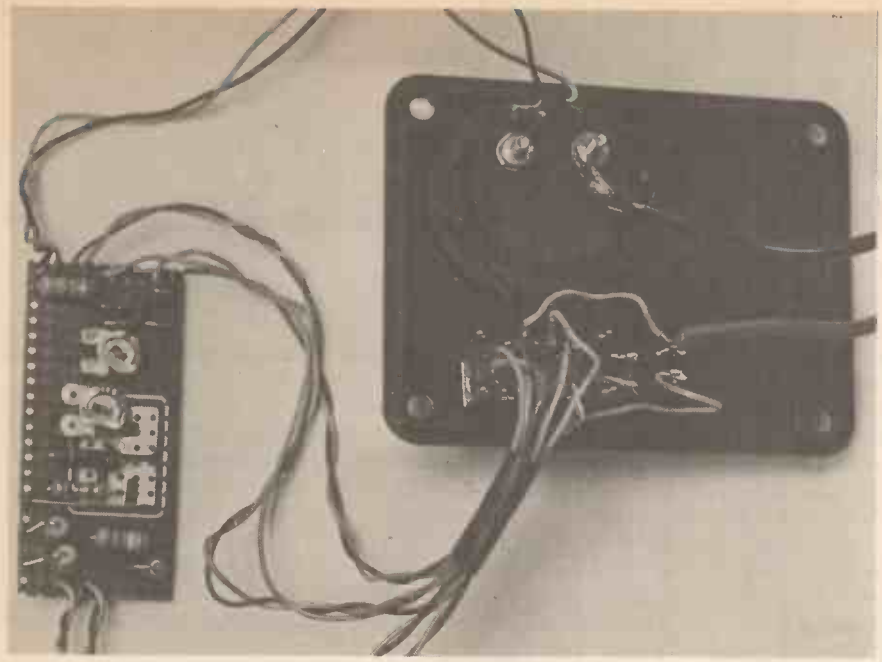
Fig. 1. Complete circuit diagram for the Battery Tester.



CONSTRUCTION

Construction is based on a piece of 0·1 inch matrix stripboard size 10 strips × 21 holes (see Fig. 2). This should be cut slightly too large then filed to fit the slots in the specified plastic box. Make the track breaks as indicated and connect the inter-strip link wire. Follow with all soldered on-board components. Note the polarities of the diodes and note that these are easily damaged by excessive heat from the soldering iron (this particularly applies to D2). Solder 10cm pieces of light-duty stranded connecting wire to the copper strips as indicated.

If wires of different colours can be used this will help in indentification when wiring up. Leave VR1 and VR2 adjusted fully *clockwise*. Check the completed circuit panel carefully then prepare the case by drilling holes for the meter, switches and for the test leads to pass through. Mount the meter and switches, then referring to Fig. 3 complete all wiring. (Unused S1 pins may be cut off



Completed Battery Tester showing interwiring to the stripboard, meter ME1 and the slide switch S1.

COMPONENTS

See Shop Talk page 436

Resistors

R1,R2	1k (2 off)
R3	10k
R4	15
R5	390
R6	3Ω9
R7	100

All 0·5W carbon film ±5%

Potentiometers

VR1	22k
VR2	220k

Miniature horizontal carbon presets

Semiconductors

D1	1N4148
D2	OA90
D3	BZY88C 6·2 Zener diode

Miscellaneous

S1 4-pole 3-way slide switch; S2 push-to-make switch; ME1 0–50μA panel meter 32 × 32 × 34mm; 0·1in. matrix stripboard size 10 strips × 21 holes; stranded wire; plastic box size 76 × 56 × 35mm internal.

Approx. cost Guidance only £5.50

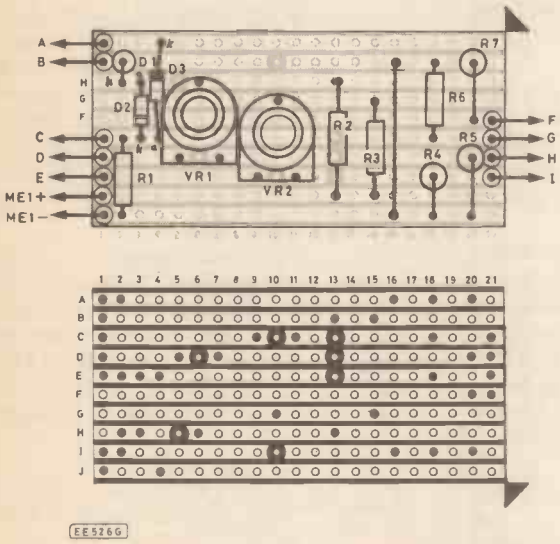
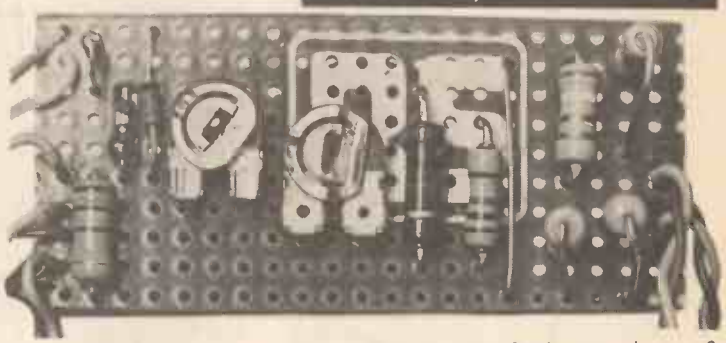
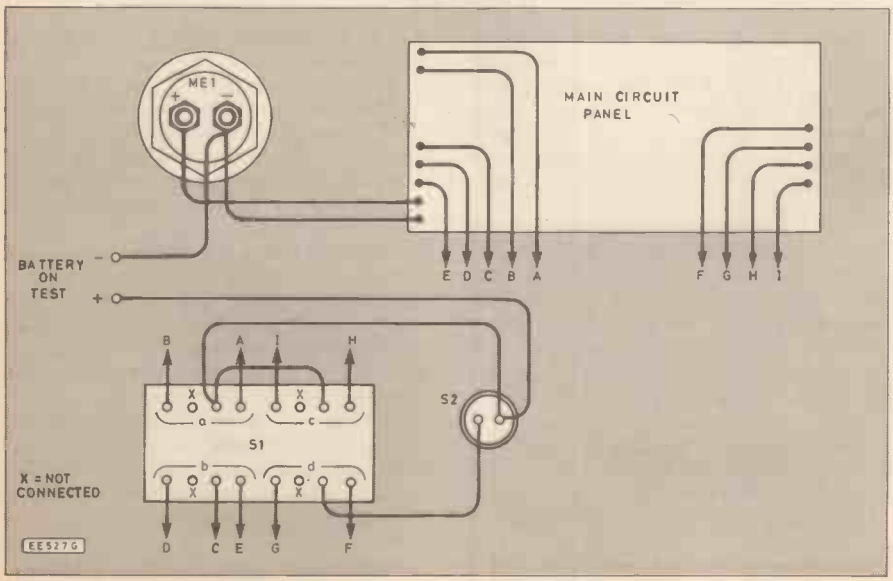


Fig. 2. Layout of components on the stripboard and details of breaks in the copper strips on the underside.



The completed circuit board.

Fig. 3. Interwiring details of the meter, slide switch and circuit board.



short.) For the test leads use pieces of stranded wire, red for the positive connection and black for the negative.

Knot them together inside the case to provide strain relief (while not recommended for equipment which operates for long periods or any mains-powered items this method is adequate for the battery tester). Tin the free ends so that they may be conveniently held against the terminals of the battery being tested.

TESTING AND ADJUSTMENT

Begin with a *new* 1·5V cell. Set S1 to "1·5V" and connect the test leads, observing the polarity. Adjust VR1 anticlockwise until the meter gives full-scale deflection. Make a similar adjustment using a new 9V battery. Set S1 to "9V" and adjust VR2 for full-scale deflection.

Test some other batteries including, if possible, some which are nearly "flat"—the meter should show readings which are lower than when new batteries are used and pressing S2 will reduce them still further. A little practice will soon reveal what the readings mean. Switch S2 should not be used when testing very small batteries (AA or AAA size cells and PP3 batteries). As a rough guide, readings below 30–40 indicate a failing battery. A reading which continues to fall indicates a battery in a poor state of health. □

FOR YOUR ENTERTAINMENT

BY BARRY FOX

Captain Midnight

Who is Captain Midnight? And will he strike in Britain?

The Captain is an electronics buff who has hit the US broadcasting industry where it hurts. He has proved that he can jam the satellite broadcasts on which cable stations rely for their programmes.

The jamming is in retaliation against the decision by programme provider "Home Box Office" to scramble its signals so that they can only be received by cable stations or viewers with private aerials who have paid HBO for a decoder. This pulled the rug from under the several hundred thousand people in the US who have each paid several thousand dollars to install private "backyard" dish aerials capable of receiving premium programmes like HBO.

In January this year HBO began scrambling its signals and asking $12.95 a month for a decoder. Other programme providers plan to follow HBO's lead. The "Showtime/Movie Channel" service said it would start scrambling at the end of May—but then Captain Midnight proved that it is technically possible for third parties to hijack a broadcast satellite and hold the cable industry to ransom.

Although it is not widely known, "Sky Channel" in Britain was blocked from getting its signal onto *Eutelsat* and across Europe a year or so ago when an interloper—never indentified—beamed up a rival signal. It could have been a dry run for the future.

Sales of backyard dish aerials in the US plummeted as soon as HBO began scrambling. The company received anonymous threats of interruption. Engineers did not take them seriously because they believed it would need a very powerful signal from a very large dish to override the legitimate signal being sent up to the satellite and "capture" its receiver so that the satellite transmitter re-broadcasts a pirate programme instead of the intended one.

Recently, during an HBO broadcast of the feature film "Falcon and the Snowman" the picture disappeared for 5 minutes and was replaced by a test pattern and the words *"Good evening from Captain Midnight. $12.95 a month? No way. Showtime/Movie Channel Beware"*.

HBO engineers increased the power of the uplink signal being sent to the satellite. They do not know whether the increase of power over-rode the hijacking signal or whether Captain Midnight switched off before there was any chance of detection.

Video Terrorism

HBO engineers and the US Federal Communications Commission investigators believe the hijack, which they are calling "video terrorism", needed at least 4 kilowatts of transmitter power and a dish at least 5 metres in diameter. They suspect Dallas as the culprit area. The broadcasting convention was held there recently and there was a surfeit of hi tech equipment and expertise in town.

What the industry does not want to admit is that there is no possibility of detecting a hijacker who operates in short bursts. A transmission dish looks like a reception dish. If the beam is tightly focused by using a large dish which is very accurately aimed at the satellite aerial power, a skilled amateur working in short bursts may be able to interrupt services with a low power jammer and virtually no fear of detection.

Broadcast engineers' secret fear is that a hijacker with inside knowledge may be able to send up signals which switch the satellite off or alter its position in orbit so that all ground aerials need realignment.

The practical proof that satellites can be jammed by dissidents will worry cable programme providers in Europe and the UK. They have been laying plans to follow HBO's lead and scramble their signals as soon as enough people in Europe have bought backyard dishes to make it worthwhile.

So far only "Filmnet" on the Continent and Rupert Murdoch's "Sky Channel" from the UK are scrambled. Sky's programmes are mainly re-runs of TV English language soap series, watched by expatriates and hotel guests in foreign countries, so owners of backyard dishes in Europe have not been too bothered about whether Sky scrambles or not.

Also UK Sky scrambles its signals by the relatively simple expedient of reversing the negative/positive polarity of the synchronising pulses needed to keep the picture stable on a TV receiver screen. An electronics enthusiast wanting to watch Sky without paying for a decoder would find it far easier to build an unauthorised circuit than set up a hijack transmitter.

Sky Jack

Be warned! If anyone tries to sell pirate decoders Sky simply reports them to the UK copyright bodies, like PRS, and the film and TV companies who own the programme rights. And that can be a fate worse than death. British Telecom, which uplinks Sky's signals to *Eutelsat* never comments on security; in this case, says BT, "We have every confidence in all our security arrangements."

But if other cable satellite broadcasters with more enticing fodder, like the film, sports and news channels, adopt complex scrambling techniques to control reception, then UK cable viewers might well see interruptions from a British cousin of Captain Midnight.

Let us hear your views on the exploits of Captain Midnight. What is your opinion on a Satellite TV Subscription.

Speechless

Little things mean a lot. I have talked with several other journalists about DBS or direct broadcasting by satellite, and why Britain's plans failed. We all have much the same theory. It was not the technology or the price that killed DBS, but the attitude of *Unisat*.

This was the consortium of British Telecom, British Aerospace and GEC Marconi which the government said must provide the hardware. Dealing with Unisat was, as one of the other journalists has written: "like shouting down a speaking tube to Hong Kong or Bangkok and getting only echoes in reply".

This was a particulary apt allusion because the spokesman for Unisat had a loudspeaking telephone on his desk. He insisted on using it, even though it made communication absurdly difficult.

The wretched gadget chopped off the beginnings and ends of words, sounded as if you were talking to a foghorn and destroyed all hope of a private chat. Callers knew everyone in the room, and probably the street outside, could hear every word.

I used to play a game, saying "sorry I didn't hear that" every time the spokesman spoke. By the end of the conversation he'd be shouting. But still he refused to switch his prize gadget off and use an ordinary telephone handset instead.

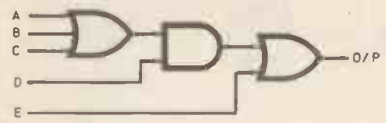
If you were a director of the BBC, trying to negotiate a satellite rental contract worth £25 million a year, would you want to do it while shouting down a speaking tube?

TEACH-IN '86

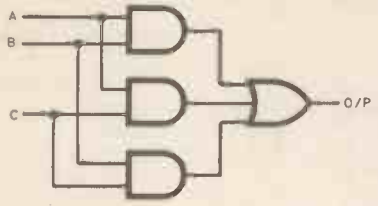
The answers to the Problems set in the final instalment—June 1986 (Part 9)—of Teach In '86 are given below.

9.1 Three input OR

9.2

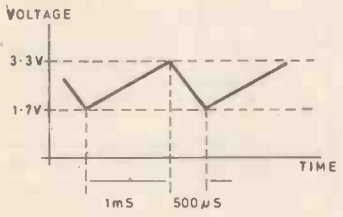


9.3



9.4 R1 = R2 = 72·15kΩ

9.5



PLEASE TAKE NOTE

Note corrections to Figures 9.4 and 9.5 (Page 296)—Car parking light control system.

"The lower two inverters are NOT required and should be replaced with direct connections."

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The books listed below have been selected as being of special interest to our readers, they are supplied from our editorial address (mail order only) direct to your door.

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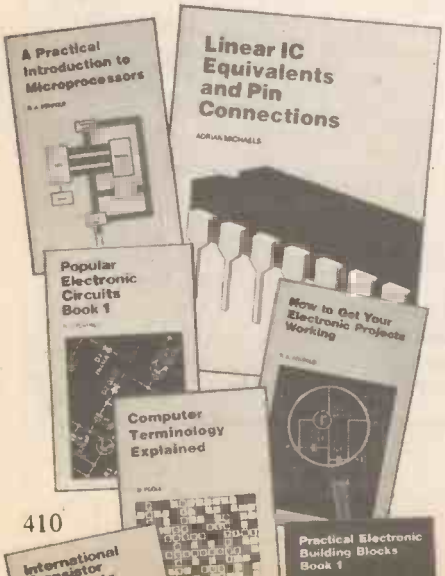

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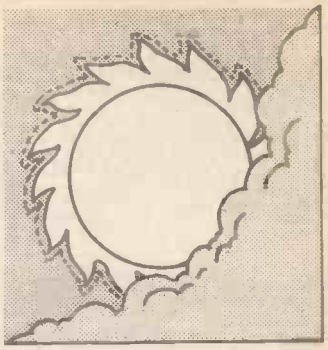

BARRY WISE

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ALONG with other renewable energy sources, solar energy is greatly under-exploited in the UK. We have grown up with the idea that the fossil fuels are going to last forever. But fossil fuel stocks are becoming depleted and more difficult to extract, and environmental pollution caused by burning them is becoming a major problem. Harnessing solar energy is one way to reduce our dependance on fossil fuels.

The simplest application of solar energy is in providing part of the heat required for domestic hot water. The most common method of doing this is to use a flat plate collector as shown in Fig. 1.

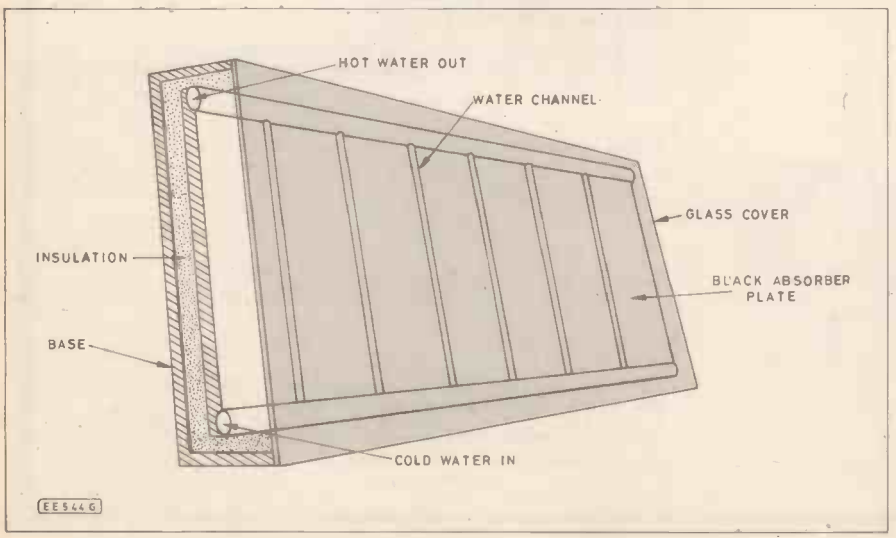
Solar radiation is absorbed by a black sheet and the resulting heat is transferred to the hot water cylinder by water circulating through the sheet or through pipes attached to it. Heat loss from the absorber is minimised by back insulation and a clear plastic or glass cover.

In the simplest systems water is circulated using thermo-syphon principles. However, a pumped arrangement allows greater flexibility of panel position and improves thermal efficiency. The controller described here can be used for most solar heated water systems. It ensures that water is pumped only when there is a useful amount of heat to be gained.

CIRCUIT

The full circuit diagram of the Solar Heating Controller appears in Fig. 2. Diodes D2 and D3 act as sensors mounted on the hot water tank and solar panel. A constant current is passed through each of them via R1 and R2. One property of small signal diodes is that a change of temperature will cause their forward conduction voltage to vary in a repeatable manner. This differential voltage is applied to the inputs of IC1, which is configured to act as a Schmitt trigger with positive feedback introduced by R9. R3 and VR1 are used to balance the schmitt trigger inputs initially so that a differential temperature change within the desired range will be detected.

Fig. 1. Flat plate solar collector.



COMPONENTS

Resistors

R1,R2	4k7 (2 off)
R3,R13	100 (2 off)
R4,R5,R6	2k2 (3 off)
R7,R8	10k (2 off)
R9	4M7
R10	1k5
R11	330
R12,R14	2k2 ½W
R15	1k 1W

All ¼W ±5% except where stated

See Shop Talk page 436

Potentiometer

VR1	100 cermet preset

Capacitors

C1	470n polyester 100V
C2,C3	100n polyester 100V (2 off)
C4	330µ radial elec. 63V
C5	100n suppression cap 250V

Semiconductors

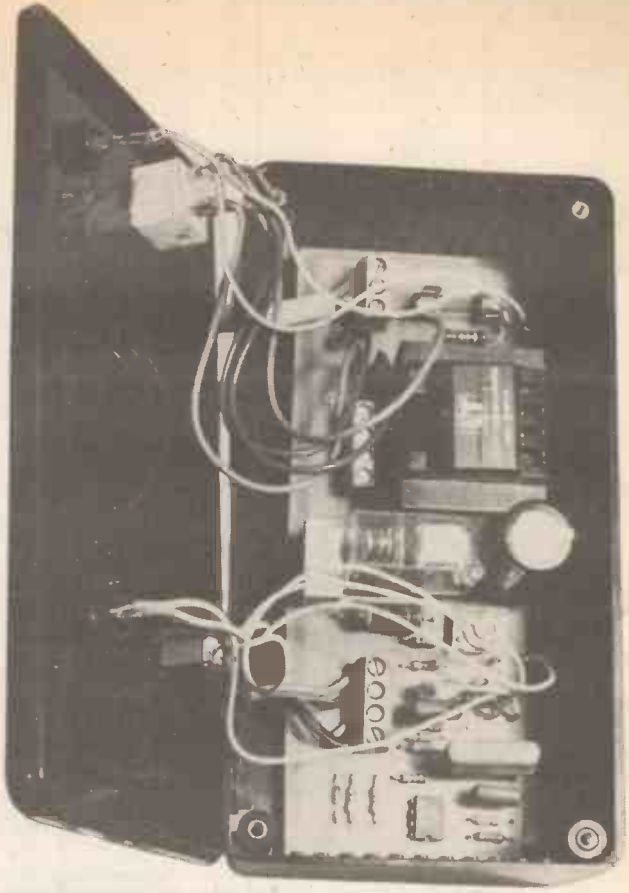
D1	8V2 Zener diode
D2,D3,D4	1N4148 (3 off)
D5,D6	1N4002 (2 off)
D7	green l.e.d. (with mounting clip)
D8	red l.e.d. (with mounting clip)
TR1	BC182L
IC1	LM741 op-amp

Miscellaneous

RLA	10A single pole changeover relay, 24V coil
T1	3VA transformer, 240V primary, 20-0-20V secondary
S1	d.p.s.t. switch, 240V a.c. 4A
S2	s.p.s.t. switch, 30V d.c. 1A

Three-way terminal block; four-way terminal block (2 off); p.c.b. terminal pins (10 off); 1 amp fuse and p.c.b. mounting fuse clips (2 off); plastic case, size 150 x 80 x 50mm; grommets (3 off); printed circuit board available from the *EE PCB Service*, order code *EE*533; twin 7/0·25mm cable; epoxy putty; fixings, etc.

Approx. cost Guidance only **30**



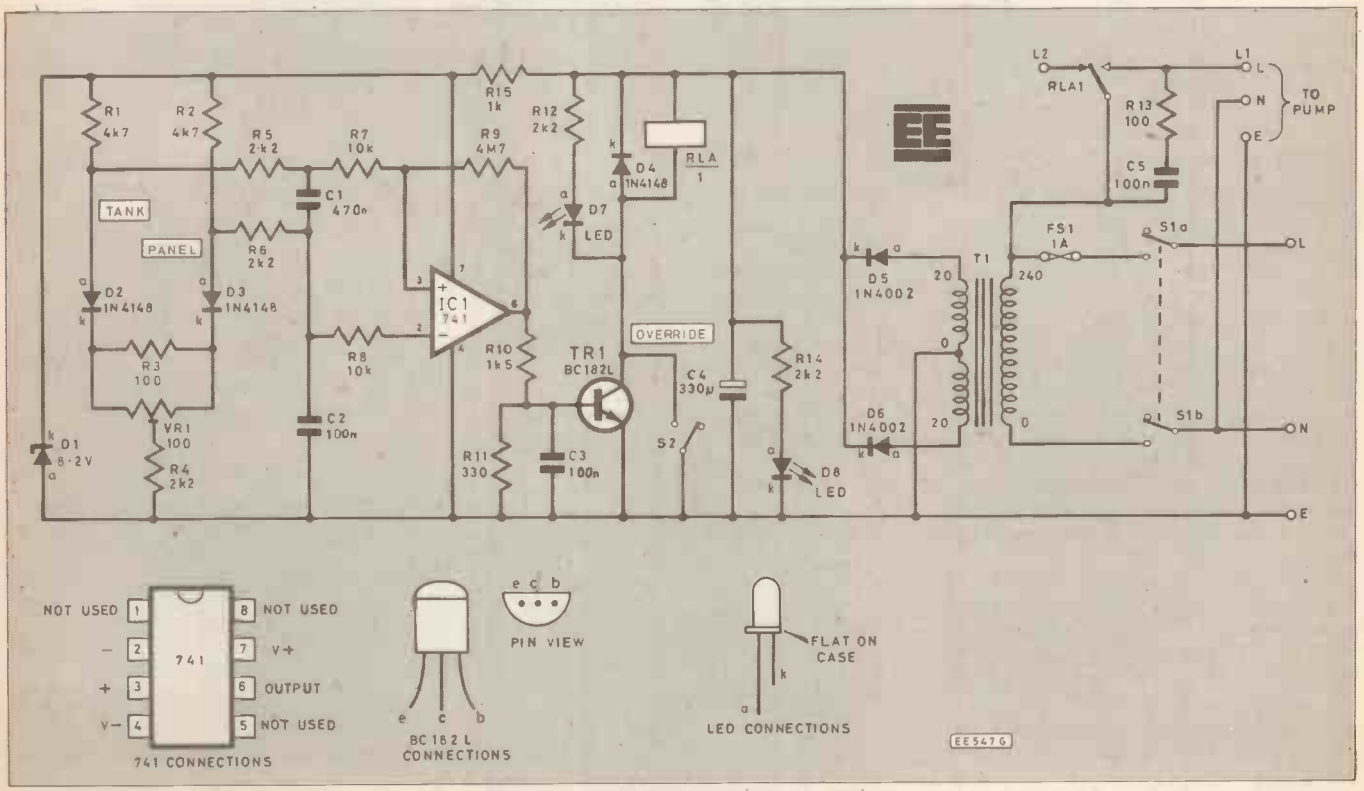
Front panel folded back to reveal the mounting of the printed circuit board and wiring to components on the rear of the front panel.

