EVERYDAY ELECTRONICS

OCTOBER 1987

INCORPORATING ELECTRONICS MONTHLY

£1·20

FREE WALLCHART INSIDE... UK Issues Only
Mullard Periodic Table of the Elements

Set New Horizons with our City and Guilds Certificate Course
Introducing Microprocessors

Video Controller

Transtest

Automatic/Manual Porchlight

The 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
5 – 3 flush electrical switches
7 – 4in flex line switches with neons
8 – 2 80 watt brass cased elements
9 – 2 mains transformers with 6V 1A secondaries
10 – 2 mains transformers with 12V ½ A secondaries
11 – 1 extension speaker cabinet for 6½" speaker
12 – 5 octal bases for relays or valves
13 – 12 glass reed switches
14 – 4 OCP 70 photo transistors
16 – 4 tape heads, 2 record, 2 erase
17 – 1 ultrasonic transmitter and 1 ditto receiver
18 – 2 15000 mfd computer grade electrolytics
19 – 2 light dependent resistors
20 – 5 different micro switches
21 – 2 mains interference suppressors
22 – 2 25 watt crossover units 2 way
23 – 1 40 watt 3 way crossover unit
28 – 1 6 digit counter mains voltage
30 – 2 Nicad battery chargers
31 – 1 key switch with key
32 – 2 humidity switches
34 – 96 x 1 metre lengths colour-coded connecting wires
36 – 2 air spaced 2 gang tuning condensors
37 – 2 solid diaelectric 2 gang tuning condensors
38 – 10 compression trimmers
41 – 6 Rocker Switches 10 amp mains SPST
43 – 5 Rocker Switches 10 amp SPDT Centre Off
44 – 4 Rocker Switches 10 amp DPDT
45 – 1 24 hour time switch mains operated (s.h.)
46 – 1 6 hour clock timeswitch
48 – 2 6V operated reed switch relays
49 – 10 neon valves – make good night lights
50 – 2 x 12V DC or 24V AC, 4 CO relays
51 – 1 x 12V 2C O very sensitive relay
52 – 1 12V 4C relay
55 – 1 locking mechanism with 2 keys
56 – Miniature Uniselector with circuit for electric jigsaw
57 – 5 Dolls' House switches
60 – 5 ferrite rods 4" x 5/16" diameter aerials
61 – 4 ferrite slab aerials with L & M wave coils
62 – 4 200 ohm earpieces
63 – 1 Mullard thyristor trigger module
64 – 10 assorted knobs ¼ spindles
65 – 5 different themostats, mainly bi metal
66 – Magnetic brake – stops rotation instantly
67 – Low pressure 3 level switch
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
73 – 4 3 watt wire wound pots 50 ohm
77 – 1 time reminder adjustable 1-60 mins
78 – 5.5 amp stud rectifiers 400V
85 – 1 mains shaded pole motor ¾" stack – ¼ shaft
86 – 2 5" ali fan blades fit ¼" shaft
87 – 2 3" plastic fan blades fit ¼" shaft
88 – Mains motor suitable for above blades
89 – 1 mains motor with gearbox 1 rev per 24 hours
91 – 2 mains motors with gearbox 16 rpm
93 – 4 11 pin moulded bases for relays
94 – 5 B7G valve bases
95 – 4 skirted B9A valve bases
96 – 1 thermostat for fridge
98 – 1 motorised stud switch (s.h.)
101 – 1 2½ hours delay switch
103 – 1 6v mains power supply unit
104 – 1 4½ V mains power supply unit
105 – 1 5 pin flex plug and panel socket
107 – 1 5" speaker size radio cabinet with handle
109 – 10¼" spindle type volume controls
110 – 10 slider type volume controls
112 – 1 heating pad 200 watts mains
114 – 1 1W amplifier Mullard 1172
115 – 1 Wall mounting thermostat 24V
118 – 1 Teak effect extension 5" speaker cabinet
120 – 2 p.c.b. with 2 amp full wave and 17 other recs
122 – 10 mtrs twin screened flex white p.v.c. outer
132 – 2 plastic boxes with windows, ideal for interrupted beam switch etc
155 – 3 varicap push button tuners with knobs
188 – 1 plastic box, sloping metal front, 16 x 95mm, average depth 45mm
241 – 1 car door speaker (very flat) 6½" 15 ohm made for Radiomobile
243 – 2 speakers 6" x 4" 15 ohm 5 watt made for Radiomobile
266 – 2 mains transformer 9V ½ A secondary split primary so OK also for 115V
267 – 1 mains transformers 15V 1A secondary p.c.b. mounting
330 – 2 6V 0.6V mains transformer .3a p.c.b. mounting
350 – 40 double pole leaf switches
365 – 1 7uf 660V 50hz metal cased condenser
453 – 2 2¼ in 60 ohm loudspeakers
454 – 2 2¼ in 8 ohm loudspeakers
463 – 1 mains operated relay with 2 sets c/o contacts
464 – 2 packets resin filler/sealer with cures
465 – 3 5A round 3 pin plugs will fit item 193
466 – 4 7 segment l.e.d. displays
470 – 4 pc boards for stripping, lots of valuable parts
480 – 1 3A double pole magnetic trip, saves repairing fuses
498 – 4 1000uf 25V axial electrolytic capacitors
504 – 1 Audax PM 8" speaker 15 ohm 5 watt rating
515 – 100 4BA 1½" cheesehead plated screws and 100 4BA nuts
541 – 1 pair stereo tape head as in cassette recorder/players
546 – 1 bridge rectifier 600V international rectifier ref 3SB100
548 – 2 battery operated relays (3-6v) each with 5A c/o contacts 2 pairs
553 – 2 lithium 3V batteries (everlasting shelf life)

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	£1
Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 B.T. extension sockets	£11.50
100 mtrs 4 core telephone cable	£8.50

COMPACT FLOPPY DISC DRIVE EME-101

The EME-101 drives a 3" disc of the new standard which despite its small size provides a capacity of 500k per disc, which is equivalent to the 3½" and 5¼" discs. We supply the Operators Manual and other information showing how to use this with popular computers: BBC, Spectrum, Amstrad etc. All at a special snip price of £27.50 including post and VAT. Data available separately £2, refundable if you purchase the drive.

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 and case £17.50 post £2.

THIS MONTH'S SNIP

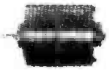
is a 2½kW tangential heater, metal box to contain it and 3 level switch to control it. Special price £7.50 post paid.

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

12 volt MOTORS 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

SOUND TO LIGHT UNIT

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

9" MONITOR

Ideal to work with computer or video camera uses Philips black and white tube ref M24/306W. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and EHT circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. The VDU comes complete with circuit diagram and has been line tested and has our six months guarantee. Offered at a lot less than some firms are asking for the tube alone, only £16 plus £3 post.

LIGHT BOX

This when completed measures approximately 15" x 14". The light source is the Philips fluorescent 'W' tube. Above the light a sheet of fibreglass and through this should be sufficient light to enable you to follow the circuit on fibreglass PCBs. Price for the complete kit, that is the box, choke, starter, tube and switch, and fibreglass is £5 plus £2 post, order ref 5P69.

TANGENTIAL HEATERS

We again have very good stocks of these quiet runnng instant heat units. They require only a simple case, or could easily be fitted into the bottom of a kitchen unit or book case etc. At present we have stocks of 1.2kw, 2kw, 2.5kw, and 3kw. Prices are £5 each for the first 3, and £6.95 for the 3k. Add post £1.50 per heater if not collecting.
CONTROL SWITCH enabling full heat, half heat or cold blow, with connection diagram, 50p for 2kw, 75p for 3kw.

FANS & BLOWERS

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 £5.00
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

TELEPHONE LEAD

3 mtrs long terminating one end with new BT, flat plug and the other end with 4 correctly coloured coded wires to fit to phone or appliance. Replaces the lead on old phone making it suitable for new BT socket. Price £1 ref BD552 or 3 for £2 ref 2P164.

POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, shop, work room etc. Makes you feel better and work harder – a complete mains operated kit, case included. £9.50 + £2 P&P.

J & N BULL ELECTRICAL

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

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 or 203500.

NEW ITEMS

Some of the many described in our current list which you will receive with your parcel.

£2 POUNDERS*

2P120 – 1 combined clockwork switch and thermostat for boiler control
2P122 – 1 30a rotary switch, surface mounting with pointer knob
2P123 – 1 25a rotary switch, surface mounting, cover engraved, high, medium low and off
2P124 – 1 28kv .001 mfd block condensor
2P127 – 1 30a bridge rectifier assembly on heat sinks
2P129 – 1 10rpm motor 115V so supplied with adaptor for 230V
2P131 – 1 Crouzet motor 230V fits the Crouzet gearbox
2P132 – 1 ceiling heat-stat for fire warning or protection
2P133 – 1 Circuit breaker 20a, Crabtree ref C50
2P134 – 1 9V 500mA psu, plugs into 13a socket
2P135 – 10m 10 conductor intercom cable
2P136 – 1 2½ kw element made for tangential blowers
2P137 – 1 Thermo couple, stainless steel tipped for measuring internal heat
2P138 – 1 Mains transformer 20V-0-20V 1a upright mounting
2P141 – 1 rechargeable battery D size (4 AH) solder tag ended
2P142 – 10m 4 pair intercom cable White PVC outer
2P144 – 1 mains operated relay with 4 x 8a c/o contacts
2P145 – 1 10,000 uf 70V d.c. smoothing capacitor
2P146 – 1 7,800 uf 150C d.c. smoothing capacitor
2P148 – 1 Technical information on 3" FDD refundable if you buy fdd
2P149 – 5 diff battery operated model motors
2P150 – 1 PSU chassis with all components for 24V 2A d.c. unwired
2P151 – 1 Metal box 14½ x 14 x 4 with lid add £2.00 post
2P152 – 1 Motor start capacitor 80uf 250V
2P153 – 1 Two station intercom unused but line reject
2P154a – 1 Nicad charger – plug into 13a socket 5.2V .7UA output
2P154b – 1 Nicad charger – plug into 13a socket 6V .9VA output
2P155 – 1 Mains transformer giving 16, 17, 18 & 20V 60W
2P158 – 1 Oven thermostat with temp calibrated knob
2P159 – 1 9V 500ma cased with mains lead and output lead
2P160 – 1 13a plug adaptor fused takes 3 x 3a plugs
2P161 – 1 6" diagonal side cutters
2P162 – 1 Stereo Matrix PCB mounting deemphasis K35
2P163 – 1 AC Working capacitor 12uf 660V AC or 1500V dc
2P164 – 3 Phone leads 3 mtrs long tags one end B.T. plug other end

£3 POUNDERS*

3P7 – 1 DC voltage, doubler or halver for 12V to 24V 12 to 6V 24 to 12V
3P8 – 1 24hr time switch Sangamo, new condition Guaranteed 1 year
3P9 – 12V 500mA psu plugs in 13a socket regulated
3P10 – 1 Mains transformer 50V 2A with 6.3 pilot light winding, upright mounting, fully shrouded plus £1 post
3P13 – 1 Noise filter to fit in mains lead of appliance up to 25a
3P15 – 1 waterproof case will take 150 watt transformer
3P16 – 1 signal box, 3 lamps on face plate of metal box size 5½ x 3½
3P17 – 1 choke and starter to work 8" fluorescent tube at 125W
3P18 – 1 22V 3a mains transformer with bridge rect fitted on top panel
3P20 – 1 0-5a ammeter 3½ ac/dc ex equipment
3P21 – 1 power factor correction condenser 35uf 350ac
3P22 – 1 200va – auto transformer 230 to 115V torroidal encapsulated £1.50 post
3P23 – 1 36V-0-36V tapped 20V-0-20V 100va
3P24 – 1 3" floppy disc for Amstrad etc.
3P25 – 1 7" Electricians pliers

£4 POUNDERS*

4P12 – 50m low loss co-ax 75ohm + £1 post
4P13 – 3 Horstmann time and set switches 15amp
4P14 – 1 150w mains transformer "c" core 43V 3.5A secondary
4P15 – 1 powerful motor 2" stack fitted with gearbox final speed 60rpm mains operated, could operate door opener etc.
4P17 – 1 Uniselector 3 pole 25W, 50V coil standard size
4P18 – 1 Volt meter with digital display (DIGIVISOR)
4P19 – 1 12V dc motor will fit to gearbox 4P20
4P20 – 1 Gear train giving speed reduction

£5 POUNDERS*

5P86 – 1 Transformer upright mounting 230/240V primary 2 x 100 1a secondary
5P88 – 1 Transformer in waterproof metal box 24V 5A add £2 post
5P89 – 1 4 bank heating element each 2kw ideal convector heater
5P90 – 1 18" long tangential blower with motor at one end
5P91 – 1 14" blower, motor in middle
5P92 – 10m Audio co-ax double screened 75ohm super low loss for TV
5P93 – 1 6" Alarm bell 24V dc or ac
5P94 – 1 Current transformer 14V out with 1a dc input
5P95 – 1 Vintage photo cell
5P97 – 1 Impedance matching transformer 0-4-5-8-160 ohm 100 add £1.50 post
5P98a – 1 0-90a ammeter for mounting outside control panel
5P98b – 1 0-180a ammeter for mounting outside control panel
5P99 – 1 Mains operated blower centrifugal output size app. 5" x 1½"
5P100 – 1 Mains splitter 45a switch 3 x 15a fused circuits
5P101 – 1 Model motor 1 rpm from 6V reversible

£7 POUNDERS*

7P1 – 1 Instant heat solder gun – mains with renewable tip and job light

£8 POUNDERS*

8P1 – 1 Charger transformer 10a upright mounting 230/240 primary 16v 10a secondary
8P2 – 1 6" underdome alarmbell suitable for a fire alarm or burglar alarm mains operated.
8P3 – 1 heat sink big powerful so ideal for power transmitter
8P5 – 1 ½ hp motor 900 rpm capacitor run
8P6 – 1 24hr time switch – 2 on offs 16a c/o contacts 3" x 3" x 1½"
8P7 – 1 Silent sentinel invisible ray kit
8P8 – 1 Papst fan 3½ x 3½ x 1½ 230V metal bodied

£10 POUNDERS*

10P13 – 1 reversible motor with gearbox 104 rpm Parvalux
10P14 – 1 100a time switch 1 on/off per 24hr extra triggers £1 per pair
10P15 – 1 Max demand meter 230 ac mains
10P16 – 1 powerful air mover 2 small type blowers with motor in middle
10P18 – 1 mains operated klaxon
10P19 – 1 12V alarm bell really loud, mains operated. In iron case + £5 post
10P22 – 1 sensitive volt meter relay
10P23 – 1 fruit machine heart 3 fruit wheels each stepper motor operated add £3 post
10P24 – 1 big panel meter face size 4¾ x 2½ 200uA movement scaled 1-10
10P26 – 1 "Secretary" phone auto-dialer complete untested sold as such
10P29 – 1 12V engine cooling fan
10P30 – 1 instrument psu on pcb has 4 outputs .12V/.5V 6A/12V .5A/5V .5A
10P31 – 1 7 day time switch 16a c/o contacts sep switches for each day
10P32 – 1 68 rpm 1/6th hp motor reversible

£15 POUNDERS*

15P1 – 1 kit for 115W hi fi amp
15P2 – 1 kit for psu to supply one or two 15P1 amps
15P3 – 1 time switch battery or mains operated – 16a c/o contacts. 7 day programmable has 36hr reserve

£25 POUNDERS*

25P1 – 1 1500 PSI hydraulic pump 24V dc motor, made for operating aircraft undercarriage etc.

LIGHT CHASER KIT motor driven switch bank with connection diagram, used in connection with 4 sets of xmas lights makes a very eye catching display for home, shop or disco, only £5 ref 5P56.

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ABC

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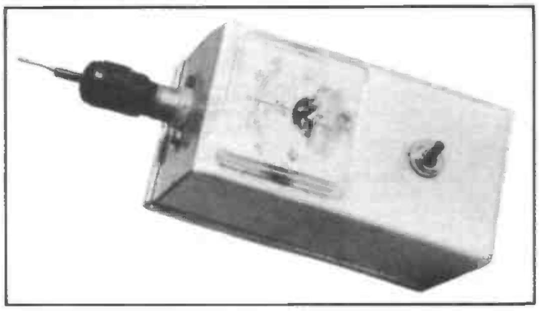
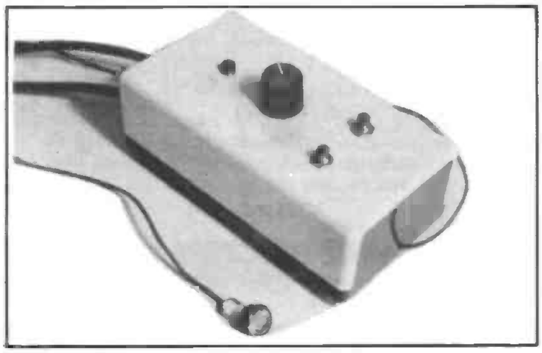
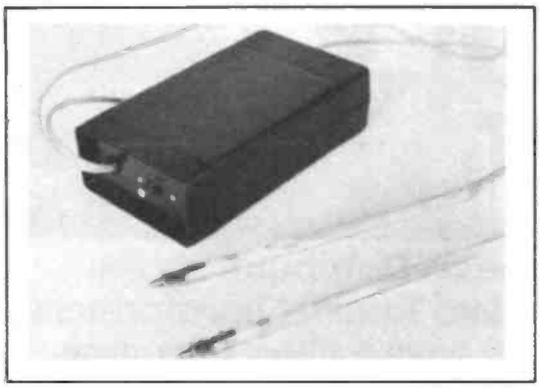
PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .







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Our November 1987 issue will be published on Friday, 16 October 1987. See page 543 for details.

Projects

Series

Features

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24 hours

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4024B	0.40
4025B	0.20
4028B	0.26
4030B	0.29
4040B	0.50
4042B	0.41
4050B	0.29
4053B	0.50
4063B	0.70
4066B	0.20
4068B	0.21
4069B	0.20
4070B	0.20
4071B	0.20
4078B	0.21
4081B	0.16
4510B	0.46
4511B	0.46
4514B	0.91
4518B	0.40
4543B	0.58
4547B	1.23
40174B	0.48
40192B	0.56
40193B	0.56
40194B	0.65
40195B	0.83
40373B	1.10
40374B	1.10
74LS SERIES	
74LS00	0.20
74LS04	0.20
74LS13	0.28
74LS14	0.42
74LS20	0.20
74LS32	0.20
74LS37	0.20
74LS42	0.42
74LS85	0.62
74LS123	0.67

74LS132	0.54
74LS139	0.46
74LS193	0.98
74LS240	0.67
74LS244	0.58
74LS245	0.75
74LS365	0.42
74LS373	0.58
74HC SERIES	
74HC00	0.33
74HC02	0.33
74HC04	0.33
74HC11	0.33
74HC85	0.83
74HC139	0.58
74HC200	1.01
74HC240	0.58
74HC244	0.95
74HC245	0.95
74HC251	0.43
74HC273	0.83
74HC354	0.51
74HC373	0.79
74HC374	0.79
74HC4002	0.71
74HC4022	0.54
74HC4040	0.54
74HC4060	0.56
MICRO & LSI	
MC3448AP	3.90
MC68488P	8.04
Z80A-CPU	1.80
Z80A-DART	4.28
Z80A-PIO	1.68
Z80A-SIO/0	4.96
UPD41256-15	2.65
TC5516APL-2	3.00
ICM72171P1	4.21
IM64021PL	6.30
AD & DA CONVERTERS	
AD7525LN	19.25
DAC80N-CBI-V	19.50
*ADC1210HCD	45.55
*ADC1211HCD	39.96
DAC0800LCN	2.45
*DAC1200HCD	18.84
*DAC1201HCD	18.15
ICL7109CPL	8.40
AD7542KN	18.94

LINEAR	
TDA 3810 Stereo Simulator	3.97
UGN3020 Hall Effect IC	2.58
074 Quad Op/Amp	0.68
1436 High Volt Op/Amp	5.70
1458 Dual Op/Amp	0.41
311 Comparator	0.44
324 Quad Op/Amp	0.41
3340 Elec Attenuator	1.30
398 Sample & Hold	3.96
714 Precision Op/Amp	4.48
741 Op/Amp	0.18
555 Timer	0.46
759 Power Op/Amp	2.72
SWITCHING REGULATORS	
3524 PSU Controller	2.85
3526 PSU Controller	3.69
3526J Ceramic Package	4.92
7660 Neg Volt Gen	1.76
IR REMOTE IC'S	
SL486DP	2.20
SL490DP	1.92
ML926DP	2.73
ML928DP	2.73
VOLTAGE REGS 1A FIXED VOLTAGE PLASTIC TO220 PACK 7800/7900 SERIES	
-24V to +24V	0.45
0.1A FIXED VOLTAGE 78L00/79L00 SERIES PLASTIC TO92 PACK	
-15V to +15V	0.27
DIODES	
1N4001-7	0.05
1N4148	0.02
1N4933	0.25
1N3891	1.89
1N5339B	0.38
1N5401-6	0.12

31DQ03	0.64
BAT85	0.10
BYV32-100	1.24
BYV95B	0.18
BYV95C	0.20
BVX71-600	1.10
BY206	0.20
40HF20	1.16
40HFR20	1.16
M16-100	0.93
M16-100R	0.93
M25-100	1.27
M25-100R	1.27
IR OPTO	
TPS703A	1.25
TLN105A	0.44
TLN105	0.40
ZENER DIODES	
BZY88C2V7	0.05
BZY88C4V3	0.06
BZY88C5V1	0.06
BZY88C7V5	0.06
BZY88C9V1	0.06
BZY88C10	0.06
BZY88C11	0.06
BZY88C15	0.06
BRIDGE REC'S	
KBPC808	1.42
SKB202L5A	0.43
KBU4D	0.95
W005	0.26
TRANSISTORS	
BC107	0.12
BC108	0.12
BC182	0.12
BC212	0.12
BC327B	0.12
BC546B	0.12
BC556A	0.12
BD131	0.40

BD233	0.33
BF259	0.26
BSR50	0.44
BUS48P	2.65
BUS98	5.70
IRF520	1.75
J112	0.30
IRF840	7.59
MTP8N10	1.85
MJ3001	1.46
MJ2501	1.52
TIP110	0.36
TIP115	0.39
TIP121	0.39
TIP126	0.39
TIP141	1.59
TIP146	1.63
2N2646	0.55
2N3055	0.50
2N3704	0.20
2N3819	0.40
2N5307	0.20
2N5308	0.20
IC SOCKETS TURNED PIN	
6 WAY	0.12
8 WAY	0.16
14 WAY	0.28
16 WAY	0.32
18 WAY	0.36
20 WAY	0.40
22 WAY	0.44
24 WAY	0.48
28 WAY	0.56
40 WAY	0.80
PLAIN LOW COST	
6 WAY	0.05
8 WAY	0.06
14 WAY	0.10

16 WAY	0.11
18 WAY	0.13
20 WAY	0.14
22 WAY	0.15
24 WAY	0.17
28 WAY	0.20
40 WAY	0.28
DISC CERAMIC	
47pF63V	0.03
120pF63V	0.05
100pF50V	0.03
1000pF63V	0.02
2200pF63V	0.03
4700pF63V	0.04
0.047μF50V	0.04
0.1μF25V	0.05
0.1μF50V	0.14
TANTALUM	
1.0μF16V	0.09
6.8μF10V	0.12
10μF10V	0.10
10μF16V	0.13
22μF16V	0.21
33μF16V	0.32
47μF6.3V	0.23
100μF6.3V	0.57
150μF6.3V	0.94
RESISTORS CARBON FILM	
0.25W 5%	
1R - 10M	0.02
0.5W 5%	
10R - 10M	0.03
METAL FILM	
0.4W 1%	
10R - 1M	0.04
THERMISTOR BEAD (NTC)	
4K7 GM472W	1.95

POTENTIOMETERS CERMET 3/8" SQ	
PCB TOP ADJUST	
100R - 200K	0.50
PCB SIDE ADJUST	
500R - 200K	0.50
CONNECTORS	
Flying lead to PCB Via the MOLEX KK SYSTEM	
0.1" PITCH PLUGS	
3 WAY POLARISED	0.28
5 WAY POLARISED	0.37
0.1" PITCH HOUSINGS	
3 WAY POLARISED	0.12
10 WAY POLARISED	0.20
17 WAY POLARISED	0.30
CRIMPS	0.04
0.156" PITCH PLUGS	
2 WAY LOCKING	0.23
5 WAY NON LOCKING	0.33
8 WAY LOCKING	0.91
10 WAY NON LOCKING	0.66
0.156" PITCH HOUSINGS	
2 WAY LOCKING	0.16
4 WAY LOCKING	0.21
5 WAY NON LOCKING	0.21
8 WAY LOCKING	0.25
10 WAY LOCKING	0.30
10 WAY NON LOCKING	0.30
CRIMPS	0.04
EQUIPMENT WIRE PVC 7/0.2 ALL COLOURS SOLD BY THE METER	0.04

ENAMELLED COPPER WIRE SOLD BY THE METER	
0.071mm	0.02
0.10mm	0.03
0.15mm	0.04
0.21mm	0.06
0.212mm	0.06
0.375mm	0.10
0.40mm	0.11
0.45mm	0.12
0.75mm	0.20
1.0mm	0.27
1.12mm	0.30
1.25mm	0.34
2.50mm	0.68
CAPACITORS POLYESTER	
0.022μF 250V	0.11
0.047μF 250V	0.12
0.068μF 250V	0.13
0.1μF 100V	0.14
0.47μF 100V	0.20
ELECTROLYTIC	
2.2μF 50V RADIAL	0.17
4.7μF 63V AXIAL	0.20
10μF 35V RADIAL	0.08
10μF 35V AXIAL	0.17
10μF 63V RADIAL	0.08
22μF 100V RADIAL	0.14
33μF 16V RADIAL	0.08
47μF 25V AXIAL	0.23
47μF 100V RADIAL	0.23
100μF 10V RADIAL	0.08
100μF 25V AXIAL	0.27
100μF 25V RADIAL	0.09
100μF 50V RADIAL	0.22
100μF 63V RADIAL	0.22
220μF 10V RADIAL	0.09
330μF 16V RADIAL	0.20

*** PROJECTS ***

Distance Measuring Instrument

An accurate temperature compensated Ultrasonic measuring device. Basically designed for measuring between two parallel objects up to 26ft. (65ft with Optional Parabolic Reflector).

Applications: Room dimensioning, Car reversing, Surveying, Robotics, Instrusion, height gauge, and lots more. OUTPUT: Four Digit BCD (Multiplexed), Interfaces Indirectly to a four-digit LCD Display board (optional). Kit comprising of: PCB, Components, Transducer, Slide Switch, Push Switch, Thermistor, PP3 Battery Connector.

KIT PRICE 22.95
BUILT AND TESTED 34.95

Optional Extras

LCD Display board comprising:
4-Digit Liquid Crystal Display with Drivers and on board DF Oscillator.

KIT PRICE 13.95
BUILT & TESTED 17.95

Ultrasonic Parabolic reflector, Distances up to 65ft have been achieved

PRICE 2.95

RS232 → Parallel Centronics Converter

Ideally suited for computers that cannot support Parallel Printers. Kit comprising: PCB, Components, 36 way Centronics IDC Plug & Patch Lead

KIT PRICE 17.95
BUILT & TESTED 25.95
Sinclair QL "SER1 or 2" Plug 1.42

Car ICE Warning Indicator

KIT PRICE 5.95
BUILT & TESTED 8.95

****Z80 Based Controller Board**

This simple to understand Z80 CPU based board has all the necessary hardware to control menial to most complex tasks. Hardware Includes 16 output lines and 16 input lines. 2K static RAM and 2K EPROM. Kit comprising of: PCB, Z80A CPU, RAM, EPROM, LOGIC, 4Mhz XTAL, R's & C's, CONN'S

KIT PRICE 19.95
BUILT & TESTED 29.95

Electrolytic cont.	
470μF 16V RADIAL	0.20
470μF 50V RADIAL	0.64
1000μF 10V AXIAL	0.47
2200μF 16V RADIAL	0.48

CRYSTALS	
32.768MHz (WATCH)	0.78
1.0MHz (MICRO)	5.34
2.4576MHzz (BAUD)	2.70
3.2768MHz (TIME)	2.70
4.0MHz(MICRO)	1.10

L.E.D'S 4.9mm DIA	
RED TLR113A	0.13
GRN TLG113A	0.13
YEL TLY113A	0.22
ORG TLO113A	0.22
L.E.D.'S 3.1mm DIA	
RED TLR123	0.22
GRN TLG123A	0.13
YEL TLY123	0.13
ORG TLO123	0.17

L.E.D. DISPLAYS	
0.30"	
COM/CATH TLR332	0.89
COM/ANO TLR333	0.89
0.43"	
COM/CATH TLR342	0.89
COM/ANO TLR343	0.89
0.53"	
COM/CATH TLR358	0.89
COM/ANO TLR359	0.89

D TYPE CONNECTORS SOLDER BUCKET	
9 Way Skt	0.43
9 Way Plg	0.38
9 Way Shell	0.98
15 Way Skt	0.60
15 Way Plg	0.53
15 Way Shell	1.07
25 Way Skt	0.60
25 Way Plg	0.53
25 Way Shell	1.16

PLEASE ADD £1 P&P. and 15% VAT TO TOTAL. Some Data sheets available – phone for details. Stock items normally by return of post. Please ask us to quote for items not listed. Part numbers are exact or near equivalents. Prices correct at time of going to press. Send s.a.e. for stock listing.
*Available until stocks are exhausted.

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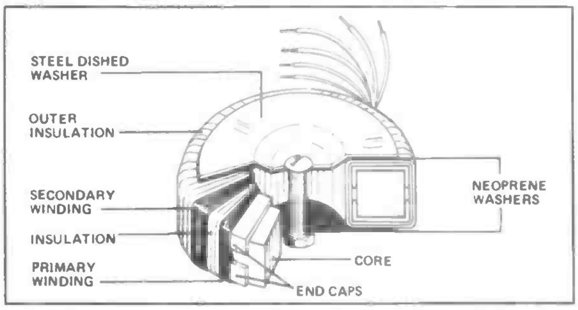

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£1.75

PACK G
25 Green LEDs 5mm
£2.00

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£2.50

PACK J
50 x 1N4148 Si. Diodes
£1.00

PACK K
40 x NPN/PNP Transistors BC182/212 General Purpose
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NEW ELECTRONIC GUARD DOG KIT

One of the best deterrents to a burglar is a guard dog and this new kit provides the barking without the bite! The kit when assembled can be connected to a doorbell, pressure mat or any other intruder detector and will produce a random series of threatening barks making the would be intruder think again and try his luck elsewhere. The kit is supplied complete with high quality PCB, transformer, all components and instructions. All you need is a mains supply, intruder detector and a little time. The kit even includes a horn speaker which is essential to produce the loud sound required. The "dog" can be adjusted to produce barks ranging from a Terrier to an Alsatian and contains circuitry to produce a random series of barks giving a more realistic effect.

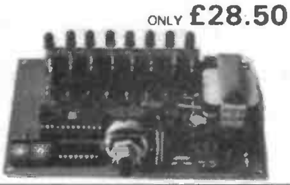
XK125 Complete kit of parts £21.95

DISCO LIGHTING KITS

DL1000K – This value-for-money 4-way chaser features bi-directional sequence and dimming. 1kW per channel £17.50
DLZ1000K – A lower cost uni-directional version of the above. Zero switching to reduce interference £9.85
DLA/1 (for DL & DLZ1000K) Optional opto input allowing audio 'beat'/light response 70p
DL3000K – 3-channel sound to light kit features zero voltage switching, automatic level control and built-in microphone. 1kW per channel £14.25

The DL8000K is an 8-way sequencer kit with built in opto-isolated sound to light input which comes complete with a pre-programmed EPROM containing EIGHTY – YES 80! different sequences including standard flashing and chase routines. The KIT includes full instructions and all components (even the PCB connectors) and requires only a box and a control knob to complete. Other features include manual sequence speed adjustment, zero voltage switching, LED mimic lamps and sound to light LED and a 300 W output per channel.
And the best thing about it is the price.

ONLY **£28.50**



TEN EXCITING PROJECTS FOR BEGINNERS

This Kit has been specially designed for the beginner and contains a SOLDERLESS BREADBOARD, COMPONENTS, and a BOOKLET with instructions to enable the absolute novice to build TEN fascinating projects including a light operated switch, intercom, burglar alarm, and electronic lock. Each project includes a circuit diagram, description of operation and an easy to follow layout diagram. A section on component identification and function is included, enabling the beginner to build the circuits with confidence.

ORDER NO XK118 £13.75

XK102 3-NOTE DOOR CHIME

Based on the SAB0600 1C the kit is supplied with all components, including loudspeaker, printed circuit board, a predrilled box (95 x 71 x 35mm) and full instructions. Requires only a PP3 9V battery and push-switch to complete.
AN IDEAL PROJECT FOR BEGINNERS **£6.00**

XK113 MW RADIO KIT

Based on ZN414 IC, kit includes PCB, wound aerial and crystal earpiece and all components to make a sensitive miniature radio. Size: 5.5 x 2.7 x 2cms. Requires PP3 9V battery.
IDEAL FOR BEGINNERS **£6.00**

VERSATILE REMOTE CONTROL KIT

This kit includes all components (+ transformer) to make a sensitive IR receiver with 16 logic outputs (0–15V) which with suitable interface circuitry (relays, triacs, etc – details supplied) can be used to switch up to 16 items of equipment on or off remotely. The outputs may be latched (to the last received code) or momentary (on during transmission) by specifying the decoder IC and a 15V stabilised supply is available to power external circuits. Supply: 240V AC or 15–24V DC at 10mA. Size (excluding transformer) 9 x 4 x 2 cms. The companion transmitter is the MK18 which operates from a 9V PP3 battery and gives a range of up to 60ft. Two keyboards are available—MK9 (4-way) and MK10 (16-way), depending on the number of outputs to be used.

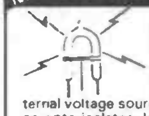
MK12 IR Receiver (incl. transformer) £14.85
MK18 Transmitter £7.50
MK9 4-Way Keyboard £2.00
MK10 16-Way Keyboard £5.95
601 133 Box for Transmitter £2.60

HOME LIGHTING KITS

These kits contain all necessary components and full instructions and are designed to replace a standard wall switch and control up to 300W of lighting.

TDR300K	Remote Control Dimmer	£16.45
MK6	Transmitter for above	£4.95
TD300K	Touchdimmer	£8.50
TS300K	Touchswitch	£8.50
TDE/K	Extension kit for 2-way switching for TD300K	£2.70
LD 300K	Light Dimmer	£4.35

NEW POWER STROBE KIT



Designed to produce a high intensity light pulse at a variable frequency of 1 to 15Hz this kit also includes circuitry to trigger the light from an external voltage source (eg. a loudspeaker) via an opto isolator. Instructions are also supplied on modifying the unit for manual triggering, as a slave flash in photographic applications or as a warning beacon in security applications. The kit includes a high quality pcb, components, connectors, 5Ws strobe tube and full assembly instructions. Supply: 240V ac. Size: 80 x 50 x 45.

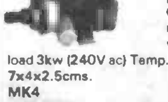
XK124 STROBOSCOPE KIT £12.50

NEW HIGH SECURITY LOCK KIT

Designed for use with our lock mechanism (701 150) this kit will operate from a 9V to 15V supply drawing a standby current of only 50µA. There are over 5000 possible 4-digit combinations and the sequence can be easily changed. To make things even more difficult for an unauthorised user an alarm can be sounded after 3 to 9 incorrect entries—selectable by means of a link. The alarm can sound for a few seconds to over 3 minutes during which time the keyboard is disabled preventing further entries. A latched or momentary output is available making the unit ideal for door locks, burglar alarms, car immobilisers, etc. A membrane keyboard or pushbutton switches may be used and a beep sounds when a key is depressed. Kit includes high quality PCB, all components, connectors, high power piezo buzzer and full assembly and user instructions.

XK121	LOCK KIT	£15.95
350 118	Set of Keyboard Switches	£4.00
701 150	Electric Lock Mechanism 12 volt	£16.50

PROPORTIONAL TEMPERATURE CONTROLLER KIT



Uses "burst fire" technique to maintain temperature to within 0.5°C. Ideal for photography, incubators, wine-making, etc. Max. load 3kw (240V ac) Temp. range up to 90°C. Size: 7x4x2.5cms.
MK4 **£7.10**

TOOLS ★ TOOLS ★ TOOLS

Good quality tools selected to offer outstanding value for money.
650 004 6in mini. Snipe Nose Pliers. Serrated jaws and return spring. £2.10
650 005 6in lap jointed side cutters. Insulated handles and return spring. £2.10
650 006 Light duty cutters. Cutting capacity 0.22–1.2mm copper wire. £1.60
TOOL KIT – Contains: side cutters, snipe nose pliers, wire strippers, flat blade screwdriver, phillips screwdriver in black textured, reinforced and padded case which when opened out measures 240x205mm £6.80

650 007 Self-adjustable automatic wire stripper with built-in cable cutter. £3.95
650 012 Watchmakers Screwdriver Set. 1.0/1.4/2.0/2.4/3.0/3.8mm £1.75
650 019 Set of 4 Stainless Steel Tweezers. Straight nosed, straight noosed-reverse action, bent nosed, flat nosed. 110mm long. £3.65
650 502 Reliant 9–12V dc Drill. £6.90
650 500 Titan 12V dc Drill. £10.25
650 570 Saturn Mains Drill. £16.50
WE ALSO STOCK ANTEX IRONS AND ACCESSORIES

LOGIC PROBE

A MUST for working with TTL & CMOS devices. Displays logic levels and pulses down to 25nS with LEDs and sound. Comprehensive instruction booklet supplied.

Working voltage	4-16V dc
Input Impedance	1M
Max. I/p frequency	20MHz

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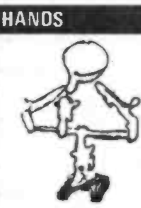
RECHARGEABLE SOLDERING IRON

Powerful cordless iron complete with table-top/wall-mounting charging bracket. Reaches soldering temperature in 10 seconds. Includes lamp which lights when soldering. Comes with mains charging unit and 12V car battery adaptor. **£17.95**

HELPING HANDS



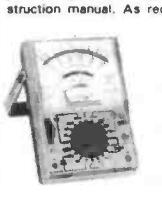
Magnifier and crocodile clips on ball and socket joints mounted on a heavy base. Ideal for holding and inspecting PCBs during soldering, fault finding, etc.
(650 035) **£3.95**

MW RADIO

SCOOP PURCHASE ONLY £1.95!!!
Comprises ready-built AM Tuner module (superhet), separate audio amp with volume control and miniature speaker. All you have to do is connect these three items to a 9V battery. Full instructions supplied. AVAILABLE WHILE STOCKS LAST.

HANDY MULTIMETER

An ideal multimeter for the hobbyist featuring 20k/V input impedance, 19 ranges including 10A d.c., battery checker and continuity buzzer. Supplied complete with test leads, battery and instruction manual. As recommended for the EE "Teach In" series. Dimensions: 135mm x 89mm x 40cm.



AC Volts: 0-50-250-1kV (5%).
DC Volts: 0-2.5-10-50-250-1k.
DC Current: 0-5-10-500mA-10A
Resistance: 10k-100k-10M
dBs: –20dB to +62dB
Part no. 405104 **£12.95**

P.C.B. ETCHING KIT

Ideal starter pack. 2 pieces Copper Laminate, Circuit Etchant, Etch Resist Pen, 7 Assorted Transfer Sheets and Tray. Full and comprehensive instructions on laying out and etching your own PCB designs. **£5.20**

SOLAR POWERED NICAD CHARGER

Takes up to 4 x AA size. Charges 2 batteries in 4–6 hrs., 4 in 10–14 hrs. depending on strength of sunlight. Ideal for boating, caravanning, modellers, etc. **£5.95**

VELLEMAN KITS

We stock the full range of Velleman Kits. Why not try one of these!!
K1771 Miniature FM TRANSMITTER (50mW). 9–12V DC. Frequency: 100–108MHz. Ideal for babyphone, etc. £6.50
K2572 STEREO PRE-AMPLIFIER £7.93
K2583 HEATING CONTROLLER. Enables four temperatures to be set and maintained for set periods in a day. Display shows time or temperature. £75.76
K2638 CAR ALARM. Easy to mount. No false alarms. Adjustable entry/exit times. Automatic reset prevents discharging of battery. £16.80
K2603 YEAR TIMER. Standard memory – 40 steps expandable to 240 steps. Non-volatile memory holds program without any power source. Auto-start after power failure. Two programmable "sleep" times. 4 relay outputs – one relay (3A/240V) supplied with kit. Extra relays (K2632). Membrane keyboard and housing included. (Transformer not included.) Size: 241x116x59mm. £132.30
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Send sae 12" x 9" for full catalogue.

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EE PROJECT KITS MAGENTA

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If you do not have the issue of E.E. which includes the project – you will need to order the instruction reprint as an extra – 80p each. Reprints available separately 80p each + p&p £1.00.

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SAE or 'phone for prices

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- NOISE GATE Sept 87 £22.14
- PERSONAL STEREO AMP Sept 87 £13.63
- CAR OVERHEATING ALARM Sept 87 £8.21
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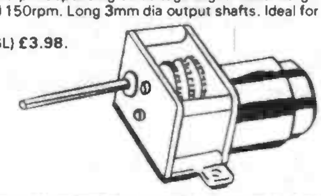

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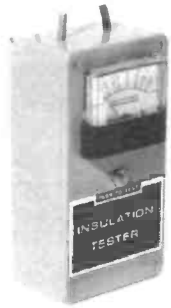

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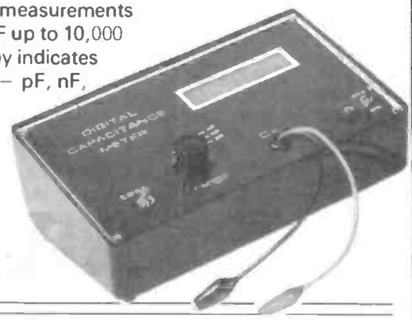

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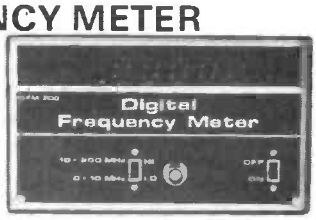

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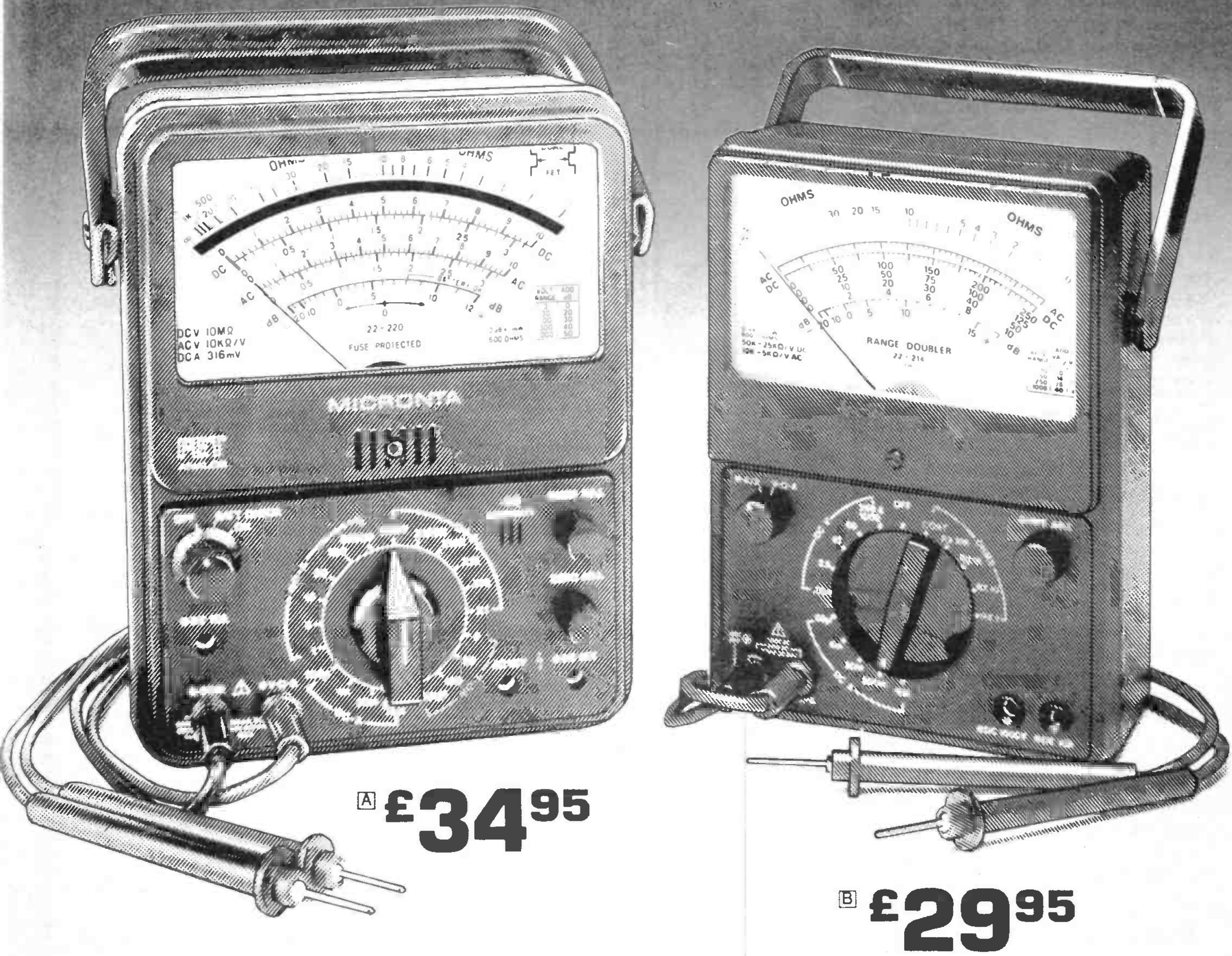

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The Magazine for Electronic & Computer Projects

VOL 16 No. 10 **October '87**

Editorial Offices
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You will find if you compare EE with its rivals that we pack much more onto every page than any of our competitors and, on average, carry more projects per issue than other monthlies. Even though we do this there is often still not room for the likes of *Circuit Exchange* or a feature article every month.

Of course issue size is governed by cover price, advertisement revenue, circulation and production costs. In view of our buoyant circulation, and advertising (in addition to some cost savings on production) from the December issue, we will be including free Data Cards in seven issues (starting with two free cards in December issue).

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We must of course thank you for your part in this continuing success. The magazine is shaped to some extent in response to your views and wishes. Please continue to let us know of your likes and dislikes – all feedback on the magazine is very welcome.

You will find some more *Readers' Letters* in this issue. We will be particularly keen to get some feedback on our new City and Guilds certificate series and there is provision for this in the planned topics – see page 538.

Mike Kenward

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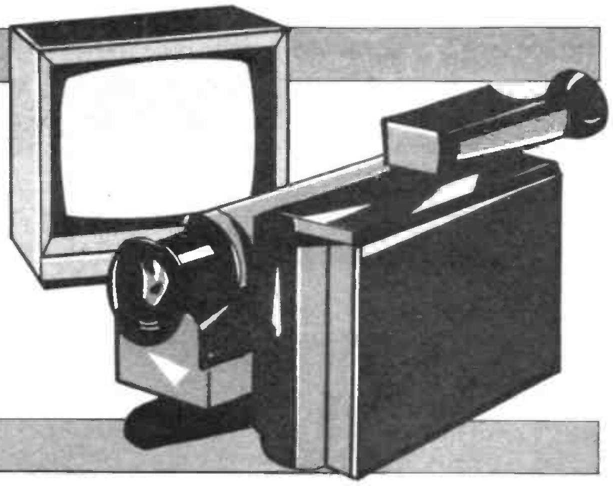


VIDEO CONTROLLER

ROBERT PENFOLD

A simple unit which provides a video fader and audio mono/stereo mixer and fader

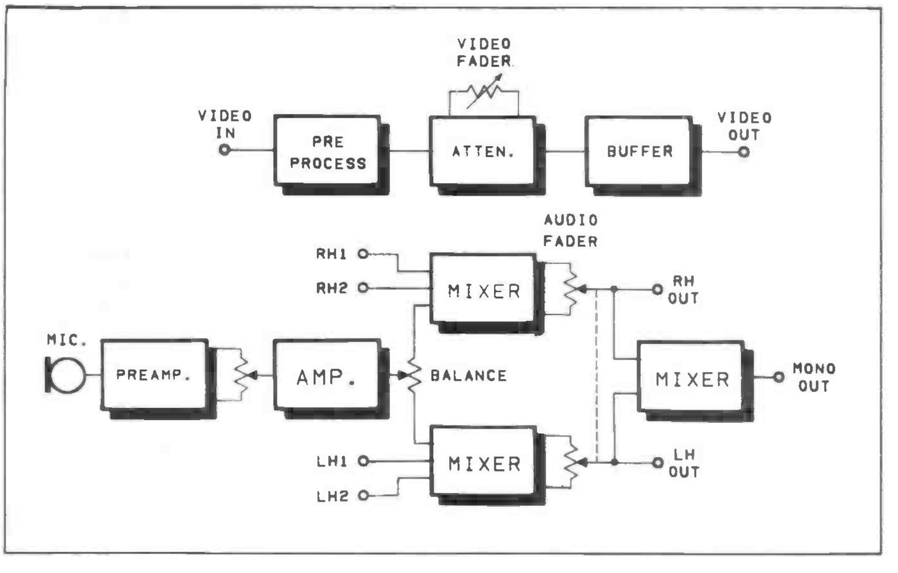


Fig. 1. Block diagram of the Video Controller.

HOME-VIDEO production appears to be an increasingly popular hobby, and seems likely to gain a larger following than home movies of the cine film variety ever managed. Methods of production are very different to the old cine techniques, and there is no absolute equivalent to splicing pieces of film together to edit the individual scenes into the finished product. The accepted technique with videos is to copy the scenes from tapes placed in one recorder to a single tape in a second recorder where the full video is built up.

This can actually be done without the need for any extra equipment apart from the connecting lead, albeit rather crudely. More professional results can be obtained with the aid of a video controller of some kind, and the most basic type is just a video fader. The idea is to fade down the signal at the end of one scene, and then fade it up again at the beginning of the next scene. This gives what is generally a better effect than an abrupt cut from one scene to the next, and it is a technique that is much used by professional programme makers.

For best results an audio fader should also be fitted to the unit, so that the sound signal can be faded in unison with the video signal if desired. The normal approach is to have separate video and audio fader controls so that the two signals can be controlled in precisely the required manner, but to use slider controls mounted side-by-side so that they are easily operated together when necessary. For greater versatility an audio mixer should be included, so that background music or a commentary are easily added to the original sound track.

THE SYSTEM

This video controller uses the arrangement shown in the block diagram of Fig. 1. The top set of three blocks form the video fader, which is separate from the audio section of the unit apart from a common on/off switch and battery supply. Although an audio signal can be faded up and down using nothing more than a simple potentiometer connected to act as a variable attenuator, things are far less straightforward with a video signal. This is due to the fact that a video signal is really a mixture of two signals. The main one is the positive modulation signal which varies the brightness of the spot which is scanned across the screen to produce the image. This is the signal which must be attenuated in order to fade down the picture. The other part of the signal is the negative going synchronization pulses.

There are two types of synchronization pulse, the frame pulses at a frequency of 50Hz, and the line synchronization pulses which are shorter and at a much higher frequency of 15.625kHz. This second frequency may seem to

be too low at first sight. However, it should be remembered that although there are 50 frames per second, a system of interlacing is used, and two frames are needed to produce one complete picture. This gives only 25 full pictures per second (25 pictures × 625 lines = 15625).

In the present context the important point is that a simple attenuator will not just fade down the modulation signal, but will also affect the synchronization pulses. It will give the desired fading effect, but there is a strong likelihood of proper synchronization being lost before the picture is fully faded down. At best this would give a grossly distorted picture, and at worst synchronization would be lost completely with the picture breaking up as a result.

There are quite complex fader circuits which split the signal into its modulation and synchronization pulse elements, process the modulation signal, and then recombine the signals. It is not essential to do things in this way though, and it is possible to devise a circuit that will fade out the main picture signal while leaving a perfectly adequate modulation signal. In this case the general scheme of things is to use some preprocessing ahead of a variable attenuator to ensure that the faded signal retains a sufficiently strong synchronization signal.

A buffer amplifier at the output of the video section ensures that the unit has a low enough output impedance to drive a composite video input properly. Note that the unit will only work with a composite video signal, and it can not be used with a u.h.f. signal.

AUDIO SECTION

The audio section includes a two stage microphone preamplifier which incorporates a microphone level control. There are three mixer stages, which can make the unit look a bit confusing at first, but the extra mixer is needed because the unit is designed to give both mono and stereo outputs. The microphone signal is fed to both inputs of the stereo mixer, and a channel balance control is included here. There are two high level inputs for each channel of the stereo mixer circuit, but there are no level controls for either of these. It has been assumed that the output controls of the tape decks (or whatever equipment feeds these inputs) will be used to get the signal levels right. Of course, there would be no difficulty in adding volume control style variable attenuators at each input if desired.

A dual gang potentiometer can be used to control the output level from both channels of the mixer. It is the outputs from this main fader control that constitute the stereo output signal. The third mixer stage is simply used to combine the stereo output signals to provide a mono output. If the mono output is used, then obviously the microphone balance control is superfluous, and will have little effect.

VIDEO CIRCUIT

The circuit diagram for the video stages of the unit appears in Fig. 2. There is nothing much to the preprocessing circuit which is basically just a diode and potential divider circuit which ensures that suitable voltages are fed to the video fader potentiometer, VR2. Transistor TR1 acts as a buffer amplifier which provides a low enough output impedance to drive the fader circuit properly. VR1 and VR6 are adjusted to give a good control characteristic from VR2. This avoids having the fade-down introduced over a short length of track towards the middle of VR2's adjustment range.

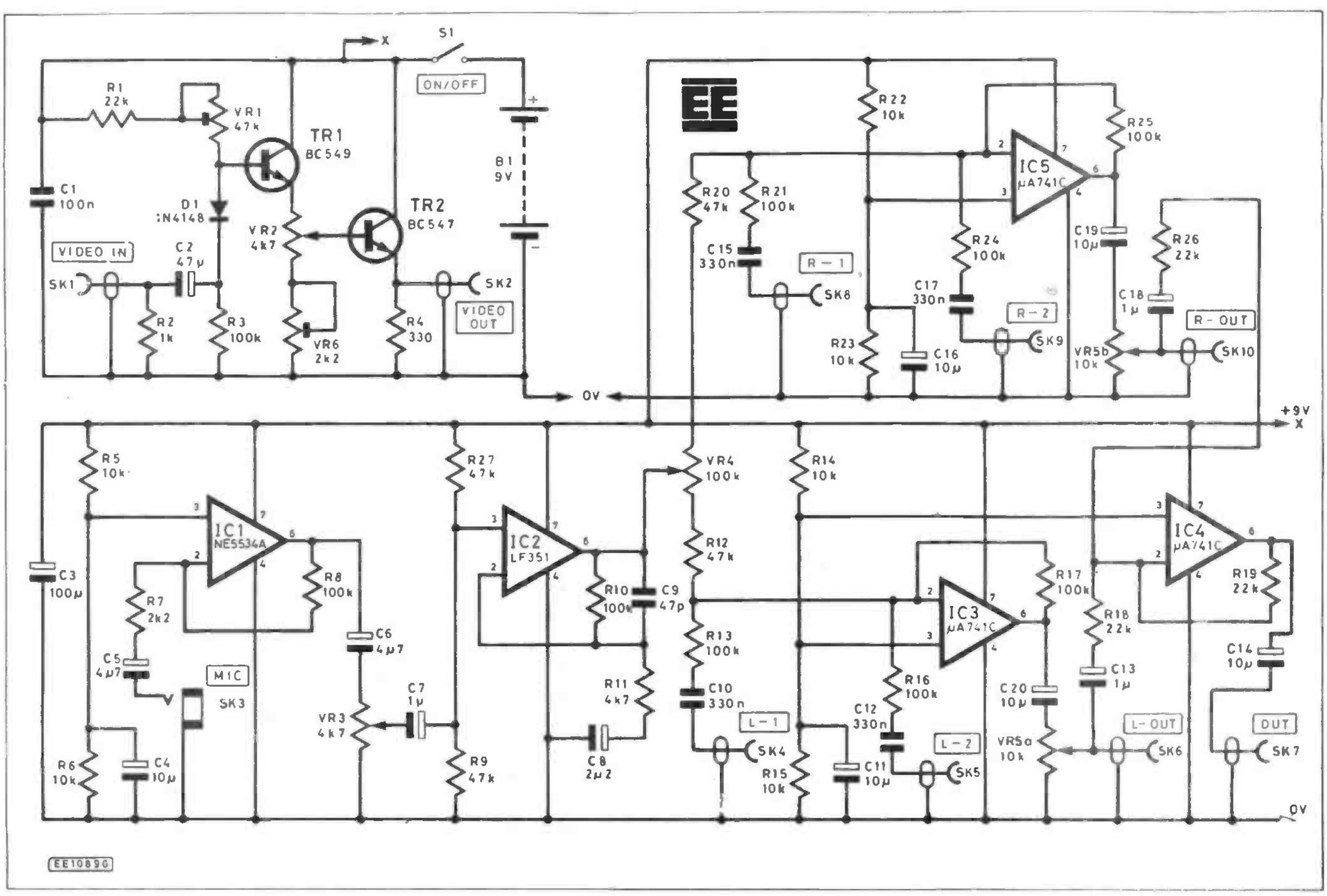
By having the fade-down introduced over virtually all VR2's adjustment range it is much easier to precisely control things and to have a very slow fade out if desired. It also gives a better match with the audio fade-down control. The effect on the picture as the signal is faded out is much the same as turning down the brightness control of a television receiver, but there is also some reduction in contrast as the signal is attenuated.

AUDIO CIRCUIT

The audio stages are somewhat more complex, as can be seen from the preamplifier and mixer circuit diagram which appears in Fig. 2. IC1 acts as the preamplifier stage, and this is a special low noise operational amplifier which operates here in the inverting mode. It has a voltage gain of about 45 times and gives an input impedance of 2k2. The circuit will work using a less expensive device in the IC1 position, including the standard μA741C type. The NE5534A is much to be preferred though, as the output from a microphone is at a very low level, and noise from the preamplifier can be excessive when using a device which offers anything less than excellent noise performance. The noise level is actually about 20dB lower (i.e. about one tenth in terms of voltage) using the NE5534A instead of an ordinary μA741C or a similar device.

The input characteristics of the microphone input are suitable for most types of microphone. Low or medium impedance dynamic types will work well with the unit, as will any types that have similar output properties. With some low impedance types it may be better to reduce R7 to 1k so as to give slightly increased gain. The unit will work with high impedance dynamic microphones and similar types, but better results are likely with these if R7 is raised to about 22k in value. This reduces gain and boosts the input impedance.

Fig. 2. Complete circuit diagram showing the video and audio sections.



COMPONENTS

See Shop Talk
See page 563

Resistors

R1	22k
R2	1k
R3	100k
R4	330
R5,R6,R14,R15, R22,R23	10k (6 off)
R7	2k2
R8,R10,R13,R16 R17,R21,R24, R25	100k (8 off)
R9,R12,R20,R27	47k (4 off)
R11	4k7
R18,R19,R26	22k (3 off)

All resistors 0.25W 5% carbon

Potentiometers

VR1	47k sub-min horizontal preset
VR2	4k7 lin.slider
VR3	4k7 log. rotary
VR4	100k lin.rotary
VR5	10k log.dual gang slider
VR6	2k2 sub-min horizontal preset

Capacitors

C1	100n ceramic
C2	47µ 16V radial elect.
C3	100µ 10V radial elect.
C4,C11,C14, C16,C19,C20	10µ 25V radial elect. (6 off)
C5,C6	4µ7 63V radial elect. (2 off)
C7,C13,C18	1µ 63V radial elect. (3 off)
C8	2µ2 63V radial elect.
C9	47p ceramic plate
C10,C12,C15, C17	330n poly layer (4 off)

Semiconductors

TR1	BC549
TR2	BC547
IC1	NE5534A
IC2	LF351
IC3,IC4,IC5	µA741C (3 off)
D1	1N4148

Miscellaneous

SK1,SK2,SK4 to SK7	phono socket (6 off) see text.
SK3	3.5mm jack socket
S1	s.p.s.t. sub-min toggle switch
B1	9V battery (e.g. 6 × HP7 in holder)

Sloping front case approx 170 × 143 × 31/55mm; printed circuit board available from the EE PCB Service, order code EE581; slider control knobs (2 off); rotary control knobs (2 off); slider control bezels (2 off); 8 pin d.i.l. i.c. holders (5 off); battery connector; screened lead; connecting wire; solder pins; fixings, etc.

Approx. cost Guidance only £19 plus case

Crystal microphones are unsuitable for use with this project.

Potentiometer VR3 is the microphone gain control, and this is followed by the second stage of the microphone preamplifier. This is a non-inverting circuit based on IC2, and it provides a voltage gain of approximately 22 times. Its output feeds straight into the channel balance control, VR4.

The stereo mixer uses IC3 and IC5 as conventional summing mode mixers, one in each stereo channel. These have unity voltage gain and provide an input impedance of about 100k at each input. VR4 forms part of one input resistance for each channel, and it gives approximately unity voltage gain from the output of IC2 to the output of each mixer, but only when it is at a central setting. By adjusting VR4 so that the wiper is right at one end of its track or the other, the two input resistances become unequal. One becomes just the 47k of the fixed input resistor, while the other becomes this 47k plus the full 100k of VR4's track (totalling 147k).

The gain of each mixer circuit is equal to 100k divided by the input resistance. Therefore, at the extremes of its settings VR4 boosts the microphone signal in one channel by about 6dB, and reduces it by a few dB in the other channel. This does not permit the microphone signal to be panned from full left channel only through to right channel only. In terms of position in the sound stage, as little as 6dB difference between the two channels is adequate to place a signal well over to one side or the other. VR4 can therefore be used to pan the microphone signal over to one side of the sound stage if desired, instead of using it to balance the signal for a central image.