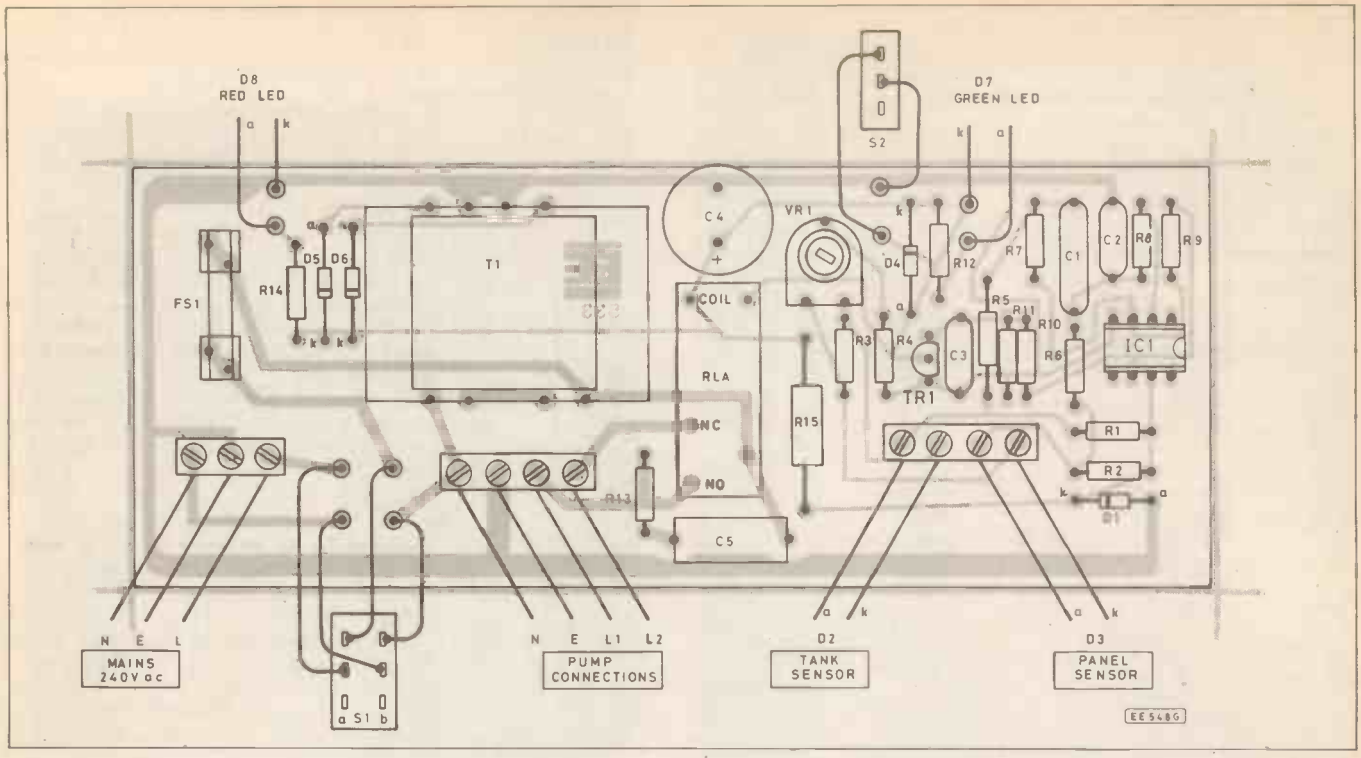
If the solar panel diode D3 becomes hotter than the tank diode D2, the output voltage of the amplifier will rise. Resistor R9 ensures that the output switches cleanly between the supply rails. This turns on TR1 which activates the relay. The green l.e.d. D7 indicates when this occurs. The power supply for the circuit comprises T1, D5, D6 and C4 giving a full wave rectified and smoothed 30V nominal. This is then dropped through R15 and clamped by D1 at 8·2V to power the op-amp and provide a stable voltage drop across R1 and R2.

Capacitor C1 has been incorporated to reduce differential input noise. Any common mode noise is filtered by C2. C3 has been provided to reduce the effects of interference on switching transistor TR1.

A manual override facility has been incorporated with S2 switching on the relay. C5 and R13 protect the relay contacts from the arcing that occurs when attempting to switch an inductive load. They also provide electrical interference suppression.

Fig. 2. Complete circuit diagram for the Solar Heating Controller.





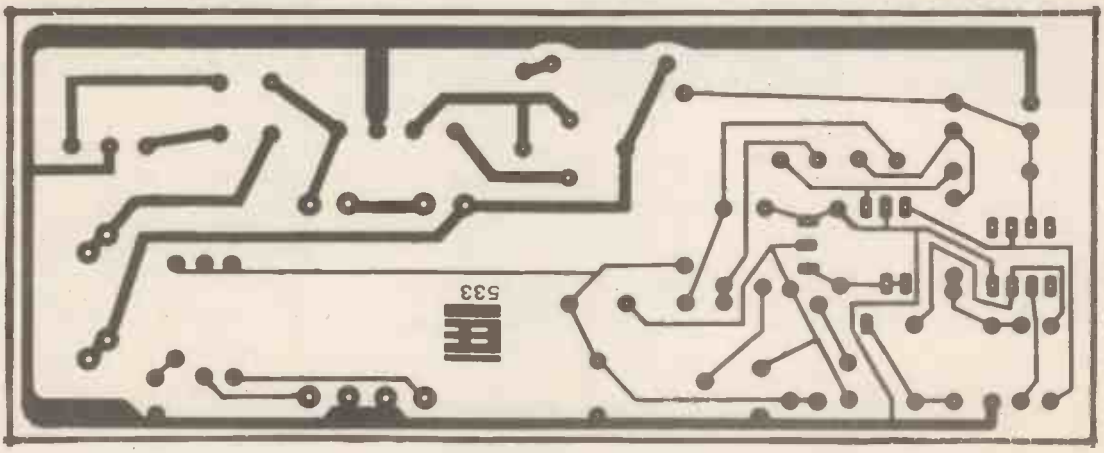


Fig. 3. Component layout, interwiring details and full size printed circuit board master pattern for the Solar Heating Controller.

CONSTRUCTION

Most of the components are fitted onto the printed circuit board as detailed in Fig. 3. Ensure that the polarity of diodes and capacitor C4 are correct and check that IC1 is the right way round!

The circuit board was designed to fit inside a plastic case measuring 150mm by 80mm by 50mm although any reasonable size may be used. Three grommets are fitted to holes in the front of the case and the l.e.d.s and switches are fitted in the lid. Position these lid mounted components so that there is sufficient clearance with the board components when the case is put together.

Complete the interwiring as shown in Fig. 3 paying careful attention to the polarity of the l.e.d.s. It is also worth double checking S1 switch wiring since this will carry mains voltage. Lower the board into the case and connect a three core mains cable to the three way terminal block. This cable should be fitted with a three amp fused plug.

SENSORS

Make up two sensor leads, one for the solar panel and one for the hot water tank. Twin 7/0·25mm cable is suitable and the type which has one side marked with a coloured stripe or ribbing is ideal. At this stage each lead can be a couple of metres long. They can easily be extended if necessary with more cable.

A 1N4148 diode is simply soldered to the end of each lead as shown in Fig. 4. Each

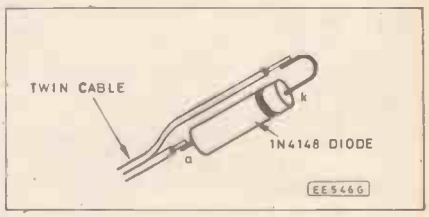
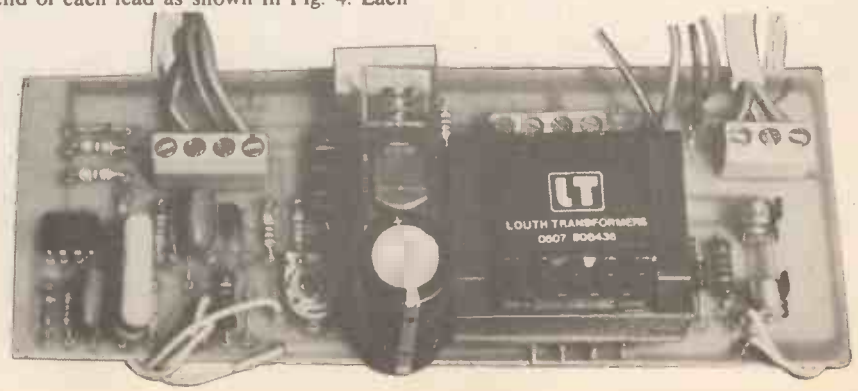


Fig. 4. Sensor construction.



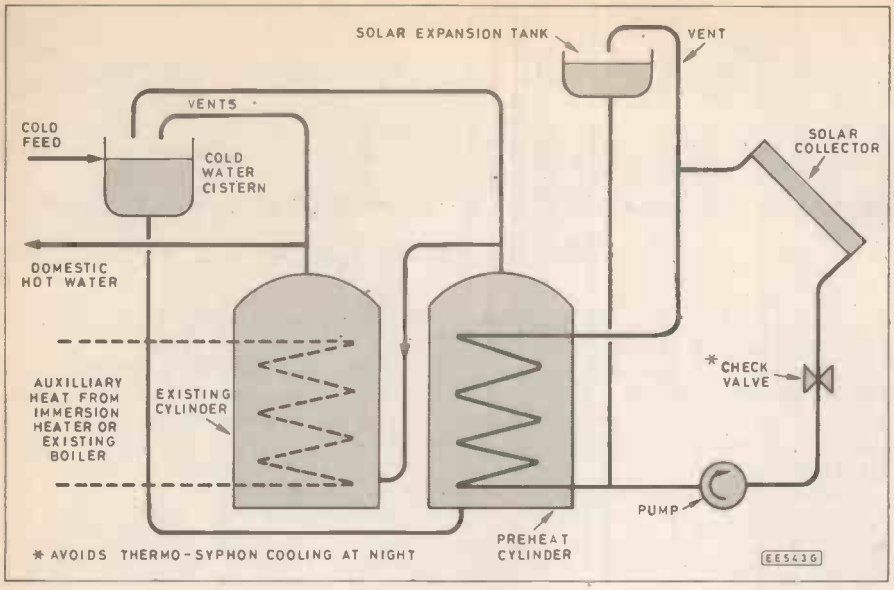


Fig. 5. Typical arrangement for a solar water heating system.

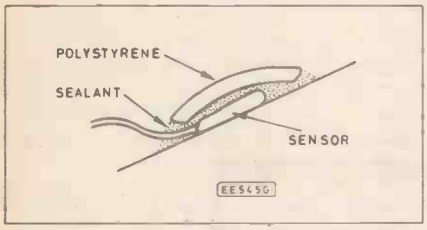
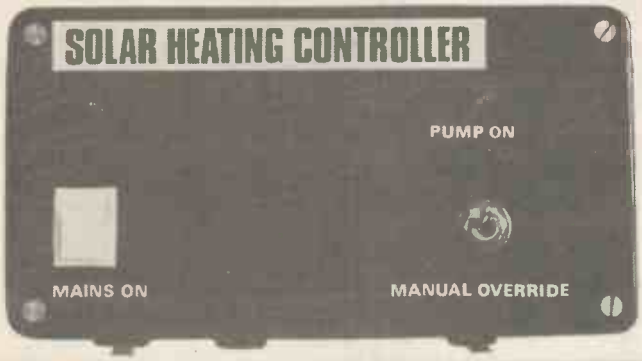


Fig. 6. Method of mounting the sensors.

sensor can then be potted by moulding epoxy putty around the diode and cable end. Ensure that no bare wires are left exposed. The putty will harden in about 24 hours.

TEST PROCEDURE

Thread the two sensor leads through the end grommet and connect into the terminal block as shown in Fig. 3. Plug in the unit and switch S1 on; the red l.e.d. should light. Switch S2 to the auto position. **Beware, the fuse clips and other components near the three way terminal block are now live!** The back of the switch, S1, is also live. Make sure the two sensors are close together and hence at the same temperature. Turning the preset, VR1, should cause the relay and green l.e.d. to turn on and off. The correct point at which to set VR1 is found as follows. Turn until the relay is on. Then turn the preset back until it is just past the point at which the relay turns off. Five degrees of rotation past the turn off point is about right.



Check the operation of the controller by holding a soldering iron against the panel sensor. The relay should turn on after a few seconds. Leave the panel sensor to cool down for a few minutes and the relay should turn off. Disconnect the unit from the mains supply ready for installation.

INSTALLATION

A typical solar heated system is shown diagramatically in Fig. 5. Solar energy, collected by the panel, is pumped to the preheat cylinder. The pump is switched by the solar panel controller. This preheated water is then drawn through the existing hot water cylinder.

The pump is normally connected to the terminals marked L1, N and E on the controller's four way terminal block. Note that L2 is live when the green l.e.d. is off; this connection being a useful feature on more sophisticated pumping systems. A pump rated at 30 watts or so is quite adequate for most solar installations. A higher powered pump will only cost you more while it is running!

The controller should be located in a visible position so that the switching of the pump can be monitored. The box should be mounted where the temperature is unlikely to vary widely. It should *not* be mounted in the attic.

The fixing of the sensors is important for good operation of the complete heating system. The sensor leads should not run next to mains leads. The sensors themselves should be fixed using epoxy putty or silicone sealant and they should be covered with some insulation such as polystyrene. Fig. 6 shows this arrangement.

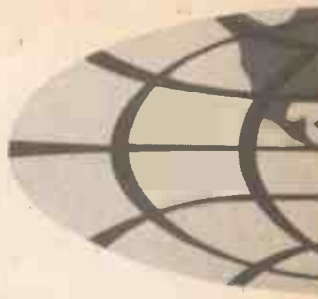
The tank sensor should be mounted on the pipe which runs from the preheat cylinder to the solar panel. Mount it as close as possible to the tank. The actual connection flange is a good place. The panel sensor should go on the black absorber plate of the solar panel, close to the outlet pipe.

MODIFYING HYSTERESIS

Hysteresis is the difference between the "switch on" and "switch off" points of the controller. The amount of hysteresis is determined by R9, the feedback resistor of the 741 amplifier. The 4M7 resistor specified gives a hysteresis of about seven degrees C which should avoid the possibility of rapid on/off cycling of the pump. If you wish to experiment with the hysteresis of your system, try changing the value of R9. A 3M3 resistor gives a hysteresis of about ten degrees C and a 10M resistor will give about 3·5 degrees C. □

...REPORTING AMATEUR RADIO...

TONY SMITH G4FAI



NEW SATELLITE

Japan's *JAS-1* amateur radio satellite is due to be launched in August. With the satellite structure and power supplies built by NEC at a cost of over a million pounds, many of the on-board electronics have been constructed by amateur enthusiasts. These include transponders for earth-satellite-earth communications, one of which will hold, and re-transmit later, messages for stations in other time zones.

Launching will be into a circular low earth orbit, at an altitude of 1500km. A maximum of eight passes a day will provide "windows" of about twenty minutes for communication purposes, and the satellite has an estimated life of three years. All being well, *JAS-1* will join a number of other satellites, from Britain, USA and the USSR already in amateur service. There will be more about these in a future column.

BAD START

The Radio Society of Great Britain (RSGB) got off to a bad start with its new scheme for Morse testing, due to begin on 1 April. Guidelines for prospective volunteer examiners did not appear until nearly two weeks after that date. Interim arrangements had to be made for tests to be held at ten exhibitions and rallies throughout the summer, but the response was so great that many applicants were disappointed.

The RSGB anticipates that at least half of the planned 70 test centres will be available within six months, and the majority of the remainder within a year. As at the beginning of May some 200 applications had been received from would-be examiners. A Chief Examiner has been appointed, and he is arranging for the testers to be tested (at 20 wpm) before appointment.

Making "official" arrangements on behalf of a government body requires careful planning and meticulous attention to detail. The RSGB has never been involved in something like this before, so the initial delays may represent an over-cautious approach, to make sure that everything is right from the beginning.

WHAT TIME IS IT?

It was reported last November that Britain was to lose Greenwich Mean Time by the end of 1985. This was due to cost-cutting at the Royal Greenwich Observatory, Herstmonceaux, where insufficient funds were available to replace the caesium standards for the Time Service's six atomic clocks.

At the time of writing, the service is, in fact, still functioning. All the standards have exceeded their average life expectation of four years, and a revised estimate now suggests that GMT will have to go before the end of 1986.

What has this to do with amateur radio? British amateurs record the time of a contact in their log books, and on QSL cards, using GMT and the 24 hour notation. The world is divided into 24 standard time zones, whereby local time changes by one hour over every 15° of longitude. Zones to the east of Greenwich progressively increase by one hour, and those to the west lose one hour.

The zones meet at the International Date Line in mid-Pacific. Crossing the line east to west, the date moves forward one day, and in the reverse direction it goes back one day.

This is why time is so important for amateurs. If they want to contact another part of the world, they must take account of time differences to ensure there is likely to be some response at the time they transmit. If they pre-arrange a contact (a "sked"), its no good saying "8 o'clock", as the time difference can cause confusion. Say "20.00 GMT", and both parties know exactly what is meant.

GMT is also known as Universal Time. Just to confuse you, radio amateurs in many countries use Universal Co-ordinated Time—UTC. This is time from a number of sources around the world closely synchronised by the International Time Bureau in Paris.

The Royal Observatory is a major participant in this service, but when GMT ceases it will become a user rather than a contributor, picking up UTC via radio transmissions. Something like £200,000 a year is needed to save this historic world famous service, which also represents Britain's "official" time. This is a very small sum in terms of national resources, but apparently insurmountable in terms of economic cuts.

So what about the amateurs? They can continue using GMT if they like, but more correctly should go over to UTC. This is also known as "Z", resulting in time sometimes being given as "20.00 zulu"!

QUESTION CORNER

Q. Why do amateur have call-signs, and what is their significance?

A. Amateur radio is the only hobby governed by international regulations, and these are laid down by the International Telecommunication Union. One regulation states that: "During the course of their transmissions, amateur stations shall transmit their call-sign at short intervals."

A call-sign is an identification code, allocated to a station, which tells others not only which country it is in, but often what part of the country, and even the type of licence applicable to the station. When there is any suggestion that regulations are being contravened, the call-sign enables the authorities to identify an offender.

Call-signs in Britain go back to 1910, when the Postmaster General notified all holders of experimental transmitting licences of a new rule, requiring all stations to have a distinctive call-signal. "Each station, when signalling, should begin each transmission with the call-sign of the station with which it desires to communicate, and end with its own call-signal."

These early calls were allocated on a rather arbitrary basis, and bear little resemblance to those of today. Examples of calls issued to well-known personalities of the time, were LUX, John Scott Taggart, and MXA, Leslie McMichael.

All activities were suspended in the 1914-18 war, and when licences were re-issued in 1920, call-signs consisted of a figure 2 followed by two letters, eg, 2FG (in this case replacing MXA). In 1924, letters indicating the country of origin were introduced, and 2FG became G2FG.

For many years, the nationality prefix letters of call-signs were similar to the signal letters of ships, and the markings of aircraft. Nowadays, so many call-signs have been allocated that new series have had to be introduced which may no longer have the same connection.

In Britain, G stations are located in England, GM is Scotland, GW Wales, GI Northern Ireland, GD the Isle of Man, GJ and GU the Channel Islands, whilst the number indicates the type of licence issued. G1, 6, and 8, with three letters, are class B (v.h.f. and u.h.f. only), and all others are class A (all bands). Australia, VK, varies the number in the prefix to indicate the State, eg, Victoria is VK3 and Queensland VK4.

Some countries, such as the USA, have rather complicated systems in which various licence classes, eg, Advanced, Extra, General, Novice, and others, are also indicated in the call-sign. Suffixes provide further information, /M indicates a mobile station; /MM maritime mobile; /P portable operation; and /A, transmission from an alternative address to that for which operation is normally licensed.

The table illustrates typical amateur prefixes of a few countries. New or special (eg, commemorative) calls are appearing all the time.

Table 1

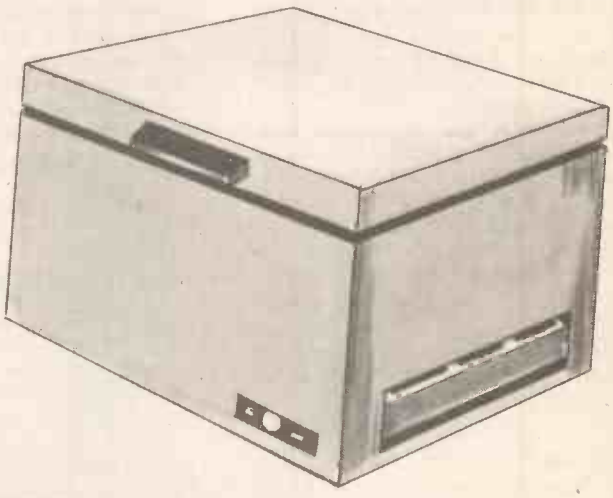
Examples of amateur call-sign prefixes

Country	Prefix
Argentina	LU
Canada	VE
Czechoslovakia	OK
Eire	EI
India	VU
Korea	HM
Mexico	XE
New Zealand	ZL
Singapore	9V1
Turkey	TA
USA	A,K,N,W
USSR	UA,UB,UC,etc.
Yugoslavia	YU

SEPTEMBER FEATURES...

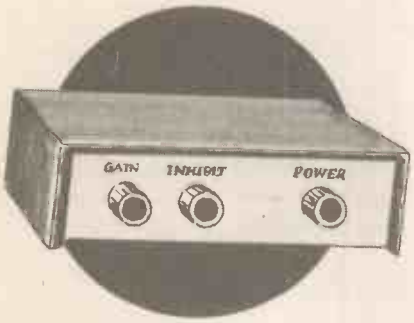
FREEZER FAILURE ALARM

Freezers are usually very reliable but if yours does break down you need to know before the food starts to thaw. This simple alarm will tell you if the temperature inside the freezer begins to rise.



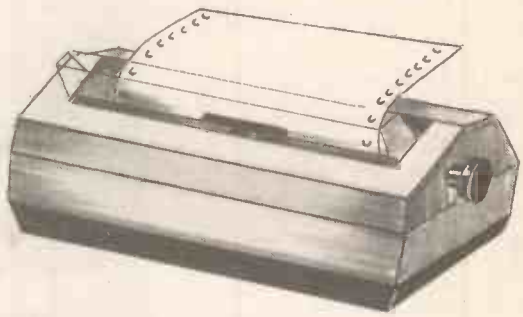
SCRATCH BLANKER

Far more sophisticated than a scratch filter this unit cuts out the noise spikes and replaces them with smooth audio—invaluable for anyone with a well used collection of conventional records.



Simple PRINTER BUFFER

Any serious computer user will find this unit is really useful. It allows the continuation of data or text entry whilst the previous letter, account, listing or what-have-you is printed out.



Feature- SEMICONDUCTORS IN PERSPECTIVE

EVERYDAY ELECTRONICS and ELECTRONICS MONTHLY

SEPTEMBER ISSUE ON SALE FRIDAY, AUGUST 15

a regular feature for the Spectrum Owner...

by Mike Tooley BA

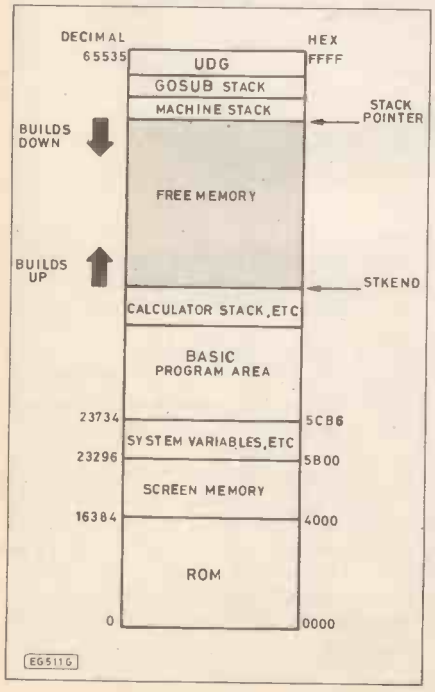
THIS month, in our eighteenth instalment of *On Spec*, we shall be examining another useful system variable and describing some applications of the simple two-chip eight-channel interface described last month. We start, by popular request, with a means of delving into the Spectrum's memory.

A Journey Into ROM and RAM

Since the Spectrum, like most low cost home computers, employs a 16-bit address bus, there are 65,536 (2^{16}) different memory locations, each having its own unique address. The allocation of memory (in terms of both ROM, RAM and specified reserved functions) can be illustrated with the aid of a "memory map".

A simplified memory map for the Spectrum is shown in Fig. 1. Readers should note that addresses are specified in both hexadecimal and decimal and that the map is effectively 8-bits wide since one byte is stored at each address.

Fig. 1. Simplified memory map for the 48K Spectrum and Spectrum Plus.



In recent months, several readers have written to ask for a means of examining the contents of memory and displaying the values contained therein. This can be quite useful and is normally undertaken with the aid of a monitor utility.

Many software suppliers have such programs available though they often form part of a more complex package which also contains a compatible assembler. The reason for this is that, when developing machine code programs, it is highly desirable to have an assembler and monitor co-resident in memory.

For those of you who cannot justify the necessary outlay required to purchase a full-blown monitor program, the simple BASIC listing (Listing 1) shown should at least provide a partial solution. This program will display, in decimal, hexadecimal and ASCII/BASIC token form, the contents of any 16-byte block of the Spectrum's memory. The display can be scrolled forwards (using the "n" option) or backwards (using the "p" option) in order to display the next or previous 16 bytes respectively.

The program displays addresses in both decimal and hexadecimal form (this can be a useful facility in its own right!) and initially displays the contents of memory starting at 32768 decimal (8000 hex). The start of the displayed block may be altered by responding to the "a" option after which the user is prompted for a new start address. If "q" is selected, the program is terminated and cleared from memory.

The program will provide a useful insight into how sections of the ROM are utilised (note, however, that it does not disassemble the code!). By selecting a suitable address within the area normally used for the storage of BASIC programs, the program can even be used to display itself (try an address of around 24000 initially!).

Listing 1: MEMORY DISPLAY

```
 10 REM *** Memory Display Program ***
 20 REM Everyday Electronics August 1986
 30 REM
 40 LET a=32768: REM Initialise
 50 PAPER 0: BORDER 0: INK 7: CLS
 60 PRINT AT 0,0; INVERSE 1;"ADDRESS"
 70 PRINT AT 0,19; INVERSE 1;"CONTENTS"
 80 PRINT AT 1,0;"DEC    HEX"
 90 PRINT AT 1,13;"DEC HEX ASCII/TOKEN"
 99 REM
100 REM *** Display 16 Bytes ***
101 REM
110 FOR i=0 TO 15
120 PRINT AT i+3,0;a+i
130 LET d=a+i: GO SUB 400
140 PRINT AT i+3,6;h$
150 PRINT AT i+3,13;PEEK (a+i)
160 LET d=PEEK (a+i): GO SUB 500
170 PRINT AT i+3,17;h$
180 IF d<32 THEN  LET b$="": GO TO 200
190 LET b$=CHR$ d
200 PRINT AT i+3,21;b$
210 NEXT i
299 REM
300 REM *** Select Option ***
301 REM
310 INPUT "n, p, a or q ? ";r$
320 IF r$="q" THEN  RANDOMIZE USR 0
330 IF r$="n" THEN  LET a=a+16: GO TO 50
340 IF r$="p" THEN  LET a=a-16: GO TO 50
350 IF r$="a" THEN  INPUT "Address ? ";a
360 GO TO 50
399 REM
400 REM *** Convert 2-byte dec to hex ***
401 REM
410 LET x=d
420 LET h$="0000"
430 LET z=4096
440 FOR y=1 TO 4
450 GO SUB 600
460 NEXT y
470 RETURN
499 REM
500 REM *** Convert 1-byte dec to hex ***
501 REM
510 LET x=d
520 LET h$="00"
530 LET z=16
540 FOR y=1 TO 2
550 GO SUB 600
560 NEXT y
570 RETURN
599 REM
600 REM *** Convert 1-byte dec to ASCII ***
601 REM
610 LET c=INT (x/z)
620 LET x=x-z*c
630 LET c=c+48
640 IF c>57 THEN  LET c=c+7
650 LET h$(y)=CHR$ (c)
660 LET z=z/16
670 RETURN
```

Readers who already have access to a monitor program, or who otherwise would not immediately find the program useful, need not despair! The subroutines starting at lines 400, 500 and 600 can be quite invaluable for those developing their own BASIC programs and requiring decimal, hex and ASCII conversion facilities.

STKEND

This month we put the STKEND system variable under the microscope. STKEND occupies locations 23653 and 23654 (5C65 and 5C66 hexadecimal) and contains the two-byte address of the first free byte above the Spectrum's calculator stack. This stack grows upwards whereas the machine stack (in high memory) grows downwards.

Now, since the CPU Stack Pointer register points to the last location to have been filled in the machine stack, subtracting the value contained in STKEND from the Stack Pointer will give the extent of free memory available within the system. Knowledge of this value can be extremely useful in a number of applications and simple routines for printing the free memory available can be easily incorporated within BASIC and machine code.

The following code, written using Z80 assembler mnemonics, subtracts the contents of STKEND from the Stack Pointer (SP) and, in order that the value can be returned to BASIC, the result is placed in the BC register pair.

```
                ORG  64000 ; relocatable
STKEND          EQU  23653
MEMCODE LD      HL,0
        ADD     HL,SP
        LD      BC,(STKEND)
        SBC     HL,BC
        LD      B,H
        LD      C,L
        RET
        END
```

Readers lucky enough to have an assembler to hand can simply enter the foregoing code which can subsequently be CALLed as a subroutine. Those not having access to an assembler can utilise the Hex Code Loader published in the December 1985 issue of *EE* (readers not having this issue will find a copy of the program contained in our *On-Spec Update*). The procedure is as follows:

1. From the initial prompt, set RAMTOP to a suitable value, say, 64000. This will become the start address of the subroutine.

2. Enter the 13 hex bytes listed below:

21,00,00,39,ED,4B,65,5C,ED,42,44,4D,C9

3. Now use the SAVE option to preserve the code on tape (the EXECUTE option will not return any value). In this particular example we shall use the filename "MEMCODE".

4. To check the code (before exiting from the hex loader) press BREAK and then type the following direct command:

PRINT USR (64000)

If the code has been entered correctly you should be rewarded with a numeric value showing the free memory available (in bytes). This will typically be around 46K with the hex loader still present in memory.

5. Now reset the machine to clear the memory and load the machine code from tape by typing:

LOAD "MEMCODE"CODE

6. Now enter the command:

PRINT USR (64000)

This should return a value nearer 48K as the hex loader is no longer in memory.

To use the code at some later stage simply save the machine code module immediately after your BASIC program and then include a line of the form,

10 LOAD "MEMCODE"CODE

in your program. To print the free memory at any later stage use a line of the form:

110 PRINT USR (64000); "bytes free."

As another alternative, the machine code may be POKEd from within a BASIC program. This is an arguably more elegant solution since a separate machine code module is not required. The following program illustrates the technique:

```
 5 DATA 33,0,0,57,237,75,101
 6 DATA 92,237,66,68,77,201
10 for i=1 TO 13
20 READ x
30 POKE (64000+i),x
40 NEXT i
110 PRINT USR (64000); "bytes free."
120 STOP
```

The 13 values contained in the DATA statements of line 5 and 6 are simply the decimal equivalent of the thirteen hexadecimal values given earlier. Readers should also note that there is nothing particularly special about the start address (64000) other than that it is an easy one to remember.

Two-chip Output Interface

The two-chip eight channel output interface, described last month, can be tested with the aid of a number of l.e.d.s, as shown in Fig. 2. Each l.e.d. requires its own current limiting resistor, 270 ohm being typical.

The following BASIC code should toggle all eight l.e.d.s "on" and "off" whenever any key (other than BREAK) is pressed:

```
100 OUT 127,255
110 PAUSE 0
120 OUT 127,0
130 PAUSE 0
140 GO TO 100
```

The two-chip interface has a port address of 127 and, to illuminate an individual l.e.d., simply output its value determined from Table 1. To illuminate the l.e.d. connected to line 5, for example, it is simply necessary to output the value, 8, using a command of the form:

OUT 127,8

Where several lines are to be activated at the same time, it is merely necessary to add the individual values together. The following command activates the two l.e.d.s driven by lines 5 and 6 (having values of 8 and 16 respectively):

OUT 127,24

An alternative technique employs the useful BIN function available in Sinclair BASIC. Each binary digit within the BIN value corresponds directly to a particular line. Thus the following command is exactly equivalent to the previous command:

OUT 127,BIN 00011000

Table 1

Pin. No. of PL1	Output value
2	1
3	2
4	4
5	8
6	16
7	32
8	64
9	128

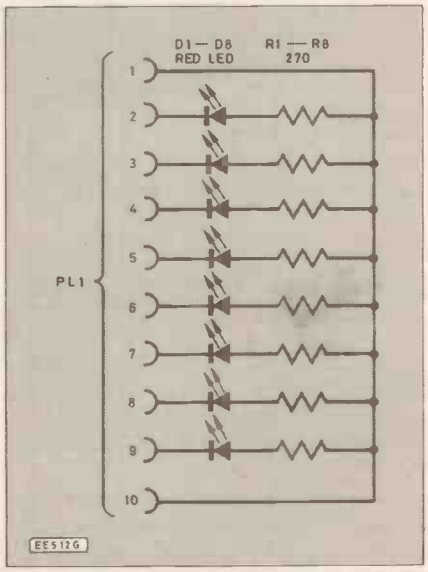


Fig. 2. Circuit for testing the Two-chip Output Interface.

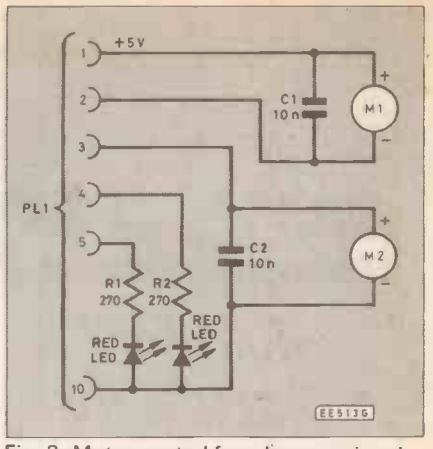


Fig. 3. Motor control for a buggy using the interface.

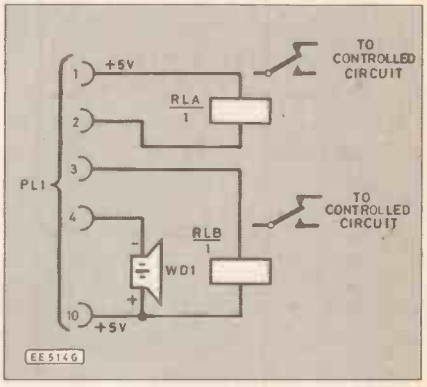


Fig. 4. Using the output interface to control a programmable darkroom timer.

Applications

Just two of the many applications of the *Simple Output Interface* are illustrated in Figs. 3 and 4. In Fig. 3 the interface provides control for a simple experimental buggy. This vehicle has driving motors, M1 and M2, connected to "port" and "starboard" wheels respectively whilst two skids are fitted "fore" and "aft". This arrangement provides "forward drive" (both motors activated), "right turn" and "left turn" (with either one of the motors activated).

How the interface may be used as a programmable darkroom timer is shown in Fig. 4. Two lighting circuits are controlled by 5V relays, RLA and RLB, whilst a 5V piezoelectric transducer, WD1, is used to provide warnings.

Regular readers will, no doubt, develop many more novel and sophisticated applications for the interface. Let me know what you come up with so that I can include details in a future edition of *On Spec*.

Next month: We shall be taking a look at the Spectrum's RAM and describe a DIY Joystick.

exploring electronics

OWEN BISHOP

This series is designed to explain the workings of electronic components and circuits by involving the reader in experimenting with them. There will not be masses of theory or formulae but straightforward explanations and circuits to build and experiment with.

PART 2 Using a transistor

THE invention of the transistor paved the way to the development of a multitude of electronic circuits, ranging from a simple switch, such as that described in this article, to the most complex of computers. There are several different kinds of transistor. In this article we use a junction transistor (see Fig 2.1). Other types will be described and used in later articles.

Junction transistor

One form of this transistor consists of a very thin layer of *p*-type semiconductor material sandwiched between two layers of *n*-type material. This is called an *npn transistor*. Connections to the three layers are named as in the diagram Fig. 2.1: Collector; Base; Emitter.

The junction transistor has two *pn* junctions:

1) ***Base-emitter***: this is normally forward-biassed (see Part 1). The base current flows when the base emitter potential difference exceeds about 0·6V.

2) ***Collector-base***: this is normally reverse-biassed.

It would be expected that no current could ever flow across them (except with a destructively large collector-base p.d!). But, for reasons we do not have space to go into here, a current *does* flow across this junction. Moreover the size of this current is related to the size of the current flowing across the base-emitter junction. This is the basis of the action of the junction transistor.

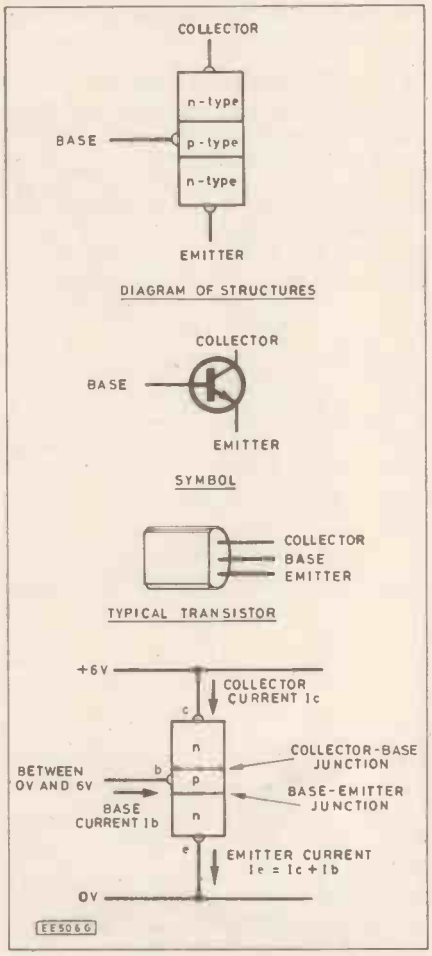
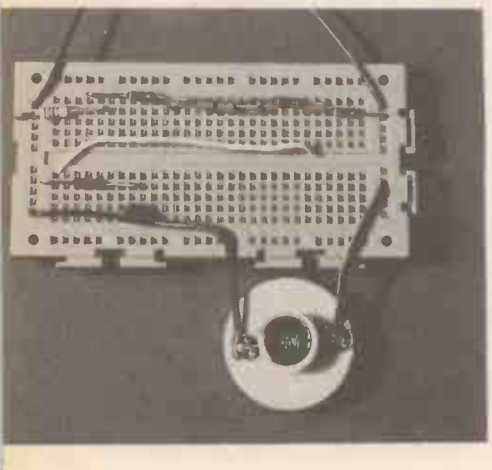


Fig. 2.1. The construction, circuit symbol and operation of junction transistor.



Junction transistors can also be made with a layer of *n*-type material sandwiched between two layers of *p*-type material (*pnp* construction). The principle of operation is the same as above, but polarities are opposite and currents flow in the opposite directions.

A TRANSISTOR SWITCH

Set up the circuit (Fig. 2.2) and connect the battery. Is a current flowing through lamp LP2? How can you tell that it is? Is a current flowing through LP1?

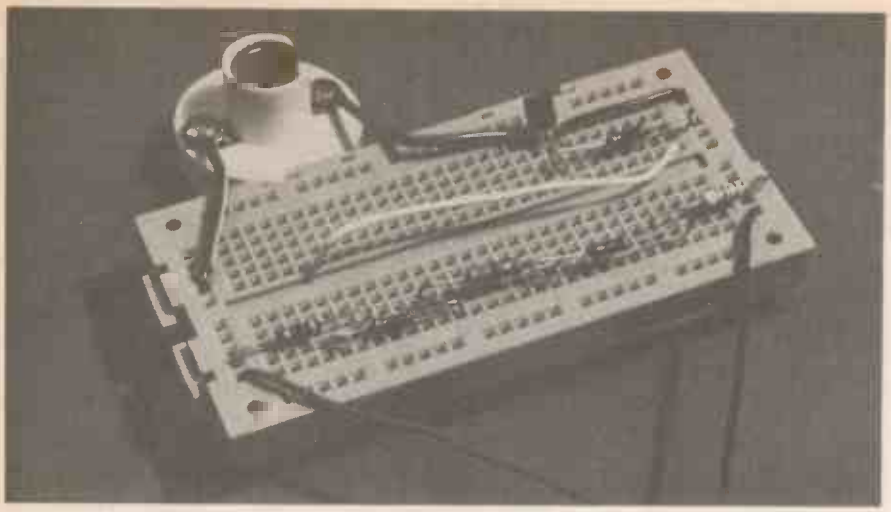
The current through LP1, if any, must be very small because LP1 does not show the slightest signs of glowing. Now unscrew LP1 and take it from its socket. What happens to LP2? Obviously, breaking the connection at LP1 has made a difference to the circuit. Presumably there was a current flowing through LP1.

Base current

The current flowing through R1, and LP1 to the *base* of TR1 is called the base current. The current flowing through LP2 to the *collector* of TR1 is called the collector current. Base current is very small. Collector current can be very large. As you have seen, the lamp LP2 glows brightly. But if the small base current is cut off the collector current is cut off, too. This is the way in which we use a transistor as a switch. By switching the *small* base current on and off we are able to control the *much larger* collector current.

Remove LP1 and connect R1 directly to the base of TR1. The lamp LP2 comes on again. Try replacing R1 with resistors of *higher* value. They allow a smaller base current to flow to TR1. What happens to the brightness of LP2 as the resistance R1 is increased and the base current is decreased? (Answer opposite).

Here is another way of controlling the switching action, Fig. 2.3. R1 limits the base current to a safe level. By touching the flying lead G to any one of the points A to F, you can apply any one of the voltages shown to the base. The greater the voltage, the greater the base current. See the effect of voltage on the brightness of the lamp. (Answer opposite.)



COMPONENTS

Resistors

R1 220 plus resistors of several values up to 47k

Transistor

TR1 ZTX300 *npn* junction transistor

Miscellaneous

LP1, LP2 6V 0·6W lamp, in holder (2 off); battery box with four 1·5V cells; breadboard (e.g. Verobloc)

Resistors

R1 100
R2 470
R3 330
R4 33
R5 47
R6 82

See Shop Talk Page 436

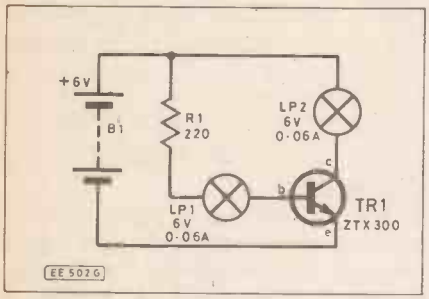
Transistor

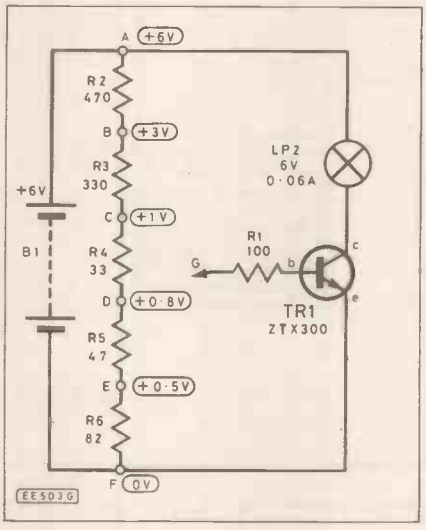
TR1 ZTX300 *npn* junction transistor

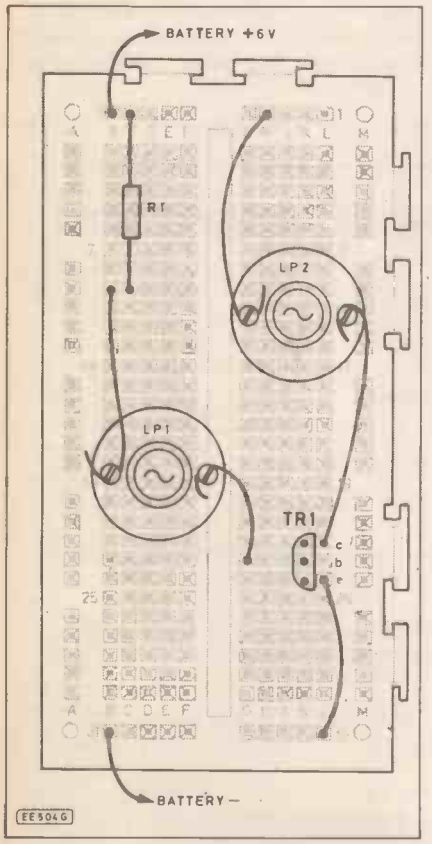
Miscellaneous

LP2 6V 0·06W lamp in holder; battery box with four 1·5V cells; breadboard.

Approx. cost Guidance only £5







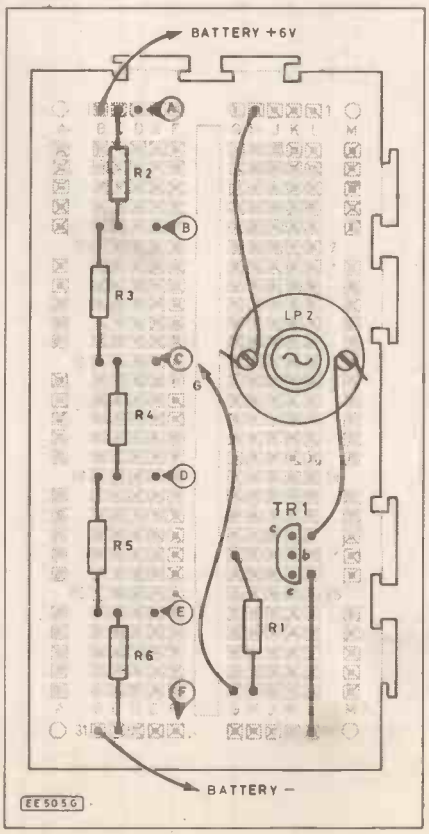


Fig. 2.2 (above). Circuit for demonstrating transistor action (Investigation 1) and working layout.

Fig. 2.3 (right), Circuit diagram and demonstration "breadboard" layout for Investigation 2.

A transistor switch—results of investigations

1st investigation

The greatest value of R1 that still produces a visible glow is 22k approximately. This gives a base current of about 0·15mA, and the collector current is about 30mA—*200 times* as much. Exact results depend on the individual transistor.

2nd investigation

Point F (0V): No base current, TR1 is "off", and LP2 does not light.

Point E (0·5V): LP2 is off because there is no base current. Remember that it needs about 0·6V to overcome the field caused by the depletion zone at a p-n junction, so the base-emitter p.d. must be at least 0·6V before a base current can begin to flow.

Point D (0·85V): A very small base current, a small collector current (which is *much larger* than the base current), so LP2 glows dimly.

Point C (1V): LP2 glows brightly, for the base current is now just enough to turn TR1 fully on (or almost fully on, depending on the transistor used).

Points B and A (3V and 6V): The lamp glows brightly as the transistor is saturated (fully on) and the collector current is the same (possibly *slightly* more) as when G was connected to point C.

Turn over for Water Detector project

WATER DETECTOR

The circuit in Fig. 2.4 warns you when there is water where it should not be. You could use it to indicate when a water tank is nearly full and about to overflow. You could use it to detect when it is starting to rain and the washing needs bringing in.

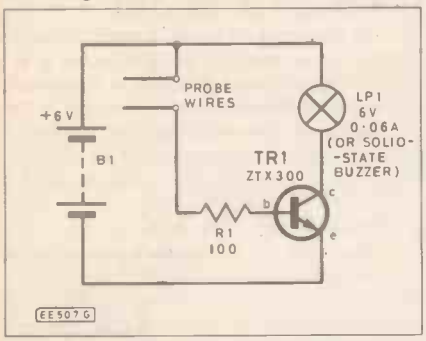


Fig. 2.4. Water detecting circuit (the breadboard layout is similar to that for Fig. 2.2.

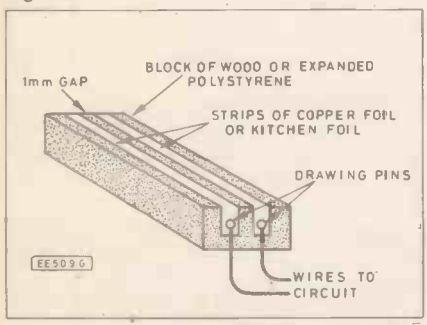


Fig. 2.6. Design for a rain detector probe.

How it works

The circuit uses a transistor as a switch and depends on the fact that a very small base current can turn on a much larger collector current. The water is detected by a probe, which consists of two pieces of wire, close together but not touching. Water, if present, completes the circuit and a current flows from one probe wire to another, through the water. The amount of current that flows through the water is not enough to light a lamp. But, with the transistor circuit, the small base current that flows when the probe is in water is quite enough to turn the transistor on. The lamp glows at full brightness (or almost). As in the circuit in the investigation above, R1 is there to limit base current to a safe amount—for example, in case you accidentally touch the probe wires together.

You will find that even a thin film of water is enough to trigger this circuit. A useful feature of the circuit is that the probe can be at the end of a long pair of wires. The probe can be outdoors, or in some place that is difficult to get to, while the lamp and the rest of the circuit can be in the kitchen or living-room.

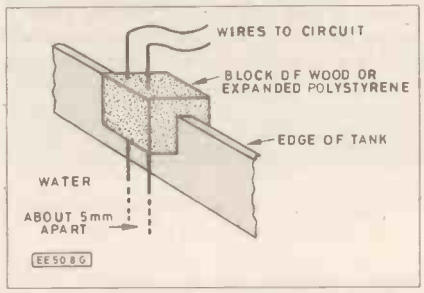


Fig. 2.5. Probe to detect water level in tank. Wires slide up or down to set operating level.

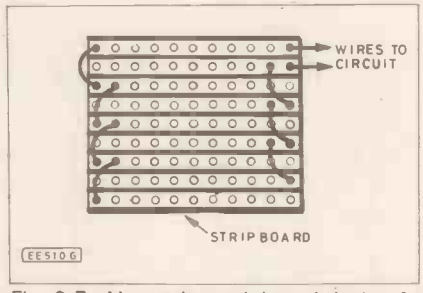


Fig. 2.7. Alternative stripboard design for a rain detector sensor.

Construction

There are lots of ways of making the probe. The diagrams Fig. 2.5 to Fig. 2.7, show designs for a probe suitable for hanging on the edge of a tank, and one suitable for detecting drops of rain. It needs only one drop to bridge the gap and the circuit is triggered.

Variations

You can replace the lamp with the solid-state buzzer, which gives a loud warning note when water is detected, or you can connect the buzzer in parallel with LP1 and have both a visual and audible alarm system.

Next Month: Another transistor switch plus a light dependent resistor project —Electronic Candle

DOWN TO EARTH

BY GEORGE HYLTON

A READER asks the meaning of the term "psychogalvanometer", which he has come across in an article on "fringe" medicine.

This a high-sounding word for something essentially simple. A psychogalvanometer is an instrument which indicates changes in the electrical resistance of the skin.

Such changes are basically the result of the operation of sweat glands in the skin. Under conditions of stress the glands operate and since sweat is salty water the resistance of the skin falls. This is known in psychology as the galvanic skin response and the instrument which measures it is a psychogalvanometer

IS YOUR RESISTANCE LOW?