The main audio fader control is VR5 and the stereo outputs are fed direct from its wiper terminals. The two signals are combined into the mono output by IC4 which acts as another summing mode mixer circuit.

Power is provided by a nine volt battery, and as the current consumption is quite high at around 17 milliamps a fairly high capacity battery such as six HP7 size cells in a holder is required, alternatively a "high power" version of the PP3 is suitable.

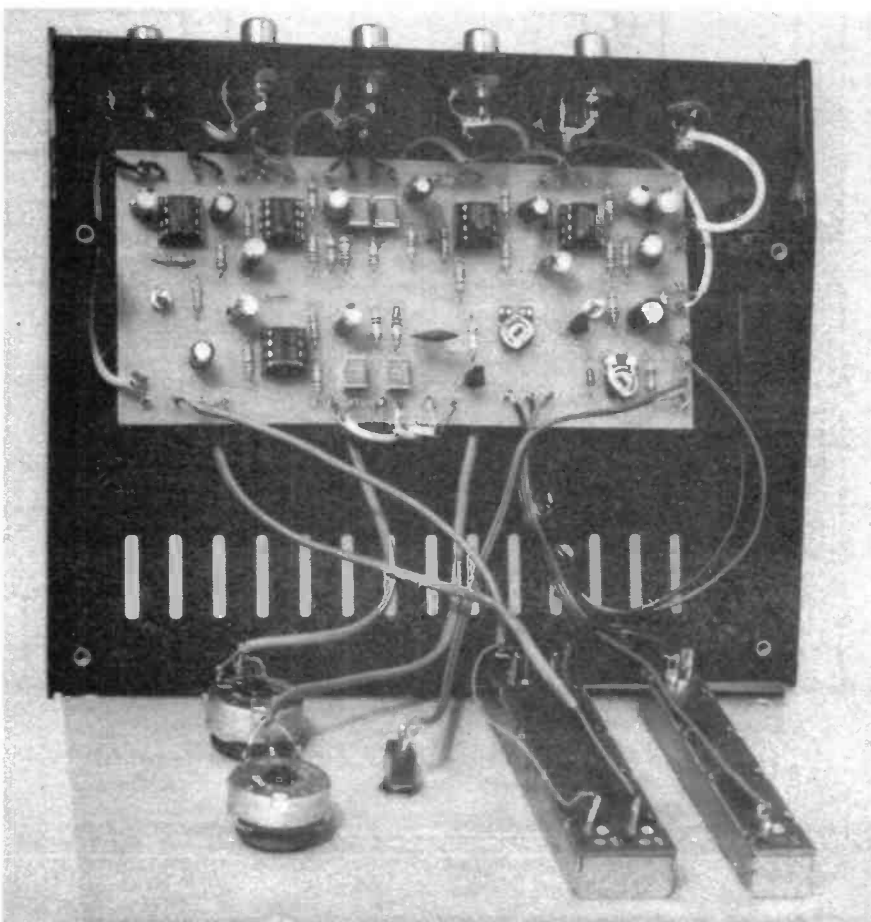
CONSTRUCTION

Details of the printed circuit board are provided in Fig. 3. None of the integrated circuits are MOS types, but I would still strongly advocate the use of a holder for IC1 at least. The NE5534A is rather more expensive than the average operational amplifier. The capacitors must all be miniature printed circuit mounting types if they are to fit onto the board neatly and without difficulty. Ideally the four polyester capacitors should be 7.5 millimetre pitch components.

Be careful not to omit the single link wire which is situated about half way between IC3 and IC5. A piece of wire trimmed from a resistor leadout can be used for this link. Be careful to fit the integrated circuits and the polarised components the right way round. At points where connections to off-board components will be made only single-sided pins are fitted to the board at this stage.

For a project which has some slider controls there is a definite advantage in using a sloping front case, and a number of these are available. It is also beneficial to use a case of all metal construction and to earth it to the negative supply rail. This helps to minimise any problems with stray pick up of electrical noise. Unfortunately, there seems to be a paucity of sloping front cases of all metal construction at present. I used a type having an aluminium front/top panel but otherwise of plastic construction. Of course, it is not essential to use a sloping front case, and the controls could be mounted on the top panel of an ordinary type. It is not even necessary to use slider potentiometers (I only used this type for VR2 and VR5). However, accurate control of the two fader controls is very much easier if they are both slider types, and the case is a sloping front type.

From the electrical point of view the exact layout used is not too important, and it is really a matter of arranging the components in a manner that makes the unit easy to use. Phono



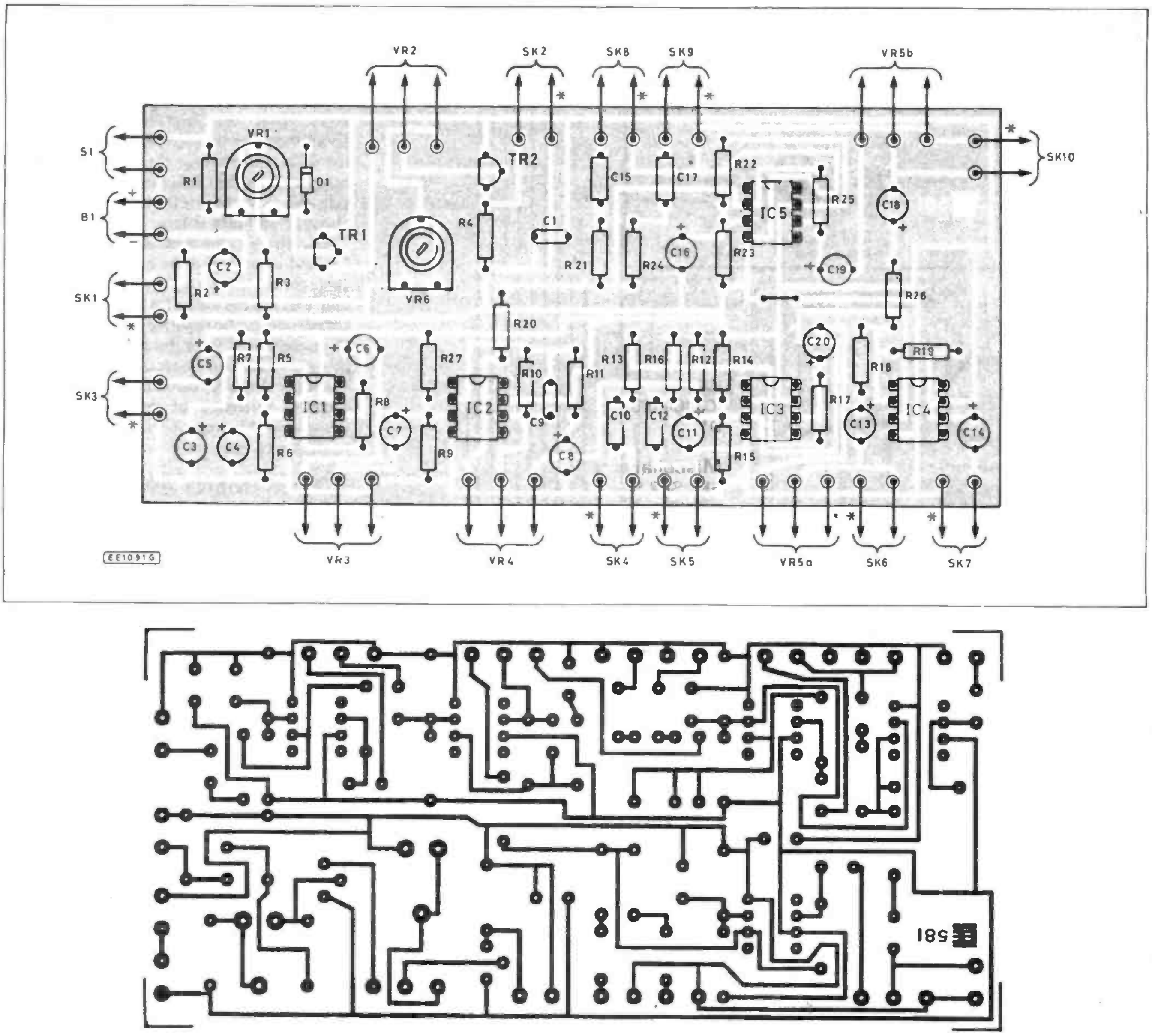
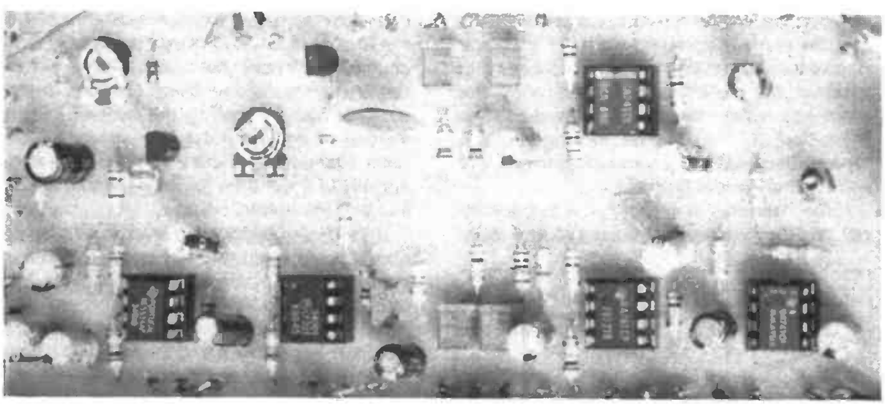
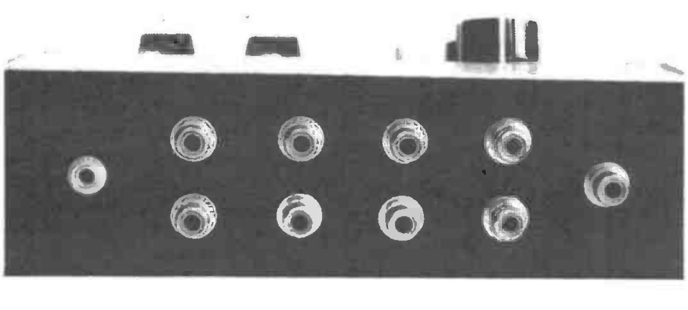


Fig. 3 Printed circuit board layout and wiring for the Video Controller. The ★s mark the earth connections.





sockets were used for all the input and output sockets, apart from SK3 (the microphone socket) which is a 3.5 millimetre jack type. If necessary though, these can be changed to any types which fit in with your particular audio and video equipment. You might find it better to use BNC connectors for SK1 and SK2 for example.

The completed printed circuit board is mounted on the base panel of the case using M3 or 6BA fixings. Make sure that it is mounted where it will not come into contact with any of the front panel mounted components when the top/front panel is fitted into place. Also be careful to leave sufficient space for the battery somewhere in the case!

Making the slots in the front panel for the slider potentiometers can be a bit difficult, but probably the easiest method is to first drill a row of holes about 3 to 4 millimetres in diameter along the length of the required slot. The holes can then be joined up using a miniature round file. This method is generally less strenuous than simply filing out the slot, and the holes help to keep the file going in a straight line. A miniature flat file can be used to

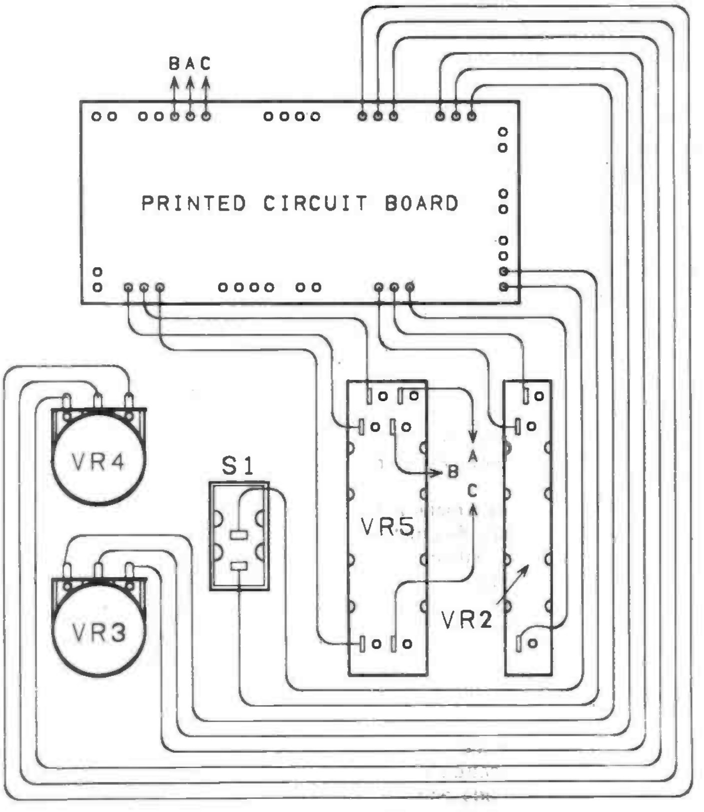


Fig. 4. Interwiring of the controls.

enlarge the slots to exactly the required shape and size. Self-adhesive slider control bezels are available, and the use of these helps to give a very neat and professional appearance to the completed unit. The bezels might be slightly too long to fit the case properly, but they can easily be trimmed to size using a hacksaw.

WIRING

There is a substantial amount of hard wiring needed to complete the unit. It is probably best to start with the wiring to the sockets, and this is fairly straightforward. The only point to watch is that each "earth" terminal on the board connects to the appropriate tag on its corresponding socket. The cable which connects the board to SK3 must be a screened type (with the outer braiding carrying the earth connection) as the microphone input is very sensitive to stray pick up. It is advisable to use screened lead for the connections from SK1 and SK2 to the board. This is to prevent radiation of the video signal and stray pick up in the microphone preamplifier wiring. It is also advisable to keep the wiring to VR2 as far away from the microphone preamplifier components as possible. It is not essential to use screened cable for the connections to the other sockets, but it is probably best to play safe and do so for any leads that are more than about 25 millimetres long.

The wiring to the controls is shown in Fig. 4. I would recommend the use of twin screened cable for the leads which connect to VR3, VR4 and VR5. In the case of VR4 there is no track connection to the negative supply rail that can be connected to the outer braiding in order to provide screening. Connecting the braiding to the wiper (middle) terminal of VR4 will give effective screening of the other two leads though, and these are the ones that are sensitive to stray pick up.

ADJUSTMENT AND USE

Exactly how the unit is wired into your system will obviously depend on precisely what equipment is in use. All the connecting leads should be of the appropriate screened variety. There should be no difficulty in testing the audio mixer section of the unit, and this does not require any setting up or adjustment before it is ready to use.

There are two presets to be set up in the video fader section, and initially VR1 should be adjusted to a roughly mid-point setting. VR6 should be set at maximum value (turned fully clockwise). The unit may well work perfectly satisfactorily with the presets at these initial settings, but it might be found that there is still some picture evident when VR2 is fully backed off. VR6 should then be adjusted in an anticlockwise direction just far enough to fully blank the screen of the monitor. VR1 is given any setting that provides a good fade-up characteristic. A little experimentation is called for here, and with some systems virtually any setting of VR1 will give good results. □

LETTERS

Meter Resistance

Sir – Referring to your writing of *Down To Earth* in **EE** of May, when you mentioned that the ohmmeter with a 1.5V internal battery is using about 0.7 volts on the diode, don't you think that you have excluded the series resistor or variable resistor to set the zero position of the needle? Although I am nothing compared with you in electronic servicing, I say that there will be a small loss on the series resistor.

I have been buying **EE** for four years, I hope I am not bothering you with my letter. Thank you very much.

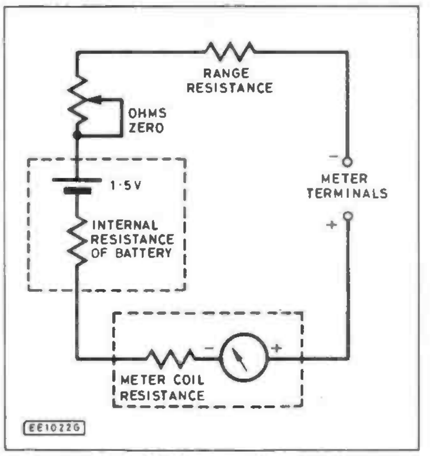
J. Camillen, Gozo, Malta

You are correct in saying that the potential drops across the ohms-range resistance and the ohms-zero resistance come into the picture. These voltage drops were taken into account by my description, but it is worthwhile looking in detail at an ohmmeter circuit to see what happens when a diode is tested.

The diagram shows what is about the simplest practical ohmmeter arrangement. There are four resistances inside the meter. One is the ohms-range-setting resistance, switched into circuit (in a multimeter) as required. To this must be added the resistance of the moving coil of the meter itself (assuming that we are using an analogue meter with a pointer indicator). There is an important hidden resistance: this is the internal resistance of the meter's battery or cell. This internal resistance varies with the condition of the battery. To correct for these variations, an ohms-zero-setting resistance is provided.

When the internal resistance of the battery is low, the ohms-zero resistance is set high, and vice versa. The setting is done by connecting together the meter leads and adjusting the ohms-zero resistor for full-scale deflection. This is marked "O" on the ohms range, which "reads backwards" in comparison to the voltage and current ranges.

If the "battery" is in fact just a single 1.5V cell, and the meter reads full scale at 1mA then,



when the ohms-zero resistor is correctly set, all these resistances inside the meter must add up to 1.5k. (1.5V/1.5k = 1mA.) The whole of the battery's 1.5V is, under these conditions, absorbed by the inside resistances.

If the meter leads are now unshorted and connected across an external resistance of 1.5k the total resistance in circuit is doubled to 3k and the meter reads half scale. Clearly, half the battery voltage is now being absorbed by the external 1.5k and half by the internal 1.5k. If, instead of an external 1.5k resistor, a diode were connected (in the way needed to allow current to flow) then the diode would absorb some of the battery voltage.

If the diode happened to drop 0.75V then the meter would again read half scale. In practice, the voltage drop across a silicon diode is likely to be less than 0.75V.

Most multimeters nowadays read full scale at a current less than 1mA. If the full-scale current is 100µA the diode drop for a silicon diode may be, say, 0.6V. The relative amounts of battery voltage absorbed by the diode and the inside resistance of the meter vary with the ohms-range setting, because on the higher ohms ranges the range resistor is higher. This means that if the same diode is tested on different ranges the meter deflections differ. If the diode drop is only 0.5V on some particular range then the meter will read two-thirds scale.

The internal arrangement of a multimeter for ohms measurement varies somewhat from one design to another and these figures are therefore only a rough guide.

Georgy Hylton

FOR YOUR ENTERTAINMENT

BY BARRY FOX

Free Check

When you buy a pack of batteries in Japan you get the neatest little electronic gadget for many a year, free. The one I got was made by Matsushita, under the Panasonic brand name, but other firms are making the same thing. It's a battery checker with no moving parts.

A thin strip of transparent polyester film, around 10cm long and 2cm wide, has a metallic contact pad at each end. The pads are connected by a strip of resistive material which is embedded in the plastic surface. The strip narrows along its length, so that its electrical resistance varies. Patches of liquid crystal material are printed over the strip.

When the strip is bent over a battery, and the two metal contacts held against the battery's positive and negative terminals, current flows through the resistive track. This generates heat, with the strip getting hottest where it narrows. This makes the l.c.d. cells glow red or blue.

A fresh, strong battery heats a long section of the strip, and changes the colour of several l.c.d. cells. A weak battery heats only a short section of strip and lights fewer cells.

A flat or discharged battery lights none. So the simple checker provides an instant indication of whether a battery needs replacing or not.

There is only one snag, warns Matsushita. The l.c.d. cells can be destroyed by ultraviolet light so the checker should be kept out of strong sunshine.

Although batteries are big business and the profit potential for the trade is high, the battery industry has, up till now, done a rotten job educating the trade and public.

After heavy flak from the trade and press, and foreseeing EEC legislation, Duracell is now date-stamping its alkaline cells. This gives the trade (and the public) a chance to keep within a "use by" date. Although alkaline cells last longer than zinc carbon types they still lose power on the shelf – especially if the weather is hot.

Beware cheap batteries on sale in street markets, even if they carry a well-known brand name like Duracell. Often they are "grey imports" from the Continent, which have been stored too long and in poor conditions.

Under Common Market law, Duracell admits that they can do nothing to prevent grey importing from other EEC countries. Over the last two years a trickle of greys has become a flood. Batteries have become a currency commodity.

Duracell says there is only one way to be sure. Look on the back of the packet and see if it carries the Duracell UK address. If it doesn't, it isn't an approved import.

More public warnings are needed but the battery makers keep quiet for fear of blackening their name.

Poles Apart

You would be surprised how few people in the battery business understand what they are selling. I stumbled recently on some entertaining proof of this.

Even the text books contradict each other on the crucial issue of how to identify the electrodes. Some books call the positive terminal of a battery the anode; others call it the cathode. Here is the nitty gritty.

Root cause is the fact of physics that when negative electrons flow from negative to positive, electric current flows in the *opposite* direction. It was truly unfortunate that when electrons were discovered, after electricity, physicists defined them as electrically negative, instead of positive.

Since then engineers and electricians have thought positive while physicists think negative. I know one engineer who is married to a physicist and on that score they can never agree.

In a cell there are two electrodes, a metal and a metal oxide, in electrolyte paste. The metal can be zinc or mercury or silver or lithium; the oxide is usually manganese dioxide. I was brought up to call the metal the cathode or negative terminal. Old text books say it that way.

Duracell has published some glossy technical literature which says exactly the opposite. The metal is the anode because it is dissolving, releasing negative electrons to the external circuit and positive ions to the electrolyte.

The metal oxide is the cathode and the released ions are called cations because they make their way through the electrolyte to the cathode. So the cathode is the positive terminal and the anode is the negative terminal.

Kodak recently launched a new range of 9V lithium batteries – although I must tell you that a couple of months later none were actually available, not even in the staff store of Kodak's head office in Hemel Hempstead. With the launch brochure came a technical backgrounder which explained that the lithium metal is the cathode and manganese dioxide is the anode.

When I asked Kodak about the contradiction with Duracell's description, Kodak said the original description from America had been worded the Duracell way but the British office had reversed the wording to suit local convention.

Macropaedia

Both Duracell and Kodak quoted me dictionaries to support their opposite wordings; metal-anode for Duracell and metal-cathode for Kodak. I have to say that Duracell's references were by far the most impressive. They contradict the older books on my shelf, and Kodak's shelf too. McGraw-Hill's *Encyclopaedia of Science and Technology* and the *Britannica Macropaedia* both say the metal is the negative anode.

So I'm forsaking Kodak's literature, my Penguin *Dictionary of Electronics* and my Paladin *How Things Work*. As from now on I am voting for metal anode negative terminals.

It will be interesting to see what happens when Kodak launches its next range of batteries. Will the metal still be the cathode or will it have quietly switched parties to anode?

Called To Task

We hear a lot of talk about computer fraud – programmers taking advantage of loopholes in a system which no-one else has spotted. British Telecom has a different problem. Exchange operators have been taking advantage of a system which is vulnerable because it isn't computerised. The scam has cost BT's shareholders £10 million.

A sorry stream of international operators and phone users recently trailed through the Guildhall Magistrates Court, after two dawn raids by the City of London police on BT's Wren House exchange. The first raid, in February, netted 57 operators of which 36 were charged with conspiracy to defraud BT; the next, early in July, netted one more.

The police then swooped on BT customers suspected of getting free calls in return for cash or favours. At least seven were booked.

Whereas direct-dialled calls are automatically billed to a subscriber's account, calls connected by an operator are manually billed. The operator fills out a paper slip, with ticks in numbered boxes. The slip is passed to an electronic device which optically reads the ticks and bills the call.

Some operators had hit on the idea of 'losing' slips or adding a mark to signify no reply or number unobtainable. So expensive international calls went uncharged.

Honest operators grew suspicious. BT monitored Wren House and gave evidence to the police. One businessman was fined £150 with £100 costs for making free calls to Kenya.

More cases were tried through the summer. The newspapers tucked reports away in the small print or ignored the matter altogether.

BT will not say how it collected the evidence. Insiders believe that investigators were monitoring and recording international calls made through Wren House for the last five months of 1986. Innocent subscribers, who paid for calls, may now wonder what they may have said which they would prefer the police did not hear.

BT admits that 100 per cent security is impossible because the docket system, like banking, relies on staff honesty. And where trunk dialling is unreliable or unavailable there is no alternative to operator connection.

Warning for Speaker

Loudspeaker manufacturer KEF asks me to warn readers about unauthorised, unnecessary and potentially damaging modification of speaker driver units.

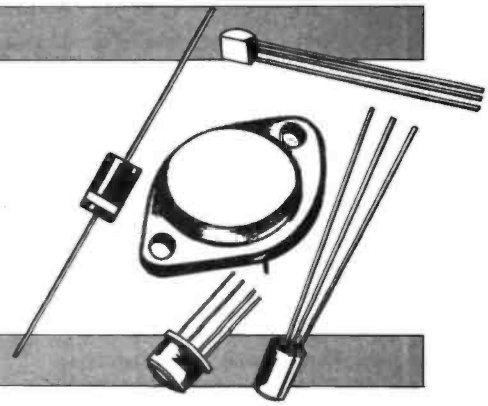
Some high power drivers have ferrofluid in the gap between the magnet and voice coil. Ferrofluid is an odd material; a magnetic oil which conducts heat and so helps keep the coil cool and safeguard it against overload and burnouts. Some speaker drivers are designed for use with ferrofluid. Others are not.

Some people have the idea that they can improve existing speakers by adding ferrofluid to the gap. Usually they can't. More often they cause expensive damage to the driver.

Hopefuls have been paying £5 or more to have a few drops of ferrofluid squirted into the voice coil gaps of drivers that were never intended to be fluid-filled. In most cases the fluid won't get into the gap. It just clings to the magnet coil outside. And if it does get into the gap, it will alter the electrical and mechanical damping of the loudspeaker and so alter the system performance, probably for the worse.

KEF tell me that it cost one of their customers the best part of £100 to pay first for unnecessary ferrofluid conversion and then for replacement of all the drivers that had been spoiled by the modification. Needless to say all speaker guarantees are invalidated by unauthorised modifications like this.

If you are tempted, ask the maunfacturer for advice first. The chances are that he will tell you to leave well alone.



TRANSTEST

ANDY FLIND

Simple in-circuit testing of diodes and transistors

ONE of the more useful service aids that has recently appeared on the market is a simple "in circuit" transistor and diode checker. Compact and battery powered, it indicates which end of a semiconductor junction is the cathode, and whether it is healthy, by means of flashing l.e.d.s. Since in basic d.c. continuity checks transistors behave like two diodes placed back-to-back, they can be given simple functional tests with this instrument, often without even being removed from circuit.

Ordinary diodes and Zeners may also be tested, so it can be seen that this is an extremely useful addition to any repair bench. The types presently available are priced around thirty pounds, enough to deter many potential amateur users. Fortunately however, the circuitry involved is so simple that the complete instrument can be built for little more than £10, placing it within reach of just about everyone.

OPERATING PRINCIPLE

The operating principle of the instrument is quite straightforward. Between the two test probes, which are placed on either side of the junction to be tested, there is a low alternating voltage. Any current passed by the junction as a result of this voltage is indicated by a pair of flashing l.e.d.s. These will remain unlit for an open circuit, whilst both will light for a short. If the junction is healthy, current will pass in only one direction, so only one l.e.d. will light, indicating that the associated probe is in contact with the cathode.

Where devices are to be tested whilst still in circuit, they will often be shunted to some extent by other components; usually resistors, capacitors or a combination of both. For the tester to be effective, it must be capable of ignoring resistance above a few hundred ohms and capacitance up to a few tens of microfarads. Resistance is no problem as it simply restricts the current too much to be confused with a forward-biased junction. Capacitance is slightly more difficult to cope with.

As is well known, capacitors conduct alternating current, their effective impedance being related to capacitance and frequency. As a start, the frequency has been kept very low, to about 10Hz in this design. For each half-cycle the positive probe is connected in series with a 100μ capacitor that has been discharged during the previous half cycle. The voltage rise produced across this depends, of course, on the total current passed between the probes, but it must reach half the supply voltage before the appropriate l.e.d. will light. If the shunt capacitance is less than about 47μ the total charge passed will be insufficient to do this, despite the high initial current flow. This principle works well and the resulting circuitry is reasonably uncomplicated, yet it enables effective in-circuit testing of semiconductor components in most cases.

CIRCUIT

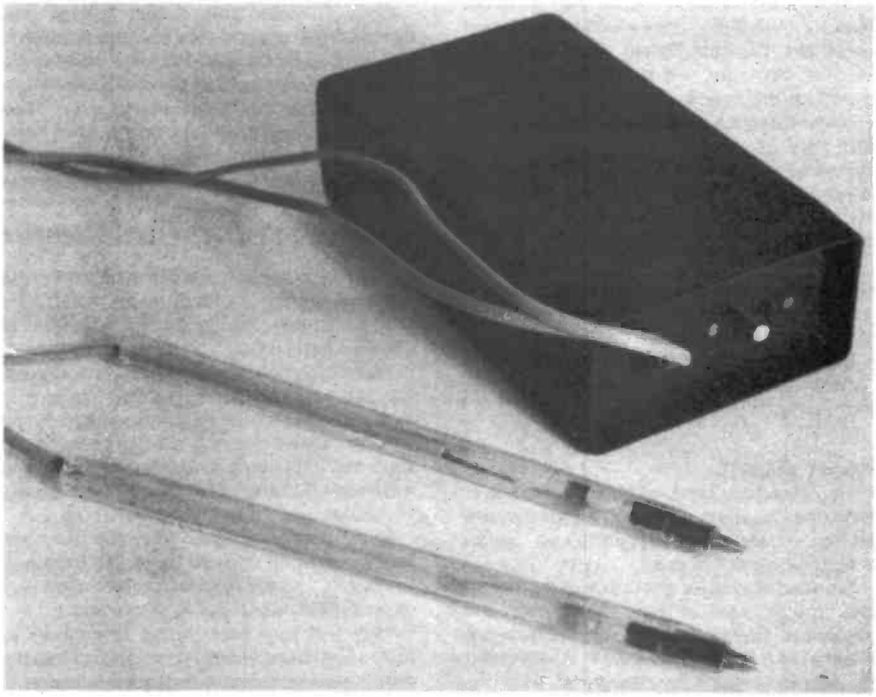
In the full circuit of Fig. 1, IC1 is a CMOS quad NAND gate. Two of the gates, "a" and "b", are connected as an oscillator with a frequency of about 10Hz and two outputs. These are "complementary", that is, when one is high, the other is low, and they are buffered by pairs of transistors, TR2, TR3 and TR5, TR6, which supply the probes. The action of the circuit is best understood by considering what happens during a single half-cycle. If it is assumed that the output from IC1a has just gone high, then probe "A" will be high (positive). At the same time IC1b and probe "B" will have gone low (negative). TR1 will have just turned "off", having been "on" for the previous half-cycle, so C2 will be in a discharged state. The test current is supplied through this capacitor. It flows down through TR2, out through probe "A" to the component on test, back in through probe "B" and reaches negative through TR6.