With an ordinary ohmmeter capable of measuring resistances up to about a megohm you can measure your skin resistance. All you do is hold the test prods or clips firmly, if necessary moistening your fingers to get a better contact.

If your meter is not sensitive enough you can rig up a simple transistor amplifier (as shown in Fig. 1). Your skin resistance is now the base bias resistance and any current through it is amplified h_{FE} times, which should be at least 100 for a decent modern silicon transistor. It follows that the meter should be on a low current or low voltage range.

I can hear some of you objecting that the meter is responding not just to the resistance of the skin but to the resistance of the whole body, from the fingers of one hand, up the arm, through the chest and back down the other arm. True. The equivalent electrical circuit, shown in Fig. 2, contains three resistances: two for the skin, which the current must traverse at each end; and one for the body. But the body resistance is quite low, because the body is mostly water and salty water at that. Ths skin resistances, in comparison, are high and swamp the body resistance.

FEAR AND PAIN

As readers of adventure stories know, fear traditionally brings on a cold sweat. This moistens the skin and reduces resistance. Pain has a similar effect, as indeed has anything that causes excitement, tension or anxiety.

If you are sufficiently stoical (or masochistic) you can experiment on yourself. Try biting your tongue while holding the meter prods, of the transistor connections. You might see a drop in resistance, after a few seconds

CONTACT RESISTANCE

The great problem with contact resistance is that the two electrodes tend to make an erratic and variable contact with the skin. Our equivalent circuit really needs two extra resistances to take this into account, see Fig. 3. The contact resistances are likely to vary randomly, as your grip relaxes or tightens and can introduce "noise" (unwanted variations).

Improving the quality of skin contact is the most useful single step towards obtaining consistent results. Professional measurements of the Psycho-Galvanic Response (PGR for short) make use of commercial electrodes, often made of conductive rubber or plastic. These are coated with a special conductive electrode jelly. The idea is to provide a large area of contact and to reduce the contact resistance to as low and steady a value as possible.

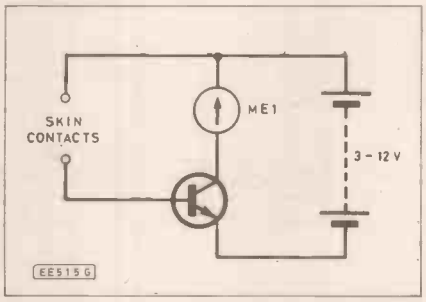


Fig. 1. A simple transistor amplifier circuit.

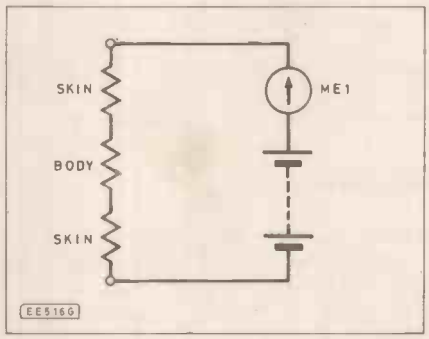


Fig. 2. Analogy of "skin resistance" using Fig. 1.

INDICATION

The more optimistic sort of PGR instrument design uses the skin resistance as the timing resistance of an RC Audio Oscillator. The frequency then changes in response to psychological influences such as fear and pain and emotion generally.

The trouble is that in ordinary circumstances the changes are very small. With a crude PGR instrument they may be too small to observe.

This is useless in the most common application of these instruments, bio-feedback "experiments". Here the PGR is utilised as a convenient indicator of some change in a subject or patient. Often the patient is asked to try to relax. If the pitch of the noise in his earphone falls he knows he's succeeding. (I'm saying "he", but of course it's just as likely to be "she" in practice.)

BRIDGE TECHNIQUE

For this sort of work a really sensitive indicator is needed, so that even a tiny step in the desired direction is detectable. One possibility is to make changes in skin resistance unbalance a bridge, see Fig. 4. The unbalance voltage is then amplified by an op.amp. before being made to activate an indicator—audible or visible.

Another advantage of the bridge technique is that the bridge can always be set to balance at the start of a session, whatever the skin resistance of the individual subject. Skin resistance varies enormously from person to person.

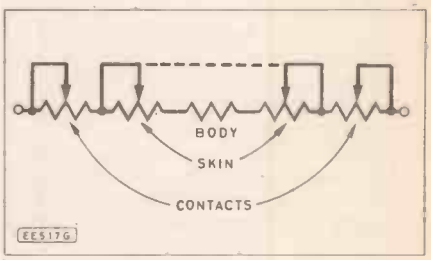


Fig. 3. Adding variable resistance to model effects of "contact resistance".

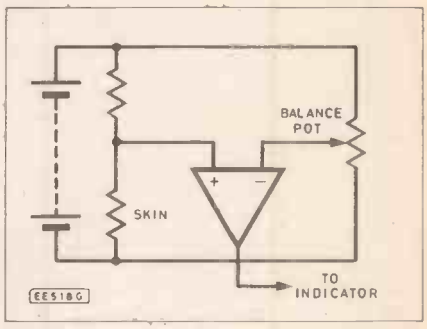


Fig. 4. Employing an op-amp in a bridge circuit to improve sensitivity.

BIO VARIABLES

The PGR is only one of many biological quantities which vary and can be used in biofeedback work. Others are pulse rate, skin temperature, and blood pressure. All are potentially useful in relaxation exercises and other "mind over body" training.

Despite suspicion by doctors and despite the bad reputation gained by the so-called lie detector, which measures the same quantities but frequently gives erroneous results, these bio-feedback techniques do have a genuine role to play in medicine. This is still a relatively new field for research, and interested readers may be able to use their knowledge of electronics or information processing to make improved instruments or indicators.—See Biological Amplifier, *Microcomputer Interfacing Techniques, Part 7*, EE January, 1984.

NEWS ...from the wo

INSECT ATTACK–EARLY WARNING

Electronics helps to fight off the threat of insect pests invasion

RESEARCH at the agricultural centre, Rothamstead Experimental Station, aims to provide farmers with warnings of attacks by insect pests according to Dr. Graham Bent (Entomology Department), as reported to our correspondent George Hylton.

This entails keeping an eye on what insects are flying over the fields. In a fully developed system, automatic reporting stations dotted about the country would sample the insect population and report back to headquarters, where the data would be collated and mapped.

Until now, mechanical traps have been used. These are essentially pipes sticking up above the fields. Fans draw air down the pipes into filters where the insects are retained. The contents are examined by human inspectors who identify the species and count the numbers.

Current research is aimed at replacing this slow and labour-intensive system with a fully automatic one. Radar beams, directed upwards from field stations, will detect insects flying by at heights of 12·5 to 250 metres. Sophisticated signal processing by an inbuilt microprocessor will not only count the insects but compute their direction of flight and, it is hoped, identify them. All this information would then go to H.Q. via land-line or radio link.

Insect detection by radar is not easy, because the targets are so small. Conventional wisdom says that for good reflection of a radar wave the target should be at least comparable in length with a quarter of the radar wavelength. This is far from true with the Rothamstead radar, which uses 3cm waves on insects only a millimetre or so long. The echoes are very faint and can only be detected by careful processing.

However, the wavelength mismatch does bring a bonus. The faint echoes from insects are produced by a process called Rayleigh scattering, and this turns out to be proportional to the mass of the insect. So the first step in identification—knowing the size of a insect—has already been taken. For large insects, the radar echoes are modulated by the wing-beat frequency, and this could be used as a further aid to identification. Radar Taxonomy, as the zoologists calls it, is being born.

In time, it is hoped, insect forecasts may become as familiar an event in summer as pollen counts.

Rank Awards

The 1986 Rank Prize Funds Awards have been presented to three Philips research scientists who, at the beginning of the seventies, laid the basis for the optical recording and reading of information on a disc. With this international distinction, Dr. P. Kramer, Senior Managing Director of Philips Research, Mr. G. Bouvhuis, senior scientist, and Dr. K. Compaan, now retired, have received recognition for a basic invention which has led to the LaserVision optical disc, the Compact Disc and the disc for storage of digital data, along with the corresponding electronic systems.

They received the Awards from Sir John Davis, Chairman of the Trustees of the Rank Prize Funds, at the Royal Institution in London. Awards were also presented to eight scientists from the UK and USA for their work on infra-red recording and large-screen television techniques.

In his speech of thanks, Dr. Kramer stated, "Ideas like an optical disc need a proper environment to grow: a large multi-disciplinary research organisation, expertise in a number of technological areas and a spirit of entrepreneurship, both technical and commercial.

"One needs also perseverance and some luck, because gambling is unavoidable. We did not need so much perseverance, because it was a nice, friendly and converging subject. And we had some luck."

Jeffrey Fellows has been appointed the first Director of Projects and Technology at the British National Space Centre (BNSC). Based at the BNSC's technical centre at the Royal Aircraft Establishment, Farnborough. He will be responsible for, among other things, developing and promoting national initiatives of high technical and scientific merit.

This will either be within the framework of the European Space Agency or bilaterally, through the Director General, advising the Defence Secretary on technology of relevance to MOD programmes. This means advising on the compatibility, efficiency and effectiveness of the research and development activities in the various programmes undertaken or sponsored by BNSC.

WOMEN GO UNDERGROUND

Watching a man working down a hole is not all that unusual a pastime, but in Scotland these days if you peer down a hole, you could just spot a lassie instead. For Diane Lauder, from Edinburgh, is a trained British Telecom jointing engineer—probably the only one in the UK?

For her latest assignment, Diane is busy helping to prepare communications links for the Commonwealth Games due to start next week (24 July). BT has a major involvement in the Games and is using multiple technologies taking in satellite, digital, optical fibre, microwave and cellular radio links. There is even a transportable dish aerial to handle special satellite links.

Diane, seen in our photograph working at the Meadowbank Stadium, major arena of the forthcoming Games, works with an external maintenance control group.

GATEWAY TO THE FUTURE

External forces, including the probable relaxation of the law regulating the services building societies can offer, has led the Gateway Building Society to reconsider its approach to information processing.

The building society has asked information systems consultants BIS Applied Systems to define a suitable forward strategy for the development of its information systems for the late 1980's and early 1990's.

The review will look at the society's approach to IT, encompassing both hardware and software, in the light of future business requirements.

Cirkit Distribution has reached agreement with Belling Lee Intec for the UK distribution of their range of fibre optic components which includes d.c. transmitter and receiving modules, dry termination connectors and analogue transmission systems.

Mike Sandham, Cirkit's Industrial Sales Manager, said *"This represents an important progression for Cirkit enabling us now to offer a top line in fibre optic components for the first time alongside existing in-depth stocks of electronic components from other leading suppliers."*

DEALERINTERLINK

A low-cost, on-demand private network system, entitled Dealerinterlink, has just been introduced by British Telecom in the City of London. More than 40 major banks and dealing houses have already signed up for the service.

Dealerinterlink enables private circuits—to provide fast trading links between two points—to be established within 24 hours.

British Telecom has reached an agreement with the Minstry of Post and Telecommunications in China to open an International Direct Dialling (IDD) service.

Direct dialling will open between Britain and Beijing (Peking), Shanghai and 24 other major cities and towns, covering all but a handful of China's 5 million telephones.

Calls will be sent via a satellite orbiting 22,300 miles above the Indian Ocean, between BT's Goonhilly earth station and a new satellite station at Beijing.

Software Certificate

The Institution of Electrical Engineers (IEE) and the National Computing Centre (NCC) are to combine their resources in an effort to introduce a National Certificate in Software Engineering. This, it is hoped, should lead to a large increase in the supply of skilled software engineers.

This joint initiative comes in response to concern expressed by both organisations over the current shortage of high quality engineers in the new technologies of electronics, communication and control.

The IEE has identified an annual shortage of at least 1500 graduates in the new technologies. The Alvey Directorate predict that this shortage will increase to 5,000 by 1988. An even greater shortfall in the number of technicians trained in these fields is anticipated by the Engineering Industry Training Board (EITB) which estimates that the 3,000 being trained annually is only half the number required.

Clwyd Technics have just launched a Welsh version of Edword, their highly acclaimed Word Processing Package for schools.

Electronics To Do The Walking

British Telecom have announced that it is to start an electronic extension of its Yellow Pages Directories. Information on advertisers will be held on a central database, accessible at no cost (other than the ordinary telephone charge) by anyone with a suitable communicating terminal.

Electronic Yellow Pages (EYP) will initially contain information covering the London, Reading and Guildford areas. Any company currently paying for advertising at semi-display level or above in the ordinary Yellow Pages covering those areas will qualify for a free listing on the database.

LOCAL LINKS

Optical fibre cables worth £8·5 million have been ordered by British Telecom from British firms.

Single mode optical fibres will, for the first time, be used in the junction network which connects local telephone exchanges over distances up to 20 miles. More than half the cable ordered is of the high capacity single mode variety.

BT is claimed to be the first telecommunication authority in Europe to deploy single mode optical fibres on a large scale between local exchanges. They are able to contain costs because the new cables can be equipped for high capacities, up to 140 Mbit/s or 3840 simultaneous conversations on one pair of fibres.

SATELLITE RECEPTION

Printer importer/distributor Micro Peripherals have announced plans to diversify into satellite television. Trading under the name of Vusat, they have already designed a domestic system and hope to have UK and European models on the market by the autumn.

Managing director Ian Jones, an ex-BBC engineer, indicated that satellite television would become extremely sophisticated with complex signal encryption. This would mean each domestic receiver could be addressed via satellite from a central computer permitting access to programmes only if the required subscription had been paid.—A case here for "Captain Midnight"? See For Your Entertainment.

Polytechnics and colleges running degree level courses in electrical and electronic engineering are to receive £3M from the Department of Trade and Industry to buy electronic computer aided design (ECAD) equipment.

PLEASE TAKE NOTE

BBC Midi Interface *(March 1986)*

Some readers seem to have a problem with data either not making it through the opto-isolator, or being corrupted. This could possibly occur with a combination of relatively low available current drive from the synthesiser and relatively inefficient opto-isolator (which should be the type with the "3" suffix and a guaranteed high level of efficiency).

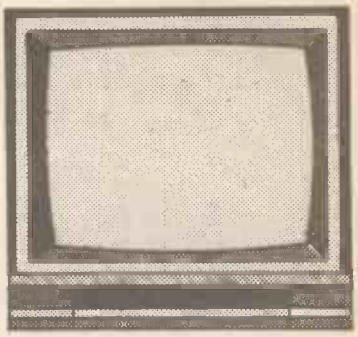
The problem might be helped by making resistor R1 slightly higher in value, and R2 a little lower in value. Also there is just an outside possibility that it is due to excessive sensitivity, resulting in IC2 being held in the "on" state, and making these resistors lower and higher in value (respectively) should cure the problem.

Replacing the opto-isolator would probably cure the problem, but this should be unnecessary and some slight adjustments to the values of R1 and R2 should be all that is required.

TILT ALARM *(July 1986)*

The authors name for the *Tilt Alarm* should be Mark Stuart *Not* I. P. Kemp. We apologise to both authors for any inconvenience caused.

FLAT TELEVISION AERIAL



M.JAMES

A novel approach to TV reception that will take less than one hour to complete

THIS DESIGN is for a flat television aerial that can be made very cheaply (for less than £1) and very quickly (in half an hour or less) and will give excellent results in an enclosed space, at a low level indoors (such as a flat or bedsit).

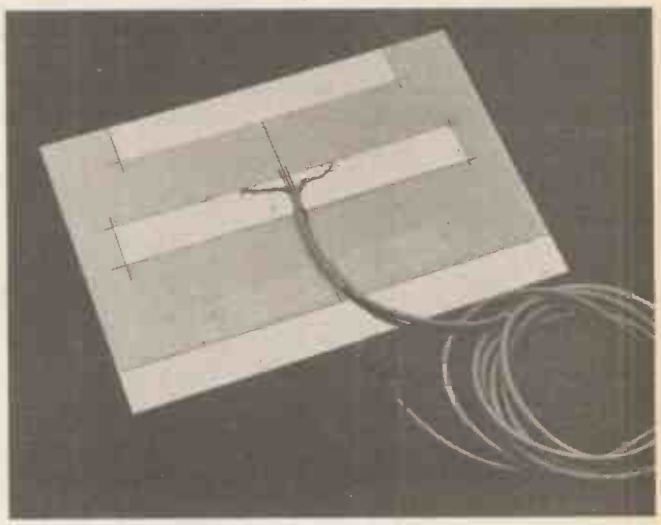
The design is best suited to areas with horizontally polarised signals — if in doubt look at the aerials in your area. Aerials with the "rods" in a horizontal position are for horizontal polarisation and those with vertical "rods" for vertical polarisation. The flat aerial can be used vertically but this may cause some mounting problems unless one of your walls is in line with the direction of the transmitter. Obviously the aerial could be hung by two threads from the ceiling but this will look rather odd. However, the card used as the basis for the aerial can be painted with various designs or larger pieces of card can be used, then cut to form decorative shapes and painted, e.g. a butterfly shape suitably painted might look very good in the right setting, it cannot of course be allowed to move around as this would upset reception.

DESIGN

The Flat Television Aerial is based on the "Yagi" design, but has the advantage of being very thin (about five millimetres). This is achieved by using kitchen aluminium foil for the elements. The foil is given strength and rigidity by sandwiching it between two sheets of card. In the prototype, for ease of construction, the cardboard backs of pads of A4 paper were used. To build it you will need the following materials and tools: aluminium foil (at least 30 centimetres wide and 9 centimeters long); two sheets of cardboard (21 by 30 centimetres each); paper/card glue ("Pritt-Stick" etc.); a stapler; a very sharp knife (preferably a craft or "Stanley" knife); a co-axial plug for the television; two metres (or more if appropriate) of thin co-axial TV aerial cable and insulation tape.

CONSTRUCTION

The foil positions are marked out on one of the pieces of card, around a central line 15 centimetres from the edge (see Fig. 1). The appropriate pieces of aluminium foil are then cut out and pasted to the board. The co-axial cable is stripped and stapled to the dipole elements, near the central gap. The second board is then pasted on top of the first — over the foil — and then the two are stapled together and taped around the edges, giving the profile seen in Fig. 2. The co-axial plug is now soldered to the other end of the lead-out flex and the aerial is finished.



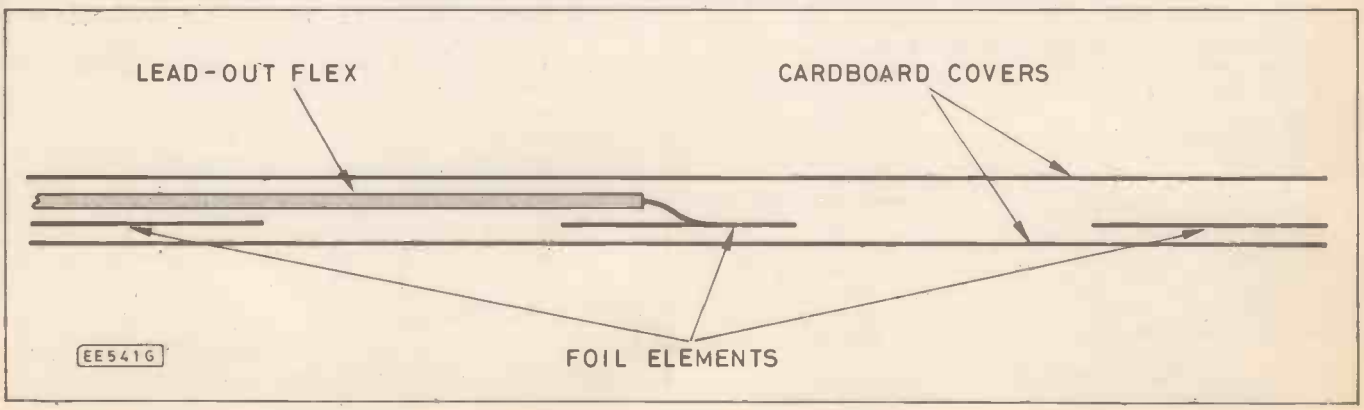
The completed aerial before being "sandwiched" with a piece of card.

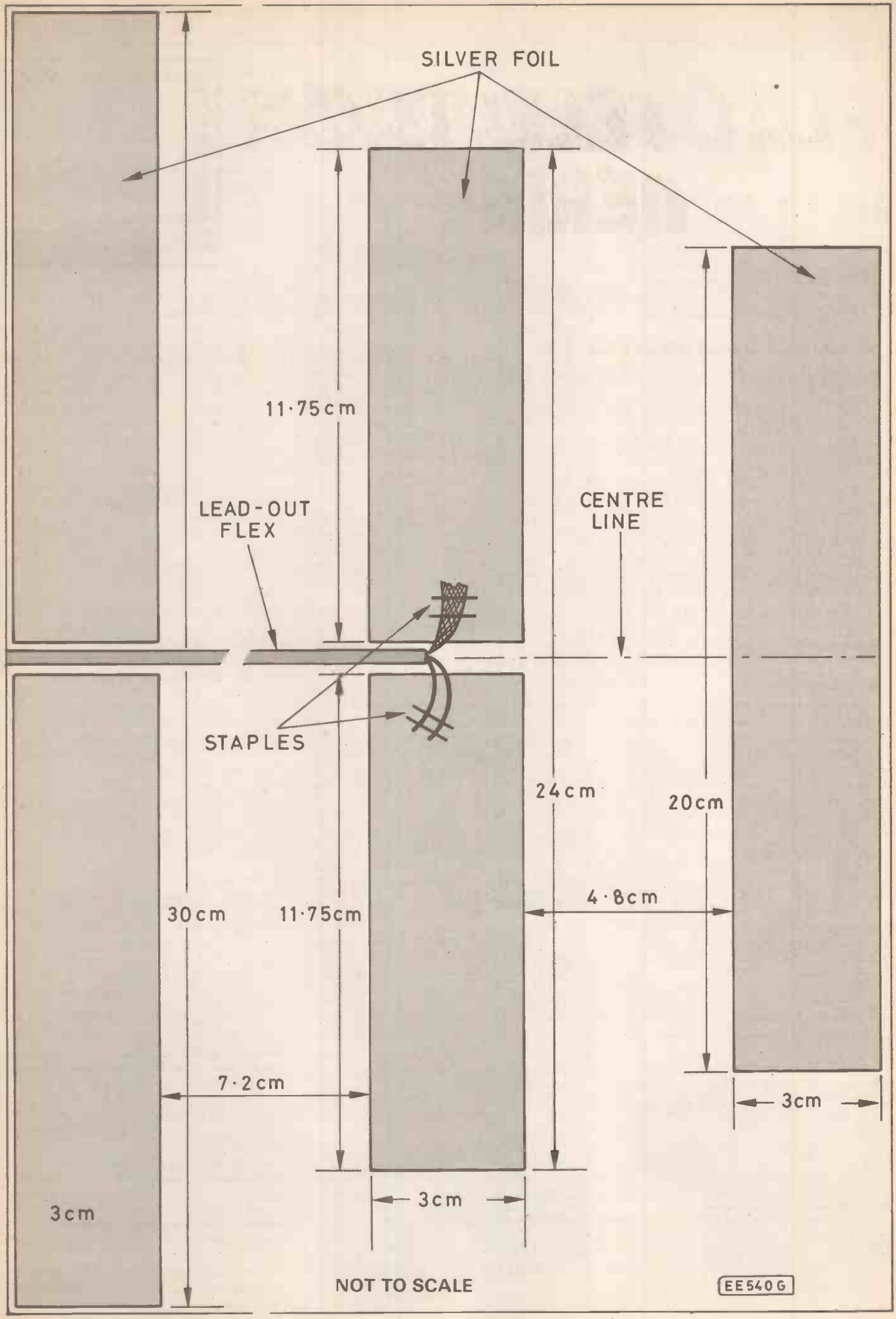
Fig. 1 (opposite). Dimensions and layout details for the Flat TV Aerial.

IN USE

In practice the aerial is very simple to use, the basic rule being as high and as far from obstructions as possible. Mount the aerial either horizontally or vertically, depending on the signal in your area (as mentioned earlier) and rotate it until the best signal is received. It may then be fixed in position. If you live in a flat or "bedsit", the easiest position for it would be mounted flat on the ceiling, held by "Blu-Tak" or drawing pins. But if you live in a house with an attic or loft then it could be mounted there. □

Fig. 2. Profile detail showing the "sandwich" arrangement for the aerial.




SILVER FOIL
11·75cm
LEAD-OUT FLEX
CENTRE LINE
STAPLES
24cm
20cm
30cm
11·75cm
4·8cm
7·2cm
3cm
3cm
3cm
NOT TO SCALE
EE540G

Actually Doing it!!

BUILDING projects into tobacco tins and the like seems to be a lost art, and is perhaps rather out of keeping with today's projects with their LSI integrated circuits and other high technology components. There seems to be a preference for projects to look as much like the commercially produced "real thing" as possible, rather than looking home-made.

Being realistic about it, if you have difficulty making projects look reasonably professional it does not really matter, and a smart looking project will work no better than one which is an eye-sore. I know of no electronics law which states that more fun is derived from building a well finished project than from putting together one with a relatively crude appearance.

On the other hand, anyone seeing your handywork is more likely to judge it by its appearance than by the skill involved in putting the electronics together, and it does not require a great deal of time or money to considerably enhance the appearance of a project. One final point that should not be overlooked is that adding neat and easily read legends to a project help to make it that much easier to use, especially where someone other than the constructor will sometimes use the unit.

PAINTING

Home-made cases are not very popular these days, and with a wide range of good quality ready-made types available at reasonable prices there is not much incentive to do it yourself unless this is an aspect of construction which you particularly enjoy. Most cases have a fairly high standard of finish as supplied, and any attempt to improve on them could easily have the opposite effect.

One exception to this are the diecast aluminium boxes which are popular for certain types of project (musical effects pedals for example). Some of these are supplied painted with a tough hammer finish paint, but others have a "natural" finish, which generally seems to mean a dirty and unpolished finish.

Sometimes quite a reasonable appearance can be achieved by thoroughly polishing the case with a metal polish (practically any type is effective with aluminium) and then painting it or spraying it with clear lacquer. However, this should be a type intended for use on non-ferrous metals. Without the lacquer the surface will soon start to show finger marks and return to virtually its original condition.

Diecast boxes can look very good when painted, but simply painting straight onto the raw surface with enamel will not give a durable finish, and the covering will soon start to chip and scratch. Prepare the surface by comprehensively cleaning it with a scouring pad, and then let it dry thoroughly before applying a coat of metal primer. In my experience primers of this type seem somewhat reluctant to give a good covering, and two or three coats may be required.

SPRAYING

The case is then ready to receive the paint, and spraying is likely to give a better, more even finish than brush painting. In either case it will almost certainly be better to use two thin/medium coats rather than one heavy coating.

Spray painting is best undertaken out-of-doors on a fairly calm day. This minimises the risk of inhaling paint or fumes, or of any off-target paint damaging anything important.

Use plenty of old newspaper around the area being sprayed, and allow for the fact that the paint will spread out over a much wider area than one would reasonably expect. Paint containers always carry the manufacturers recommendations and warnings, all of which should be read carefully and heeded.

Most suppliers offer a Ford choice of colours when it comes to inexpensive plastic cases, and you might be tempted to try a colour change. Many plastic cases seem to take spray paints with no surface preparation other than making sure that the case is clean and free from grease marks.

With types that are made from a high-gloss soft (p.v.c.-like) plastic things seem to be a little more awkward. Using a very wet, wet and dry paper or something of this nature to give a matt finish helps to give a mechanical key for the paint, but it can still be difficult to obtain a really good finish, and some other type of covering or leaving a natural finish are probably more practical options.

(Left) The tough hammer finish of this diecast box is ideal for musical effects footswitches.
This diecast box has been painted and coloured transfers used to enhance the final appearance.

VENEERS

An alternative to painting is to use some form of plastic veneer. The most common type is the thin self-adhesive material which is available from most do-it-yourself stores, and the woodgrain types can be very useful when making cases for hi-fi equipment or other items of equipment for ordinary domestic use.

These veneers are quite easy to use, although they can be a little awkward when covering large cases. Also, great care has to be taken to avoid letting two adhesive surfaces come into contact with one another—you may never be able to separate them again.

The best approach to using these depends on the particular type of case involved. With a small to medium size case with square corners it is possible to use one piece to cover five sides, with a second piece to cover the removable lid or front panel.

This is not the method I would recommend though, as although it can look very neat initially, with time most of these self-adhesive plastic veneers seem to become less flexible and even slightly brittle. They then become slightly loose at what were once tight corners, giving a rather shabby appearance.

Probably a better way of doing things is to cover each side individually. This is basically just a matter of cutting pieces slightly larger than is really needed, fitting them in place, and trimming them exactly to size using a sharp modelling knife.

When laying the veneer, start at one end of the case and sort of roll it into place pressing it down firmly as you go. This should avoid any air bubbles under the veneer, but if necessary it can be carefully peeled back and relaid.

Small bubbles can be removed by bursting them with a pin and firmly pressing the veneer down on to the case. Be careful not to leave any slightly protruding edges as these will tend to catch on things, pulling the veneer away from the case and possibly tearing it.

JOINING UP

With a case such as the diecast aluminium variety, which have rounded corners, the top, bottom, and two sides should be covered with a single piece of plastic. This leaves the problem of making a neat join, the easy way to do this is to overlap the ends and then cut through them both with a sharp knife.

With the two surplus pieces of material removed the two ends should then butt together perfectly. With something like a woodgrain pattern this will not disguise the join since the pattern will not match, and the best way to make it so that you "can't see the join" is to arrange for the join to be underneath the unit or out of sight at the back.

There are much thicker types of self-adhesive veneer available, and these generally give a better and harder wearing finish, although at a higher cost. They are really only suitable for flat surfaces or fairly large cylindrical objects as they will not take tight corners.

The woodgrain types are good for loudspeaker enclosures, hi-fi cabinets, etc., and there is also a brushed aluminium effect veneer which is ideal for front

panels. These veneers are much tougher than the non-rigid variety, and are that much more difficult to trim to size once fitted.

Cutting the pieces precisely to size prior to fitting them, and then aligning them accurately with the panels of the case is beyond the capabilities of most of us though, and final trimming with the veneer in place is probably the only practical method.

Take things very carefully and slowly though. Air bubbles are not usually a problem, but any that do occur will probably not be removable with the puncture method. It will be a matter of carefully lifting the material and relaying it.

It has been assumed here that the self-adhesive veneers are of the type which has a sheet of backing paper which is removed to reveal a sticky surface. These are, of course, simply pressed into place.

Some veneers have a thermal adhesive which must be ironed into place. These are relatively difficult to deal with, and it seems to be crucial to have the iron set at the correct temperature. In particular, having the temperature slightly too low will result in the veneer soon coming unstuck.

The importance of keeping the covering pressed firmly against the case until the glue has set cannot be over emphasised. If this is not done the inevitable result will be air bubbles that produce patches where the veneer is not fixed in place. With time these patches tend to grow until the covering comes away from the case completely.

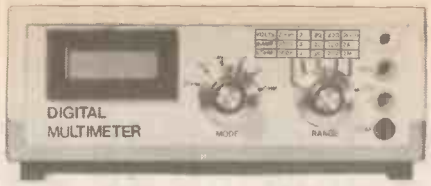
It has also been assumed here that the veneer is made of plastic rather than real wood or aluminium. In fact real wood veneers are available, but these are somewhat more difficult to deal with, and can be difficult to trim across the grain with even the sharpest of knives. The edges can be carefully sanded down to a perfect fit though. Being genuine wood, when the covering has been completed the veneer can be sanded and then varnished or polished, and generally treated as solid wood.

TREATING ALUMINIUM

Many cases have aluminium front panels, and although these are relatively soft and easy to work, they are also vulnerable to scratching, and most suppliers seem to provide a selection of scratches at no extra cost! The easiest way of hiding these is to use the brushed aluminium effect trim. It seems to be best to fit the veneer after any drilling of the panel has been completed, and to use a sharp knife to cut matching holes in the veneer.

Another possibility is to use a metal polish to polish out any scratches, but to avoid bright patches where the scratches were situated the *whole* panel must be well polished. Incidentally, this method of polishing out scratches is also quite effective on plastic cases. With deep scratches this method is unlikely to be practical, and some form of covering is then the only solution.

An inexpensive way of giving a neat appearance and hiding minor scratches is to repeatedly wipe the panel from end to end using wire-wool (or a scouring pad). This gives an effect which is similar to a brushed aluminium type, and other attractive effects are possible by using (say) a series of small circular movements or a criss-cross pattern.

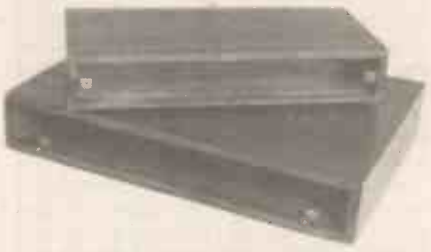


The aluminium front panel of this two-tone plastic case has been finished with "dry rub-down transfers". A plastic bezel smartens-up the display.

The shroud of this aluminium case has been finished with a black "vynil-effect" covering.

A piece of coloured card, artistic drawing and some lettering make for a novel front panel.

The sloping front panel and plastic stick-on labels make for easy operation of this compact memory synthesiser.



An example of a chipboard veneered surround that can be used for housing audio equipment to give a quality finish.

It is important to thoroughly wipe the finished panel clean to remove any aluminium dust, and to then protect it with a clear lacquer of some kind. Otherwise the surface of the panel will almost certainly start to oxidize, producing a very dull and unattractive finish.

Robert Penfold

LETTERS

Astray

Sir—Re s.r.b.p.; I believe your contributor, R. A. Penfold (May issue, p. 248) goes astray in his explanation of this abbreviation. 40 years ago and more it was explained to me in the drawing office of the establishment where I worked that the letters stood for synthetic-resin-bound paper, and that similarly s.r.b.f. stood for synthetic-resin-bound fabric. Of course, in conversation these materials were (and, I guess, still are) referred to as Paxolin and Tufnol. But as these names are, or were, trademarks of a particular firm they could not be used in official documents.

In his piece on transformers (p. 276), it seems to me that G. Hylton falls below his usual level of accuracy and clarity, mainly in the first section. The statement, "In theory the output current from each transformer could be doubled" is I suppose based on the idea that a transformer should have a constant wattage output. But this is not a correct idea. Except perhaps in a very small transformer, the maximum current rating is likely to be controlled by I^2R heating, and no teaching text on power transformer should fail to explain this.

It is a great pity that it is not generally accepted by editors such as yourself that teaching is the most serious and responsible of all activities and that your authors should treat it as such.

E. F. Good C.Eng., MIEE
Darlington.

Regarding the point raised by Mr. Good, the most widely accepted meaning for s.r.b.p. seems to be sheet resin bonded paper, but alternatives such as synthetic resin bonded paper, and synthetic resin bound paper also seem to exist. As the meaning is much the same in each case it is difficult to establish which one is the original.—R. A. Penfold.

Mr. Good is, of course, quite right to say that the "copper loss" of a transformer limits the power it can handle. I indicated this in my article.

When I wrote that "in theory" a transformer could deliver twice the normal current I meant that a perfect, lossless transformer could do so. In practice, the winding resistances are a limiting factor.

The amount of extra current obtainable in practice depends very much on the design of the particular transformers being used. It so happens that for reasons of convenience of manufacture the primary windings of the miniature mains transformers so often used in transistor equipment are commonly made with wire of a thicker gauge than necessary. The primary iron loss of such a transformer is relatively low, and series connection carries a small penalty in terms of copper loss. In these circumstances a series primary, parallel secondary arrangement can be fairly efficient.

May I take this opportunity to reinstate a point which had to be omitted from the article for lack of space? If a "series opposing" connection of two secondaries is used to obtain a reduced voltage then the "regulation" is poor. The output current has to traverse both the secondary resistances and the voltage drop is high.—G. Hylton.

MICRO MINI TUNER

JOHN BECKER

A computerised aid for musical instrument tuning.

THIS is a simple little tuning aid for the average solo instrumentalist. Both electronic and acoustic instruments can be used with it. It has been designed for control by the BBC, C64 or PET series of computers, but can be readily used with other computers having an 8-bit parallel socket such as a User Port or IEEE 488 port, with only minor modifications to the program. The computer performs most of the controlling analysis, and gives a screen readout showing the frequency received, the nearest note to it, and the ideal frequency for the note. A scale shows the deviation from the ideal.

TUNING PRECISION

Instrument tuning is not the precision science that some may believe it to be, and strangely instruments tuned to exact mathematical frequencies do not always sound correct to the ear. The main criteria can be summed by saying that a note which sounds right *is* right!

The making of music is a very subjective activity and throughout history different racial groups have had different ideas about the ideal notes to be played. Despite this, the basic relationships of notes played in succession have certain common factors. Essentially these result in frequency relationships of one to two and two to three producing the most satisfying sounds. From these ratios, other frequency ratios can be established to produce a scale within an octave.

By definition of course, an octave implies eight notes to the scale, the first and last notes having the frequency ratio of two to one. The ideal frequency of these eight notes depends on the starting point. Starting with one note, the next seven can be tuned so that when played consecutively they will sound correct. But if the starting note is one of the other notes just played, it is quite probable that when playing the rest of the notes the tuning will sound incorrect. Some of the notes may sound right, but others need to have a different pitch.

WELL PITCHED

In 1885, a Mr. Helmholtz remarked on an extreme instrument designed to produce all possible pitch variations in true scales. This resulted in 53 notes to each octave! Insanity must have been the end product for any musician attempting to play such a monster. More realistically, if instruments are tuned close to the standard one to two and two to three ratios, a range of 18 notes to the octave can be accepted as an ideal. For many stringed and wind instrument players this ideal is not hard to achieve, but for keyboard instruments a requirement of 18 notes is a problem for the designer, the tuner, and the player. Fortunately some of these notes are so close in frequency that we have now adopted the less than ideal standard of 12 notes to an octave, resulting in some sharps and flats being treated as interchangeable.

Also by way of standardisation, a convention in 1939 pronounced that note A in the treble clef should have a precise frequency of 440Hz. Literature shows that prior to 1939 the frequency of treble A had varied amongst instruments in different countries between 373Hz and 567Hz. The table shown later gives the calculated note frequencies for the modern tempered scale.

UNIFORMITY

However, scientific definition of a note does not ensure ideal uniformity. A note correctly produced under laboratory conditions may sound totally wrong under concert conditions. Indeed if all instruments were identically tuned to precise frequencies the music produced could sound extremely dull and uninteresting. The fullness of an orchestral sound is partly due to instruments not playing at precisely the same frequency and degree of synchronisation. In fact professional musicians will often vary the frequency of a particular note by introducing vibrato. This generally can vary the frequency to either side of the ideal by as much as half a tone, and at a rate of about 6·5 times per second. The exact deviation and rate of modulation is highly personalised and will vary from musician to musician, and in regard to the mood of the music.

In electronic music production, frequency modulation is often introduced by using chorus or vibrato units inserted between the instrument and the amplifier. They can add considerable richness to a sound when used in moderation.

STABILITY

Stability of a tuned note is also a common problem for musicians. Any instrument player will be aware that a note produced at the start of a session will probably have changed in pitch a short time later. One of the reasons for this is changes in temperature. As a concert hall becomes warmer, so the instruments will be subjected to expansion, whether they are metal, wood, stringed or membraned.

Electronic instruments suffer from a similar problem due to the characteristics of resistors, capacitors and semiconductors, etc. changing slightly the warmer they get. Expansion with a rise in temperature is a fundamental fact of nature, and although sophisticated design techniques can counteract this to a certain extent, the tendency to drift still remains.

PITCH PERCEPTION

Atmospheric temperature and moisture content also play a significant role in pitch determination. A frequency counter can be used when setting an instrument to an exact frequency, yet the ear may not regard this as correct, even though the meter says it is. Again, it is another factor of nature, this time related to the speed of sound. The speed of sound is not a constant, and should be expressed in relation to the conditions of the medium through which it travels. The density of the medium is a fundamental controlling factor. This will change with temperature, pressure and in the case of air, with the moisture content.

The usual speed of sound is taken to be 1120 feet per second at 0 degrees C at sea level. Through fresh water at 20 degrees C the figure is 4756 feet per second, five times as fast. Although concert halls are not usually flooded, just the addition of water molecules breathed out by the audience can alter the speed of sound to an extent. This means that the perceived pitch of an instrument may be different from the frequency shown on a meter alongside the player.

Increased intensity of a sound can also raise the perceived pitch. This is especially true of instruments producing purer tones that are close to sine shaped. Complex tones though, may appear to be more stable with amplitude variations. This is probably due to complex tones containing harmonics less likely to cause perceived pitch changes.

OBJECTIVES

From the above, the uninitiated may well query the need to tune at all, since it is all so variable. Initially musical satisfaction can only come from playing notes that sound right. Precise frequency control, though, is less important than consistency. If a whole group decide to tune for A at 435Hz instead of 440Hz, it really makes little difference since it is expected that everyone will still be playing subsequent notes that are harmonically related. If they do not have their notes equivalently tuned the sound can be appalling.

So in tuning the objective is to take a standard starting point, and tune other notes so that they are harmonically related to the first. This is where the problem arises for those who are not fortunate enough to have perfect pitch perception.

TUNING AIDS

Amongst any group of musicians there will usually be at least one who can establish the starting note from which the others can tune their instruments. The amateur soloist though, sitting alone in a room somewhere, may have to rely on a tuning aid of some sort. There are several types available, ranging from tuning forks, pitch pipes, frequency meters, to electronic frequency comparators. All have their advantages and disadvantages.

TUNING FORKS

The tuning fork is arguably the simplest to use for settting the initial note. The commonest one is probably the one tuned to 440Hz, as this is the international frequency standard for treble A. If a tuning fork is hit on a hard surface and held to the ear at the same time as an instrument note is played, the two frequencies produced will interact, resulting in a third or beat frequency. The closer the first two frequencies are to each other, the slower will be the beat frequency. By adjusting the instrument note until the beat is no longer apparent, precise tuning can be achieved. It is very easy, and perfect pitch perception is not necessary.

Having set the first note, subsequent notes can be tuned in a series of rising and descending steps, usually in octaves and musical fourths or fifths. The notes are adjusted until a certain number of beats can be counted and related to predetermined beat tables, enabling precise matching to be achieved.

Experience is needed though, since if each note is tuned just fractionally out, the errors can accumulate across the full range, and inharmonious discords result. This is especially true with a keyboard instrument like a piano. Guitars are perhaps more easily tuned against a fork since the fretting enables the same string to produce different notes. So, for example, if E is tuned on one string, A can be readily tuned on another by fretting the first string at a point where it should produce note A, in this instance the fifth fret. By playing both strings simultaneously the tension of the second string can be adjusted until the beat frequency disappears. Other notes can be tuned in a like fashion, providing of course the player is sufficiently experienced to know which fretting should produce which note.

PITCH PIPES

Pitch pipes take the tuning fork principle a little further since they normally have six notes of E, A, D, G, B, E octave. Oddly they only appear to be available with A at 220Hz rather than 440Hz. Using pitch pipes, tuning can again be done whilst listening for beat frequencies. There is the danger though that if they are blown too hard, a false pitch somewhat higher than the ideal is produced.

Pipes are also rather harsh and inexperienced ears may have difficulty in recognising the difference between a note and one of its harmonics since the tonal qualities of the pipe and the instrument are likely to be different. It is also very easy to become out of breath whilst using them!

Electronic frequency comparators extend the pitch pipe principle to a much wider range of musical notes, often to a full eight octaves, covering 96 notes. For several years special tone generator chips usable in this way were produced, but they appear to have vanished from semiconductor catalogues.

FREQUENCY COUNTERS

Frequency counters can be used as tuning aids, though in this case the frequency needs to be related to a chart giving the equivalent musical notes and octaves. Frequency determination can be either by measuring the duration of one cycle, or by counting the number of cycles or pulses received during a predetermined time. The unit presented here employs the latter method, using the computer to set the sampling rate and translate the pulse count into notes and octaves.

With a frequency counter of this nature, the timing period across which the pulses are counted will depend upon the degree of accuracy required. For musical purposes, the accuracy of the pulse count will be relative to the octave in question. For example, note A of the 3rd octave has a frequency of 1760Hz. Since A#′ is 1864Hz and G#′ is 1661Hz, a deviation of several cycles in the count can be tolerated. It is unlikely that the ear will readily detect the difference between 1760Hz and say 1750Hz. However, for A at 220Hz a difference of 10Hz in the count is the equivalent of a semitone, which the ear will certainly notice.

The length of time for which a stringed note will vibrate will depend on the string length and tension. Higher notes cannot be sustained for as long as lower ones. Consequently timing ranges must be changed for different octaves. This could be done manually, but since the computer is being used to calculate notes from frequency, it is just as easy to also make it automatically control the sampling rate in accordance with the frequency that it detects. Which leads us to the block diagram.

BLOCK DIAGRAM

Most of the work is carried out by the computer, and so the electronics of this project is extremely simple. It consists basically of a pre-amplifier and a sample period gating stage, Fig 1. A reference frequency output stage is also included, not as an essential part of the unit but as an extra facility that can be plugged into an audio amplifier.

INPUT STAGE

Acoustic instruments can be coupled in via a microphone, preferably of the high output type. This should be placed as close as possible to the sound output. Electronic instruments or signal generators can be plugged straight in. Those producing a 5V squarewave output can be switched directly to the computer via S2 (Fig. 2). Other signal sources need to be pre-amplified and shaped so that the voltage swing can be detected by the computer.

Potentiometer VR1 sets the initial input level, and enables signals greater than 5V to be processed. The gain of the pre-amp IC2a is set by both VR2 and S1. With S1 open, VR2 can vary the gain from around unity to ×10. With S1 closed, VR2 varies the range between about ×10 and ×100. The precise amount of gain is determined by the ratio of the input resistance of R1 plus R2, to the total feedback resistance of R3 plus VR2.

IC2a is coupled to the comparator stage IC2b. The reference level here is 2·5V as set by R8 and R9. R7, R10 and R12 set the comparator trip point. In the absence of an input signal, the output of the comparator

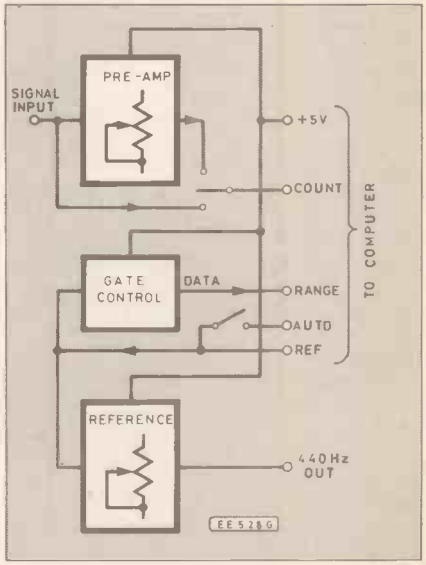


Fig. 1 Block diagram of the Micro Mini Tuner.

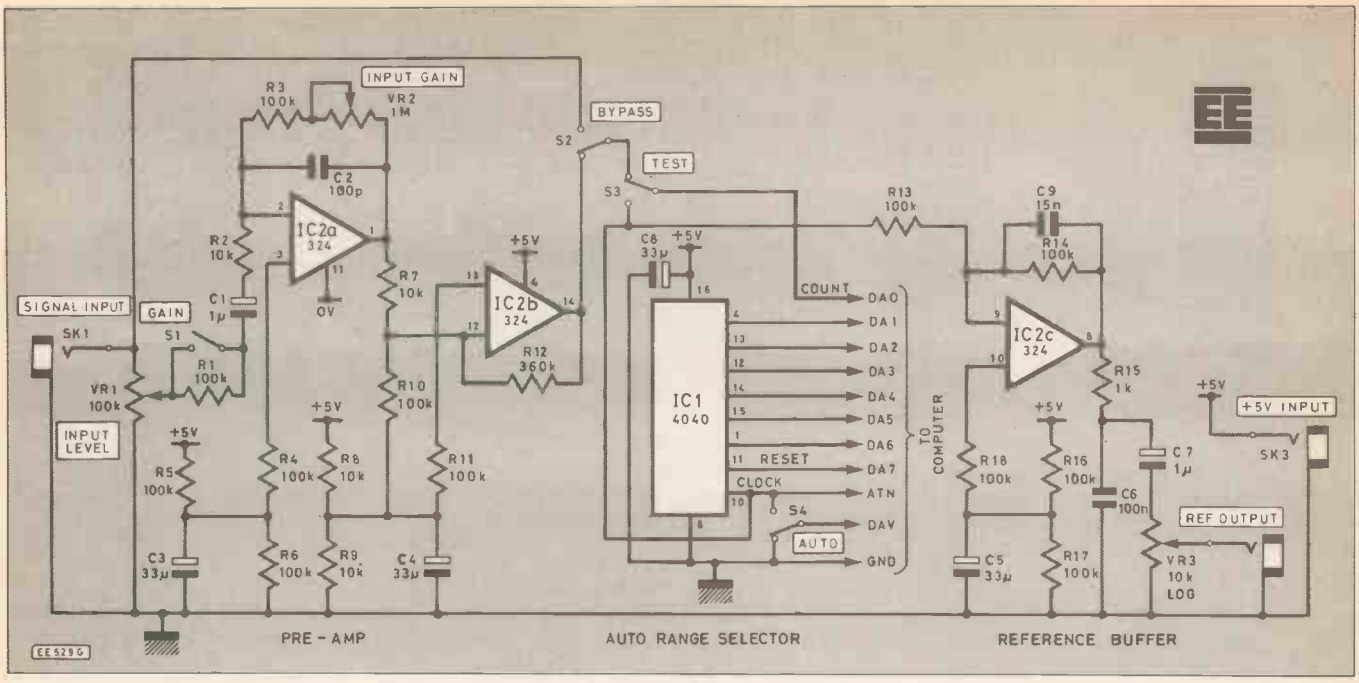


Fig. 2 Complete circuit of the Micro Mini Tuner.

will be static. As the input signal level increases, the output of IC2a will swing in sympathy by an amount dependent upon the gain set. When the output rises above the reference level, so the output of IC2b will change from low to high.

Once the waveform falls below the threshold the comparator will again change state. As it is being tripped by opposing cycles of the signal waveform, irrespective of its shape, so the output will be a squarewave of the same frequency. This is switched via S2 and S3 to the first data line DA0 of the computer. The software program for the computer is written so that the number of times the squarewave goes high and low can be counted.

COMPUTER CONTROL

One of the handshake lines of the computer can be used for calling the attention of external equipment. For this reason it is referred to here as the ATN (attention) line. The computer has an internal timer that can be program controlled to cause the ATN line to put out a constant frequency. Here the program sets this output as close as possible to 440Hz, and it is used as the clock input to the counter IC1. This is a 12-stage binary counter, each output of which divides the frequency by two.

Output one, therefore, is half the input frequency, output two is one quarter, output three is one eighth, etc. Since each output is at half the rate of the previous one, the rates are, in musical terms, one octave apart. The computer data lines DA1 to DA6 are connected to IC1 outputs seven to 12 respectively.

The program detects which of these lines is high at any particular moment. When a selected line goes high, the computer stores the pulse count so far received, calculates the equivalent frequency, finds its note and octave values, and displays them on the screen. It then checks the figures against an internal table, and decides whether the counting period should be changed. In this case, on the next counting round it chooses a different data input as its trigger line.

After processing the count, the computer sends data line DA7 up and down, which resets IC1 back to zero. The count restarts and once more the computer counts the signal input pulses until the relevant trigger line goes high. In this way the optimum sampling period for particular octave ranges is constantly updated.