The negative end of C2 thus starts at positive supply voltage and falls by an amount depending on the total current allowed to pass between the probes. If it drops below half the supply, IC1c output goes positive (NAND gates invert) and turns on TR7, which lights l.e.d. D1. Whilst all this is in progress, TR3 and TR5 are "off" but TR4 is "on", ensuring that C3 becomes fully discharged. During the next half cycle the situation is reversed, probe "A" becoming negative and probe "B" positive, with D2 being lit if the voltage from C3 should become low enough. To ensure a constant, low test voltage, all the circuitry apart from the l.e.d.s is supplied from the five volt regulator IC2.

CONSTRUCTION

All the components for this project are mounted on a single, compact printed circuit board. The track pattern and component layout are shown in Fig. 2. It is suggested that for ease of assembly the resistors are fitted first. Care should be taken to see that the electrolytics are mounted the correct way round. Being CMOS, IC1 is potentially static-sensitive so the usual handling precautions should be observed. A d.i.l. socket should be used, and the i.c. should not be inserted until the rest of the board is complete.

For testing, a pair of l.e.d.s should be temporarily soldered to the appropriate connection points and a nine volt battery



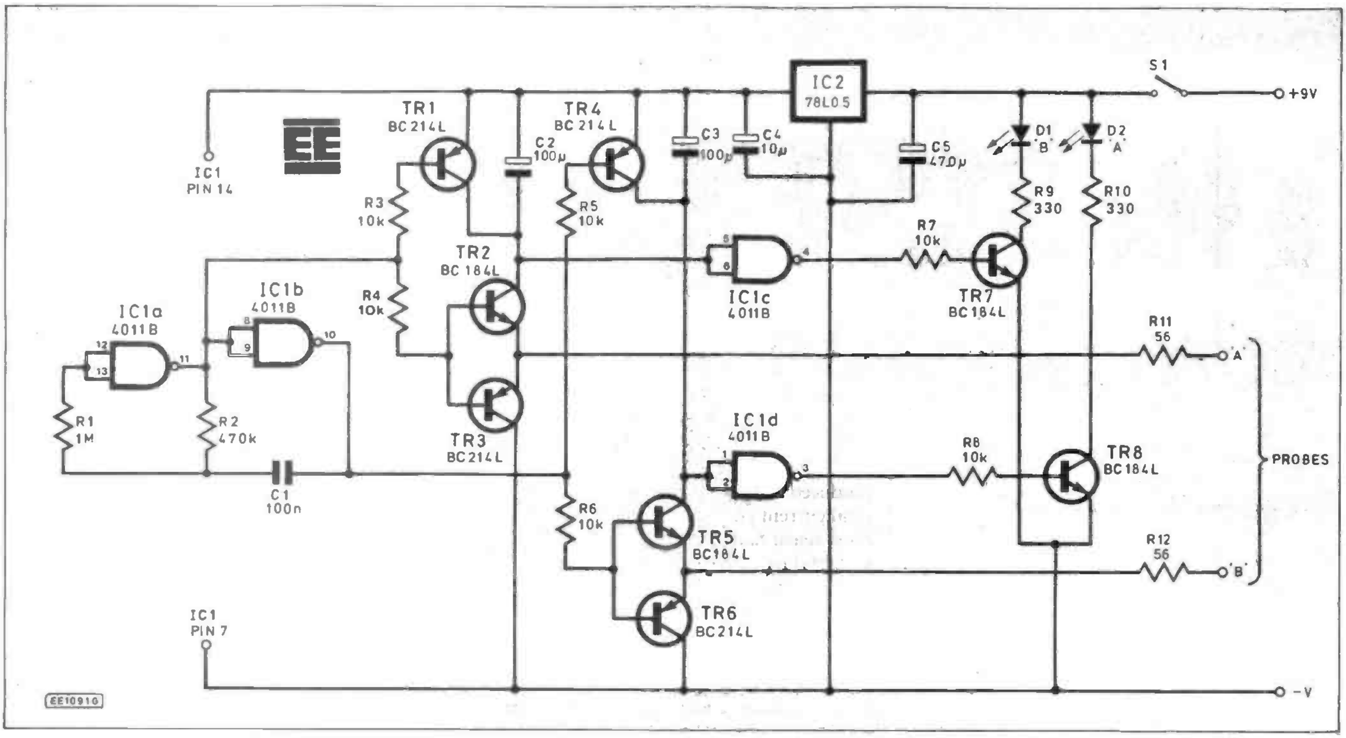


Fig. 1. Transtest circuit diagram

COMPONENTS

See **Shop Talk** See page 563

Resistors

R1	1M
R2	470k
R3,R4,R5,R6, R7,R8	10k (6 off)
R9,R10	330 (2 off)
R11, R12	56 (2 off)

Capacitors

C1	100n polyester layer
C2,C3	100µ axial 10V elect. (2 off)
C4	10µ axial 25V elect.
C5	470µ axial 10V elect.

Semiconductors

IC1	4011B CMOS quad NAND gate
IC2	78L05 5V 100mA regulator
TR1,TR3,TR4, TR6	BC214L silicon *p.n.p.* transistor (4 off)
TR2,TR5,TR7, TR8	BC184L silicon *n.p.n.* transistor (4 off)
D1,D2	red l.e.d., 3mm sub-min (2 off)

Miscellaneous

S.P.S.T. slide switch; printed circuit board, available from the EE PCB Service, order code EE580; case; 14-pin d.i.l. socket; PP3 battery and connector clip; miniature screened twin lead; silicon compound; clear plastic tubes from two ballpoint pens; fixing, etc.

Approx. cost Guidance only £10

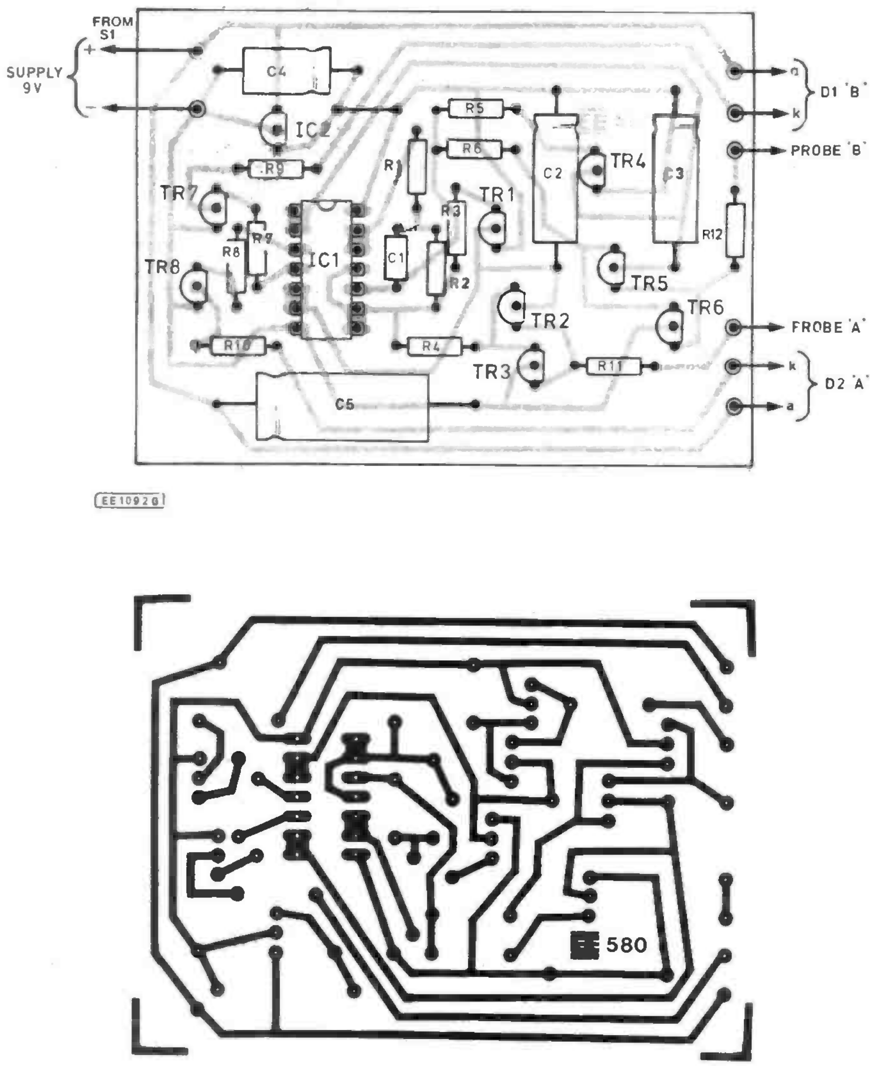
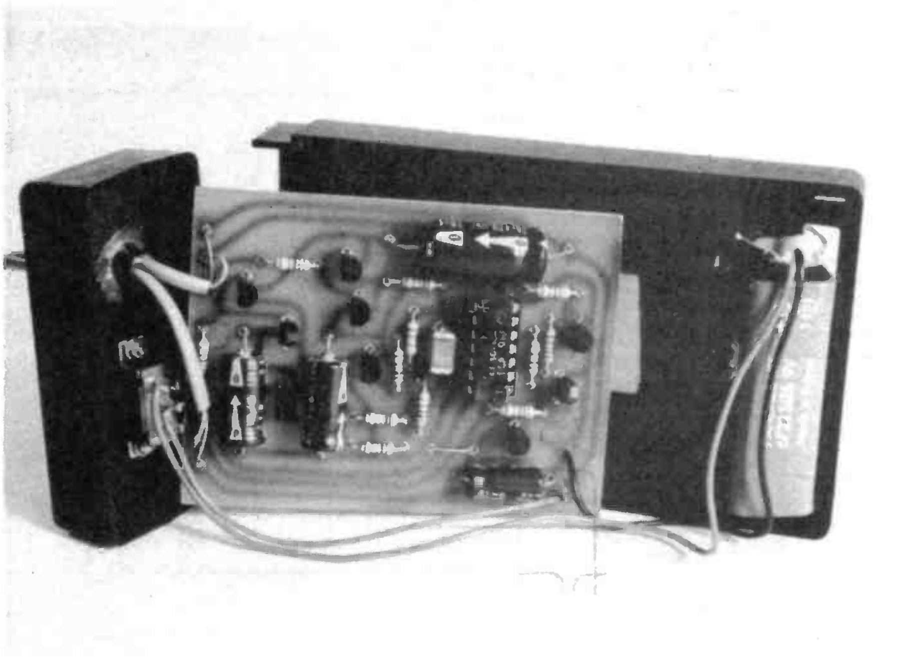


Fig. 2. Component and printed circuit board layout and wiring for the Transtest



connected. The current drawn from the supply should be checked; after the initial surge as C5 charges this should fall to a mere 3mA or so. Five volts should appear across the 10μ capacitor C4, indicating correct operation of the regulator IC2. With respect to negative, an analogue meter should indicate about 2V to 2.5V at each probe connection, possibly with a slight visible flicker. If it does not, the appropriate outputs of IC1 (pins 10 and 11) can be checked as a first step.

Assuming all is well, shorting the probe connection points should cause both l.e.d.s to flicker brightly. If a diode is used instead of the short, only the l.e.d. at the cathode end should flicker. If these tests are successful, the board is ready for use.

CASE

The case used and the final layout are very much up to the individual constructor. The board could be incorporated into an existing piece of equipment, with simple switching to bring it into operation. For the prototype a neat, inexpensive case described as a "small remote control box" was used. This has a compartment with a removable cover to hold a PP3 battery, and a space where the p.c.b. is fitted with double-sided sticky pads. The tiny, recessed front panel was drilled to take a slide switch and a securing clip for the probe leads.

The obvious place to put the l.e.d.s is in the case; one of the two manufactured models seen by the author has them mounted here and this would be the simplest arrangement to construct. However, another version has them incorporated into the probes, and for the intended use this has some advantages. Since custom-moulded probes are not available to home constructors a certain amount of ingenuity is necessary, but it's by no means impossible. In the prototype they are fitted into the clear plastic tubes from a pair of cheap ballpoint pens.

The lead from the p.c.b. to each probe is a miniature twin audio cable with a braided screen, this being connected to the probe tip, whilst the two cores carry power to the l.e.d.s. Fig. 3 shows how the cable l.e.d. and probe tip are connected. Each tip is made from a 20mm length of 4BA brass screw, held in the chuck of an electric drill whilst a neat point is filed on one end. To obtain more clearance in the tube the flange around the base of the l.e.d. is carefully filed off.

The l.e.d. should ideally face back towards the user, but even with the flange removed there is insufficient room for the necessary three cores to pass; also they might obscure some of the light. To overcome this, short lengths of thin enamelled copper wire (28s.w.g. in the prototype) are used to connect the screened cable to the l.e.d. and probe tip.

The probe "works" are potted into the tube with a clear silicon rubber sealant; "Dow Corning" aquaria sealant is ideal. These sealants are normally supplied in some form of plunger-operated container fitted with a nozzle. The tip and l.e.d. are passed right through the tube and bent over so that the three thin enamelled wires are all that obstructs sealing between the injection nozzle and the tube. Silicon compound is then forced down the full length of the tube from the tip end. A large blob of it is formed around the l.e.d. and tip, so that they can be pulled carefully back into place without drawing in any air bubbles, after which the surplus is wiped off with tissue.

The procedure is messy but reasonably practical, and results in a totally potted probe incorporating the l.e.d. It should be left to cure for a couple of days, after which the surplus compound can be picked away quite easily from the cable and outside of the probe.

IN USE

The cases of commercially produced testers are adorned with little drawings like those of Fig. 4, which are practically self-explanatory. For a simple diode, the probe (or l.e.d.) associated with the cathode will flash. A *p.n.p.* transistor behaves like two diodes, emitter to base, and collector to base, the base in each case being the cathode. With an *n.p.n.* type these apparent diodes are reversed, the cathodes being the emitter and collector whilst the base acts as common anode.

An apparent open circuit should exist between emitter and collector. Through these tests it is usually possible to identify the base, whether the device is *p.n.p.* or *n.p.n.*, and if there is a reasonable chance of it being healthy. In most cases it will be possible to carry them out without removing the component from circuit (switch off first though!), although shunt components, as mentioned earlier, may sometimes produce false indications.

The tester should not respond to resistors above about three hundred ohms or capacitors below about 47μ. Testing is also possible with Zener diodes down to 2.7V; these behave like ordinary diodes with clear indication of the cathode. L.e.d.s, unfortunately do not give reliable results, although most do light dimly on the probe current, which may prove useful in some instances. □

Fig. 3. Details of the Transtest probe construction

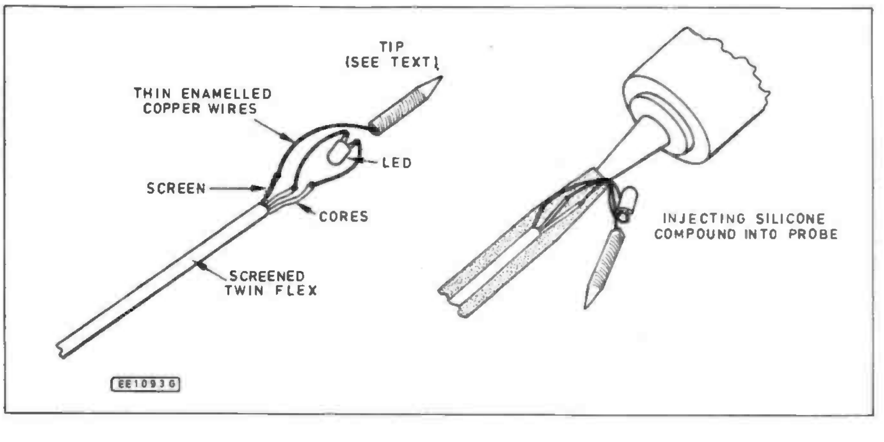
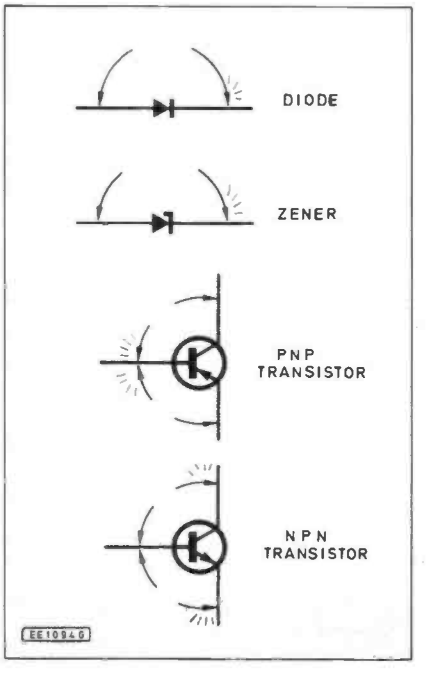
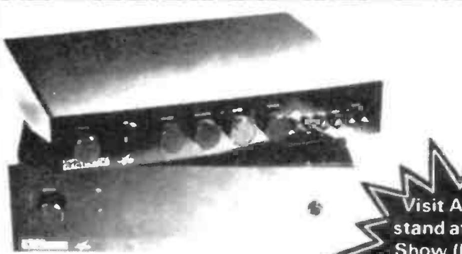


Fig. 4. Using the Transtest





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10	20	25.32	2.84
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2	1	5.15	1.70
4	2	5.94	1.90
6	3	9.31	2.05
8	4	10.89	2.10
12	6	13.20	2.25
16	8	15.73	2.60
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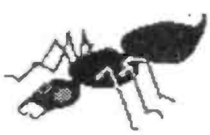

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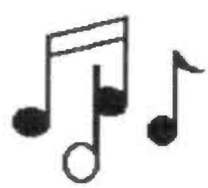

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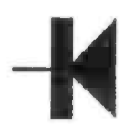

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City and Guilds

C+G

INTRODUCING MICROPROCESSORS

MIKE TOOLEY B.A.

Introduction

Welcome to Introducing Microprocessors! Over the next nine months this brand new series aims to provide readers with a thorough understanding of the principles and practice of microprocessors. More significantly, this series breaks new ground in the field of distance learning; it is the first to offer assessment and certification in conjunction with an internationally recognised examining body. We hope that you will stay with us for the next nine months and that many of you will complete the study programme which leads to the award of a City and Guilds certificate in Introductory Microprocessors.

THIS introductory part aims to prepare readers for the study programme which follows and should help to answer many of the questions which you may have. In particular, it provides an outline of the syllabus content and course calendar. Those following the course will need to refer to this information as the course progresses and thus it should be filed away safely for future reference!

Syllabus content

The City and Guilds syllabus for Introductory Microprocessors is divided into seven principal sections as follows:

1. Microcomputer Systems
2. Microprocessors
3. Memories
4. Input/output
5. Interfacing
6. Programming
7. Related Theory

The teaching text for the module will broadly follow these seven syllabus headings but, from time to time, we shall pause to review the work covered in an attempt to put things into context. In keeping with the general philosophy of the programme, we shall be introducing Related Theory as, and when, it is required.

The teaching order of the EE series will thus be as follows:

Part Number	E.E. Issue	Topics Covered
1	November 1987	MICROCOMPUTER SYSTEMS Terminology. Integrated circuits. Logic families. System architecture. Binary and hexadecimal number systems.
2	December 1987	MICROPROCESSORS – 1 Internal features and architecture. Some common microprocessors.
3	January 1988	MICROPROCESSORS – 2 Instruction sets. The fetch-execute cycle. The system monitor.
4	February 1988	REVISION OF PARTS 1 TO 3 Readers' Forum. Assessment preparation. Practical Assignment – 1.
5	March 1988	MEMORIES Semiconductor RAM and ROM. Memory maps. Practical Assignment – 2.
6	April 1988	INPUT/OUTPUT I/O methods. Programmable parallel I/O devices.
7	May 1988	INTERFACING Driving peripheral lines; l.e.d.s and relays.
8	June 1988	PROGRAMMING High and low level languages. Flow charts. Assembly language. Practical Assignment – 3.
9	July 1988	REVISION OF PARTS 5 to 8 Readers' Forum. Assessment preparation. Practical Assignment – 4.

With the exception of parts four and nine, each instalment will have stated aims (in objective format), questions (with answers), supplementary practical work (optional), and a glossary of the most recently introduced terms and abbreviations. In addition, we shall be including some suggestions for additional background reading (and some pull out data cards with useful information) so there should be plenty of work to do!

Assessments

The various course assessments will be introduced at the point at which they should be first attempted together with some "hints and tips" for their successful completion. Readers will, however, not be tied to any specific examination timetable as this particular City and Guilds programme has been designed with flexibility in mind. More on this topic later!

In order that readers can plan ahead, the following "course calendar" is presented as a guide:

Course calendar

October	1987	Course commences in EE
January	1988	Register with your local centre
February	1988	Complete first practical assignment
March	1988	Complete first written assignment
April	1988	Complete second practical assignment
May	1988	Complete third practical assignment
June	1988	Complete fourth practical assessment
July	1988	Complete second written assessment
July	1988	Centre requests issue of certificate

Prospective candidates should note that the above schedule is given only as a guide and that, whilst the EE series has been designed to be studied over a conventional academic year, the various course assessments may be taken as, and when, readers feel that they are ready for them.

Students who would prefer to work at a slower pace, or may have other commitments which must take a higher priority, need therefore not worry overmuch. The suggested timescale should, however, suit the vast majority of readers and should also prove acceptable to most of the centres which will be providing the necessary facilities for student assessment.

Feedback

We always welcome feedback from readers and furthermore shall be devoting space in the series to answering readers' queries. To this end, parts four and nine of the series will include a Readers' Forum. This will not only aim to provide answers to questions raised by readers but will also help clarify any points which may not have been properly understood.

We expect a larger than usual amount of mail from readers in connection with the series so *please include a stamped addressed envelope* and also be prepared to wait a week or two if you require an individual reply. Also note that all correspondence on the series should be sent directly to the author at the address given at the end of this article *(and NOT to the Editorial Office)*.

About the City and Guilds 726 scheme

The City and Guilds 726 scheme has been designed to meet the needs of a wide variety of people requiring nationally recognised qualifications in Information Technology and its component disciplines.

The main features of the scheme are:

a) a modular structure which provides self-contained units each covering an area of information technology

b) each syllabus is presented in objective format (i.e. precise statements of what the candidate needs to achieve in order to meet the requirements of the scheme)

c) progress is made at a pace determined by the candidate and tutor

d) assessment is administered by an approved centre and can be undertaken by the candidate at any mutually agreed time. The assessment material is provided as part of a scheme's documentation (supplied to approved centres). A system of monitoring (by means of Visiting Assessors) is used to maintain standards and ensure validity

e) the modules will permit candidates and tutors to select and undertake those subjects which meet individual and local requirements

f) the "self-pacing" and "on demand assessment" features of the scheme permit flexible scheduling and open study methods (such as this) to be employed

g) each module is regularly reviewed to ensure that it remains up-to-date.

The Information Technology scheme comprises a number of modules which are grouped together under three disciplines; Computer Programming and Software, Electronics and Hardware, and Computer Applications and Related Studies. Modules are also offered at four distinct levels; Introductory, Elementary, Intermediate, and Advanced.

Each "module document" (available from City and Guilds at the address given at the end of this article) contains aims, syllabus, objectives, assessment procedures and materials.

The scheme's flexibility provides for transfer and progress at all levels within the scheme and can be undertaken at centres of all types including further education colleges, ITeCs, schools, training centres and company training establishments. A prime feature of the scheme (and unlike most of its conventional counterparts) is that the course objectives can be met at a pace appropriate to individual candidates. No time limits are imposed for any module and assessment can be undertaken as, and when, the candidate is ready. In the case of the Introductory level modules, City and Guilds suggest a study time of between 30 and 60 hours as being normally adequate.

The scheme is currently offered by a large number of approved centres who register their candidates and the modules being undertaken. After registration, centres receive from City and Guilds the necessary documentation for completing the scheme, such as assessment materials and answer sheets. Centres carry out all candidate assessment and are monitored during the running of the scheme. On completion of the scheme, centres request certificates for all successful candidates and these are then issued by City and Guilds.

Overseas readers should note that, unlike many other City and Guilds schemes, the 726 programme is NOT available overseas. It does, however, seem likely that consideration will be given to wider availability of the scheme in the near future and we will keep readers fully informed of any changes which may extend the programme to overseas centres.

Assessment

The assessment of a candidate's understanding of Introductory Microprocessors involves two major components:

a) Written Assessments. These are multiple choice questions (which comprise a short question "stem" and four possible answers of which only ONE is correct). The candidate has to select the ONE correct answer in each case but no marks are deducted for incorrect answers. Question papers (which generally comprise some twenty, or so, questions) are selected randomly for candidates. In the case of Introductory Microprocessors, candidates will be required to tackle two individual written assessment papers.

b) Practical Assignments. These have been devised to cover a number of related objectives. The resource requirements and marking criteria are stated in the module documentation. In the case of Introductory Microprocessors, candidates will be required to tackle four individual practical assignments.

A record of a candidate's performance (both successful and unsuccessful) is kept by the centre and this information is kept for inspection by the centre's visiting assessor who may also wish to question individual candidates about their work. Requests for certificates can be made at any time after successful completion of a module.

Questions and answers

Having dealt with some of the more important administrative details of the City and Guilds 726 scheme, I shall attempt to ward off a large quantity of correspondence by dealing with some of the questions which readers are most likely to raise!

Why Introductory Microprocessors?

Microprocessors are fundamental to the operation of the majority of modern electronic systems and are finding their way into almost every facet of electronics. Whether we like it or not, the most cost-effective solution to many of today's electronic design problems involves the use of a microprocessor. Such devices offer a highly flexible solution to the problem of control since significant changes in performance can be affected simply by making changes to software. This is usually far easier and quicker to implement than making extensive changes to hardware.

Will the course be dominated by software?

No, but software is important. Until recently there has been a rather rigid boundary between software and hardware. The world of modern electronics is dominated by microprocessor based systems and it is essential to have a knowledge of both hardware AND software in order to provide fully functional and fully optimised systems. In short, we are advocating a partnership between hardware and software; one complements the other and neither would function properly if the other was deficient in any respect. This is a fact of life which many of today's electronic engineers are only slowly beginning to grasp.

Which microprocessor will be featured?

Introducing Microprocessors is only concerned with the most common eight-bit microprocessors of which the following are typical examples: 6502, 6800, 8085, and Z80. If you already have some knowledge of any one (or more) of these devices you will already have a foundation on which to build. If not, don't worry as we shall assume that you have not met any of them before!

What previous knowledge is assumed?

Very little. The course is ideal for the complete newcomer.

How much will it cost?

We have tried to make the programme as inexpensive as possible. At a minimum you will need to secure the next nine issues of EE (at a cost of around £11). If you don't already subscribe, now would be an ideal time to take out a subscription or place a regular order with your newsagent (see page 525 for both). You will probably also wish to purchase a number of components to carry out Practical Assignments 3 and 4 and these will be available from advertisers in EE at the time (expected cost will be around £25 in total).

In addition, you can purchase a copy of the City and Guilds module documentation (cost £10 including postage, available from the address given at the end of this article) but this is by no means essential. You will also need to register with a local centre as a candidate/student. The fee for registering with the City and Guilds is approximately £5 and this is payable by the centre with whom you register. The centre will also make a charge for offering their facilities and for supervision of the assessment, etc. This charge may vary considerably and **some centres may not accept external candidates.** In all cases this will be a matter for you to negotiate with the centre and the cost will depend upon the facilities offered, the amount of time you require, and the normal scale of fees levied by a centre. We would normally expect this to involve a total expense of between £15 to £45 depending upon your needs and the centre's facilities.

Readers may also wish to equip themselves with one, or more, of the books suggested for background reading. These are all reasonably priced but should you not wish to purchase them, they may often be obtained from college and centre libraries (which you will almost certainly have access to as a registered 726 candidate). The total minimum cost, *spread over a period of nine months*, can thus be expected to be in the region of £60. We think that this represents exceptional value for money when compared with alternative study programmes! If you are prepared to spend much more than this, you may like to consider equipping yourself with your own educational microprocessor system (see our next issue for a list of suppliers). This will of course be useful if you wish to go on to higher level studies later.

What form will the assessment take?

The assessment is based on two straightforward multi-choice tests (each containing approximately twenty questions) and four practical assignments. There will be no long-winded examinations!

What further courses are available?

A huge range of modules are currently available within the City and Guilds 726 scheme. Whilst the most obvious modules for progression would be Elementary Microprocessors and Intermediate Microprocessors, candidates may wish to progress to modules in other areas such as Introductory Digital Electronics, Introductory Electronic Circuits and Components, or even Introductory BASIC. See the City and Guilds advertisement at the end of this article.

How often will I need to visit my local centre?

As a minimum, you will need to visit your local centre to register and undertake the various course assessments and assignments. These can be arranged to take place at times which are mutually convenient between the centre and yourself. Centres will wish to be given notice well ahead of your needs for assessment as most of them will have extensive commitments to candidates for other examinations. In addition, you may also wish to make more extensive use of the centre's practical facilities (such as a microprocessor laboratory or microcomputer workshop) for which a fee may be charged to cover supervision and overheads. If, on the other hand, you have access to your own educational microprocessor system or even a microcomputer then you will need to spend proportionately less time at a centre.

What do I have to do now?

Quite simply, nothing other than making sure that you get next month's issue of EE so that you can make a start. If you do want to start with some background reading then follow the suggestion given under *Preparatory Reading*.

Recommended Books

Rather than provide a long list of recommended books at this stage (which readers may be tempted to rush out and buy!), we will simply suggest titles for background reading as the course progresses. The books suggested are all well known and should be available from most public and college libraries. Rather than use a single source of reference for the series we feel that students should get into the habit of reading more widely; selecting relevant chapters or sections from several books. To start the series off we would suggest the following title (which is broadly relevant to the entire study programme and ideal for beginners):

Beginner's Guide to Microprocessors
by E.A. Parr
(A Newnes Technical Book published by Heinemann-Newnes) ISBN 0 408 00579 3
This is available from the *EE Book Service* – see page 572. Price £4.95.

Preparatory Reading

The following reading should help readers get ready for the course; **Beginner's Guide to Microprocessors**, Chapter One. This sets the scene nicely and introduces readers to a hypothetical computer (called Marvin). Readers should also take a look at the Appendix entitled "Number Systems".