Since there are six lines available, six octaves of input frequency can be assessed with their relative sampling rates standardised. Taking the treble clef octave containing A–440Hz as octave 1, octaves between –1 and +4 have standardised counting periods. Octaves above and below these points can be sampled, though the relative accuracy will deteriorate. The duration of each sampling count is thus controlled between 0·11Hz and 3·5Hz.

The number of times that samples are made in a given number of seconds is also displayed on the screen. It is calculated by adding the sampling rate to the length of time that the computer takes to process each answer. This range varies from 0·64Hz for octave 4 to 5·15 seconds for octave –1. Do not be confused by sampling rates and sampling periods. The sampling period is the time during which the count is collected. The sampling rate is the total of the sampling period plus the time taken to process the answer.

OVERRIDE

If only an approximate idea of frequency is needed, sampling consistency can be dispensed with. Consequently switch S4 is included to tell the computer to sample at the highest rate irrespective of the musical octave. In this mode the computer's second handshake line is used. This is termed here as the DAV, or Data Valid Line. It is connected in the computer to a register that detects the arrival of a leading or trailing edge of an input pulse. The state of the register can be read and appropriate action taken.

In this unit, S4 can switch the constant stream of 440Hz pulses onto the DAV line, so that the register can be kept constantly set by the leading edges of the ATN signal. If the DAV register is found to be set, the

COMPONENTS

See Shop Talk page 436

Resistors

R1, R3 to R6, R10, R11, R13, R14, R16 to R18	100k (12 off)
R2, R7 to R9	10k (4 off)
R12	360k
R15	1k

All ¼W ±5%

Capacitors

C1, C7	1µ elect. 63V (2 off)
C2	100p polystyrene
C3 to C5, C8	33µ elect. 6V (4 off)
C6	100n polyester
C9	15n polyester

Potentiometers

VR1	100k log. mono rotary
VR2	1M mono rotary
VR3	10k log. mono rotary

Semiconductors

IC1	4040
IC2	324

Switches

S1 to S4	min s.p.d.t. (4 off)

Miscellaneous

SK1, SK2, SK3 mono jack socket (3 off); knobs (3 off); 14-pin i.c. socket; 16-pin i.c. socket; p.c.b.; ribbon cable and suitable multiway socket for connection to computer; connecting wire; case (15 x 11·3X 4·5cm); fixings etc.

Approx. cost Guidance only £25.00

computer will only respond to the setting of the first trigger line from IC1, line DA1. It will then perform all its sampling at the highest rate. As less processing work is required, the sampling rate goes up to 0·24Hz.

440Hz REFERENCE

As the computer is putting out a known frequency on the ATN line, this can be used as an audio reference signal. It is fed to IC2c, which acts as a buffer stage, and also gives a bit of filtering due to C6 and C9 in order to smooth off the edges of the squarewave signal. Squarewaves are a bit harsh to listen to for any length of time. Smoother ones are less tiring to the ear. VR3 controls the output level. The signal may be fed to any normal amplifier system and at maximum is about 1·5V peak to peak. As a self check facility, the 440Hz reference can be switched direct back to the computer by S3.

POWER SUPPLY

The unit requires a power supply of 5V at about 1mA. This can be supplied direct by the computer or from a separate p.s.u. The PET can deliver 250mA from its cassette port. The C64 cassette port can deliver 100mA, and the cartridge port 450mA. The BBC has 100mA available at its user port.

ASSEMBLY

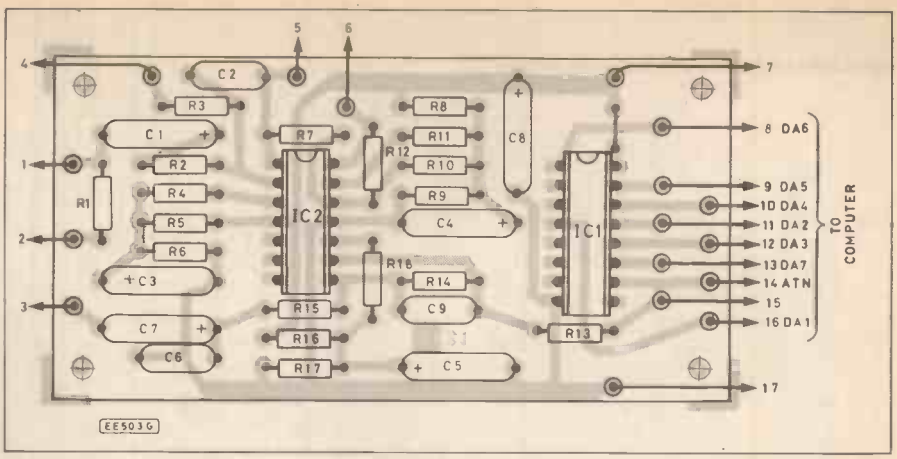
Assembly of the unit is straightforward and needs no special comment. Just ensure that all joins are checked and the wiring is kept neat. Fig. 3 shows the p.c.b. layout and Fig. 4 interwiring of the controls and connectors. The computer socket and its connections can be varied to suit the lead available. The case used in the prototype measures 15cm × 11·3cm × 4·5cm. Holes for the potentiometers are drilled 21mm above the base, 30mm apart starting 45mm from the left. Switch holes are 20mm from the sides, at 15mm and 30mm above the base.

Connections to the PET, C64 and BBC are shown in Fig. 5.

PROGRAM

The pulse counting of audio frequencies must be performed as efficiently as possible. Consequently the sampling part of the program is carried out by a machine code routine. The rest of the processing is in BASIC. The screen presentation is shown in the photograph. The program is written for the Commodore PET, with additional information given for use with the C64 and the BBC. The differences between these three machines are very minor, and largely consist of memory location and cursor control code variations. Notes in the software listing give all the necessary information for using the unit with any of these three computers.

The program can be readily altered for use with other computers possessing similar facilities. The requirements are that an eight-bit parallel data socket with two handshake lines is available. This can be of the User Port or IEEE 488 variety. Most computers have a BASIC that is only a dialect variation on Microsoft BASIC, and translations should be quite simple. The machine code, though, is for computers having 6502 and 6510 microprocessors, often found in conjunction with a Microsoft interpretor. Manuals should be consulted if it is intend-



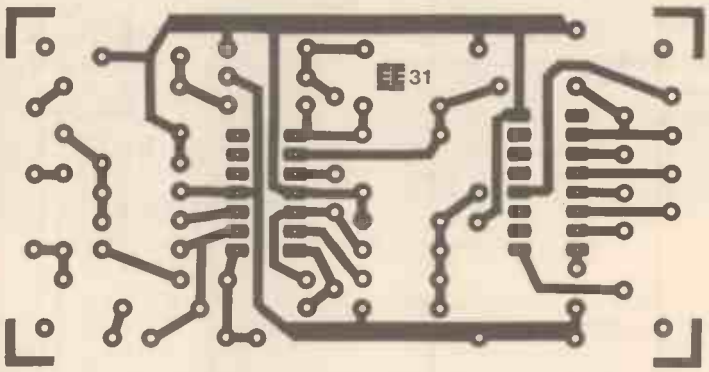
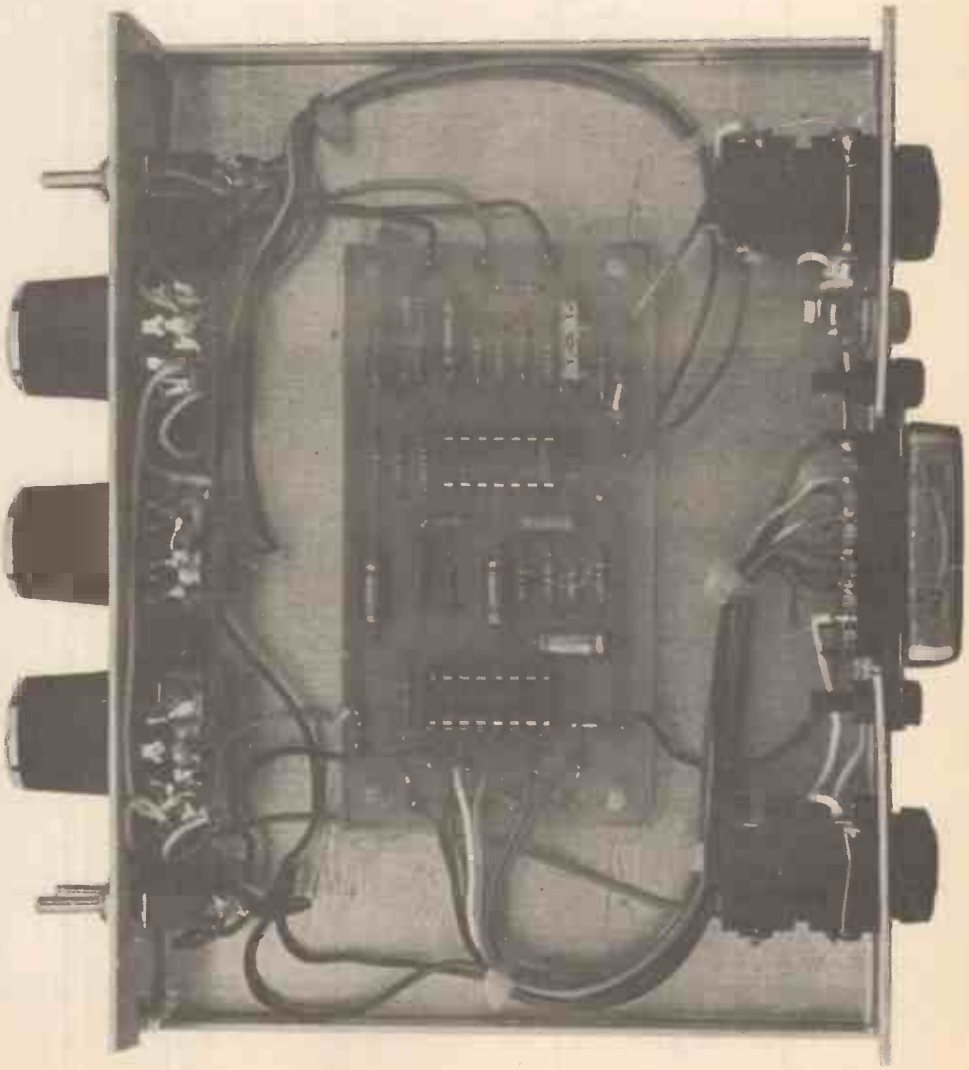


Fig. 3 Layout and wiring of the p.c.b.



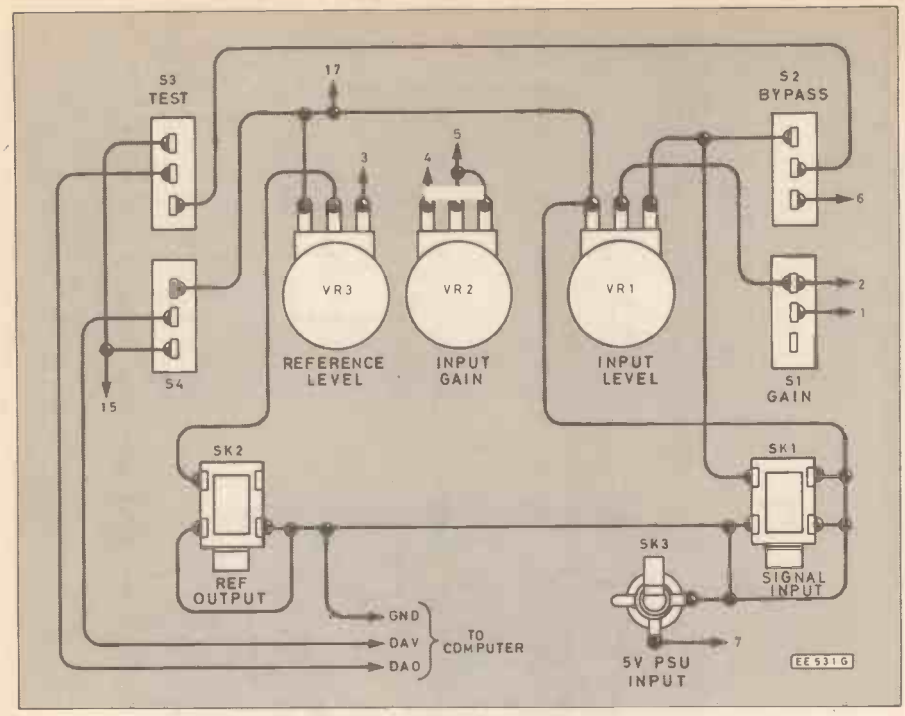


Fig. 4 Interwiring of the controls and connectors.

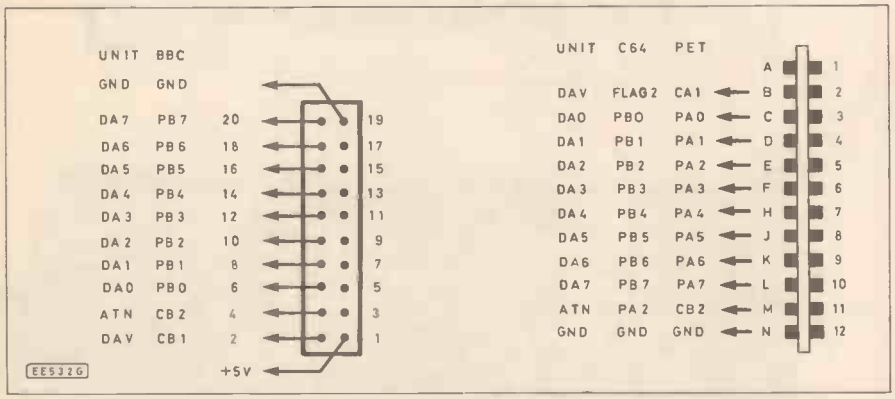


Fig. 5 Connection details for the PET, C64 and BBC computers.

ed to use the unit with other processors. The program requires a little over 3K of memory.

USE

It should be remembered that the signal being sent to the unit should be as free from noise and extra harmonics as is possible. If either are present, the tuning interpretation may erroneously also calculate on the unwanted input portions.

As stated earlier, tuning is in many ways a matter of personal interpretation. Any tuning unit should therefore be used with discretion and treated as a guiding source rather than a definitive analyser. Professional tuning, through centuries-old practise of setting relative fourths, fifths and octaves, is still superior if you have the ear and patience. Nonetheless, for the average musician, this tuning aid should remove the question marks from the tuning of many instruments by guesswork and bring about a little more harmony. □

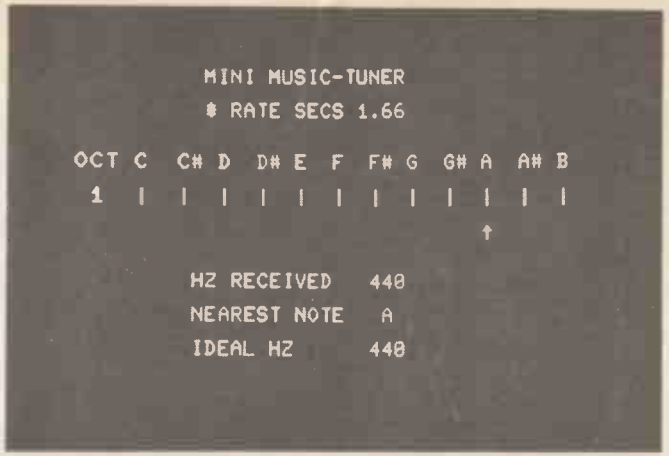
Table of note frequencies.

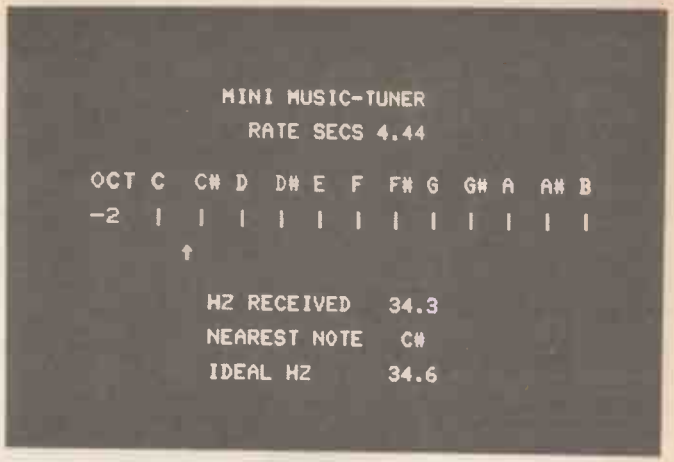
NOTE FREQUENCIES IN HZ

OCTAVES -3 TO +4. TO 6 SIGNIFICANT FIGURES

OCT	-3	-2	-1	0	+1	+2	+3	+4
C	16.3516	32.7032	65.4064	130.813	261.626	523.251	1046.5	2093
C#	17.3239	34.6478	69.2957	138.591	277.183	554.365	1108.73	2217.46
D	18.354	36.7081	73.4162	146.832	293.665	587.33	1174.66	2349.32
D#	19.4454	38.8909	77.7817	155.563	311.127	622.254	1244.51	2489.02
E	20.6017	41.2034	82.4069	164.814	329.628	659.255	1318.51	2637.02
F	21.8268	43.6535	87.3071	174.614	349.228	698.456	1396.91	2793.83
F#	23.1247	46.2493	92.4986	184.997	369.994	739.989	1479.98	2959.96
G	24.4997	48.9994	97.9989	195.998	391.995	783.991	1567.98	3135.96
G#	25.9565	51.9131	103.826	207.652	415.305	830.609	1661.22	3322.44
A	27.5	55	110	220	440	880	1760	3520
A#	29.1352	58.2705	116.541	233.082	466.164	932.328	1864.66	3729.31
B	30.8677	61.7354	123.471	246.942	493.883	987.767	1975.53	3951.07

Micro Mini Tuner Screen photographs showing the display produced.





Listing 1: Program for the Micro Mini Tuner

```
100 REM EE MINI TUNER PROG259 23JUN86 *** SEE NOTES AT END BEFORE TYPING IN
110 DATA1-PET USER REM SUBSTITUTE RIGHT NO & NAME IN THIS LINE = 2-C64, 3-BBC
120 GOTO530
130 L$=CHR$(CL)+"      ":U$=CHR$(CU)+" "
140 T=64:CL$="                                                  ":A=SY-1:TI$="000000"
150 READB$:IFB$="*"THEN250
160 A=A+1:IFB$<"A"THENPOKEA,VAL(B$):GOTO150
170 IFB$="UU"THENPOKEA,UU:GOTO150
180 IFB$="DD"THENPOKEA,DD:GOTO150
190 IFB$="OUT"THENB=OUT:GOTO240
200 IFB$="IN"THENB=IN:GOTO240
210 IFLEFT$(B$,1)="Z"THENB=VAL(MID$(B$,2)):POKEA,Z(B):GOTO150
220 IFB$="REG"THENREG=A:POKEA,2:GOTO150
230 STOP
240 HI=INT(B/256):LO=B-(HI*256):POKEA,LO:A=A+1:POKEA,HI:GOTO150
250 W=36/LOG(2):Y=LOG(2)/12:FORA=1TO20:IFEXP(Y*A)<1.71875THENNEXTA
260 K=LOG(1.71875)-(Y*(A-1)):POKERE,2:D=1:R=INT(6400/Z)/100:S$="**":Z$="*****"
270 PRINTTAB(80);"OCT ";:FORB=1TO11:READN$(B):PRINTN$(B)" ";:NEXT:READN$(12)
280 PRINTN$(12):PRINTTAB(44);:FORB=1TO11:PRINT"|   ";:NEXT:PRINT"|":FORB=1TO5
290 D$=D$+CHR$(CD):NEXT:V$=CHR$(CH)+D$+D$:PRINTV$;D$;TAB(8);"HZ RECEIVED"
300 PRINTTAB(48);"NEAREST NOTE":PRINTTAB(48);"IDEAL HZ":POKEDRT,128
310 D$=CHR$(CH)+D$
320 PRINTD$;TAB(3)"*";TAB(20),R+(INT(TIME/6)/10);L$:TI$="000000"
330 SYS(SY):N=PEEK(Z(1))*256+PEEK(Z(0)):F=(N*Z/T)/D:PRINTTAB(9);U$
340 IFF>19THEN370
350 D=1:POKEREG,2:R=INT(6400/Z)/100
360 PRINTV$,S$;TAB(83);CL$:PRINTTAB(101);Z$;TAB(103);S$;TAB(101);Z$:GOTO320
370 L=LOG(F)*W:H=INT(L/36):P=LOG(F)/Y:K=INT(P/12)*12:F=INT(F*10)/10
380 M=INT(P-K):IFM-INT(M)>0.5THENM=M+1
390 M=INT(M):W=(K+M)*Y+X:S=INT(EXP(W)*10)/10:IFF>100THENF=INT(F):S=INT(S)
400 J=INT(L-(H*36)):IFJ-INT(J)>=.5THENJ=J+1
410 IFJ<1THENJ=1
420 IFPEEK(DAV)ANDSETHENG=11:GOTO450
430 G=H:IFG<7THENG=6
440 IFG>11THENG=11
450 G=11-G:D=2^G:E=D*2:POKEREG,E:R=INT(6400*D/Z)/100
460 PRINTV$;H-7:PRINTTAB(44);LEFT$(CL$,J-1),"↑";LEFT$(CL$,35-J)
470 PRINTTAB(101);F;L$;TAB(103);N$(M+1);TAB(101);S;L$:GOTO320
480 DATA120,162,0,134,Z0,134,Z1,134,Z2,169,UU,141,OUT
490 DATA169,DD,141,OUT,173,IN,168,41
500 DATAREG,240,1,96,152,41,1,197,Z2,240,240,133,Z2,24,101,Z0,133,Z0,165,Z1
510 DATA105,0,133,Z1,240,225,208,223,0,0,*
520 DATAC ,C#,D ,D#,E ,F ,F#,G ,G#,A ,A#, B ,*
530 READA$:A=VAL(A$):ONAGOSUB650,690,740
540 PRINTCHR$(CC),TAB(129)"MINI MUSIC-TUNER":PRINTTAB(51)"RATE SECS"
550 IFA<3THENSY=PEEK(MM)*256+PEEK(ML):GOTO570
560 SY=HIMEM
570 A$="":FORC=0TO4:A$=A$+CHR$(PEEK(SY+C)):NEXT:IFA$="TUNER"THEN610
580 B=SY-65:IFA<3THENHI=INT(B/256):LO=B-(HI*256):POKEML,LO:POKEMM,HI:GOTO600
590 HIMEM=B
600 A$="TUNER":FORC=0TO4:POKE(B+C),ASC(MID$(A$,C+1,1)):NEXT:CLR
610 DIMN$(13):RESTORE:READA$:A=VAL(A$):ONAGOSUB650,690,740
620 IFA<3THENSY=PEEK(MM)*256+PEEK(ML)+5:GOTO130
630 SY=HIMEM+5:GOTO130
640 REM PET USER PORT
650 CU=145:CD=17:CL=157:CC=147:CH=19:Z(0)=0:Z(1)=1:Z(2)=2:ML=52:MM=53
660 DRT=59459:IN=59457:OUT=59471:DAV=59469:CTL=59467:OSC=59464:SRL=59466
670 Z=440:Q=140:UU=128:DD=0:SE=2
680 POKECTL,PEEK(CTL)AND227OR16:POKEOSC,Q:POKESRL,15:RETURN
690 REM C64 USER PORT
700 CU=145 CD=17 CL=157 CC=147 CH=19 Z(0)=251 Z(1)=252 Z(2)=253 ML=55 MM=56
710 DRT=56579:IN=56577:OUT=56576:DAV=56589:CTL=56591:OSC=56582:SRL=56583
720 Z=440 Q=95 UU=199 DD=251 SE=16:POKECTL,7:POKEOSC,Q:POKESRL,4:RETURN
730 REM *** CORRECTION FOR C64 USE - SWAP OVER WIRES TO PCB PINS 13 & 14 ***
740 REM BBC USER PORT
750 CU=11 CD=10 CL=8 CC=12 CH=30 Z(0)=112 Z(1)=113 Z(2)=114 UU=128 DD=0
760 DRT=&FE62:IN=&FE60:OUT=&FE60:DAV=&FE6D:CTL=&FE6B:OSC=&FE68:SRL=&FE6A
770 Z=440 Q=140 UU=128 DD=0 SE=16
780 POKECTL,PEEK(CTL)AND227OR16:POKEOSC,Q:POKESRL,15:RETURN
790 REM BBC USER NOTES
800 REM THE BBC USES '?' INSTEAD OF 'PEEK' AND 'POKE', THUS 'POKEA,VAL(B$)'
810 REM WOULD BECOME '?A=VAL(B$)'. FOR 'PEEK' THE '?' CAN BE SUBSTITUTED
820 REM DIRECTLY, THUS 'N=PEEK(Z1))' BECOMES 'N=?(Z(1))'. 'SYS' BECOMES
830 REM 'CALL' SO 'SYS(SY)' BECOMES 'CALL(SY)'. 'TI$="000000"' BECOMES
840 REM 'TIME=0' WHEN TYPING IN. NORMAL BBC REQUIREMENTS FOR A SPACE BETWEEN
850 REM SOME STATEMENTS SHOULD BE OBSERVED.
```

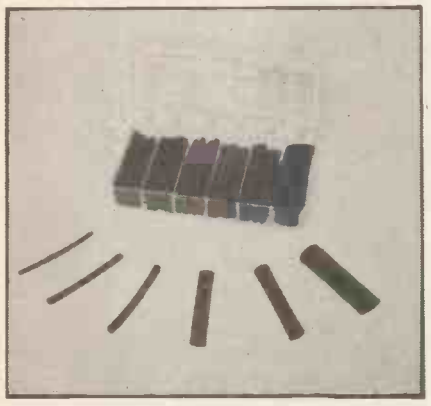
SHOP TALK

BY DAVID BARRINGTON

Shrinking Protection

The usefulness of heat shrink tubing is usually only appreciated when confronted with the problem of protecting "live" terminals from being touched and the possibility of shorting leads together when building projects in confined spaces.