List of Approved Centres

The following is a list of centres which have City and Guilds approval to offer the 726 programme. Readers should note that **they may not all have the necessary resources required to provide assessment** in conjunction with the Introductory Microprocessors module. The list has been printed at this stage so that readers can identify one, or two, centres which are near to them; **readers should NOT contact centres at this stage.**

APPROVED CENTRES

	TEL
AVON	
Bath Control Centre ITeC	0225 337992
Bristol ITeC	0272 779247
Brunel Technical College – (Bristol)	0272 41241
Business ITeC (Bristol)	0272 603871
North Bristol ITeC (Bristol)	0272 517127
BEDFORDSHIRE	
Bedford College of HE	0234 45151
INTEC Training Service (Milton Keynes)	0908 367045
Luton College of HE	0582 34111
Milton Keynes Skillcentre (Bleak Hall)	0908 670001
BERKSHIRE	
Bracknell ITeC	0344 489091
Langley College of FE	0753 49222
Newbury & District Industrial Training Group (Newbury)	0635 49382
Rank Xerox ITeC (Slough)	0753 684358
Reading College of Technology	0734 583501
Reading ITeC	0734 598515
Slough College of HE	0735 34585
Windsor & Maidenhead College (Windsor)	0628 25221
BUCKINGHAMSHIRE	
John Hampton Grammar School (High Wycombe)	0494 29589
Milton Keynes College	0908 668998
CAMBRIDGESHIRE	
Cambridge ITeC	0223 323612
Peterborough ITeC	0733 312120
CHESHIRE	
Chester College of Further Education	0244 677677
Halton College of FE	051 423 1391
Macclesfield College of FE	0625 27744
South Cheshire College	0270 69133
Specialised Technical Services Ltd	061 477 7777
CLEVELAND	
Cleveland ITeC (Middlesbrough)	0642 221280
Cleveland Technical College (Middlesbrough)	0642 473132
Hartlepool College of FE	0429 75453
Longlands College of FE (Middlesbrough)	0642 248351
Stockton Sixth Form College (Stockton)	0642 012611
CO DURHAM	
Derwentside ITeC (Consett)	0207 501252
Derwentside Technical College (Consett)	0207 502906
Derwentside Training Workshop (Consett)	0207 505211
Durham ITeC	0385 772474
Durham Skill Centre	0385 780601
Peterlee College	0783 862225
Peterlee ITeC	0783 871177
CORNWALL	
Cornwall ITeC (Truro)	0872 70964
Mid Cornwall College of FE (St Austell)	0726 5541
Riverside Business Centre (Truro)	0872 71600
CUMBRIA	
West Cumbria ITeC	0946 66636
DERBYSHIRE	
Chesterfield College of Technology and Arts	0246 31212
Chesterfield ITeC	0246 211738
South East Derbyshire College	0602 324212
DEVON	
Dartington ITeC	0803 866076
Exeter ITeC	0392 219038
North Devon College (Barnstaple)	0271 45291
North Devon Microcentre (Barnstaple)	0271 44260
Plymouth College of FE	0752 264728
Plymouth ITeC	0752 671110
Plymouth Skill Centre	0752 335921
South Devon College of Arts & Tech	0803 213242
DORSET	
Bournemouth Computer and Technology Centre Ltd	0202 290943
Bournemouth and Poole College of FE	0202 295511
Christchurch ITeC	04252 78795
ESSEX	
Basildon ITeC	0268 286929
Ford Training Workshop (Dagenham)	01 526 3538
Harlow ITeC	0279 446556
Havering Technical College	0424 55011
South East Essex Technology Centre	0702 201070
Thurrock Technical College	0375 71621
Witham Technology Centre	0376 521411
GLOUCESTERSHIRE	
Gloucestershire College of Arts and Technology (Gloucester)	0452 426504
Gloucestershire ITeC (Hucclecote)	0452 63141
GREATER MANCHESTER	
Bury Metro College of FE	061 761 4327
Central Manchester College (Centre of Building)	061 831 7791
Central Manchester College (Openshaw Site, Openshaw)	061 223 8282
Computer Training College (Manchester)	061 835 1315
Nord Anglia Training Services (Manchester)	061 445 4860
North Manchester College (Moston Centre)	061 205 7525
North Trafford College	061 872 3731
ORT/GEC ITeC (GEC Distribution Switchgear Ltd, Higher Openshaw)	061 301 2201
Rochdale ITeC	0706 350600
South Manchester Community College (Wythenshawe)	061 902 9982
Y.M.C.A. ITeC	061 429 9146
Y.M.C.A. (Manchester)	061 286 0090
HAMPSHIRE	
Basingstoke Technical College	0256 54141
Computer Education Centre (Southampton)	0702 221398
Eastleigh College of FE	0703 614444
Gosport Computer Centre	0705 587862
Isle of Wight College of Arts & Tech (Newport)	0983 526631
Isle of Wight ITeC (Newport)	0983 523705
Portsmouth ITeC	0705 834014/834054
Southampton ITeC	0703 38966
Southampton Technical College	0703 35222
HEREFORD/WORCESTER	
Herefordshire Technical College (Hereford)	0432 267311
Redditch College of FE	0527 63607
Worcester ITeC	0905 358118
HERTFORDSHIRE	
De Havilland College (Welwyn Garden City)	0707 326318
HUMBERSIDE	
Beverley College of Further Education	0482 868362
East Yorkshire College of FE (Bridlington)	0262 672676
Grimsby College of Technology	0472 79292
Grimsby ITeC	0472 362779
Hull ITeC	0482 25576
North Lindsey College of Technology	0724 855022
Scunthorpe ITeC	0724 852302
KENT	
Ashford ITeC	0233 2165415
Key Training Workshop (Chatham)	0634 44930
Maidstone ITeC	0622 686489
Medway ITeC (Chatham)	0634 577777
Mid-Kent College of Higher and Further Education (Chatham)	0634 41001
Thanet Technical College	0843 65111
LANCASHIRE	
Balderstone Community School (Rochdale)	0706 49049
Burnley ITeC	0282 34327
Ferranti PLC (Oldham ITeC)	061 624 0281
Fylde Coast ITeC (Blackpool)	0253 302511
Preston ITeC	0772 735753
LEICESTERSHIRE	
Charles Keene College of FE (Leicester)	0533 25840
Leicestershire Training Workshop (Leicester)	
Loughborough Technical College	0509 215831
North Leicestershire ITeC (Loughborough)	0509 261763
LINCOLNSHIRE	
East Lindsey ITeC (Louth)	0507 601111
Lincoln ITeC	0522 43532
LONDON	
Acton Technical College (Mill Hill Road, W3)	01 993 2344
Brent ITeC (Harrow Road, NW10)	01 965 7232
Camden ITeC (Kentish Town, NW5)	01 485 3324
Cavendish College (Court Road, W1)	01 580 6043/4
City and East London College (Pitfield Street, E1)	01 253 6883
Computer Insight Ltd (Penge) (High Street, SE20)	01 778 8322
Computer Literacy Centre (Fore Street, N18)	01 807 1558
Covent Garden ITeC (Long Acre, WC2)	01 240 8377
Croydon ITeC (Thornton Heath)	01 683 3183
David Game Tutorial College (Old Brompton Road, SW7)	01 584 7580
Docklands ITeC (Millharbour, Millwall, SE18)	01 987 6248
East Ham College of Technology (High Street, E6)	01 472 1480
Enterprise Training (Cornwall Road, SE1)	01 928 4448
Greenwich ITeC (Macbean Street, SE18)	01 854 8255
Hackney College of FE (Dalston Lane, E8)	01 985 8484
Hackney ITeC (French Place, E1)	01 729 3116
Hammersmith & West London College – Dept. of Crafts (Barons Court, W14)	01 743 3321
Islington ITeC (Old Street, EC1V)	01 608 1961
John Kelly Boys School (Crest Road, NW2)	01 208 2201
Kingsway Princeton College (Sidmouth Street, WC1H)	01 278 0541
North London College (Camden Road, N7)	01 609 9981
Outset ITeC (Creekside, SE8)	01 692 7141
Paddington College (Paddington Green, W2)	01 723 8826
Poplar Centre of FE – Hackney College (Poplar High Street, E14)	01 987 4205
School of Computer Technology (Oxford Street, W1N)	01 636 6441
Southwark Microtech Ltd (London Road, SE1)	01 928 8434
Tottenham College of Technology (High Road, N15)	01 802 3111
Tower Hamlets Adv Tech Training (THATT) (Whitechapel Road, E1)	01 247 4682/3
Waltham Forest ITeC (Hoe Street, E17)	01 521 4311
Willesden College of Technology (Denzil Road, NW10)	01 451 3411
MERSEYSIDE	
Cavendish Enterprise Centre Ltd	051 653 3525
Charles Wootton ITeC (Liverpool)	051 709 0340
Knowsley Central Tertiary College (Roby)	051 480 6161
Knowsley ITeC	051 547 3933
Marconi ITeC (Wallasey, Wirral)	051 630 6027
METEL ITeC (Liverpool)	051 207 2281
Newton-le-Willows College of FE	09252 4656
Sefton ITeC	051 933 3100
South Liverpool ITeC	051 488 0018
St Helen's ITeC	0744 611365
The Greenbank Project (Liverpool)	051 733 7255
Wirral Commercial Business Training Centre (Birkenhead)	051 647 5486/7
Wirral Metropolitan College (Birkenhead)	051 327 4331
MIDDLESEX	
Ambrose Fleming School (Enfield)	01 804 1393
Brent Microelectronics Project (Wembley)	01 903 3903
Hounslow ITeC (Isleworth)	01 568 5108
Middlesex Training Centre (Uxbridge)	0895 56849
Pathway FE Centre (Southall)	01 571 2241
Southall ITeC	01 574 6565
Spelthorne ITeC (Stanwell)	07842 48804
NORFOLK	
Great Yarmouth College of FE	0493 655261
Norwich ITeC	0603 20341
NORTHAMPTON	
Corby ITeC	05363 63290
Nene College (Northampton)	0604 714101
Northampton ITeC	0604 24427
The Wellingborough College	0933 224165
NORTHERN IRELAND/EIRE	
AnCo (Ballytivan, Sligo)	01035371 61121
AnCo (Finglas)	0001 348311
AnCo (Limerick)	061 28333
AnCo (Loughlinstown, Dublin)	0001 821811
Bann Area Training Services (Coleraine)	0265 53764
Belfast College of Technology	0232 227244
Castlereagh College of FE (Belfast)	0203 797144
North Down College of FE (Newtownards)	0247 62254/5 812116
Portadown College of FE (Craigavon)	0762 337111
Quest Youth Workshop Ltd (Belfast)	0232 238009
Tullow Community School (Co Carlow)	0503 51473
NORTH YORKSHIRE	
Craven College (Skipton)	0756 61411
Whitby School	0947 602406
NOTTINGHAM	
Arnold & Carlton College of FE (Mapperley)	0602 876503
Mansfield ITeC	0623 050263
Nottingham ITeC	0602 584647
W.E.B.S. Training Association (Nottingham)	0602 866886
OXFORDSHIRE	
Information Processing Services (Oxford)	0865 727011

APPROVED CENTRES (Continued)

North Oxfordshire Technical College (Banbury)	0295 52221
Oxford College of FE	0865 245971
West Oxfordshire Tech College (Witney)	0993 3464
SCOTLAND	
Aberdeen ITeC	0224 642121
Ayrshire ITeC	0294 212252
Borders ITeC (Galashiels)	0896 56517
Clydebank ITeC	041 952 2459
Cumbernauld ITeC	02367 22111
Dundee & Tayside ITeC (Dundee)	0382 25473
Dumfries ITeC	0387 67633
Edinburgh ITeC	031 652 1288
Falkirk ITeC	0324 20710
Gear ITeC (Glasgow)	041 554 1185
Govan ITeC (Glasgow)	041 440 1059
Highland ITeC (Inverness)	0463 226505
Intec (Inverclyde) Ltd (Greenock)	0475 29123
Sterling ITeC	0786 73171
West Lothian ITeC (Livingstone)	0506 415208
SHROPSHIRE	
Telford ITeC	0952 581738
SOMERSET	
Somerset College of Arts & Technology (Taunton)	0823 83403
SOUTH YORKSHIRE	
Barnsley College of Technology	0226 299191
Barnsley ITeC	0226 298091
Doncaster College for the Deaf	0302 62166
Doncaster ITeC	0302 537341
Doncaster Metropolitan Institute of Higher Education (Waterdale)	0302 22122
Rockingham College of FE (Rotherham)	0709 874310
Rotherham College of Arts & Technology	0709 62111
Sheffield PC Skillcentre	0742 446471
STAFFORDSHIRE	
Cannock ITeC	05435 77039
Computeach (Stoke) Ltd	0782 416412
Newcastle ITeC (Newcastle under Lyme)	0782 626354
Newcastle under Lyme College of FE	0782 611531
Stafford ITeC	0785 212255
Stoke on Trent ITeC (Hanley)	0782 279423
Stoke on Trent Technical College (Burslem)	0782 85258
SURREY	
Brooklands Technical College (Weybridge)	0932 53300
East Surrey College (Redhill)	0737 72611/4
Guildford ITeC	0483 502414
North East Surrey College of Tech (Ewell)	01 394 1731
SUSSEX	
Brighton College of Technology	0273 685971
Brighton ITeC	0273 606089
Crawley ITeC	0293 25912
TYNE AND WEAR	
Gateshead ITeC	091 4787107
Gateshead Technical College	0632 770524
Hebburn ITeC	0632 832231
Lloyds British – Newcastle ITeC (Walker)	0632 635456
North Tyneside Brass Tacks Ltd (North Shields)	0632 575029
North Tyneside College of FE (Wallsend)	091 2624081
Sunderland ITeC	0783 492842
Wearside College of Further Education (Sunderland)	670794 653870
WALES	
Aberdare College of FE	0685 873405
Afan College (Port Talbot College of FE)	0639 882107
Bargoed & District Training Workshop (Bargoed)	0443 838184
Barry College of FE	0446 733251
Blaenau Gwent ITeC (Tredegar)	049 5254311
Brecon College of FE	0874 5252
Cardiff ITeC	0222 448429
Deeside ITeC (Flint)	0244 816236
East Dyfed ITeC (Llanelli)	0554 778321
Ebbw Vale College of FE	0495 302083
Gwynedd ITeC (Caenarfon)	0286 76477
Llandrillo ITeC	0492 46666
Llynfi Training Workshop (Maesteg)	0656 732773
Mainport Training (Pembroke Dock)	021 360 3543
Merthyr Tydfil Technical College	0685 5399
Neath ITeC	0639 4141
Newport ITeC	0633 280991
Pontypridd Tech College (Rhydyfelin)	0443 400121
Rhondda Enterprise (Mid Glam)	0443 682312
South Glamorgan Women's Workshop (Cardiff)	0222 493351
Swansea ITeC	0792 464561
Treforest ITeC (Pontypridd)	0443 85 4133
Vale of Clwyd ITeC (Rhyll)	0745 824832
West Dyfed ITeC (Pembroke)	0646 684650
Wrexham ITeC	0978 350575
WARKWICKSHIRE	
Bedworth ITeC	0203 310150
Intec Training Services (Leamington Spa)	0926 882524
Intec Training Services (Nuneaton)	0203 344054
Intec Training Services (Rugby)	0788 70578
Mid Warwickshire College of FE (Leamington Spa)	0926 311711
Rugby ITeC	0788 60825
South Warwickshire College of Further Education (Stratford upon Avon)	0789 66245
WEST MIDLANDS	
Aston ITeC (Birmingham)	021 359 2891
Austin Rover ITeC (Birmingham)	021 475 5135
Brooklyn Technical College (Birmingham)	021 360 3543
Coventry ITeC	0203 25555
Coventry Technical College	0203 57221
Forward Training Group (Birmingham)	021 643 2653
G.E.C. Telecommunications (Coventry)	0203 452152
Handsworth Technical College	021 551 6031
Henley College of FE (Coventry)	0203 611021
Matthew Boulton Technical College (Birmingham)	021 359 6721
NACRO (Wolverhampton ITeC)	0902 636170
Project TEC-COM ITeC (West Bromwich)	021 553 6096
Queen Alexandra College (Birmingham)	021 162115
Solihull College of Technology	021 705 6376
Solihull ITeC (Sheldon)	021 742 8591
Sutton Coldfield College of FE	021 355 5671
Tile Hill College of FE (Coventry)	0203 461444
Tyseley ITeC (Birmingham)	021 707 4242
Walsall College of Technology	0922 25124
Walsall TEC (Darlaston)	021 526 6050
West Bromwich College of Commerce and Technology	021 556 9955
WEST YORKSHIRE	
Bradford & Ilkley Community College (Ilkley)	0274 753309
Bradford ITeC	0274 752894
Bramley Unemployed Self Help (Leeds)	0532 553310
Halifax ITeC	0422 590267
Huddersfield Technical College	0484 36521
Kirklees ITeC (Batley)	0924 441661
St John Fisher High School (Dewsbury)	0924 462927
Wakefield District College	0924 370501
Wakefield ITeC	0924 373635
Womens Technology Centre (Bradford)	0274 752139

Addresses

Readers requiring their own copy of the module documentation should write to the following address, clearly stating "Everyday Electronics – Introductory Microprocessors" and enclosing a cheque or P.O. for £10 made payable to City and Guilds (do not forget to include your name and address!): Publications Department, City and Guilds of London, 76 Portland Place, London W1N 4AA.

Comments and queries from readers **should be sent directly to the author** at the following address: Department of Technology, Brooklands Technical College, Heath Road, Weybridge, Surrey KT13 8TT.

Please include a stamped addressed envelope if you require an individual reply. General queries will be dealt with in Readers' Forum which will appear in parts four and nine of the series.

Information Technology

City and Guilds' development of the Information Technology (726) scheme is continually expanding to meet the needs of school leavers and specialists alike. The modules are:

726/200 Introductory Coding and Programming in BASIC
726/201 Introductory Coding and Programming in COBOL
726/203 Introductory Coding and Programming in PASCAL
726/212 Introductory Computers and Computing
726/220 Elementary Coding and Programming in BASIC
726/221 Elementary Coding and Programming in COBOL
726/223 Elementary Coding and Programming in PASCAL
726/238 Elementary Program Design Techniques
726/300 Introductory Electronic Circuits and Components
726/301 Introductory Digital Electronics
726/302 Introductory Electronic Systems
726/303 Introductory Microprocessors (to be published)
726/310 Introductory Technical and Graphical Communications
726/320 Elementary Electronic Circuits and Testing
726/400 Introductory Wordprocessing
726/401 Introductory Database Methods
726/402 Introductory Spreadsheet Methods
726/405 Introductory Microcomputers and Business Applications
726/411 Introductory Office Practice and Organisation
726/412 Introductory Health and Safety
726/420 Elementary Wordprocessing
726/421 Elementary Database Methods
726/422 Elementary Spreadsheet Methods.

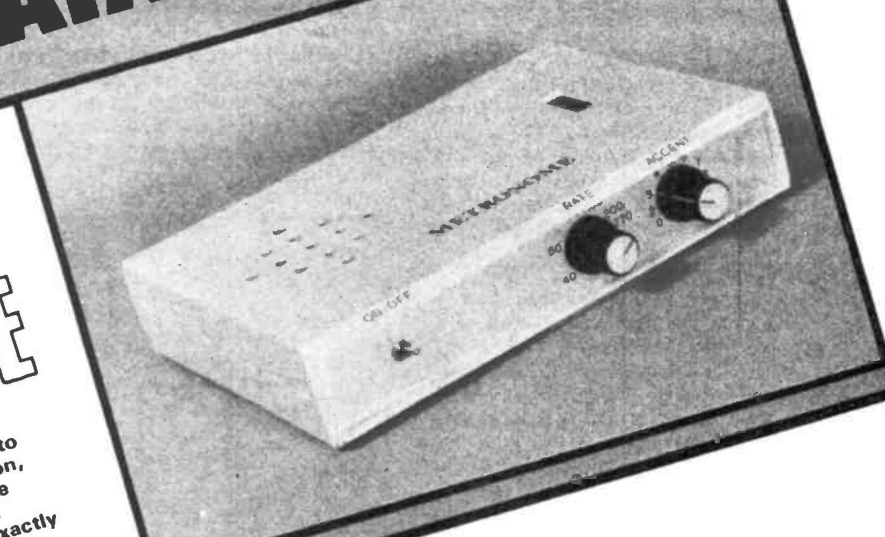
Further details may be obtained from Division 13, City and Guilds of London Institute, 46 Britannia Street, London WC1X 9RG. Tel. 01-278 2468.
Telex 266586. Prestel ★21163.

City and Guilds
C+G

NOVEMBER FEATURES...

FREE GREENWELD 88 PAGE CATALOGUE

Once again EE is pleased to be able to give away the full Greenweld catalogue as soon as it is published. It comes free inside every copy next month.



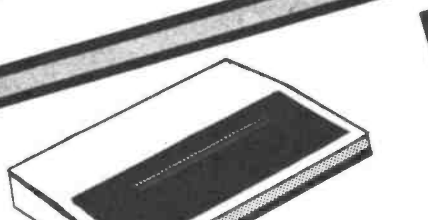
ACCENTED METRONOME

This is a modern equivalent to the traditional pendulum metronome; it has been designed to give the same sort of 'click' sound. In addition, every second beat to every tenth beat can be accented. A bargraph display gives a visual indication of the beat sequence showing exactly which beat is the current one in the sequence.

ACOUSTIC PROBE

An electronic "stethoscope" designed for identifying strange noises in car engines. This instrument can save £'s when investigating noises or buying second-hand cars.

BBC SIDEWAYS RAM



Easy to build and install, this unit provides two blocks of RAM each of 16K. It can be used to hold ROM based software saved on disc and then loaded into the extra RAM as required; or used as a printer buffer or data store etc.

EVERYDAY ELECTRONICS

NOVEMBER ISSUE ON SALE FRIDAY OCTOBER 16

a regular feature for the Spectrum Owner...

by Mike Tooley BA

THIS month, as promised, we shall be describing a versatile Counter/Timer Interface based on the Z80-CTC. We also have some important news for those of you who would like to make more use of machine code routines but don't wish to go to the extent of investing in a full-blown assembler/debugger.

VERSATILE COUNTER/TIMER

Some months ago I described how a Z80-PIO could be very easily added to a Spectrum in order to provide two 8-bit parallel I/O ports. This month I shall show how another member of the Z80 chip family can be added to the Spectrum in order to provide some useful counter/timer facilities.

The counter/timer module is based on the Z80-CTC. This versatile device can be used in a variety of timing and counting applications; the aim being that of relieving the workload on the CPU such that it is free to get on with more useful and more demanding tasks.

The internal architecture of the Z80-CTC is shown in Fig. 1. The four independent counter/timer channels (0 to 3) are linked by an internal bus which is driven from the Z80 system bus by means of some conventional bus interfacing logic. The CTC chip is also able to generate a unique interrupt vector for each channel which can be used for automatic vectoring to appropriate interrupt service routines.

The simplified schematic of each of the counter/timer channels is shown in Fig. 2. Essentially, the channel logic comprises:

(a) registers for channel control and time constant
(b) an 8-bit prescaler (binary divider)
(c) an 8-bit down counter (another binary divider).

Happily, the Z80-CTC can be very easily interfaced to the system and no additional logic is required since the two chip select lines (CSO and CS1) are driven from address lines A5 and A6 respectively whilst the chip enable ($\overline{CE}$) line is connected to address line A7.

The complete circuit of our Spectrum Counter/Timer Interface is shown in Fig. 3. This circuit is suitable for use with the following versions of the Spectrum; 16K, 48K, 128K, Plus, and Plus Two.

For test purposes, three transistor l.e.d. drivers have been fitted. These can be used to indicate the state of the four channel outputs. Readers should note that the Channel 3 CTC output has no zero count/timeout output pin and thus three, rather than four l.e.d. drivers are required. Constructors should feel free to omit the l.e.d. drivers from the board should they not be required.

Construction

The Counter/Timer Interface may be assembled on a piece of Veroboard measuring approximately 80mm × 100mm. The precise dimensions of the board are unimportant provided that it has a minimum of 28 tracks aligned in the vertical plane sufficient to allow the mounting of a 28-way double-sided edge connector. This connector should be fitted to the lower edge of the board and will require five holes across the full width of the stripboard so that the board stands vertically when the connector is mated with the Spectrum.

Before soldering any of the components (including the 28-pin i.c. socket) it is important to allow some clearance for the rear overhang of the case. For the Spectrum this gap should correspond to 8 rows of holes (20mm approx.) whilst for the Spectrum Plus and 128, the gap should be increased to 12 rows of holes (30mm approx.).

Component layout is generally uncritical though, as with most of our *On Spec* projects, considerable economies can be made by carefully planning the layout in advance of mounting the components and i.c. socket. Readers are advised to carry out this exercise on paper first (using, if desired, the layout sheet provided with our *On Spec Update)*.

After mounting the i.c. socket, great care must be taken to ensure that all unwanted tracks are cut (including, in particular, those which link the upper and lower sides of the 28-way connector). A purpose designed "spot-face" cutter is ideal for this purpose or, if such a tool is not obtainable, a small sharp drill bit may be used.

The remaining components (resistors, capacitors, connectors and optional transistors and l.e.d.s) should then be fitted to the board. As usual, the decoupling capacitors (C1 to C3) should be distributed around the board with the smaller value capacitors (C2 and C3) being placed close to the supply input pins of IC1.

Links on the underside of the board should make use of appropriate lengths of miniature insulated wire (of the type normally used for wire wrapping). Readers requiring further information on the connector should refer to March 1985 *On Spec* or send for the *Update*.

When the stripboard wiring has been completed, the Z80-CTC circuit should be inserted into its socket (taking care to ensure correct orientation of each device). Finally, the entire board and wiring should be very carefully checked before attempting to connect it to the Spectrum. *(Note that the Spectrum should ALWAYS be disconnected from its supply before either connecting or disconnecting any interface module.)*

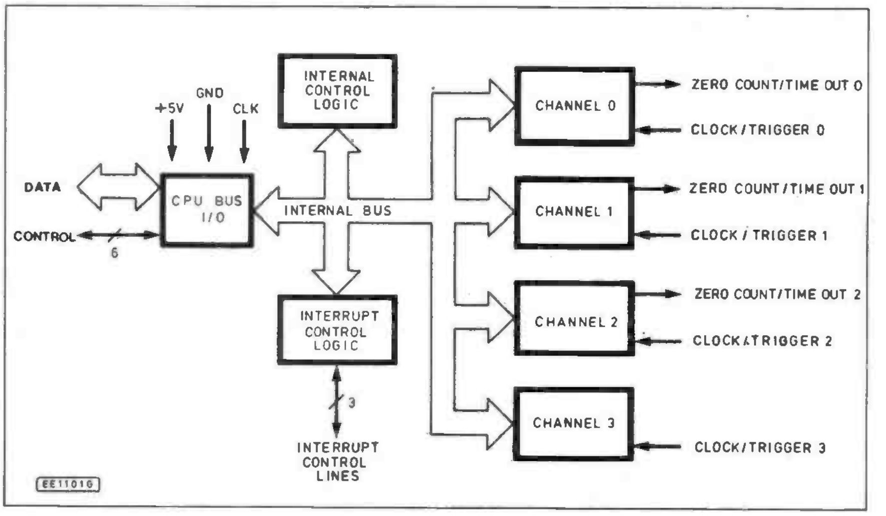
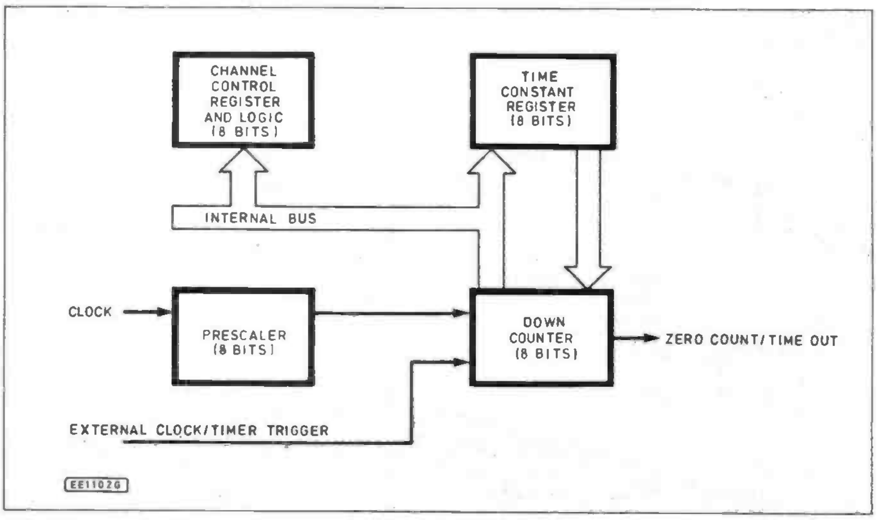
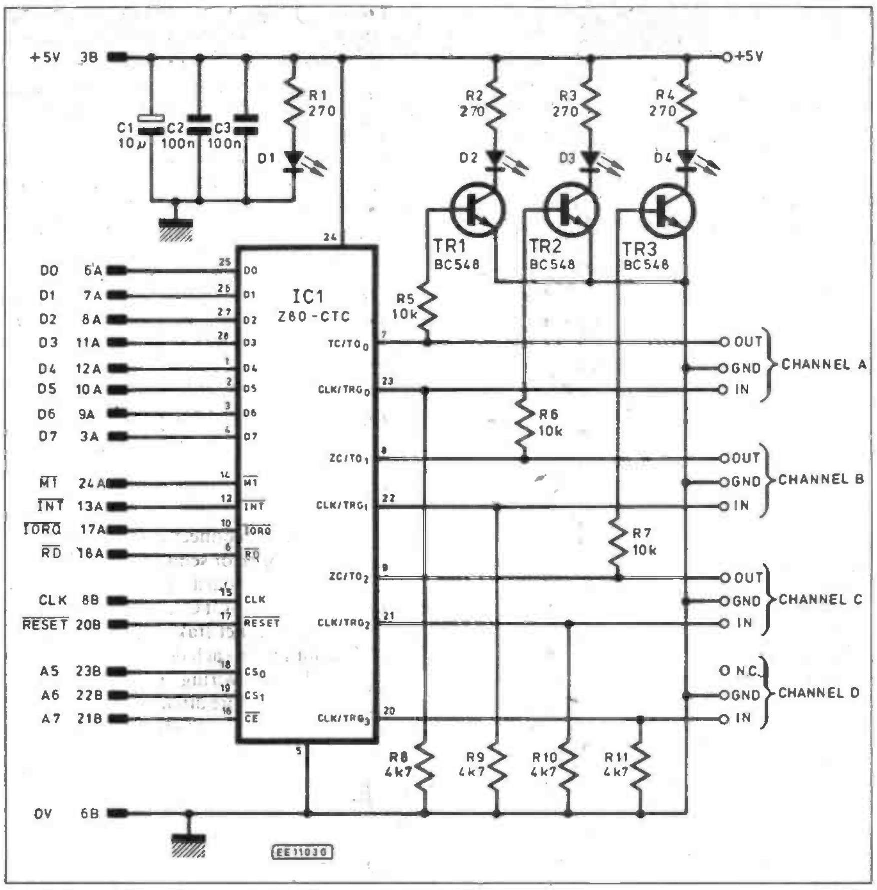


Fig. 1. The internal architecture for the Z80-CTC microprocessor.

Fig. 2. Simplified block diagram of each of the counter/timer channels.





COMPONENTS

See **Shop Talk** page

Resistors
R1 – R4 270 (4 off)
R5 – R7 10k (3off)
R8 – R11 4k7 (4 off)
All 0.25 W 5% carbon

Capacitors
C1 10µ p.c. elec. 16V
C2 – C3 100n polyester (2 off)

Semiconductors
IC1 Z80 – CTC counter/timer
D1 – D4 Red l.e.d. (4 off)
TR1 – TR3 BC548 (3 off)

Miscellaneous
28-pin low profile DIL socket; 3-way 0.1 in. pitch p.c.b. mounting connectors (4 off); Veroboard, 0.1 in. pitch, measuring approx. 80mm × 100mm; 28-way open-end double-sided 2.54mm (0.1in.) pitch edge connector (e.g. Vero part number 838-24826A).

Approx. cost Guidance only £11

Fig. 3. Complete circuit diagram of the Versatile Counter/Timer Interface.

If all is well, when power is re-applied, the normal copyright message should appear. If not, disconnect the power, remove the interface and carefully check again!

Machine Code on a Budget

For some months now, our *On Spec Update* has contained a simple hexadecimal code loader together with a subset of the most commonly used Z80 instructions listed in hexadecimal form. This little package can be used to develop simple machine code routines using a process known as "hand assembly"; one writes the code first in assembler mnemonics and then translates each instruction to its hexadecimal form by referring to the instruction subset. Whilst this process is tedious for anything other than the shortest of routines (say, 64 bytes or less) it is both simple (there are no complex commands to remember) and inexpensive (the services of an assembler are not required).

Whilst not being in any way special, our hex. code loader has provoked quite a lot of interest from readers and several of you have asked for an enhanced version. Accordingly, our latest *Update* contains a full listing of our new *On Spec* "Machine Code Loader". This program occupies approximately 3K of BASIC (hence it is too long to list in these pages) but will only require half an hour, or so, to type in.

On loading, the user is presented with a menu screen which offers the following menu options:

EDIT E<address> LOAD L<filename>
DUMP D<address> SAVE S<filename>
RUN G<address> QUIT Q

The user is then prompted for a command (entered in upper case) and the Spectrum's 'C' cursor will be seen flashing in the lower input area of the screen. Commands are entered using a single keystroke followed by an optional parameter (e.g. an address or filename). We shall now briefly explain each of the main menu options in turn:

EDIT

Edit allows the user to alter the byte present at any given memory address. The command will obviously only be effective within an area of RAM (i.e. it will not change the contents of the Spectrum's ROM!).

The edit command is invoked using E followed by an address given in hexadecimal form. Note that NO space should appear between E and its address parameter.

As an example, suppose we wish to change the byte stored at an address of A000 (40960 decimal). The following command would be used:

EA000

Pressing the ENTER key will generate the following prompt line in the bottom two lines of the screen;

Address Data New Data
A000 00

The Spectrum's cursor should now apear in the "New Data" column and the user will be able to type the new value in hexadecimal form. If we wished to place C3 into A000, for example, the reply should simply be C3 (followed by ENTER).

Having pressed ENTER, the address will increment automatically (to A001 in the previous example) and the user will then be prompted for new data to be placed in this location. If no further data is to be written to memory, the user simply presses Q and is returned to the "Command" prompt.

DUMP

Dump prints the contents of 64 bytes of memory (in hexadecimal form) from a given starting address. For example,

D0000

dumps the first 64 bytes of Spectrum ROM (from address 0000 to 4000 hexadecimal).

RUN

Run executes code from a given starting address. The command,

G8000

for example, will execute the code starting at a hexadecimal address of 8000 (32768 decimal). It is very important to note that any code which is to be tested using the "G" command MUST be terminated by a RET (C9 hex.) instruction. Failure to observe this precaution will result in loss of control and the machine will probably "lock up".

In such an eventuality the user's code will be lost since recovery can only be made by re-booting the Spectrum. Note, however, that readers who have previously constructed our *Escape Interface* (Oct-Nov '86 issues) will be relatively immune from such disasters!

In any event it is ALWAYS good practice to save any code segment to tape, microdrive or disk, BEFORE testing. This can be instrumental in saving a great deal of heartache. Incidentally,

G0000

can be used to reset the machine and clear the Spectrum's memory!

LOAD

The "L" command is used to load a machine code file from tape. Disk and microdrive users can, if desired, easily modify the program to cope with microdrive or disk storage. Users should again note that NO SPACE should be present between the "L" command and a subsequent filename. To load a machine code file called TEST, for example, the user should enter the following command:

LTEST

Having entered a filename (maximum 10 characters) the user is prompted for an address to load into. This address should again be specified in hexadecimal, however, if the user simply presses ENTER in reply to the prompt, the program will be loaded starting at the address which was used for the SAVE. Hence, if you develop all your code modules starting from the same address (e.g. 8000 hexadecimal) it should not be necessary for you to specify the load address and you can simply default the request by pressing ENTER.

The LOAD command can be extremely useful "assembling" blocks of code into a longer program. Commonly used modules (such as port initialisation, delay routines, etc.) can be produced, SAVEd to tape, and then loaded into more sophisticated programs at any desired address. This technique is extremely powerful and can be thought of as being somewhat analogous to BASIC's MERGE command.

SAVE

The "S" command is used to save machine code in a named file. The command must therefore be immediately followed by a filename and the user will then be prompted for the start address of the code to save and the length of the code (in bytes). Note that the start address and length of code to save must BOTH be specified in hexadecimal.

Once this information has been accepted by the program, the user is presented with the usual:

Start tape, and press any key

Readers should not, of course, forget to press Play AND Record on their cassette machines otherwise the code will NOT be SAVEd!

QUIT

The "Q" command quits the program and performs a NEW command (erasing the program from memory). Readers should note that, since a NEW command preserves any code resident above RAMTOP, it may be useful to preset RAMTOP before use.

This can be done simply br entering a direct command of the form:

CLEAR 32767

which sets RAMTOP to 32767 and protects any code resident above it (i.e. from 8000 hex. onwards). The CLEAR command should, of course, be entered BEFORE the Machine Code Loader is RUN.

Now, let's just discuss a typical session with the Machine Code Loader. Suppose that we wish to enter the following code module:

Address	Hex. code	Labels	Mnemonics
8000	21 00 58	START	LD HL,5800H
8003	7E	LOOP	LD A, (HL)
8004	E6 FB		AND FBH
8006	4F		LD C,A
8007	ED 5F		LD A,R
8009	E6 07		AND 7
800B	B1		OR C
800C	77		LD (HL),A
800D	23		INC HL
800E	3E 5B		LD A,5BH
8010	BC		CP H
8011	C8		RET Z
8013	18 EF		JR LOOP

Enter the code from address 8000 using the command:

E8000

The last byte of code should appear at address 8013 and, when prompted for "New Data" at address 8014, users should reply with Q.

Now check that the code has been correctly entered by dumping memory from 8000 using:

D8000

The resulting display should show:

Address	Data
8000	21 00 58 7E E6 FB 4F ED
8008	5F E6 07 B1 77 23 3E 5B
8010	BC C8 18 EF 00 00 00 00

(the rest of the block should all be 00)

Any mistakes in entering the code should now be corrected by editing the address at which any error has occurred and then pressing Q as soon as the address pointer has incremented. If, for example, the byte at 800D had been "03" not "23" the user should enter:

E800 D

and then enter 23 under "New Data". The next New Data should be responded to with Q. Finally, it is worth dumping the memory block again to check that 23 now appears at 800D.

The code module should now be saved using an appropriate filename (we shall call it RANDINK for reasons which should become obvious when the code is eventually RUN!). The command to enter is:

SRANDINK

The user should reply to the "Hex start address" prompt with 8000 and 14 in response to the "Length of code" prompt. Readers should note that the code starts at 8000 and ends at 8013 making a total of 14 (NOT 13!) hexadecimal bytes.

Having SAVEd the code (don't forget to press Play AND Record) the code may be executed using:

G8000

If all is well, readers should be rewarded with a very interesting display to look at! Note, however, that the "Command" prompt should still be intact and the cursor obediently flashing ready to accept another command.

To reload your code at another address, rewind the tape to the beginning of the program and then type:

LRANDINK

In response to the "Address to load into" prompt, reply 9000 and then press Play. After the code has loaded, display the memory from its new start address using:

D9000

and check that the program has been duplicated at this new start address (note that the display will be resplendent in the original ink colours!).

Finally, readers who wish to further develop the Machine Code Loader are advised to replace the "NEW" in line 5090 with "STOP". This allows changes to be made without the program NEWing itself from memory each time the user quits!

If you have any comments or suggestions or would just like a copy of our *On Spec Update*, please drop me a line enclosing a large (at least 250mm × 300mm!) stamped addressed envelope.

Mike Tooley,
Department of Technology,
Brooklands Technical College,
Heath Road, Weybridge,
Surrey KT13 8TT.

Next month: we shall be describing software for use with the Versatile Counter/Timer Interface.

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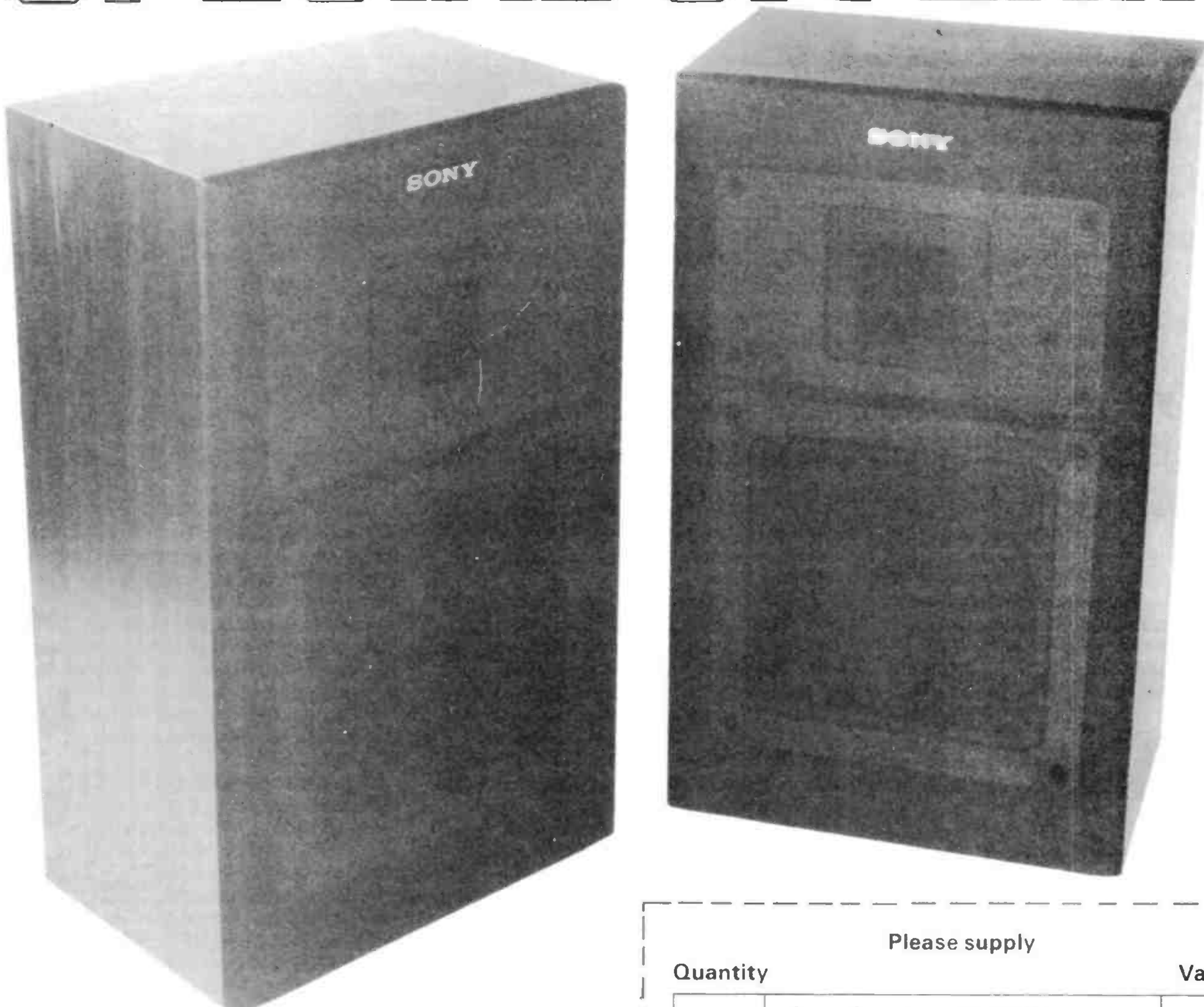

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AUTOMATIC/ MANUAL PORCH LIGHT

M.P. HORSEY

A light activated switch for the home with many other possible applications

THE PROJECT to be described causes a porch light (or any light) to switch on automatically at dusk, and switch off again in daylight. Two push switches are provided which enable manual control without affecting automatic operation. For example, the light may be switched off by pressing the "Reset" button, but it will still switch on automatically at dusk the following day.

HOW IT WORKS

The block diagram Fig. 1 shows how the circuit is divided into three main sections. Section 1 is the light sensor and Schmitt trigger. As light falling on the sensor decreases, line "a" from the Schmitt trigger goes "high" (i.e. the voltage rises to nearly 12V) and a capacitor (C2) converts this into a single pulse

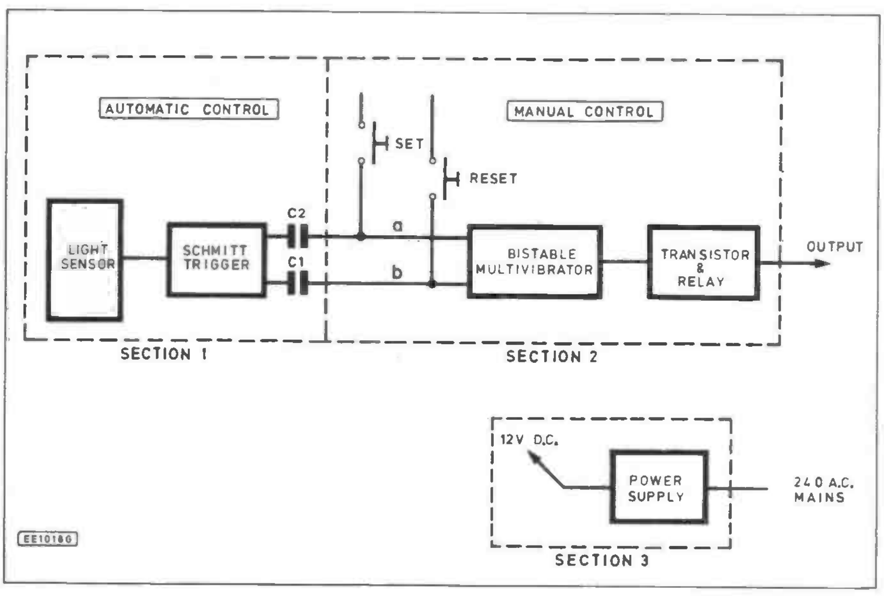
When the light level rises the Schmitt trigger causes line "a" to go "low" (i.e. nearly zero volts) and line "b" now goes "high". Again, this is converted into a single pulse, this time by capacitor C1.

The Schmitt trigger is a device which ensures that the circuit does not hesitate as the light level rises or falls. This is important as passing clouds could otherwise cause the Porch Light to switch on and off repeatedly at dusk or dawn. The Schmitt trigger reduces the sensitivity of the sensor so that slight changes in light level have no effect.

Section 2 consists of a bistable multivibrator – sometimes called a "flip flop". When line "a" goes high the output from the bistable goes high. The bistable now remains in that state even when line "a" goes low again. However, if line "b" goes high the output from the bistable returns to low. A very small current is available from the bistable, and a transistor and relay are required to enable control of the Porch Light.

Section 3 consists of the power supply. A transformer is employed to isolate the mains supply from the circuit.

Fig. 1. Block diagram for the Automatic/Manual Porch Light.



CIRCUIT DESCRIPTION

The complete circuit diagram for the Automatic/Manual Porch Light is shown in Fig. 2. A single i.c. (CMOS 4001B) contains the four NOR gates required to make the Schmitt trigger and bistable.

Gates IC1a and IC1b are wired as inverters by connecting their inputs together. When pins 8 and 9 are low, output from pin 10 is high as are input pins 12 and 13. Output pin 11 is therefore low. Resistor R4 tends to hold down the voltage at input pins 8 and 9, and this "feedback" produces the Schmitt trigger action described before.

Variable resistor VR1 and R1, a light dependent resistor (LDR), form a potential divider, with resistor R2 providing some resistance if VR1 is set to zero ohms. In practice, the user must set VR1 so that the Porch Light switches on at a suitable moment as darkness falls.

In daylight, the resistance of the LDR will be quite low, and with VR1 set correctly, the voltage at point *P* will be sufficiently low to maintain the output from gate IC1b low.

As the light level decreases, the resistance of the LDR will rise. Thus the voltage at point *P* will rise. At a certain level, the voltage at pins 8 and 9 will be sufficient to cause gate IC1a and hence IC1b to change state. Resistor R4 will reinforce this new state, preventing the gates changing back again even if the voltage at point *P* falls slightly. In fact, a fairly large rise in light level is required before the gates will return to their previous states.

If greater sensitivity is required, R4 may be increased in value, or removed altogether. However, it is likely that passing clouds will now become a problem. Resistor R3 is required to enable R4 to have the required effect on the voltage at pins 8 and 9.

To sum up, in daylight the output from gate IC1a (pin 10) is "high" and pin 11 is "low". At night, the output from IC1a (pin 10) is "low" and pin 11 is "high".

BISTABLE MULTIVIBRATOR

The two remaining gates IC1c and IC1d (which would otherwise be unused) are employed as a bistable or flip-flop. This allows manual control of the Porch Light without affecting automatic operation.

Understanding the bistable requires a clear knowledge of a NOR gate, and the following Truth Table summarising the input and output states for one gate may help.

INPUT 1	INPUT 2	OUTPUT
low	low	high
high	low	low
low	high	low
high	high	low

Assuming that the bistable is in its "low" state (i.e. IC1c output pin 3 is low), IC1d pin 5 will be low, pin 6 will be low due to the action of resistor R5, and output pin 4 will thus be "high". This high will hold IC1c input pin 2 high, and with either input at IC1c high, its output will remain low. Note that pressing the reset switch S2 will have no effect as pin 1 may be high or low providing pin 2 is high.

When the Set switch S1 is pressed, IC1d input pin 6 becomes high. This causes output pin 4 and hence IC1c input pin 2 to go low. With both inputs to IC1c low, its output goes high. Thus input pin 5 goes high and this maintains the bistable in its new state when S1 is released and pin 6 goes low again.

When S2 is pressed, input pin 1 goes high, and by similar reasoning the bistable returns to its former state. Correct operation of the bistable only occurs if the push switches are pressed then released. In effect a positive pulse at pin 6 "sets" the bistable, and a positive pulse at pin 1 causes it to "reset".

Capacitor C3 removes any small electrical spikes from the supply, and is mounted close to IC1 supply pins 7 and 14.

The primary windings of T1 are connected to the mains via fuse FS1, with the neon LP1 providing a visual warning when the supply is connected. The completed unit should be connected to the mains via a 13A plug with 1A fuse fitted, to protect the relay contacts and associated wiring.

CONSTRUCTION

WARNING: ***Ensure that the mains wiring is kept fully isolated from the low voltage circuit, and take the usual precautions when connecting to the mains supply.***

The i.c. is a CMOS type and should be left in its protective packaging until required. An i.c. socket is *essential.*

Mount the i.c. socket followed by the wire links. When fitting short wire links, thin bare tinned copper wire is ideal. Cut off a long piece, solder one end in position, then thread it though the other hole *before* cutting to length. This method enables links to be made quickly and neatly. A total of 9 short links are required.

The order in which components are fitted is not important, though it is more convenient to fit the smaller items first, and the long connecting wires at the ends of the board, last.

Ensure that the diodes and capacitor C4 are fitted the correct way round, and TR1 is fitted with the flat side towards the left. A type BC184L must be chosen (a type BC184 (without the "L") has leads in a different order).

The two push-to-make switches and potentiometer VR1 will require connecting

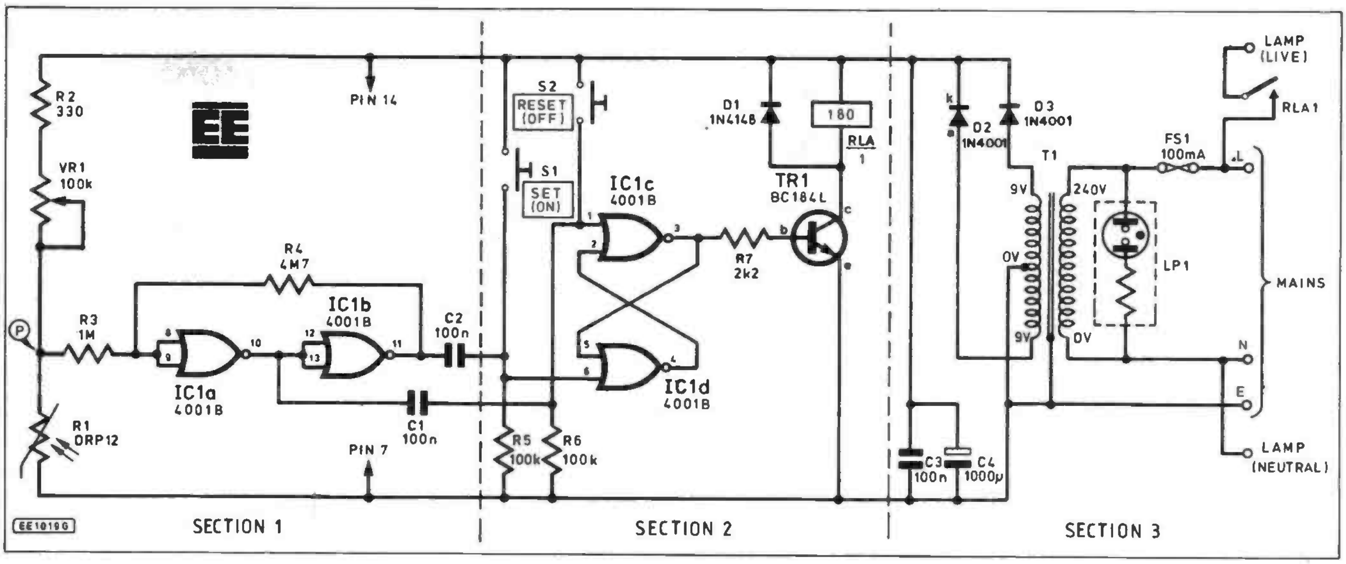


Fig. 2. Complete circuit diagram for the Automatic/Manual Porch Light. This circuit is broken down into three sections; Schmitt trigger, 'flip-flop' and power supply.

The Schmitt trigger is linked to IC1d pin 6 via capacitor C2. This ensures that when IC1b output pin 11 goes high a brief positive pulse is applied to pin 6, before resistor R5 reduces the voltage to zero again. If the voltage at pin 6 remained high, proper manual control would not be possible. Similarly, as the light on the LDR increases and gates IC1a and IC1b change state, output pin 10 goes high and capacitor C1 applies a brief positive pulse to input pin 1.

The bistable is therefore controlled by the Schmit trigger for automatic operation, or by the push switches for manual operation, without either affecting the operation of the other.

OUTPUT OPERATION

The output from the bistable pin 3 is fed via current limiting resistor R7 to transistor TR1. When pin 3 is low TR1 is switched off. When pin 3 goes high, TR1 turns on and allows sufficient current to flow through the coil of the relay RLA to close its contacts and switch on the Porch Light.

The relay should be a 12V type, and have a coil resistance of 180 ohms or more. Its contacts should be able to switch about 1A at 240V. Diode D1 prevents back e.m.f. damaging the transistor when the relay switches off.

POWER SUPPLY

Transformer T1 is a miniature type converting the 240V a.c. mains into 9V-0V-9V a.c. Diodes D2 and D3 produce a full wave d.c. supply, which is smoothed by capacitor C4.

CIRCUIT BOARD

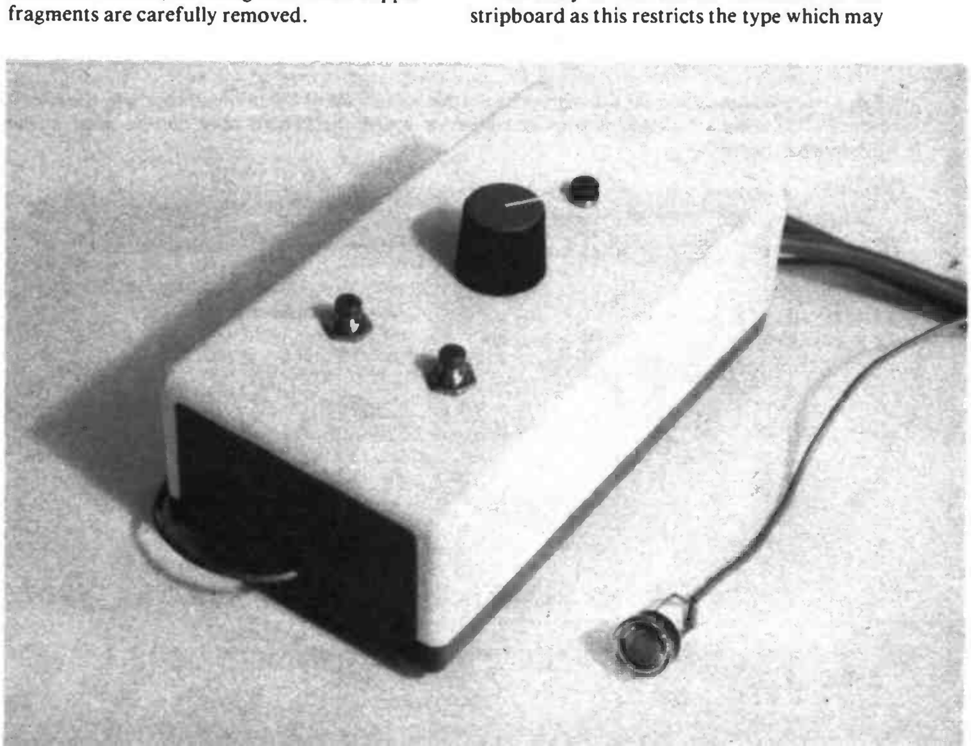
The Automatic/Manual Porch Light is constructed on a piece of stripboard of at least 30 holes by 15 tracks. The prototype employed a piece measuring 80mm by 65mm to provide room for the mounting holes and relay RLA.

The stripboard component layout is shown in Fig. 3. Begin by labelling the stripboard and the positions of the breaks. Next make the 9 breaks as shown, ensuring that loose copper fragments are carefully removed.

wires sufficiently long to reach their chosen mounting positions in the case. The light dependent resistor, R1, may be positioned on the case, or via a longer pair of wires to enable the LDR to be mounted on a window.

This choice will depend upon where the project case is situated in relation to daylight. Note that the LDR may be affected by other lights – including the Porch Light itself – if mounted too close.

The relay is not shown mounted on the stripboard as this restricts the type which may



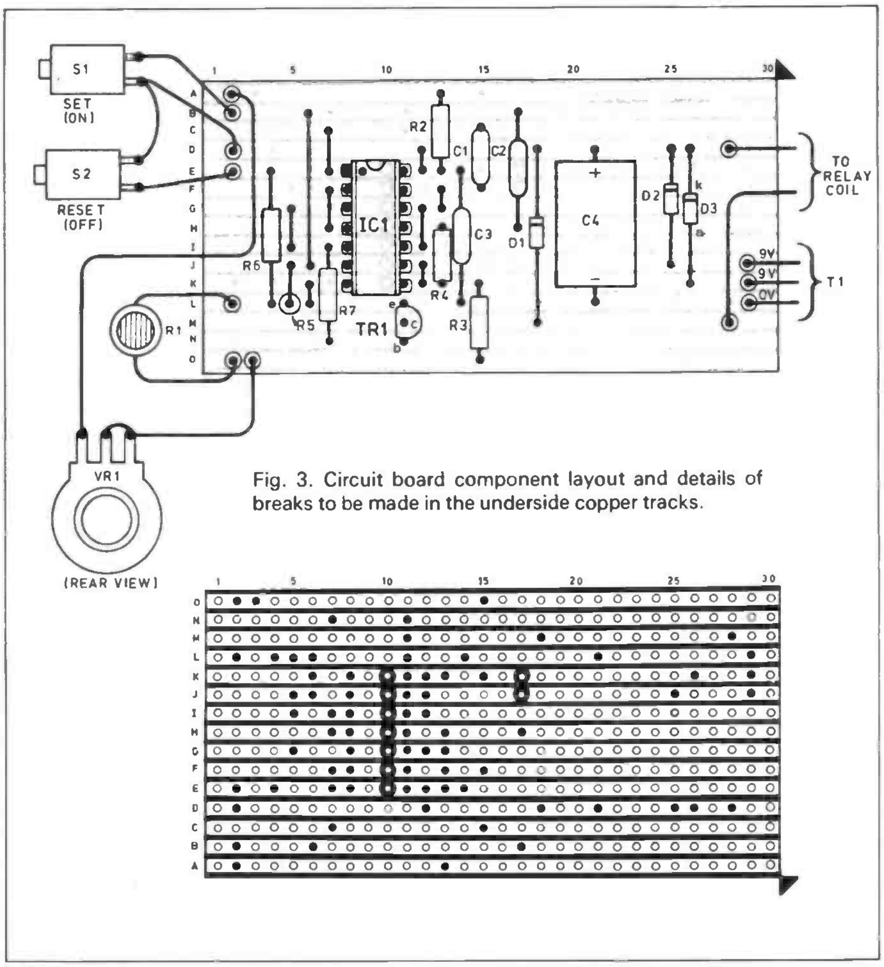


Fig. 3. Circuit board component layout and details of breaks to be made in the underside copper tracks.

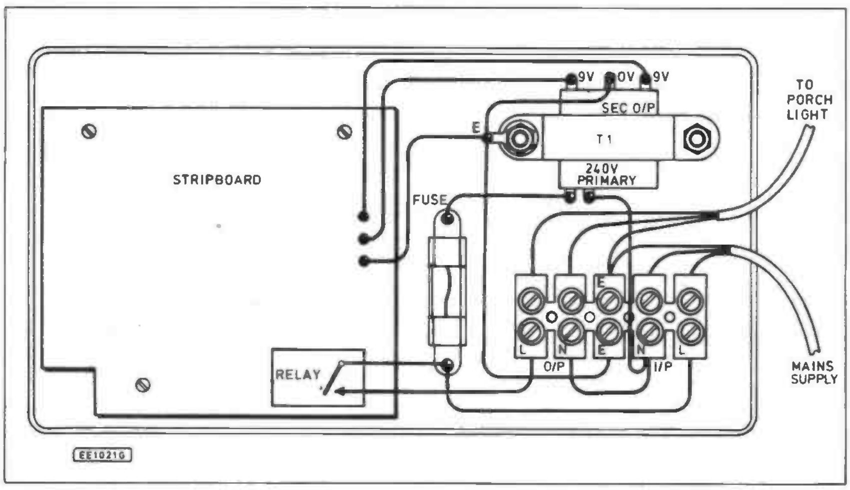
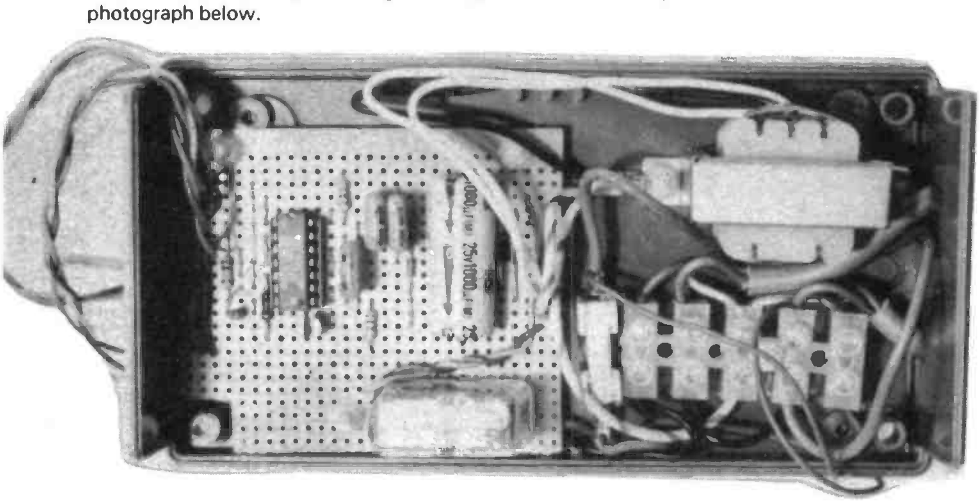


Fig. 4. Interwiring details for the high voltage (mains) section of the unit and wiring to the circuit board. The compact positioning of components inside the plastic case can be seen in the photograph below.



be chosen. If a stripboard mounting type is purchased, ensure that the mains connections are *completely* isolated from other parts of the stripboard – by several breaks. If mounting off the stipboard ensure a firm fit to prevent "live" connections touching the circuit, should the relay become loose.