With test probes it is the bare solder joints on leads, such as l.e.d.s, which can cause problems when mounting in the body of the probe. With mains, the hazard is during testing when "live" terminals are exposed.



With mains equipment, prior to heat shrinking, it is good practice to push the sleeving over the wire and plastic covering before soldering the lead in place. It is then possible to slide the sleeving over the exposed solder joint and then slide it back during testing. Once the testing has been completed satisfactorily, the tubing can be shrunk over the join or terminal.

Heat shrink tubing is available from some of our advertisers. Also, a new kit has just been announced by **Eraser**.

The Model STK-100 contains an assortment of different size pieces of flexible tubing for use on terminals, strain reliefs and for use when repairing wiring harnesses. When heat above 120 degrees C is applied to the tubing it will shrink to approximately half its original diameter.

Ideal for repair departments, laboratories and schools, further information and prices may be obtained from: **Eraser International Ltd., Dept EE, Unit M, Portway Industrial Estate, Andover, Hants, SP10 3LU.**

Hot Shot

World renowned for their tape and video care accessories, **Bib Audio/Video Products** have just marketed a 'two shot' disposable automatic audio cassette head cleaner.

As some people are aware, over a period of time, oxide particles and other harmful debris, shed by the passing tape, accumulate on the tape head guides, pinch rollers and capstan and can cause all sorts of minor frustrating malfunctions. This can range from the break up of sound to incorrect tape speed, caused by 'drag'.

The regular cleaning of the above-mentioned parts is, of course, very desirable and to be recommended. This can be accomplished with cotton wool 'swabs' and a liquid cleaning agent. The Bib method is to use a liquid loaded 'dummy' cassette and run it through the machine, so effectively 'wiping' the suspect parts clean.

The cassette is colour coded in two halves, red and grey. To clean you simply press, say, the red fluid applicator button; insert cassette, red side up; 'play' to end of tape; stop and eject. For a second cleaning, you remove the cassette, press the grey applicator button and then insert grey side up. Repeat process for first cleaning and dispose of the cassette when complete.

The Bib Two-Shot is expected to retail for around 99p and be available from most audio stores and record shops. For details of local stockists, write to: **Bib Audio/Video Products Ltd., Dept EE, Kelsey House, Wood Lane End, Hemel Hempstead, Herts, HP2 4RQ.**

Relay Guide

A new solid-state relay cross-reference guide has been produced by **International Rectifier**, listing the part numbers of relays produced by different manufacturers in numeric/alphabetic sequence along with the suggested IR equivalent.

It also includes a complete summary of their product range, along with summary information on function, switch type, and input/output current and voltage ratings.

Copies of the Solid State Relay Guide may be obtained from **International Rectifier, Dept EE, Hurst Green, Oxted, Surrey, RH8 9BB.**

Geiger Counter

Readers will probably experience some difficulty in locating a local source for the miniature Geiger Muller tube, type ZP1310 or ZP1300, listed in the *EE Geiger Counter*. The one used in the prototype was supplied by Phonosonics.

The GM tube and a complete kit of parts (£58.42 inclusive—for overseas prices see their catalogue) for the above project may be purchased from **Phonosonics, Dept EE, 8 Finucane Drive, Orpington, Kent, BR5 4ED**. The printed circuit board (£4.72 inclusive—code 265A) and the GM tube (£29.50 inclusive) are available separately.

Solar Heating Controller

The 10A 24V coil relay and mains transformer listed for the *Solar Heating Controller* are both available from Dulas Engineering. The rest of the components appear to be readily available types and should not cause purchasing problems.

In fact, a complete kit of parts for the Solar Heating Controller is available from Dulas Engineering for the sum of £31.38 (including VAT and p&p). This company specialises in electronic equipment in the field of renewable energy and is based at the Centre of Alternative Technology, Powys, Wales.

Kits may be ordered from **Dulas Engineering Ltd., Dept EE, Llwyngwern Quarry, Machynlleth, Powys, Wales, SY20 9AZ.**

Battery Tester

Some readers may experience difficulty in obtaining a suitable 4-pole 3-way slide switch for the *Battery Tester*.

An alternative switch would be a miniature 4-pole 3-way rotary type. However, this type is slightly more expensive and you would most likely need a larger case to accommodate the switch.

The choice of panel meter is not critical, the one used in the designer's model is a Maplin 'Quick-Fit' type.

Micro Mini Tuner

We cannot foresee any component buying problems for the *Micro Mini Tuner* project. A full kit of parts (£27.37 inclusive) for this project may be obtained from **Phonosonics, Dept EE, 8 Finucane Drive, Orpington, Kent, BR5 4ED**. The printed circuit board may be purchased seperately for the sum of £3.54 inclusive: quote code, 259A.

Exploring Electronics

A suitable 'test bed' for the *Exploring Electronics* experiments would be the same circuit block used in our *Teach In '86* series.

Special kits have been made up by some of our advertisers for the Teach In series and they also sell the solderless breadboard separately. Readers should browse through the advertisements in this issue to locate a stockist nearest to their town.

We would be most surprised if readers have any problems with obtaining parts for the *Flat TV Aerial*.

EE SPECIAL READER OFFER

£39-00
INCLUDING VAT AND POSTAGE

zip DIGITAL POCKET MULTIMETER

THIS pocket multimeter (shown full size on our front cover) is offered to *EE* readers at a genuine discount. The meter measures just 160 x 30 x 18mm maximum and has a 3½ digit liquid crystal display with data hold at the touch of a button. The meter operates on dual slope integration with full autoranging on volts and ohms, autopolarity (with minus sign shown), overrange indication, continuity bleeper and battery warning indicator. It is supplied with its test lead and extra insulated test clip plus a protective plastic tubular case and full instruction manual. The display also indicates V, kΩ, AC and DH (data hold).

The meter is guaranteed for one year.

SPECIFICATION

DC VOLTS RANGE	ACCURACY	RESOLUTION	INPUT IMPEDANCE
2V	± 0·5% rdg ± 4 dgts	1mV	12MΩ
20V	± 0·7% rdg ± 4 dgts	10mV	11MΩ
200V	± 0·7% rdg ± 4 dgts	100mV	11MΩ
500V	± 1% rdg ± 4 dgts	1V	11MΩ

Automatic range selection. Overload protection: 750V d.c. for one minute.

AC VOLTS RANGE	ACCURACY	RESOLUTION	INPUT IMPEDANCE
2V	± 1% rdg ± 8 dgts	1mV	12MΩ
20V	± 1% rdg ± 8 dgts	10mV	11MΩ
200V	± 1% rdg ± 8 dgts	100mV	11MΩ
500V	± 1·2% rdg ± 8 dgts	1V	11MΩ

Automatic range selection. Overload protection: 530V r.m.s. for one minute. Frequency response 40Hz to 500Hz.

RESISTANCE RANGE	ACCURACY	RESOLUTION	OPEN CIRCUIT VOLTAGE
2kΩ	± 0·7% rdg ± 4 dgts	1Ω	0·45V
20kΩ	± 0·7% rdg ± 4 dgts	10Ω	0·45V
200kΩ	± 0·7% rdg ± 4 dgts	100Ω	0·45V
2000kΩ	± 1·2% rdg ± 4 dgts	1000Ω	0·45V

Automatic range selection. Overload protection: a.c./d.c. 250V max. for one minute.
Power consumption 3mW; **Battery Life** 100 hours continuous operation.

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eb...Beeb...Beeb...Beeb...Bee

. . . 8-channel multiplexer . . . temperature sensor . . .

MOST of the published constructional projects for the BBC computer utilise the analogue port or the user port, but not both. On the face of it there is no reason why the two should be used together, since one is intended for analogue signals while the other is purely digital in nature.

However, it is possible to use the two together in a way which makes devices fitted to the analogue port operate in a much more sophisticated and convenient way. As an example of what can be done, take something like a digital capacitance meter add-on for the analogue port.

A unit of this type would have several measuring ranges so as to provide good accuracy over a wide capacitance range. This gives the problem of matching the range of the interface to the range the computer is set to display.

The most simple way of doing this is to have some means of setting the computer to the appropriate range manually, such as by operating a function key. An improved method is to drive inputs of the user port from an extra pole on the range switch, as outlined in Fig. 1.

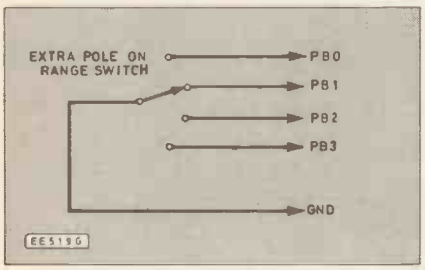


Fig. 1. Using the user port to sense the range setting of an add-on.

Software can read the range switch, and detect which range is in use by determining which line of the user port has been taken low (bearing in mind that the user port has built-in pull-up resistors that take floating inputs high). Data read from the analogue port can then be manipulated so that the value printed on the screen is appropriate for the range in use.

This is analogous to any ordinary digital readout where a pole of the range switch normally controls the decimal point, and places it in the correct position on the display. Unless data is being stored and manipulated in some special way, the computer is really being used as nothing more than an analogue to digital converter and digital readout.

Autoranging

The best way of handling the problem is to have some form of autoranging, where the computer automatically switches the add-on to the most appropriate range and displays the correct figure. This is something that can be achieved without the aid of the user port, but only in a fairly basic form which is not applicable to every situation.

The circuit diagram Fig. 2 shows the way in which things are handled from the hardware point of view, and the basic idea here is to feed all four analogue inputs from a single source. The variable resistors are set to give the appropriate sensitivity for each range.

Obviously only two or three ranges need to be used if desired. With the least sensitive range driven virtually to full scale value, the other ranges will be considerably overloaded, but the Zener diodes protect the analogue inputs against serious overloading and damage.

The software has to read the analogue inputs to find the most sensitive range that is driven to less than full scale value, and then display this value after any necessary mathematical manipulation. Listing 1 shows how this can be achieved. It is assumed here that CH0 (ADVAL 1) is the least sensitive range, running through to CH3 (ADVAL 4) which is the most sensitive.

A series of IF . . . THEN statements check the input readings from ADVAL 4 through to ADVAL 1 looking for one that provides a reading of less than 65520 (the full scale value). When a suitable value is found, the reading and ADVAL number are printed on the screen, after which the program jumps to line 90. This provides a delay before blanking out the displayed reading and looping the program back to the beginning so that a new reading is displayed. If all four inputs are overloaded the program reaches line 80 where an "OVERLOAD" warning is printed on the screen.

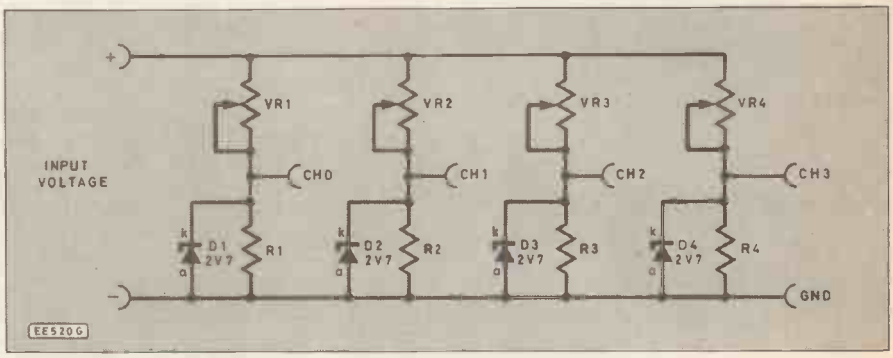
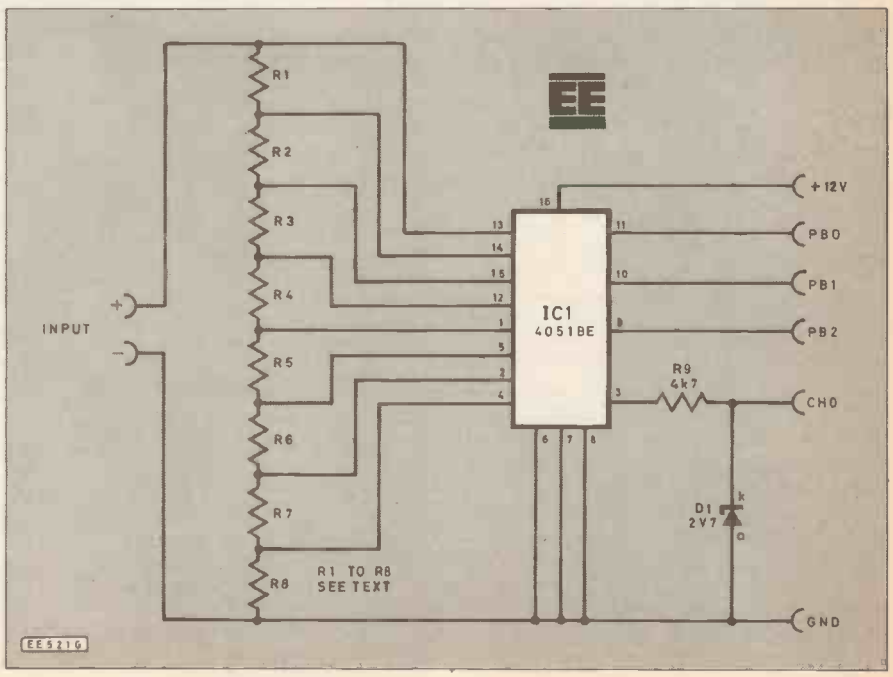


Fig. 2. Basic circuit diagram for use with autoranging.

External Control

A more sophisticated way of handling things is to use external electronic switching

Fig. 3. Using an 8-channel multiplexer with the aid of the user port.



controlled by the user port. One way of going about this is shown in Fig. 3. IC1 is a CMOS 4051BE 8-way single pole analogue switch which feeds CH0 (or one of the other analogue inputs). Only one of the eight inputs is fed through to CH0, and the required input is selected by the 3-bit binary number set up on PB0 to PB2 and applied to IC1's address inputs.

These user port lines must first be set up as outputs (?&FE62 = 7), and the required channel is then selected by writing a value in the range 0 to 7 to the user port (?&FE60). Input 0 (pin 13) is selected using a value 0, 1 for input 1 (pin 12), and so on through to a value of 7 for input 7 (pin 4).

As with the original scheme of things, it is a matter of reading the inputs one by one, starting with input 0 in this case, to find one which gives an in-range reading. R9 and D1 protect the analogue input of the computer against overloads, but the input voltage should be kept to no more than 12 volts to prevent IC1 from being damaged.

Supplies

The 12V supply for IC1 can be taken from the computer's power port. This port is primarily intended as a power source for disc drives, but many BBC systems are either cassette based or have disc drives with a built-in mains power supply, leaving it free for user add-ons.

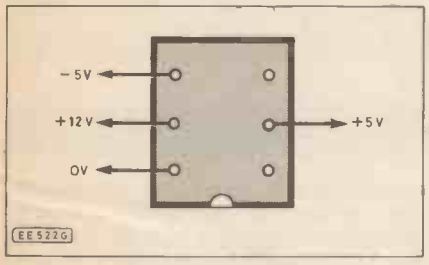


Fig. 4. Details of the power port connector.

The original model B machine can provide +5V at 1·25A, +12V at 1·25A, and −5V at 75mA. The new Master 128 has lower +5V and +12V ratings of 900mA and 1A respectively, which probably reflects greater consumption from the increased internal hardware and expansion possibilities, rather than any reduction in the potential output current of the power supply circuit. Fig. 4 shows details of the power output socket. The matching plug is an unusual type that is available from BBC accessory suppliers.

No values for resistors R1 to R8 are given in Fig. 3, as these must be chosen to suit the particular application concerned, and would probably be preset potentiometers in most cases. A point to bear in mind is that each time a new input signal is coupled through to the analogue input of the computer it might not be immediately subjected to a fresh conversion. It is therefore advisable to use a short delay loop between switching to a new input and attempting to read a new value, especialy when all four analogue channels are in use.

The system outlined in Fig. 3 is still a fairly crude way of tackling things, and ideally the electronic range switching should be incorporated into the main circuit instead of being inserted between the add-on and the analogue port as something of an after-thought. Electronic control of resistance and capacitance measuring circuits is often quite straightforward, and this

REVIEW

BBC Master Series

The new BBC Master Series computers are now available, replacing the Model B and B+. The Master Series is a range of five machines: the MS-128, which replaces the B+; the MS-Turbo, a high-speed version; the MS-512, a 16-bit business version: the MS-Scientific, a 32-bit version, and the MS-ET, which is a minimal Econet workstation. The MS-128 is the basic version, and can be expanded to any of the other versions except the MS-ET.

The most important feature of the BBC micro for readers of this column is no doubt the number of expansion ports provided, and fortunately all these are to be found on the new series. The printer port and the user port are exactly as before. The 1MHz bus is also present, but this has been improved, and the "clean-up" circuitry necessary in devices using this port is now no longer required.

The tube socket is still provided, despite the fact that the new models can now take internally-mounted second processors. The external socket uses the second processors for the previous series, and is provided for reasons of compatibility.

The disc socket is the same, but the disc operating system and the disc controller circuitry are now included as standard, rather than being an add-on as they were with the original model B. The disc system is the new ADFS, with provision for a heirarchical file structure when hard discs are used, but the "old" disc system is also included for compatibility.

Unfortunately, these sockets are in exactly the same position on the new machines as they were on the old—underneath the keyboard and facing forward. This can sometimes make connecting devices very awkward.

There are also a number of sockets on the back of the machine, including the analogue port (unchanged), the RS423 (unchanged, except that there is now an "official" way of setting the word format), a new audio output socket, and the Econet socket. Also on the back are the monitor/TV and audio cassette connections.

The new machines are much larger than the old ones. This is partly because the new machines have a larger keyboard, incorporating a numeric keypad (and with a rather better feel than the old machines), and partly to provide the space necessary for the internal expansions. One good thing to emerge from this is the much improved ventilation. Overheating was a problem with the old machines—you won't be able to keep your coffee warm on top of the new ones.

The MS-128 is provided with a considerable amount of software on sideways ROMs. There is the operating system, BASIC, an editor, the popular VIEW word processor, and the VIEWSHEET spreadsheet. However, you have to pay extra if you want the full manuals for these last two!

The only problem with this is that it doesn't leave many sockets for the user —just one for 16K ROMs and two for 32K ROMs. However, this is partly alleviated by the presence of two (Electron compatible) cartridge sockets. Empty cartridges are available, and less-frequently used ROMs can be mounted in these.

Finally, the new models have a small amount of CMOS RAM, backed up by a lithium battery. 50 bytes of this are available to the user, and can be used to set options, such as screen mode, which will be selected at switch-on.

Listing 1: AUTORANGING PROGRAM

```
   10 REM LISTING 1
   20 REM AUTO RANGE PROG
   30 CLS
   40 IF ADVAL 4 < 65520 THEN PRINTTAB(1
0,10);"ADVAL 4 READING IS  ";ADVAL 4:GOT
O 90
   50 IF ADVAL 3 < 65520 THEN PRINTTAB(1
0,10);"ADVAL 3 READING IS  ";ADVAL 3:GOT
O 90
   60 IF ADVAL 2 < 65520 THEN PRINTTAB(1
0,10);"ADVAL 2 READING IS  "ADVAL 2:GOTO
 90
   70 IF ADVAL 1 < 65520 THEN PRINTTAB(1
0,10);"ADVAL 1 READING IS  ";ADVAL 1:GOT
O 90
   80 PRINTTAB(10,10);"OVERLOAD"
   90 FOR D = 1 TO 100:NEXT
  100 PRINTTAB(10,10);"
      "
  110 GOTO 40
```

Listing 2: TEMPERATURE SENSING

```
   10 REM LISTING 2
   20 REM TEMP PROG
   30 CLS
   40 TEMP% = ADVAL 1/64
   50 PRINTTAB(10,10);TEMP%/10," DEGREES
 C"
   60 FOR D = 1 TO 1000:NEXT
   70 PRINTTAB(10,10);"
"
   80 GOTO 20
```

is something that we will look at in detail in next month's article.

More Inputs

The four analogue inputs of the BBC computer are adequate for most purposes, but some applications require more inputs. Such an application would be where a number of remote temperature sensors are used to monitor various locations, chemical solutions, or whatever.

The circuit of Fig. 3 is a simple but effective way of adding more inputs to the computer. In this role the eight resistors at the input are not needed, and a 5V supply is adequate for IC1.

The user port lines are quite capable of driving four CMOS inputs each, and it would therefore be possible to have an 8-way multiplexer at each input, giving a total of some 32 analogue inputs. With this level of expansion the conversion rate of one hundred per second would permit only two or three readings per input per second at best, but this is adequate for many tasks.

Temperature Sensor

Temperature measurement by electronic means is something that can easily be achieved these days with the aid of special semiconductor sensors such as the LM35DZ. Fig. 5 shows a simple but effective method of interfacing this device to the analogue port.

Over a 0 to 100 degree Centigrade temperature range IC1 provides a 0 to 1V output swing. This is somewhat less than ideal since the analogue inputs have a full scale voltage of 1·8V. IC2 is therefore used to boost the output voltage by an amount which is controlled by VR1. The software Listing.2 is for use with the temperature sensor, and this first divides returned readings by 64, and the integer result is then divided by ten, giving a range of 0 to 102·3 degrees Centigrade.

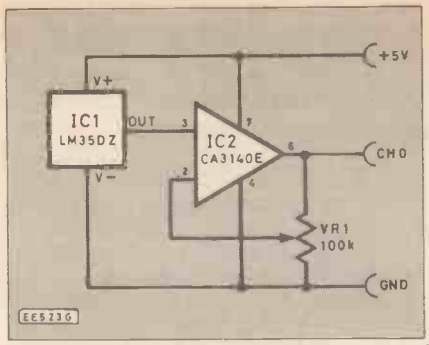


Fig. 5. Simple temperature to voltage converter circuit.

With the temperature sensor at an accurately known temperature, VR1 is adjusted to give the correct reading. If required, the divisor at line 40 can be increased to 128, and with VR1 then set up correctly, the temperature range will be 0 to 51·1 degrees Centigrade.

The circuit diagram shown in Fig. 6 will give slightly improved accuracy. Here VR2 is adjusted to give good accuracy at a temperature which approaches the full scale value, and then offset null control VR1 is adjusted for the correct reading with the sensor close to the 0 degree minimum reading. This process is repeated a few times until no further improvement in overall accuracy can be achieved.

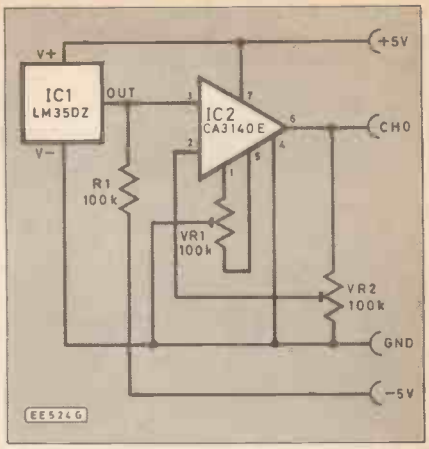


Fig. 6. Circuit diagram for improved accuracy at low temperature readings.

Next Month: Resistance and capacitance measurement.

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*If you have any ideas or comments for inclusion in the **Beeb Micro** pages, please send them to: Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH.*

CIRCUIT EXCHANGE

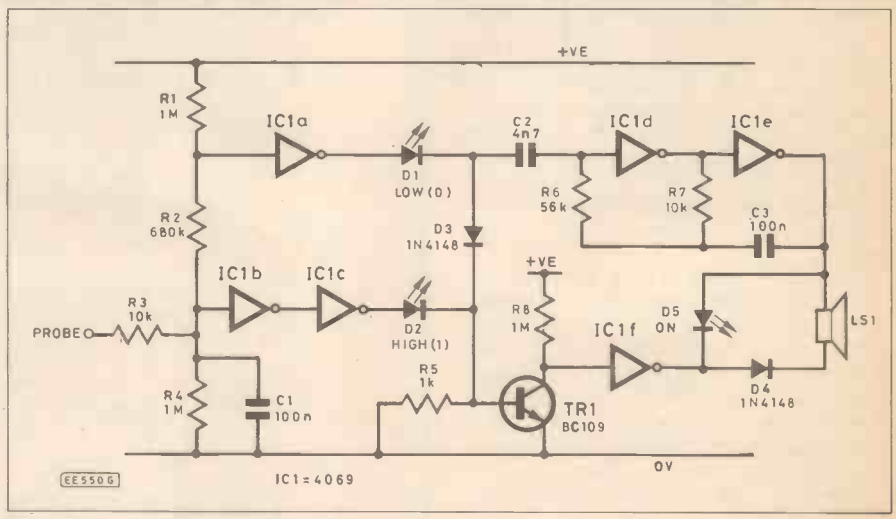
This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised. Payment is made for all circuits published in this feature. Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part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

IF you're a regular reader and have not yet submitted an idea for Circuit Exchange, why not have a go now? We will pay £40.00 per page for any article published.

We are looking for original ideas which may be simple or complex, but most importantly are useful and practical.

To help us to process articles which are offered for publication, all subject matter should conform to the usual practices of this journal. Special attention should be paid to circuit symbols and abbreviations and all diagrams should be on separate sheets, not in the text. Also manuscripts should be typed with wide margins and double line spacing or neatly hand written in the same fashion.

Just send in your idea to our editorial offices, together with a declaration to the affect that it has been tried and tested, is the original work of the undersigned and that it has not been offered or accepted for publication elsewhere. It should be emphasised that these designs have not been proved by us.



AUDIBLE LOGIC PROBE

THE CIRCUIT described here is designed to indicate if the voltage level on the probe is high or low. If it is high the light emitting diode D2 will light indicating logic level 1, and a high frequency tone will be heard. If the level is low D1 will light and a low frequency tone will be heard.