The transformer will normally have three wires leading from its secondary coil. Ensure that the centre tap (zero volts) is connected to "earth" and track *L*. The metal core of the transformer should also be connected to "earth".

CMOS i.c.s are easily damaged by static electricity, and care should be taken to earth any change in your body before removing the i.c. from its protective packaging. This is achieved by touching an earthed object, such as the metal case of an appliance plugged into the mains. Once the i.c. is plugged into its socket, the other components in the circuit will remove any static charges.

TESTING

Before mounting the components and circuit board in the case it should be tested for correct working. To prevent any risk of a mains shock, a separate 12V supply may be used for testing the circuit. Its positive side should be connected to track *D* (e.g. by clipping it to the positive side of capacitor C4) and the negative side connected to track *L* (e.g. by clipping to the negative side of C4).

Most relays produce an audible click when switching on or off. If in doubt, use a Voltmeter or l.e.d. and a series resistor of about 1k ohms across the relay coil to test the circuit. Note that the negative side of the Voltmeter or l.e.d, (flat) must be nearest the transistor.

Switch on and press S1 or S2. It should be possible to switch on the relay by pressing S1, and switch it off by pressing S2. If all is well, turn VR1 until the relay switches on, then turn the opposite way until the relay *just* switches off. Now shade the LDR. The relay should switch on again.

If these tests fail, check the supply voltage across pin 14 (positive) and pin 7 (negative) of IC1. Monitor the voltage at output pin 3, with the Voltmeter negative connected to the negative side of capacitor C4. Repeat the tests described above.

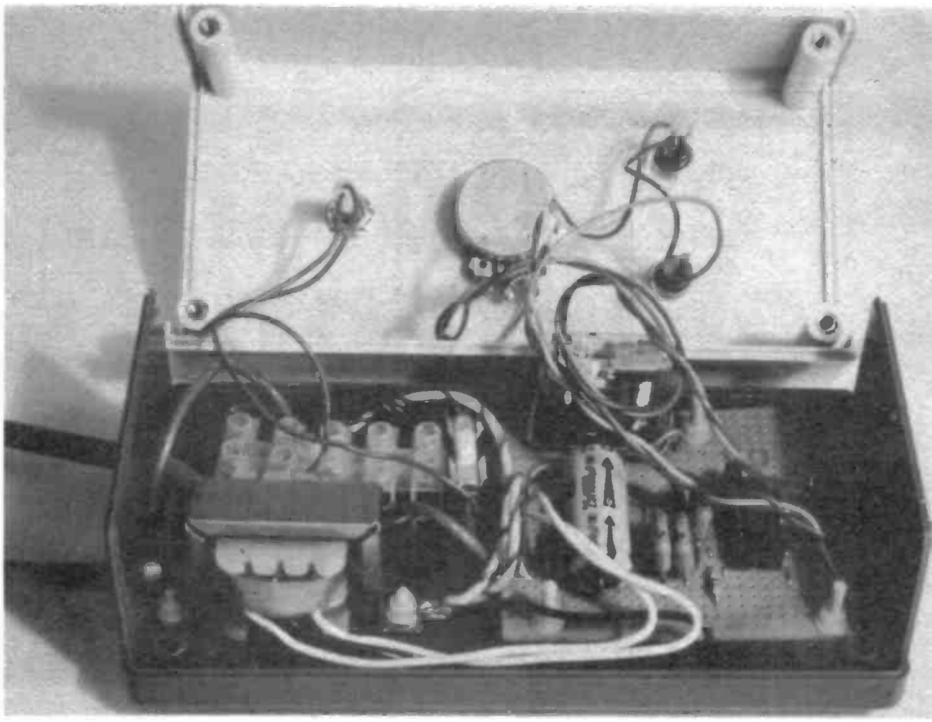
The voltage at pin 3 should be above 10V for on and below 2V for off. If this test works, the fault lies around transistor TR1, otherwise further tests must be carried out by checking that the voltage on the pins of the i.c. is in accordance with the circuit description outlined earlier.

There should be no problem in taking voltage readings on the pins of the i.c. apart from pins 8 and 9. Here the high values of resistors R3 and R4 may make readings unreliable. Instead, check that the voltage at point *P* rises and falls as VR1 is turned; check that the voltage at pin 10 does the opposite (noting that it should be either "high" or "low", rather than an intermediate value), and if this is the case it may be assumed that the circuit around pins 8 and 9 is correct.

MOUNTING IN A CASE

The prototype was housed in a Verobox type 102, measuring 150mm by 80mm by 50mm. Begin by placing the parts in the case to ensure they fit inside the rather limited space, see Fig. 4.

Select the positions of VR1 and the switches S2 and S2, ensuring there is enough clearance inside. The transformer T1 should be mounted using nuts and bolts (*nylon* ones are ideal). For safety, the terminal block TB1, fuse and



COMPONENTS

Resistors

R1	ORP12 light dependent resistor
R2	330
R3	1M
R4	4M7
R5	100k
R6	100k
R7	2k2

All 0.25W 5% carbon

Shop Talk
See page 563

Potentiometer

VR1	100k lin

Capacitors

C1	100n polyester
C2	100n polyester
C3	100n polyester
C4	1000μ axial elec. 16V

Semiconductors

D1	1N4148
D2	1N4001
D3	1N4001
TR1	BC 184L
IC1	4001B CMOS quad 2-input NOR gate

Miscellaneous

T1	Miniature mains transformer 240V primary, 9V-0V-9V 100mA sec.
RLA	12V relay, 180ohm or more coil and contacts rated at 1A 240V minimum.
S1, S2	Push-to-make switch (2off)

Stripboard, at least 30 holes by 15 strips; case, Verobox type 102 (150mm x 80mm x 50mm); 240V mains neon (with integral resistor); 14-pin d.i.l. socket; 5-way screw terminal block; 100mA fuse and fuseholder; plastic control knob; connecting wires and nuts and bolts, etc.

Approx. cost Guidance only **£15 (including case)**

stripboard should also be mounted using nylon nuts and bolts. The relay RLA should be fixed securely in place, or soldered on the stripboard as described earlier.

Mark and drill all the holes necessary including the two mains cable holes for the mains input and Porch Light output, and a hole for the LDR cable, unless mounting on the case. Complete the mains wiring, noting that the "earth" lead connects to the metal core of the transformer in addition to the secondary centre tap, and copper track *L* of the stripboard. Bolt the items to the case, and double check that the live and neutral mains connections are completely isolated from the low voltage parts of the circuit.

FINAL TESTS AND SAFETY CHECK

Before plugging into the mains supply, connect a Voltmeter across capacitor C4 to establish that the power supply components are functioning. Connect to the mains and switch on. The Voltmeter should read about 12V. A value below 10V or above 16V indicates a serious fault. Switch off at once!

Finally, disconnect from the mains, unclip the Voltmeter, connect up the lamp, and replace the lid of the case ensuring that no metal part (e.g. VR1) touches any internal connection.

The current used by the circuit is negligible compared with the current used by the house Porch Light. A fairly low wattage bulb may be employed to reduce running costs. For example, a 15W Pygmy will cost about 1p per 12 hour night. □

LETTERS

Defended

Sir – I felt I had to write to defend the "Teach-In" series having read the letter from Mr. G. Brown in the July edition.

I have been buying EE for a number of years, and I hold you partly responsible for getting me interested in electronics. I first started taking your magazine on the advice of my physics teacher, who suggested I follow the "Teach-In" series to help me understand the basic principles. Without doubt I found the series very informative and pitched at the right level. Since then I have been hooked on electronics and have now obtained a City and Guilds in Electronic Control.

I have found that the experience and knowledge I acquired from that "Teach-In" series has held me in good stead, and I have on numerous occasions recommended it to other students. Well done!

Andrew Jones
Totton, Southampton

P.S. I am a Commodore 64 user and I would love to see a range of products for this computer.

Introductory Microprocessor Course CGLI 726-303

Due to demand for the above City & Guilds certificate course, it is anticipated that it will commence in October 1987.

Content of the course is mainly practical, and persons attending will be encouraged to purchase *Everyday Electronics* each month in order to assist their personal studies.

Would you kindly bring this item to the attention of your readers so that anybody in the Humberside region wishing to undertake the course can contact me, either by writing to the following address, or telephoning 0482 448717/8.

K.H. Lamb,
Lecturer in Electrical Engineering Studies,
Department of Engineering,
Hull College of Further Education,
Ryde Avenue,
Hull HU5 1QF.

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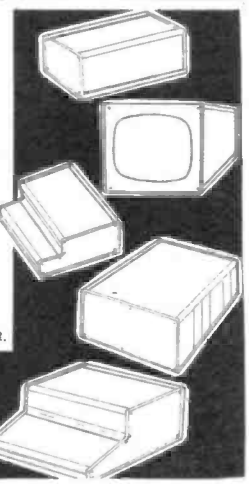

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exploring electronics

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 16 Oscillators using logic I.C.s

LAST month we saw how we could build a bistable circuit from two NAND logic gates, wired together. As explained then, the bistable (or "flip-flop") has two stable states. It can be made to flip from one state to the other by briefly connecting one of its inputs to 0V.

We can also use logic i.c.s. to build the related circuit, the astable multivibrator, which continuously alternates between one state and the other. As this project shows, an oscillating circuit such as this one has many applications.

NAND GATE OSCILLATOR

The NAND gate oscillator circuit shown in Fig. 16.1 consists of two cross-connected NAND gates, as in last month's project. In that circuit the connections were "direct-coupled" by means of plain wires, but here we use capacitors instead.

HOW IT WORKS

In one state of the circuit the output of Gate 2 has just gone high (Fig. 16.2a). This makes the potential at one plate of capacitor C2 go high.

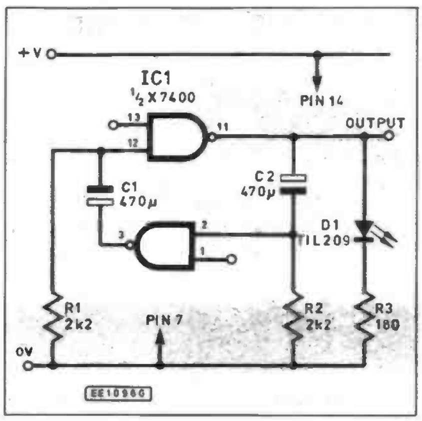
A change of potential at one plate of a capacitor initially causes an equal change at the other plate. Consequently, *both* plates of capacitor C2 go high.

As a result of this, both inputs of Gate 1 are high (remember that an unconnected input counts as being "high"), so its output is low. A low and high at Gate 2 gives a high output (see Truth Table), so the circuit is stable for the moment.

The charge on one plate of C2 gradually leaks away through resistor R2. The higher the values of R2 and C2, the longer this takes.

Eventually, the voltage in this part of the circuit has fallen low enough to produce one *low* input to Gate 1. Immediately this happens its output goes high. Both plates of capacitor C1 become charged and Gate 2 now has two high inputs. Its output must go low.

The circuit is now in its other stable state (Fig. 16.2b). It remains in this state until the charge has leaked away from



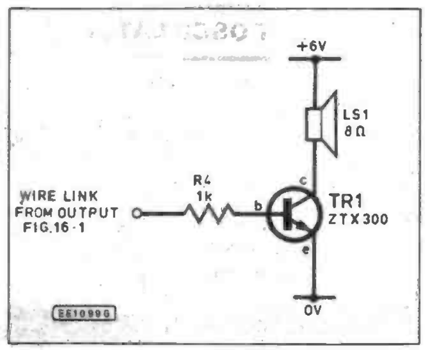


Fig. 6.1. Oscillator circuit using two NAND gates.
Fig.6.4 (above right). Providing an audio output for the oscillators.

capacitor C1 through resistor R1. Then the reverse of the action above makes it change back to its original state again.

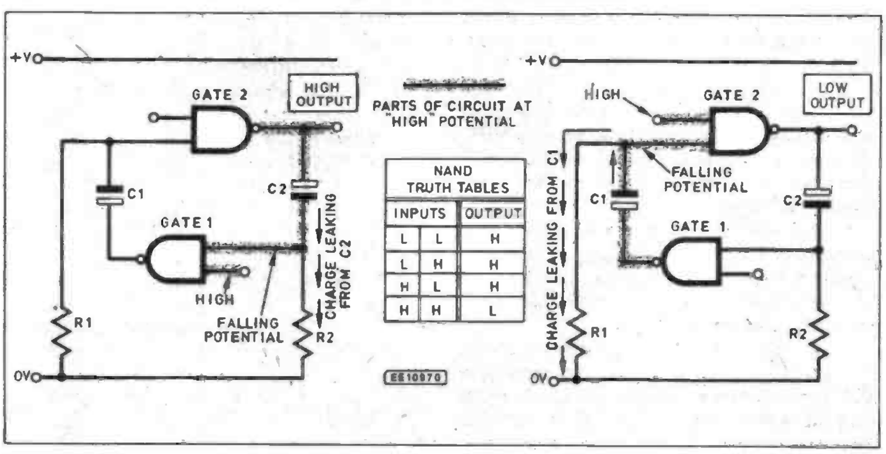
The circuit has just the same kind of action as the transistor oscillator described in Part 7 (EE, Jan 1987) but is much easier to build because the manufacturers of the i.c. have done most of the work for us. This encourages us to go one step further and, in the third project this month, we connect two oscillators together.

ONE – SLOW OSCILLATOR

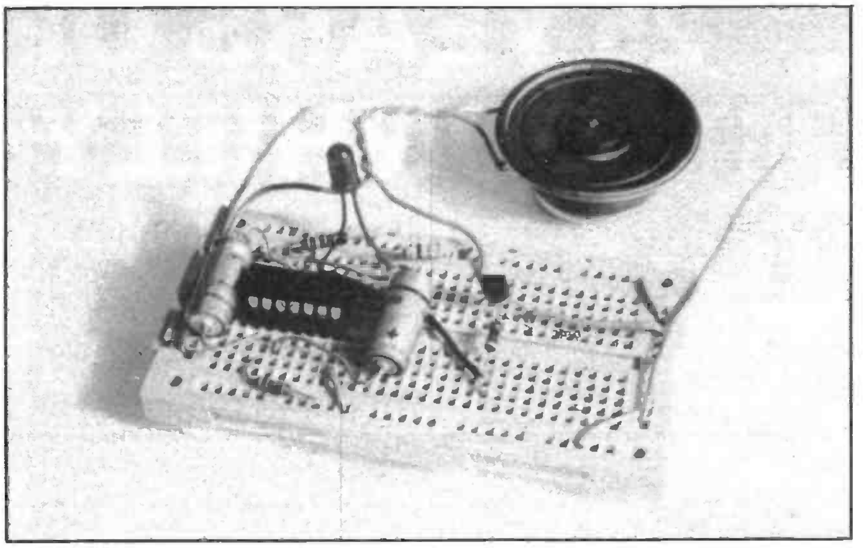
First build an oscillator that operates at about 0.5Hz by connecting up two gates as shown (Fig. 16.1) and the "test bed" component layout (Fig. 16.3). The capacitors should have the value 470µF. The resistors should always be close to 2.2k, so the only way to alter frequency is to change the capacitors.

At this stage, omit the wire link *J7* to *C21*. When this oscillator is working properly, the l.e.d. should go on and off once in 2 seconds. If you now connect the wire link as indicated by the dotted line, you should hear a steady series of ticks, about one tick per second, as the bistable changes state.

Fig. 16.2 The two states of the NAND gate oscillator and truth table.



INPUTS		OUTPUT
L	L	H
L	H	H
H	L	H
H	H	L



COMPONENTS

Resistors
R1, R2 2k2 (2 off)
R3 180
R4 1k
R5, R6 2k2 (2 off)
All 0.25W 5% carbon

Shop Talk
See page 563

Capacitors
C1, C2 470μ, electrolytic (2 off)
C3, C4 0μ47 polyester C280 (2 off)

Semiconductors
D1 TIL 209 or similiar l.e.d.
TR1 ZTX300 *npn* transistor
IC1, IC2 7400 quadruple NAND gate (2 off)

Miscellaneous
LS1 Loudspeaker (8 ohm)
Breadboard (e.g. Verobloc) (2 off); connecting wire and 5V to 6V supply

Approx. cost Guidance only £5

TWO – FAST OSCILLATOR

Having built the Slow Oscillator, we next build one that works 1000 times faster. Build it on another breadboard, as shown in Fig. 16.5.

The circuit is the same as that of the Slow Oscillator except that we use 0.47μF capacitors and there is no point in having the l.e.d. These capacitors have only 1/1000 of the capacitance of those used in the Slow Oscillator so they discharge 1000 times faster.

When this oscillator is connected to the loudspeaker circuit by a wire link from *J13* on this breadboard to *C21* on the other, we obtain a clear musical note, at about 500Hz (a little below middle C on the piano).

THREE – COMBINING THE OSCILLATORS

What about combining the outputs of these two oscillators?

The easiest way of doing this is to NAND them together by making the dashed connections shown in Fig. 16.5, *first* removing the wire at *J*13. We take the outputs from each oscillator and feed them to the inputs of a spare NAND gate.

The output of this gate is taken to the loudspeaker. What do you hear now?

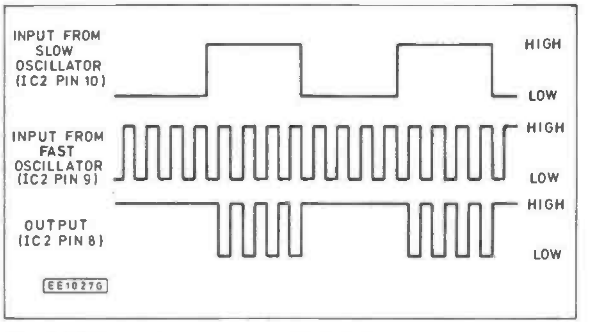


Fig. 16.6. Timing waveforms for the oscillators.

Fig. 16.3. Slow Oscillator "test-bed".

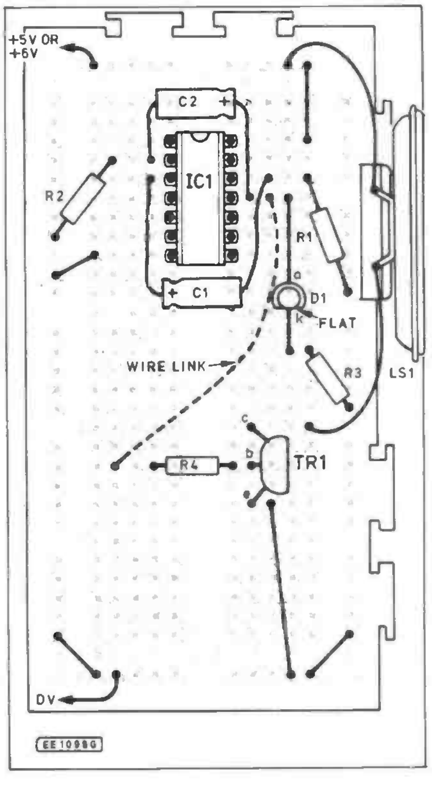
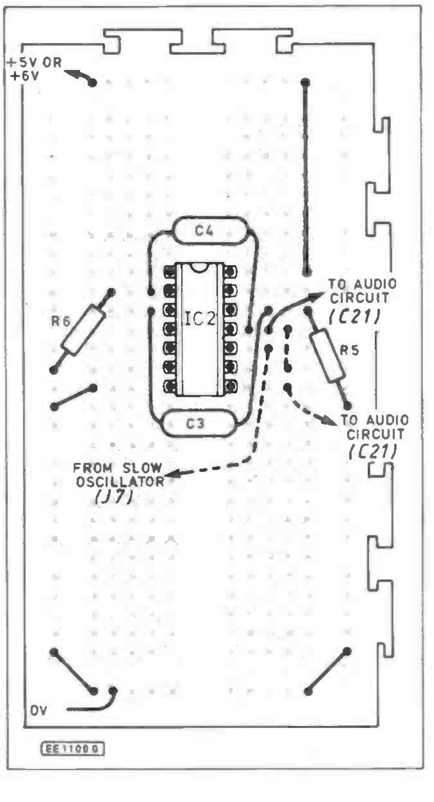


Fig. 16.5. Fast Oscillator "test-bed".



The timing on waveform diagram (Fig. 16.6) helps to explain what happens when the two oscillators are connected together. When the Slow Oscillator output is low, the NAND output is high, no matter whether the Fast Oscillator is low or high. No sound is heard.

When the Slow Oscillator goes high, the NAND output is the *inverse* of the Fast Oscillator. We hear the high-pitched sound.

You will probably have noticed that this bleeping sound is far more attention-catching than a continuous tone. It makes a good alarm tone to use with some of the devices described earlier in this series, such as the Rain Detector (August 1986), Light Operated Switch (November 1986) and the Telephone/Baby Alarm (July 1987).

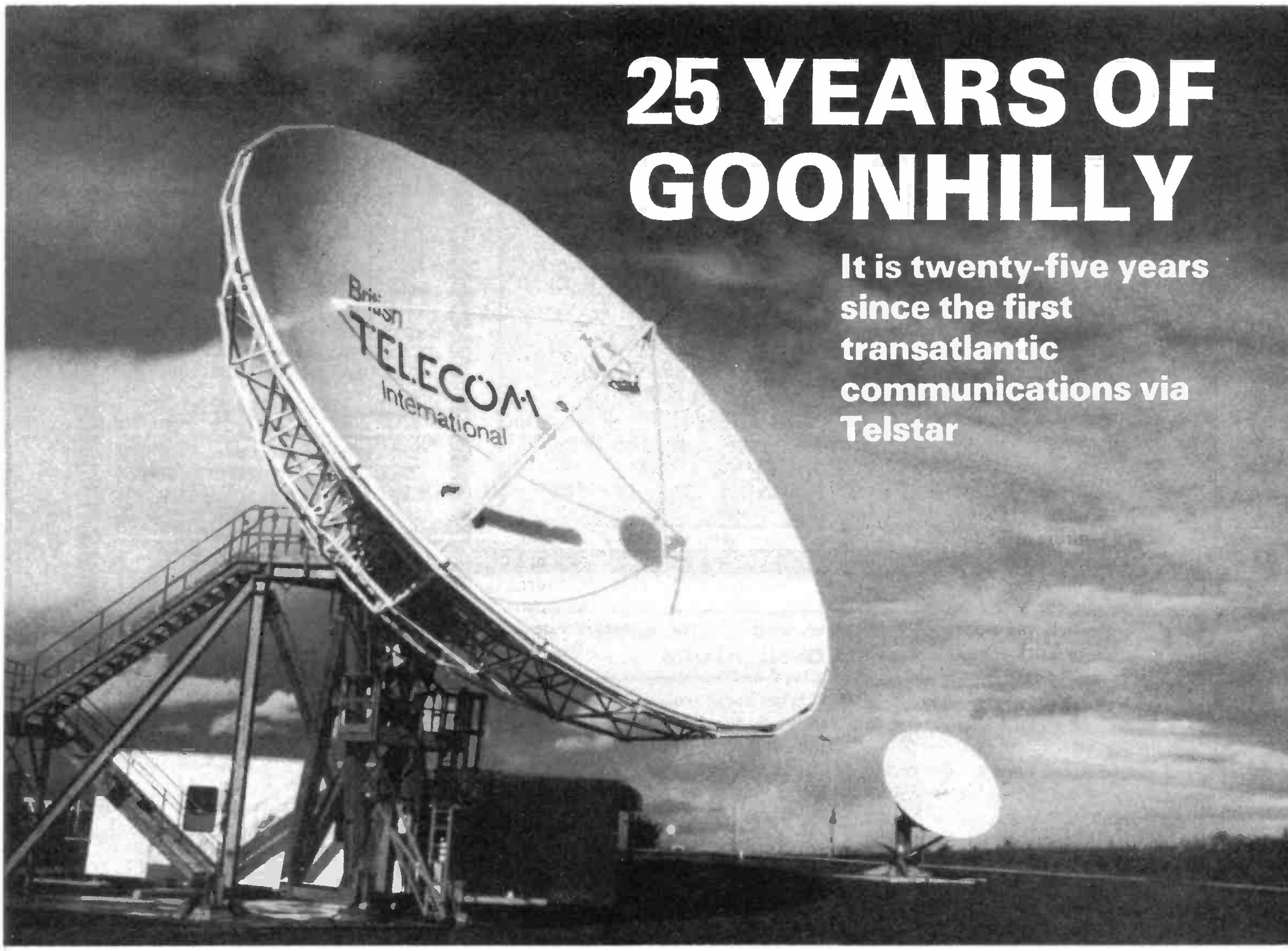
To control it, we need one or more NAND gates. Use the spare gates in IC1 or IC2. The control input is taken from the collector terminals of the circuits and possibly a NAND gate is needed to invert the control output. We leave it to the reader to work out the logic required.

Note that we shall be using the Slow Oscillator again in next month's investigations.

Next Month: Investigating the JK Flip-Flop and counting circuits.

25 YEARS OF GOONHILLY

It is twenty-five years since the first transatlantic communications via Telstar



IN THE spring of 1961 it was jointly announced in the United Kingdom, the USA and France that the US National Aeronautics and Space Administration (NASA), the French Centre for Telecommunications Studies and British Telecom, as its predecessor Post Office Telecommunications, would co-operate in a programme for transatlantic testing of communications satellites.

At the same time it was announced that satellite earth stations would be built in England and France "for the reception and transmission of telephone, telegraph and television signals across the Atlantic using satellites to be launched by NASA during 1962 and 1963."

Work began shortly afterwards to build the UK's first satellite station at Goonhilly Downs in Cornwall. The site was chosen because it was as far west as possible to obtain the maximum period of visibility to the United States via the satellite, to be remote from sources of electrical interference, and to provide an unobscured view to the horizon for the longest possible contact with the satellite.

In less than a year from gaining access to the site the station was ready. A massive, steerable dish antenna, weighing 870 tonnes with a 25.9m dish had been built. All of the equipment on the station was of British design and manufacture, with the exception of one American transmitting klystron valve.

The British design was the odd-man-out among the three earth stations to be used for the tests. Both the American station at Andover, Maine, and the French station at Pleumeur Bodou in Brittany, were equipped with horn antennas housed in radomes. The British station had cost around £800,000 to complete, about a quarter of the cost of the American and French stations.

TELSTAR

In early July 1962 it was announced that Telstar would be launched from Cape Canaveral on either July 10 or 11.

The successful launch took place at 8.35 GMT on Tuesday, July 10, and the desired orbit was achieved. With Telstar circling the earth at heights varying between 590 and 3500 miles, it was possible to achieve three or four periods during each 24 hours when mutual visibility between Goonhilly and Andover lasted for 30 to 40 minutes.

During these periods the antenna at Goonhilly had to be accurately manoeuvred to follow the satellite from the moment it rose above the horizon until it again disappeared from view. The signal transmitted from the antenna to the satellite was concentrated into a narrow beam, one-fifth of a degree in width, so absolute precision was necessary. To maintain this accuracy in high wind meant that the antenna had to be massive and sturdy. In order to move the antenna so accurately it was equipped with electric motors of some 100 horse power. However, the engineering design resulted in such good balance and smooth movement of the antenna that normally less than two horse power was required under reasonable weather conditions.

The primary purpose of the Telstar satellite tests was to acquire data on which to base the future design of satellite systems for commercial operation. However, during the period from July 10 to July 27 a number of demonstrations were carried out which illustrated the potentialities of satellite systems for world-wide telecommunications.

FAILURE!

In the early hours of July 11 the first usable orbits were the sixth and seventh and the first attempt at television reception was made. Reception was decidedly poor. Some experts were quick to blame Goonhilly's unique antenna design, and *The Times* described the experiment as "an almost total failure". Some experts said the antenna was too heavy and cumbersome to accurately track the satellite, others blamed the driving mechanism.

The problem proved to be that one component had been fitted the wrong way round and it was a twenty-minute job to correct it. The effect of the incorrect fitting had been to reverse the direction of the wave polarisation of the antenna, relative to that of the satellite, introducing a serious weakening of the strength of signals received. The problem arose because of an ambiguity in the accepted definition of the sense of rotation of radio waves; a difficulty which had been encountered both in the USA and the UK in the period just before the tests.

With the correction made, excellent pictures were received on orbit 15 during the evening of July 11, and during orbit 16 the first live television transmission between Europe and the USA was made from Goonhilly to Andover. The pictures and sound received at Andover were reported to be of excellent quality and were broadcast as received throughout the USA.

On July 12 the first two-day transatlantic telephony tests were made, showing that good-quality, stable telephone circuits with low noise levels had been achieved. These tests were to be followed two days later by the first transatlantic telephone call and photo-telegraphy (facsimile) transmission via satellite.

On July 14 during orbit 34 , the director general of the Post Office, Sir Ronald German, spoke from his home in London to the president of American Telephone and Telegraph Co (AT&T), Mr Eugene McNeely, in New York. Simultaneously, one pair of channels was used to send facsimile pictures between London and New York.

On July 15 tests to access the ability of a communications satellite to carry large numbers of telephone circuits were carried out during orbit 43. These demonstrated that at least 600 first-grade international circuits should be possible by satellite.

The first transmissions of colour television signals by satellite were made from Goonhilly during orbits 60 and 61 on July 16. With the co-operation of the BBC's research and design department, who provided a colour slide scanner and monitor equipment, the signals, on 525-line NTSC standards, comprised captions, test cards and still pictures to assess colour quality. The transmissions were initially made from Goonhilly to the satellite and back to Goonhilly but were also received in Andover. Andover reported: "Colour – good; picture quality – excellent."

During orbit 87 on July 19 satellite communications were opened up to the press. Twenty-four calls were made by the British press from Fleet Building in London, to the American press in New York.

On July 23 during orbit 125 an 18-minute long programme from the European Broadcasting Union was transmitted from Goonhilly to Andover. The programme consisted of scenes from many European countries and was transmitted by the Eurovision link to Goonhilly, from Goonhilly to the satellite, and was received at Andover and broadcast throughout the USA.

During orbit 151 on July 26, the Telstar link between Goonhilly and Andover was used to provide telephone circuits for the US Information Agency involving conversation between "notable persons" in 20 pairs of cities in the USA and Europe for the Agency's "People-to People" programme. The circuits were reported as excellent.

The Telstar Tests confirmed that communications satellites could provide high-quality, stable circuits for television and multi-channel telephony. The performance of Goonhilly earth station was reported as excellent in every respect, and the equipment, almost all of which was of a unique new design, had worked well. In fact, Goonhilly's antenna design was to prove to be the blue-print for the future.