When D1 or D2 are lit D5 will go out. If two "logic" l.e.d.s are lit at once then the logic level is alternating.

The integrated circuit used is a CMOS type 4069 but the 4049 can be used if preferred. Diodes D3 and D4 are standard 1N4148 signal diodes.

S. McGhie,
Romsey,
Hants.

COUNTER INTELLIGENCE

BY PAUL YOUNG

BOOLE SAID IT FIRST

The next time you are at a party of computer buffs, here is the ideal conversation stopper. At the most appropriate moment during the conversation, you remark casually, "By the way, did you know that Lewis Carroll sprinkled his Alice books with Boolean Algebra?" Of course when your stunned audience has recovered sufficiently you will be called upon to explain your profound remark, therefore, I in turn, had better do the same.

The corner stone of Boole's algebra, is the formulae, X = X squared, from which you will quickly deduce that X can only be one or zero. All calculators and computers depend on this idea, "On" or "Off", and many of the Alice characters see the world in Boolean terms, "Yes" or "No", "True" or "False", "Does" or "Doesn't".

Let me quote you one example:

"You are sad", the knight said in an anxious tone, "Let me sing you a song to comfort you."

"Is it very long?" Alice asked, for she had heard a good deal of poetry that day.

"It is long," said the knight, "but it's very, very beautiful.

Everybody that hears me sing it—either it brings tears into their eyes, or else—"

"Or else what? . ."

"Or else it doesn't, you know."

It might be fun to dig out your old Alice books and see how many examples you can find.

AN AUTOMATIC TALE

The first book written by artificial intelligence has arrived. It is entitled, *The Policeman's Beard Is Half Constructed*. This novel has been written by a prose synthesis computer called "Racter", an abbreviation for raconteur.

While it writes grammatically correct sentences, they don't always link up. Here is an example of its work. "The stereo whispers of love, while Benton and Diane watch each other in an appalling reflector. Their souls are exhausted." Of course it is not very good, but probably not much worse than most of the "Soaps" we watch on television.

NEW INVENTION

Reading through the small ads in one of the nationals, usually the most interesting part of the paper, I spotted a new electronic marvel. A key ring, that if you lose it, you shout and it will bleep back at you.

If it were smaller and would clip on to spectacles, I would buy one. I spend half my life searching for my wife's glasses. The moment she takes them off her nose, they disappear and she calls out with a pained expression, as if she were surrounded by a group of malevolent conjurers bent on annoying her.

Mind you, if I bought one, I know instinctively what would happen. It would start bleeping in the middle of the night, and it would take an axe to silence it.

Then again, assuming I had mislaid my ignition key, I would doubtless scream my head off, and my key finder, feeling ashamed of itself, would say, "I am not fit to be a key finder, I wake this chap up at unearthly hours, I won't make any noise this time." In the end I will give up and call a taxi!

BEWARE JARGON

A few years ago, someone produced a humorous glossary explaining Estate Agents terms, for example:

Easily managed garden	= Measures four feet by four feet.
Suit Railway enthusiast	= Mainline passes the back door.
Rustic, modernised	= An old barn with Laura Ashley wall paper.

I see that a similar effort has now been made for computers:

Compatible	= Non compatible
Revolutionary	= Incompatible
New	= Not yet available
Market Leader	= Out of date
Powerful	= Incomprehensible

Unfortunately there is a grain of truth among all these innuendoes. You have been warned!!

FREE! READERS' BUY & SELL SPOT

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Loudspeaker 15in. chassis little used. £10. L. F. Hill, 20 Dunkery Rise, Westrees Park, Ashford, Kent TN24 8QX.

Wanted: dual beam scope CT436. Must have excellent triggering and be in top notch condition. Mr. R. W. Goad, G4EFA, Flat No. 2, Osborne Chambers, 59a Osborne Road, Southsea, Hants. PO5 3LS.

Linear Amp Zetagi 100/200 watts. Good condition. With instructions. £25. Tel: Amersham 28818.

AVO model 7 recently serviced £25. Tel: 01-450 3093.

Wanted: mains transformer Heathkit scope model 10–18U 5V3A 6·3V 3·5A 360–0–360 80mA 690V3mA 6·3 0·6A. Mr. A. G. Waugh, 5 Blaking Drive, Knowsley, Prescot, Merseyside L34 0JE.

Sony μmatic VP1210 video cassette player working £50. Phillips 2020 working £45. Gunn radar module £5. J. Denby, 107 Station Road, Fenay Bridge, Huddersfield. Tel: 0484 603898.

Wanted 4 channel reel-to-reel T/R. Buy/exchange AVO 8, audio oscillator, industrial timer, electronic radio valves. J. Snow, 10 Goodings Green, Wokingham, Berks RG11 1SB.

Back Numbers Everday Electronics 1985, 84, 82. Offers please. As new. Thos Murphy, 96 St. Pauls Drive, Armadale, W. Lothian EH48 2LP.

Wanted Electronics & Wireless World December 1985. Will pay reasonable price and airmail postage. S. Shaw, PO Box 1404, Randfontein 1760, South Africa.

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EE MARKET PLACE AUGUST '86

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

LOGIC TESTER

A VERSATILE pocket-sized logic tester, offering simple "hands free" operation, has recently been marketed by **Johnson Scanatron.** The Logic Klip is designed to appeal to the professional engineer, schools, universities, training establishments and the constructor.

Having the built-in capability to monitor the interaction of up to 16 points or nodes, readout indicated by 16 numbered l.e.d.s, the unit is connected to the test circuit using a 4-point i.c. clip supplied as standard, or a combination of clips, interfaces, grabbers and probes supplied as extras. The power supply is taken directly from the circuit under test, either TTL (operating voltage +5V) or CMOS (4·5V to 18V).

The display face can be temporarily marked with a chinagraph pen to describe circuit layout or i.c. pinouts and the logic state is indicated by logic 1 (high) l.e.d. on, or logic 0 (low) l.e.d. off. A separate overlay is also included for alternative layouts, whilst extra overlays are available to enable the user to build-up a library.

The Logic Klip costs £49·95 and further information and details of local stockists may be obtained from:

Johnsons (Leigh) Ltd.,
Dept EE,
100/102 Glendale Gardens,
Leigh-on-Sea,
Essex, SS9 2AY.

MICRO VISION

THE Newcastle based electronic vision company, **Wild Vision,** has recently launched a low cost, high performance real time Image Processing System for the BBC Micro.

The Hawk V8 package consists of a single p.c.b., mounted inside the BBC computer, and an image processing software pack. Video images from a camera are digitised in real time and stored directly into the graphics display memory of the computer.

The direct memory access method used provides a system with, it is claimed, a performance comparable with high speed frame stores at a much cheaper cost. Moreover, the use of the computer's internal memory means that much higher processing speeds are also possible.

The system, developed in conjunction with MARI Advanced Microelectronics and the Tyne and Wear Innovation Centre, has already been successfully used in a medical application studying foot pressure patterns. It is also expected to prove popular in a number of diverse areas such as: microscopes and infra red cameras; security systems; computer aided design (CAD) and slow scan TV applications.

Further information and prices may be obtained from:

Wild Vision,
Dept EE, Mari House,
20/22 Jesmond Road,
Newcastle Upon Tyne, NE2 4PQ.

COLOUR PATTERN

DEVELOPED for engineers involved in servicing and designing televisions and video and computer monitors, **Black Star** have launched the Orion TV and Video PAL Pattern Generator.

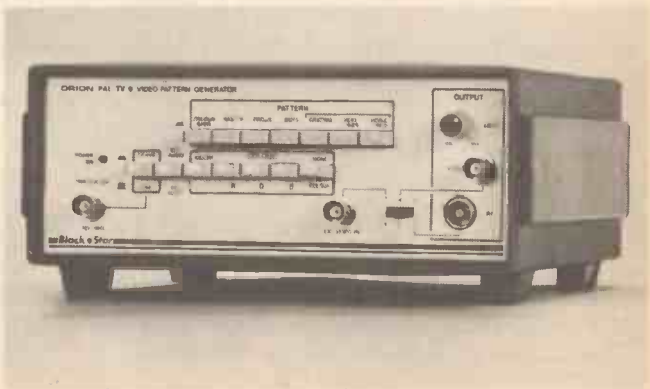
Features of the bench test instrument include separate r.f. and composite video outputs with level control, internal or external sound modulation, switchable sound carriers (5.5, 6.0, 6.5MHz), and positive or negative video modulation. In addition to switchable sound carriers, which allows use with most PAL TV systems, it provides flexible RGB outputs compatible with most video monitors.

Facilities for a separate video input to modulate camera signals; variable r.f. and video output levels enabling a.g.c. testing; and a trigger output, allowing, it is claimed, easy triggering of oscilloscope waveforms are also included.

More than 50 pattern combinations can be selected, including those for testing static and dynamic convergence, video amplifier linearity, colour purity, focus and general colour performance.

For further information and prices contact:

Black Star Ltd.,
Dept EE, 4 Stephenson Road,
St. Ives, Huntingdon,
Cambs, PE17 4WJ.



BENCHTOP MULTIMETER

THE Fluke 37 bench-top multimeter now being marketed by **Electronic Brokers** features the combined analogue/digital display pioneered in the Fluke 70 Series plus the accuracy and input overload protection found in the 20 Series.

Features include a case style designed for ease-of-use, either on the bench or in the field. The front panel has a 15 degree slope for optimum visibility and function switch access. A compartment at the rear of the case enables storage of test leads and small accessories inside the meter.

The meter has a basic d.c. accuracy of 0.1 per cent and a wide bandwidth a.c. response. It is claimed that the internal design and construction techniques employed give excellent shielding against electromagnetic interference. The meter also boasts a "touch hold" capability and autoranging facilities.

Fuses protect all the current ranges, including the 10A input. Both a.c. and d.c. voltage functions are protected to 1000V r.m.s. and the resistance function is overload protected to 500V r.m.s.

The Fluke 37 benchtop multimeter cost £187.

Electronic Brokers Ltd.,
Dept EE,
140–146 Camden Street,
London, NW1 9PB.

NEWS ...from the world of electronics

LONDON HOME ENTERTAINMENT TRADE SHOW

After surviving the annual hotel merry-go-round, we present our "pics of the show" as seen at The LONDON BROWN GOODS TRADE SHOW which are now beginning to appear in the shops.

TRAVELLING to the annual spring London trade show is almost an experience in its own right. With so many hotels dotted around West London it becomes virtually a military style operation to try and plan, in the space of a day, or even two!, a co-ordinated route that will take you to *all* exhibitors and allow time for discussion and investigation of the latest products on display.

Bearing the above in mind, we make no excuses to exhibitors for not being able to cover all the venues but, honestly, we did try! We understand the feelings of exhibitors about having their "own show" in surroundings of their choice, but the sooner they realise the advantages of holding the show under one roof or even at two adjoining locations the better for all.

Fine hot weather, probably the only good day in May, made the show a very hot climate to be in and the excitement of many new show launches helped to push the temperatures even higher. The general consensus of exhibitors was that the show had been the best ever for attendance and interest.

Talking Point

Fully expecting most of the trade talk to be about the merits of single or multi-beam lazer tracking systems, new advances in CD or the impact, or lack of it, of 8mm Video, we were surprised that most talk was about events in other areas completely. Apart from definite trends in television design with flat square tubes, FST, and now picture-in-picture, PIP, most manufactures were majoring on "improved quality and performance for your money" aspect.

In fact, the unexpected talking point at the show was the introduction of Satellite TV packages from some of the giants of industry, namely Grundig, ITT and Goodmans. Satellite TV also figured in Ferguson and Solara "rooms".

Grundig launched an impressive package that is expected to sell for around £1,750, excluding VAT. The system consists of a German built STR200 Receiver, two Low Noise Converters (LNC's), ortho-mode transducer (for splitting the *x* and *y* polarised signals), feed cables and a 1·5 metre dish aerial with polar mount. A motor mount is to be offered as a bolt-on extra later in the year.

Another area were there did appear to be recognisable movement was CD players. Here motorised loading and even the launch of numerous in-car players was confidently promised for the autumn.

Trend For The Future

A possible trend for the future is the integration of TV, video and hi fi with a unified remote control. JVC have a system called Compulink. This is a remote control system which will operate all units of a home entertainment system, including CD. All units have data buss sockets linked by jack leads. The amplifier then selects the right input for the required unit and the whole set-up can be operated by a single remote control.

Grundig were showing for the first time the TVR 5500TT, a one-unit 28in TV/VTR. The recorder being integral but also removable, for servicing, from the single cabinet.

Calling it the "future of hi fi", Hitachi are launching the Opus-1 deck style entertainment unit. The Opus-1 combines compact disc, twin cassette deck, digital tuner and a 60W amplifier in one console.

Sony Handycam Video 8 Marine Pack

Grundig TVR 5500TT combined TV/Video recorder

Hitachi Opus-1 entertainment centre

Toshiba XR-P9RC remote control portable CD player

Hitachi CD-D4 In-Car CD player

Sharp RG-C112E(BK) In-Car CD player

Sharp WQ-CD15E features CD player, 4-band radio, graphic equaliser and "back-to-back" twin cassette deck

ITT Digivision MC3896 Multicontrol TV allows the viewer to see two channels at once (PIP)

Canon VM-E1 8mm colour camcorder with auto-focus

Grundig STR200 Satellite Receiver

PCB SERVICE

Printed circuit boards for certain constructional projects are now 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 and Electronics Monthly Editorial Offices, 6 Church Street, Wimborne, Dorset BH21 1JH. Cheques should be crossed and made payable to Everyday Electronics. *(Payment in £ sterling only.)*

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.**

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

NOTE: Please allow 28 days for delivery. We can only supply boards listed in the latest issue.

PROJECT TITLE	Order Code	Cost
— JULY '83 —		
User Port Input/Output *M.I.T. Part 1*	8307-01	£4.82
User Port Control *M.I.T. Part 1*	8307-02	£5.17
— AUGUST '83 —		
Storage 'Scope Interface, BBC Micro	8308-01	£3.20
Car Intruder Alarm	8308-02	£5.15
High Power Interface *M.I.T. Part 2*	8308-03	£5.08
Pedestrian Crossing Simulation *M.I.T. Pt 2*	8308-04	£3.56
— SEPTEMBER '83 —		
High Speed A-to-D Converter *M.I.T. Pt 3*	8309-01	£4.53
Signal Conditioning Amplifier *M.I.T. Pt 3*	8309-02	£4.48
Stylus Organ	8309-03	£6.84
— OCTOBER '83 —		
D-to-A Converter *M.I.T. Part 4*	8310-01	£5.77
High Power DAC Driver *M.I.T. Part 4*	8310-02	£5.13
— NOVEMBER '83 —		
TTL/Power Interface for Stepper Motor *M.I.T. Part 5*	8311-01	£5.46
Stepper Motor Manual Controller *M.I.T. Part 5*	8311-02	£5.70
Speech Synthesiser for BBC Micro	8311-04	£3.93
— DECEMBER '83 —		
4-Channel High Speed ADC (Analogue) *M.I.T. Part 6*	8312-01	£5.72
4-Channel High Speed ADC (Digital) *M.I.T. Part 6*	8312-02	£5.29
Environmental Data Recorder	8312-04	£7.24
Continuity Tester	8312-08	£3.41
— JANUARY '84 —		
Biological Amplifier *M.I.T. Part 7*	8401-02	£6.27
Temp. Measure & Control for ZX Comprs		
Analogue Thermometer Unit	8401-03	£2.35
Analogue-to-Digital Unit	8401-04	£2.56
Games Scoreboard	8401-06/07	£9.60
— FEBRUARY '84 —		
Oric Port Board *M.I.T. Part 8*	8402-02	£9.56
Negative Ion Generator	8402-03*	£8.95
Temp. Measure & Control for ZX Comprs		
Relay Driver	8402-04	£3.52
— MARCH '84 —		
Latched Output Port *M.I.T. Part 9*	8403-01	£5.30
Buffered Input Port *M.I.T. Part 9*	8403-02	£4.80
VIC-20 Extension Port Con. *M.I.T. Part 9*	8403-03	£4.42
CBM 64 Extension Port Con. *M.I.T. Part 9*	8403-04	£4.71
Digital Multimeter Add-On for BBC Micro	8403-05	£4.63
— APRIL '84 —		
Multipurpose Interface for Computers	8404-01	£5.72
Data Acquisition "Input" *M.I.T. Part 10*	8404-02	£5.20
Data Acquisition "Output" *M.I.T. Part 10*	8404-03	£5.20
Data Acquisition "PSU" *M.I.T. Part 10*	8404-04	£3.09
A.F. Sweep Generator	8404-06	£3.55
Quasi Stereo Adaptor	8404-07	£3.56
Simple Loop Burglar Alarm	8405-01	£3.07
Computer Controlled Buggy *M.I.T. Part 11*		
Interface/Motor Drive	8405-02	£5.17
Collision Sensing — MAY '84 —	8405-03	£3.20
Power Supply	8405-04	£4.93
Infra-Red Alarm System	8406-01	£2.55
Spectrum Bench PSU — JUNE '84 —	8406-02	£3.99
Speech Synthesiser *M.I.T. Part 12*	8406-03	£4.85
Train Wait	8406-04	£3.42
Ultrasonic Alarm System	8407-01	£4.72
Electronic Code Lock — JULY '84 —		
Main Board	8407-03	£2.70
Keyboard	8407-04	£3.24
— AUGUST '84 —		
Microwave Alarm System	8408-01	£4.36
Temperature Interface—BBC Micro	8408-02	£2.24
— SEPTEMBER '84 —		
Op-Amp Power Supply	8409-01	£3.45
Micro Memory Synthesiser — OCT '84 —	8410-01*	£8.20
Drill Speed Controller	8410-04	£1.60
— NOVEMBER '84 —		
BBC Audio Storage Scope Interface	8411-01	£2.90
Proximity Alarm	8411-02	£2.65
TV Aerial Pre-Amp	8412-01*	£1.60
Digital Multimeter — DEC '84 —	8412-02/03*	£5.20
Mini Workshop Power Supply	8412-04	£2.78
Power Lighting Interface	8501-01	£8.23
Games Timer — JAN '85 —	8501-02	£1.86
Spectrum Amplifier	8501-03	£1.70
Solid State Reverb	8502-01	£3.68
Computerised Train Controller — FEB '85 —	8502-02	£3.38
— MARCH '85 —		
Model Railway Points Controller	8503-01	£2.78
Insulation Tester	8504-02	£2.53
Fibrelarm — APRIL '85 —	8504-03	£3.89
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Mains Unit — MAY '85 —	8505-02	£2.56
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Nascom Printer Handshake	8507-02	£1.90
Electronic Building Blocks—1 to 4†	8508-01	£2.98
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Stepper Motor Interface— AUGUST '85 —	8508-03	£2.40
Drill Control Unit	8508-04	£2.90
— SEPTEMBER '85 —		
RIAA Preamplifier Input Selector	8509-01	£2.36
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Transducers Semiconductor Temp. Sensor	8509-04	£2.72
Transducers Strain Gauge — OCT '85 —	501	£2.87
Soldering Iron Power Controller	504	£2.09
Transducers— — NOV '85 —		
Magnetic Flux Density Amplifier	505	£3.93
Hallowe'en Projects (single board price)	506	£2.68
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Touch Controller	510	£2.65
Function Generator — FEB '86 —	514	£3.10
Function Generator PSU Board	515	£2.09
pH Transducer	516	£2.75

*Complete set of boards.
M.I.T.—Microcomputer Interfacing Techniques, 12-Part Series.
†Four separate circuits.

PROJECT TITLE		Order Code	Cost
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BBC Midi Interface	— MAR '86 —	518	£3.26
Stereo Hi Fi Preamp		519	£5.70
Interval Timer		520	£2.36
Stereo Reverb	— APRIL '86 —	521	£2.89
PA Amplifier		511	£2.67
Mini Strobe	— MAY '86 —	522	£2.24
Auto Firing Joystick Adaptor		523	£2.73
Watchdog		524	£2.81
Percussion Synthesiser	— JUNE '86 —	525	£5.65
Personal Radio		526	£2.07
Tilt Alarm		527	£2.13
Electronic Scarecrow	— JULY '86 —	528	£2.28
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Headphone Mixer		530	£4.56
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Prices for *ELECTRONICS MONTHLY* PCBs are shown below.

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The Thing		EM/8412/4	£3.18
Speak Board	— JAN '85 —	EM/8501/2	£3.97
Headphone Amp		EM/8502/1	£2.08
Intelligent Nicad Charger		EM/8502/2	£3.50
Anti Phaser	— FEB '85 —	EM/8502/3	£4.56
Logical Lock		EM/8502/4	£3.58
Touch Dimmer		EM/8502/5	£3.29
Courtesy Light Extender	— MAR '85 —	EM/8503/4	£3.29
Disco Light Chaser		EM/8503/5	£8.11
Sound to Light Unit		EM/8504/1	£4.02
Car Audio Booster	— APRIL '85 —	EM/8504/2	£3.12
Short Wave Converter		EM/8504/3	£4.15
Car Burglar Alarm	— MAY '85 —	EM/8505/3	£2.88

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HiFi Intercom (2 boards)		EM/8508/3	£2.92
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Sinewave Generator	— SEPT '85 —	EM/8509/1	£2.76
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8/86

EDUCATION AND CAREERS

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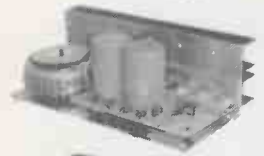

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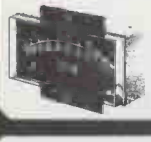

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1¼" voice coil. Res. Freq. 38Hz. Freq. Resp. to 20KHz. Sens. 89dB. PRICE £12.99 + £1.50 P&P ea.
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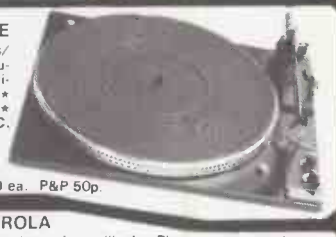

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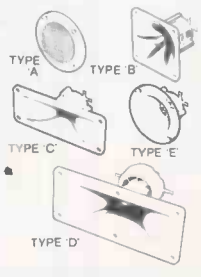

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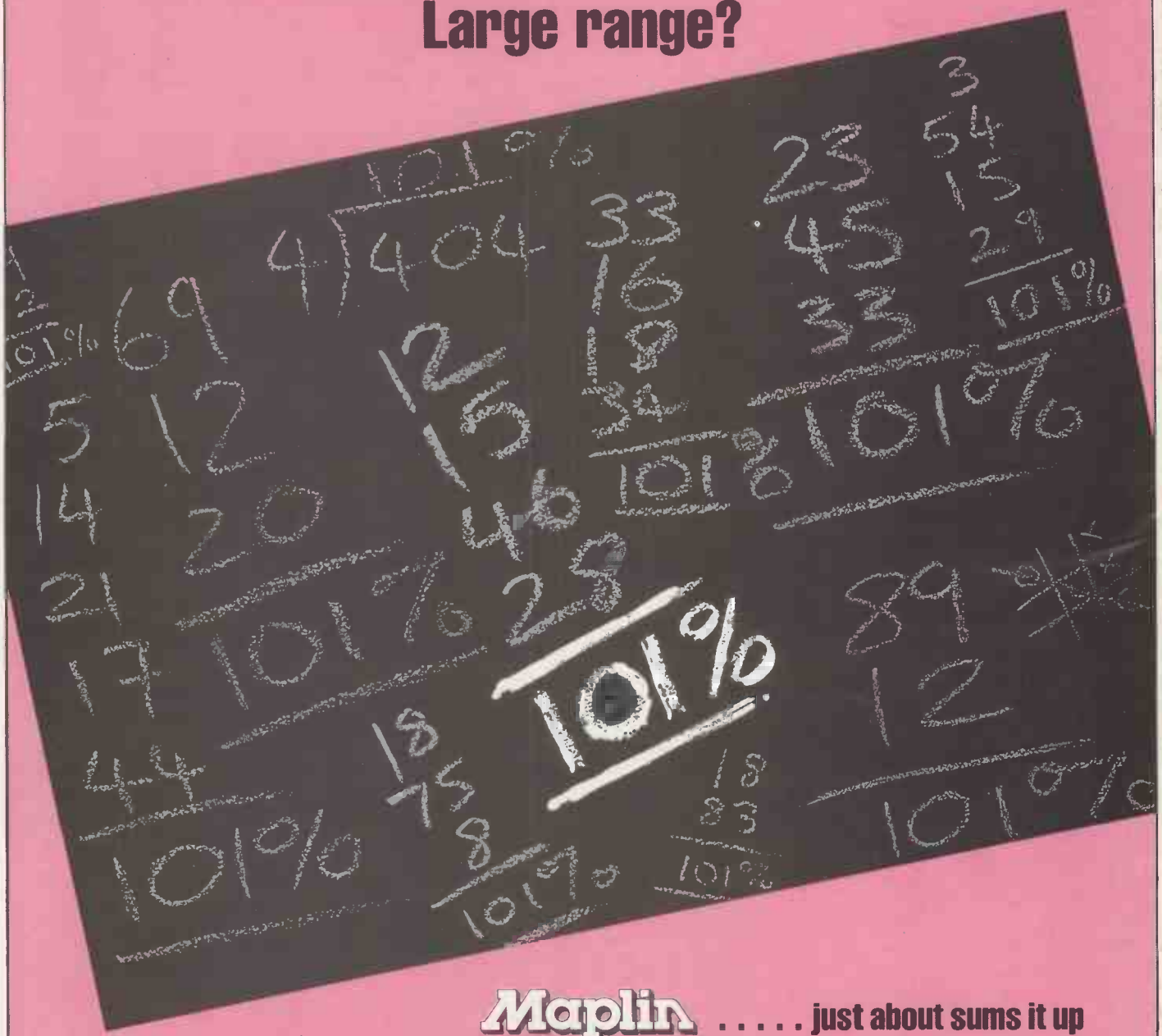

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