GEOSTATIONARY

Arthur C. Clarke had, in his 1945 paper published in *Wireless World,* proposed that satellites, circling the earth above the equator at a certain height, would appear to be stationary to the earth's surface – their period of orbit would exactly match that of the earth's natural rotation. That distance was 22,300 miles above the equator.

After INTELSAT I's successful launch to this height, commercial service opened in June 1965.

Arther C. Clarke had also proposed that three satellites in geostationary orbit could give world-wide radio coverage.

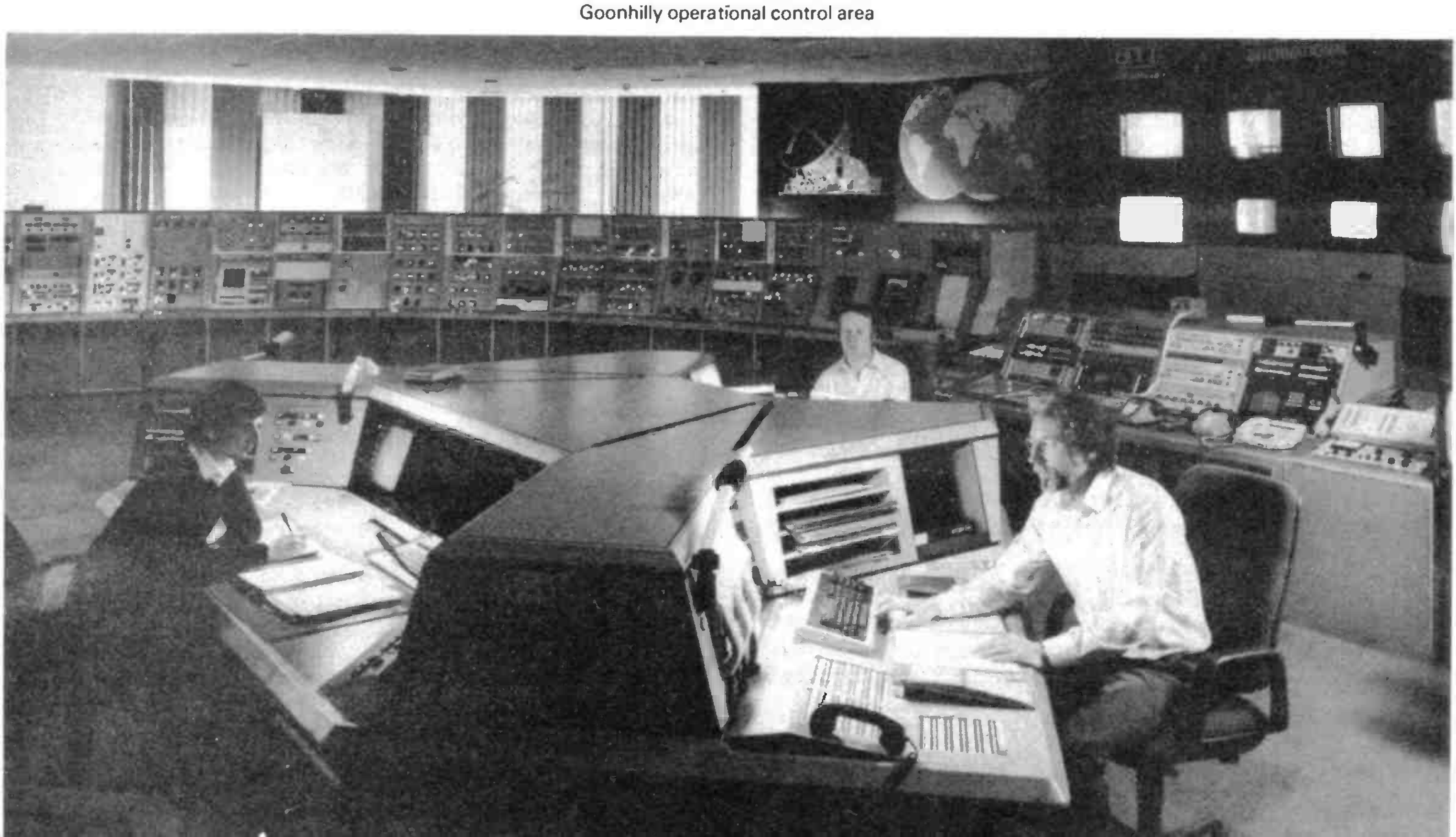
A second satellite – INTELSAT II – was launched in October 1966, and with the launch of INTELSAT II, Aerial 1 at Goonhilly, which now no longer needed to track low-orbiting satellites across the sky, had an extra reflecting surface added, pushing its weight up to 1100 tonnes.

Satellite communications had now truly entered commercial operation. As the demand for transatlantic TV and telephone transmission grew, so did Goonhilly with the added Aerial 2 in 1968.

By 1969 three geostationary satellites were in orbit, fulfilling Arthur C. Clarke's prophesy of global communications. INTELSAT III was positioned above the Indian Ocean and demand for satellite communications with the Far East grew. To meet this need Aerial 3 was brought into service in 1972.

Aerial 4 was added in 1978, to meet an ever-increasing demand for communications across the Atlantic. This was also one of the first antennas in the world to use the 11/14 GHz

Goonhilly operational control area



Experimental Skyphone at Goonhilly

frequency as soon as it became available for business satellite communications.

Demand for satellite communications grew by 20 percent a year during the 1970s and early 1980s. Further satellites were put into orbit and in October 1978 a second earth station was brought into service by British Telecom at Madley in Herefordshire, on the England/Wales border.

Demand for specialist services also grew during this period and in 1983 Aerial 5 at Goonhilly was completed to provide satellite services to ships at sea.

At the same time Aerial 6 was being built to provide further capacity on the busy transatlantic route. Aerial 6 is Goonhilly's largest dish with a diameter of 32m. It was also the first "dual-frequency" antenna, able to both transmit and receive on two frequencies simultaneously – doubling potential capacity. It entered service in September 1985.

While Aerial 6 was being built Aerial 7 was also being brought into service to provide leased TV services to North America.

LONDON TELEPORT

With continuing growth in demand for satellite communications, British Telecom announced plans in August 1983 to build a third earth station in London's Docklands, primarily for satellite TV distribution and specialised business services. The London Teleport, in North Woolwich, opened for operation in February the next year – less than six months after site clearance began.

Aerial 7 at Goonhilly, initially for TV circuits, is now being used for the trial of "Skyphone" – a telephone service to aircraft in flight – which is due to start in the autumn.

Meanwhile Aerials 8, 9 and 10 have been built. These are small-dish antennas below 14mm in diameter. They are used for research and development, and to provide monitoring and control facilities on the more than 130 satellites currently in use.

DEVELOPMENTS

Today, development at Goonhilly continues. Aerial 6, the biggest antenna has been equipped to operate to the latest development in satellite communications – Time Division Multiple Access/Digital Speech Interpolation (TDMA/DSI). TDMA/DSI means that signals from the station are grouped and sent by time rather than frequency, and on the principle that during the average telephone conversation either party is only speaking for one third of the time of the call, other groups of signals can be sent along the same channels during the lapses of conversation.

Goonhilly aerials and laboratories are used for testing new stations being built around the world. The centre is at the forefront of interference monitoring and investigation into propagation, plus the development of new systems and services.

Over the years many technological advances have been made, for instance although communications satellites are in geostationary orbit they appear to move in a relatively small figure of eight pattern during each day due to the earth's "wobble" on its axis. In order to receive high quality signals each aerial must be moved slightly to track the satellite. Originally this was done by stepping the aerial in one direction and seeing if the signal improved – by continuing the steps for a better signal or reversing them if reception was worse, the satellite was tracked. This of course is a continual process with motion on both axes. An improvement has come by using a microprocessor to "learn" the tracking path each day and therefore make more intelligent "guesses" at the direction of each step the following day. This system is called the "smooth step track controller". Both the above systems require the continual movement of the aerial over very small angles.

A novel alternative approach has now been developed by British Telecom International whereby "mode generators" are attached to the walls of the feed. These "mode generators", incorporating a PIN diode, filter and short circuit, may be switched on and off with a resulting very small deflection of the antenna beam without any physical movement of the antenna. In operation, the beam is deflected perhaps 1000 times per second in four directions and using a single channel receiver the optimum direction for any necessary wholescale antenna movement can be derived. The controller is a modified version of the smooth step track controller. Key advantages are an equivalent high performance at a lower cost arising from the simple feed and single channel receiver and the reduction in wear of the main antenna steering motors, etc.

The new "beam squint" concept is also particularly attractive for antennas mounted on moving platforms (ships, aircraft, vehicles, etc.), or antennas following fast moving low-orbiting satellites. The European Space Agency (ESA) has already adopted the system for use on-board a satellite for an intersatellite link application.

THE FUTURE

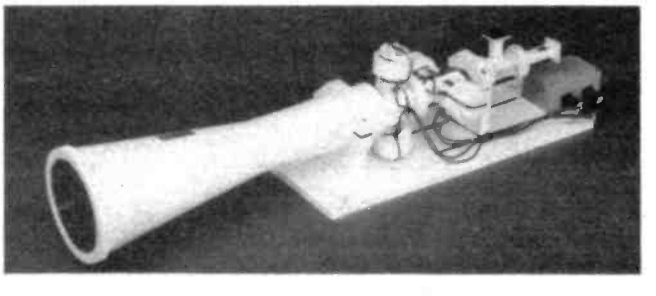
Future developments include the Skyphone – a consumer phone system for aircraft where in-flight passengers will be able to use a credit card in a payphone and dial up their friends or businesses via satellite around the world. Trials of the world's first satellite radiopaging system are also underway. This will enable drivers of long-distance lorries to be contacted immediately by their companies while they are on the road – particularly those of road haulage firms operating on routes across Europe, the Middle East and Africa. The service will provide another international extension to the existing radiopaging service operated in the United Kingdom by British Mobile Communications (BTMC).

The Message Master pagers to be used in the trial will allow short messages of up to 90 characters to be sent with the characteristic bleep-tones. The pagers will have seven digit numbers, and a liquid crystal display similar to those widely in use in Britain. Messages to drivers can be telephoned, keyed-in, or telexed in the normal way to the radiopaging system's computers. The combined Message Master pager and printer fits conveniently on the parcel shelf of the cab dashboard.

The purpose-built antenna mounted on the lorry cab roof comprises a flat plate approximately 120mm square and 10mm thick, which is wired to a small low-noise receiver mounted in a box underneath.

Communication via satellite has come a long way in the last twenty-five years. □

Beam squint feed



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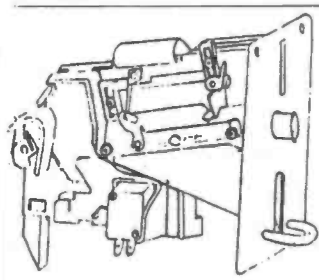

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b...Beeb...Beeb...Beeb...Beeb

. . . Archimedes — all things to all men . . .

AT THE time of writing this (about the middle of July) the new Acorn computers have recently been announced. These are the *Archimedes* range of computers, or what is really two separate ranges. The A305 and A310 are the least expensive versions, and will have the BBC name rather than being marketed as Acorn computers.

As far as I can tell, the only difference between these two models is that the A305 has 500K of memory as opposed to the 1M of the A310. Upgrading from one to the other seems to just be a matter of plugging in the extra memory chips.

The up-market Archimedes computers are the A410 and A440. The former has 1M of RAM plus a hard disc controller, whereas the latter has 4M of RAM plus a 20M hard disc drive.

These computers are of potential interest to *Everyday Electronics* readers who are interested in computer projects, as they have the facility to take "podules", which are add-on boards of various types. Included amongst these is one to give the machines the 1MHz Bus and some of the other input/output ports of the original BBC Model B computer.

The A410 and A440 are equipped to take the podules as standard, but an add-on back-plane is required for the two cheaper models. Incidentally, all models come with a 3.5 inch (640k or 800k formatted capacity) disc drive and three button mouse as standard.

RISC

The new machines are a substantial step forward from the earlier Acorn computers with their 2MHz 6502 microprocessors. The speed of the new machines should be sufficient to make even the Master Turbo computer with its 4MHz second processor look quite sluggish.

The new machines are based on Acorn's RISC (Reduced Instruction Set Computer) technology. This is very straightforward as far as the basic principle is concerned, and the general idea is to have a full 32-bit microprocessor which has only a limited but well selected range of instructions.

This may not seem like a key to high processing speeds, but with fewer instructions to contend with the processor can be made very efficient on the ones that are included. This enables virtually all the instructions to be carried out in a single clock cycle, which is 4 million per second with the Acorn processors.

In many cases several instructions are needed to replace a single instruction on conventional processors, but a RISC chip can still get the job done more quickly. Bear in mind that some instructions can take over twenty clock cycles with conventional processors.

Due to their relatively simple circuitry it is possible to run RISC chips at high clock rates more easily than for a conventional design, but this gives problems with expensive memory chips that can keep up with the processor. The Acorn RISC chips can be used with standard and inexpensive memory devices.

Dream Machines

The Archimedes computers have an enhanced version of BBC BASIC which runs extremely fast, and they also have impressive graphics capability. Apart from all the standard BBC modes (including mode 7) there are new modes which include a 640 × 512 pixel sixteen colour mode, and a 1024 × 1024 pixel mono mode.

These computers sound very much like "dream machines", but they start at VAT inclusive prices of under £1000. However, the most expensive model plus a high resolution monitor would probably cost in excess of £3000.

While I suppose that it is true to say that computers provide an increasing amount of computing power for an ever decreasing amount of money, this is only really the case if you are prepared to spend a fair amount of money — what happened to sub-£100 computers, let alone sub-£50 types?

The new Acorn/BBC computers offer more computer per pound than the original Model B, but entry level price seems to be somewhat higher. From the point of view of user constructed add-ons most current computers offer little scope, with expansion ports that are usually very difficult to use by comparison with earlier machines.

It is nice to see that the Archimedes computers will provide the standard BBC B ports, albeit via an add-on unit. I would suggest though, that any electronics enthusiast who currently owns a BBC model B should keep it for all time, as it seems unlikely that there will be anything quite as convenient for user add-ons ever again.

The new Acorn computers look to be worthy successors to the original machine, which offered a similarly amazing specification for the money at the time it was launched. The new machines keep up the "all things to all men" tradition of the Model B.

Other Machines

Lack of software and hardware compatibility between computers is probably one of the main reasons for the problems many computers manufacturers have faced over the past few years. It certainly gives computer project designers a lot of problems with questions about using a project for one computer with a different model. This is often possible, but only with a lot of changes to the software and the project itself.

A point that is worth mentioning here, is that a lot of the information given in the *BEEB Micro* articles is concerned with the user port, and the port B of the 6522 VIA which is used to provide this. Most of this information is relevant to any computer which has a 6522 VIA with port B available to the user.

The VIC-20 certainly falls into this category, with the VIA at addresses from 37136 to 37151. VIA add-on boards are available for some computers, or there have been designs published for them. With one of these added it should be possible to successfully interface vitually any add-on for the BBC machine's user port to the computer.

There are a vast number of Commodore 64 users who are not well served for computer projects. This computer (and its derivatives) have a user port, but it is supplied by one section of a 6526 CIA (Complex Interface Adaptor).

This is one of Commodore's own chips, and it is essentially an "improved" 6522. It has many features in common with the 6522, including the two timers. The *Commodore 64 Programmer's Reference Guide* includes a data sheet for the 6526, and reference to this will usually provide a means of using the Commodore 64 with add-ons intended for the BBC model B or VIC-20 user ports.

Useful Bits

Often when interfacing a project to the BBC computer an extra digital line or two is often required. It is useful to bear in mind that there are two digital lines available at the analogue port.

These are PB0 and PB1 (Fig. 1), and are intended for use when reading the "Fire-buttons" of the joysticks. They can be read from BASIC using the ADVAL function, or directly from the 6522 VIA at address &FE40. This is port B of a 6522 VIA, which is obviously not the same one that is used for the user port.

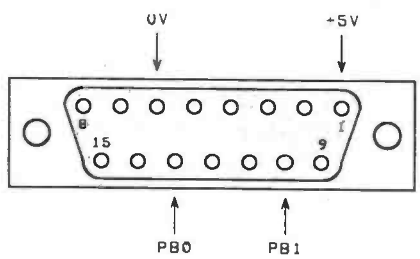

Fig. 1. Using the analogue port to provide two digital inputs.

Although these lines are referred to as PB0 and PB1 in the BBC computer's manual (or, less confusingly, I/O0 and I/O1 in places), they are actually lines PB4 and PB5 of the VIA. PB0 is therefore read by ANDing the value from ?&FE40 with 16, while the same procedure and a value of 32 is used when reading PB1. In other words, PRINT ?&FE 40 AND 16 will give a returned value of 16 if PB0 is high, or 0 if it is low. PRINT ?&FE 40 AND 32 returns values of 32 and 0 respectively if PB1 is high or low.

Using these lines as outputs is a little more difficult, and is probably not possible. The first problem is that the four least significant lines of port B of this VIA seems to be used as outputs.

Inadvertently changing the state of these outputs seems to activate the sound generator! This problem is surmountable, but there is a second one that is probably not.

The difficulty is that shortly after setting one of these line high, the computer almost immediately resets them to 0 again! I tried feeding these outputs to a 4013BE dual flip/flop, and using the pulses generated by setting these outputs high to toggle the outputs of the flip/flops from one state to another.

This worked, but using the keyboard seemed to produce output pulses that altered the states of the outputs. It would therefore seem that these two lines have to be regarded as only usable in the input mode.

Most BBC Model B computers were sold without the disc interface fitted, but probably the vast majority of these computers have now been upgraded to disc systems. I was some time in adding the disc interface to my machine as I had gained the impression that it involved a lot of dismantling, soldering, and reassembly.

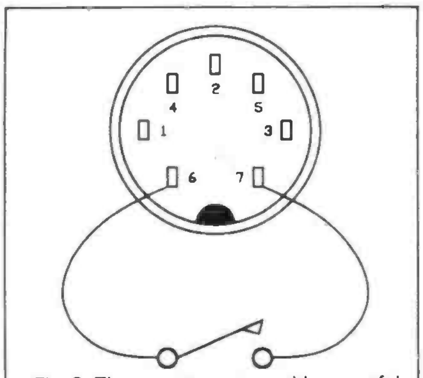

Fig. 2. The cassette port provides a useful relay for simple control applications.

In fact, it involves little more than plugging the extra integrated circuits into holders already fitted on the printed circuits board. Disc interface kits are readily available, and it is well worth making this upgrade. Even a basic 100K drive is much more convenient and capable than a cassette recorder.

If this upgrade is made, this leaves the cassette port unused. The data input and output lines are of little obvious value, but the relay used to control the cassette recorder's motor could be very useful.

The relay provides a pair of normally open contacts across pins 6 and 7 of the 7-pin Din socket used at the cassette port, Fig. 2. These contacts should NOT be used for mains loads, but are perfectly all right for low voltage loads and currents of up to about 1A.

By connecting one contact to the 0V rail and the other to the +5V rail, via a 1k resistor, a TTL compatible output is produced. It would be limited to fairly low switching speeds, and might need "debouncing" in some applications, but if only a single extra output line is needed it could be much easier than having to provide an output port on the 1MHz Bus.

The contacts are closed using the *MOTOR 1 instruction, and opened by the *MOTOR 0 instruction. Both are usable within BASIC programs.

Home CAD/CAM

Due to its widespread use in the educational and scientific fields, the BBC micro has what could be the broadest range of peripherals and software available for any computer apart from the IBM PC and compatibles. This includes software and hardware to aid the design and manufacture of printed circuit boards.

Some of the printed circuit drafting programs provide output to a dot matrix printer, and give an output at 2:1 that printed circuit manufacturing companies can use to produce boards. This system has the advantage of being relatively cheap as many BBC computer owners will already have a suitable printer. For the home constructor though, it can be difficult to translate the printed drawing into an actual board.

The alternative to a printer is a pen plotter, and the ***Plotmate*** plotters from ***Linear Graphics Ltd*** are low cost machines of special interest to BBC owners who pursue electronics as a hobby. Apart from three standard plotter languages they have what is probably the unique feature of a language that responds to the BBC computer's VDU commands. Software for the BBC computer plus Plotmate plotter includes a simple drawing program for circuit diagrams, and a printed circuit drafting program.

I used this combination to produce printed circuit boards for some time, and some of the designs have been published in *Everyday Electronics*. While not rivalling systems based on mainframes, it enables quite complex boards to be produced with relative ease. By plotting the designs onto tracing or drafting film at 1:1 it is possible to produce prototype boards using a simple photographic method (as described in *Actually Doing It*).


The Plotmate A3M plotter from Linear Graphics

As a point of interest, the techniques used in printed circuit design are based on ideas developed originally for designing plumbing systems. The scale may be very different, but the principles involved are much the same.

According to the latest press release from Linear Graphics the Plotmate equipment and software are now recommended by the Inner London Education Authority (ILEA). Their products are British designed and built, which is unusual in the Far-Eastern dominated market.

Their products are certainly well worth investigating if you own a BBC computer and are considering using it for printed circuit design work, or are interested in low cost CAD/CAM equipment for educational purposes. For further details contact: ***Linear Graphics Ltd., Dept. EE, 28 Purdeys Way, Rochford, Essex SS4 1NE.***

Next month, if it is ready in time, we will consider adding a Master 128 style battery clock/calendar to the 1MHz Bus of the standard BBC model B computer.

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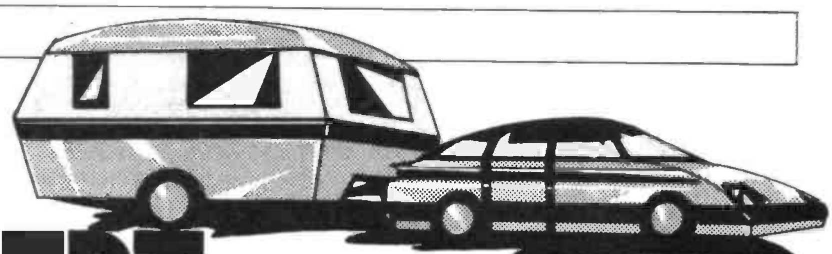


CARAVAN FRIDGE ALERT

T.R. de VAUX-BALBIRNIE

Don't take chances, on the road or on site, build this simple fridge alarm.

A REFRIGERATOR is now fitted in most caravans. This is of the *absorption* type where refrigerant is heated in a boiler to the rear of the cabinet. Two means of heating are generally provided – one for gas and the other for 12V operation. There may be a 240V mains heater also.

The gas (or mains) system is used while static and on-site because the large current drawn by the element (typically 7A) would quickly discharge the battery. While travelling, the 12V heater is used – the car generator now provides the current.

The Caravan Fridge Alert described here has two functions. Firstly, to sound a warning if the gas supply is left turned on and the ignition operated. As well as being dangerous to drive with the gas turned on, this could result in both heaters – 12V and gas – being used together with consequent overheating and damage to the fridge.

The second function of the circuit is to monitor the current flowing through the 12V element and to sound a warning if it fails for any reason such as a blown fuse, open-circuit element, broken wire or loose connection. Such faults are common and soon result in ruined food.

The circuit is housed in a small plastic box with a strip of terminal block for the external wiring. An on-off switch is provided to cancel the unit if the fridge is not in use or when a caravan is not being towed.

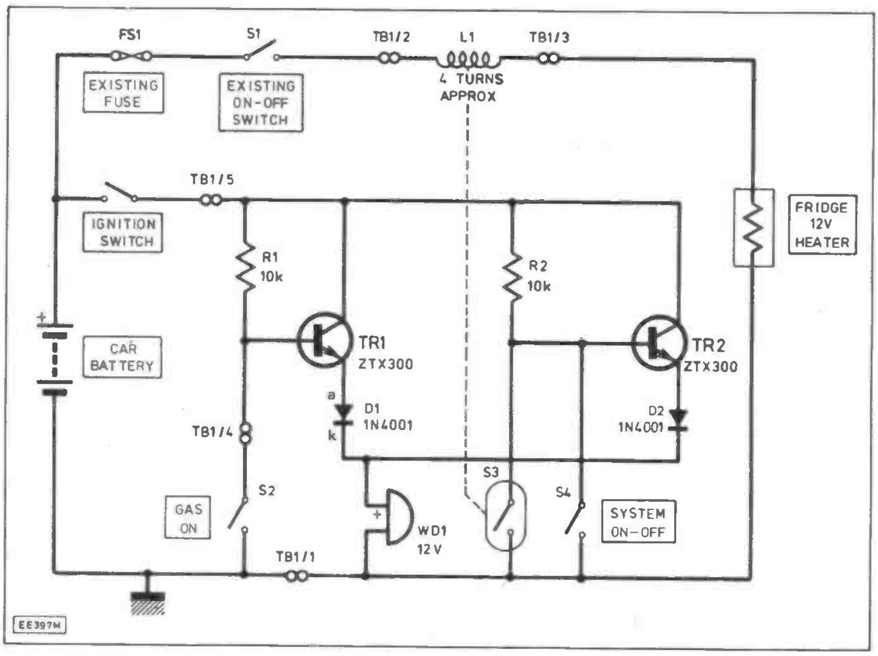
It is important to note that this switch does not control the refrigerator – if forgotten, the fridge will still work normally but no warning will be given in the event of the 12V system failing. The "gas on" warning will be given, however, whether the switch is on or off.

Although originally intended for a caravanette, there should be no difficulty using the unit with a trailer caravan. Before beginning construction work, it would be wise to check that the existing gas supply tap can be fitted with a microswitch which operates as the tap is tightened.

Specific details cannot be given since there are many different types of gas tap. However, Fig. 4 shows the method used in the prototype unit.

Readers are warned that the microswitch must in no way interfere with normal operation of the gas supply. ***If there is any doubt about being able to make a safe job, the assistance of a qualified caravan gas fitter must be sought.***

Fig. 1. Complete circuit diagram for the Caravan Fridge Alert.



CIRCUIT DESCRIPTION

The complete circuit diagram for the Caravan Fridge Alert is shown in Fig. 1. Transistors TR1, TR2 and associated components form two almost identical sections. If either transistor is turned on the buzzer, WD1, sounds.

The 12V heater element operates through coil L1, which therefore carries the main-line current from the car electrical system. The existing fridge on-off switch, S1, may be situated anywhere in this circuit and not necessarily as shown. Switch S2 is the gas tap microswitch referred to earlier.

With the ignition switched on and the gas off (S2 contacts closed) transistor TR1 base is connected to the negative supply rail. Transistor TR1 is therefore off so no current flows through diode D1. The buzzer, WD1, therefore remains silent.

With the gas on (S2 contacts open) TR1 turns on, with base current entering via resistor R1. Collector/emitter current now flows through diode D1 operating WD1. Transistor TR2 works in similar fashion and is responsible for the "12V Fail" warning.

COMPONENTS

Shop Talk See page 563

Resistors
R1, R2 10k (2 off)
All 0.25W 5% carbon

Semiconductors

TR1, TR2	ZTX300 *npn* transistor (2 off)
D1, D2	1N4001 (2 off)

Miscellaneous

WD1	12V Solid-state buzzer
S2	Lever-arm microswitch with one pair of changeover contacts.
S3	Miniature reed switch, with single-pole "make" contacts. Body size 20mm long x 3mm diameter approximately.
S4	Miniature rocker switch with single-pole "make" contacts.

Stripboard (0.1in matrix size 8 strips x 12 holes); 15A terminal block – 5 sections required; 3A auto-type connecting wire; aluminium for microswitch support bracket; L1, 20 s.w.g. enamelled copper wire; 20cm approx. case and connecting wire, etc.

Approx. cost Guidance only £6.50

A coil of copper wire (L1) is wrapped around the body of reed switch, S3. Providing L1 carries sufficient current, the magnetic field so generated operates S3, closing its contacts. This keeps TR2 off so no current flows through diode D2. The warning buzzer WD1 is therefore silent.

If the supply fails for any reason, S3 contacts open and transistor TR2 turns on, with base current entering through resistor R2; WD1 then sounds. S4 switches the 12V warning off when not required.

The circuit has been designed to be "fail-safe" under most circumstances. Thus, a fault in switch S2 or its connections will generally cause the alarm to sound. However, it will *not* work if the wiring to the ignition switch fails.

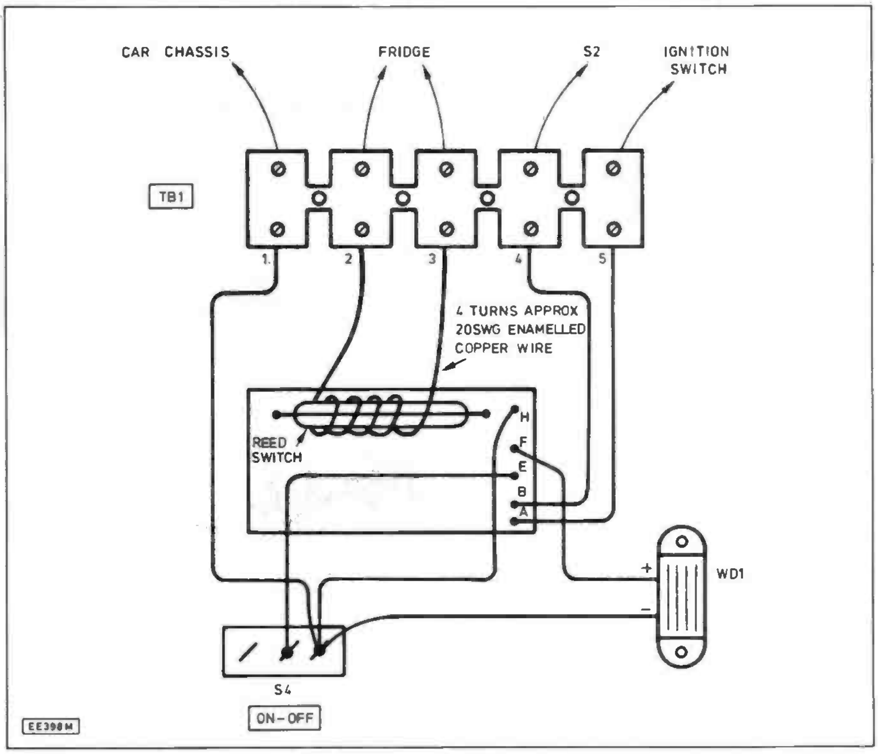


Fig. 3. Details of interwiring from the circuit board to the 5-way terminal block, rocker switch and the warning buzzer.

CONSTRUCTION

Construction of the Caravan Fridge Alert is fairly straightforward and is built on a single piece of 0.1in matrix stripboard, size 8 strips × 12 holes. The component layout and the underside view showing breaks in the copper strips is shown in Fig. 2.

Begin by drilling the mounting hole, making the breaks in the copper strips and inserting the link wire as indicated. Follow with the soldered on-board components noting the polarity of the diodes.

Take care when preparing the reed switch for mounting – do not bend the wire ends close to the body since this may break the glass and render it useless. Solder the reed switch 2mm clear of the circuit panel to allow for winding the coil L1 later.

After a careful check for errors, particularly for accidental "bridging" of adjacent copper strips, solder 10cm pieces of light-duty stranded connecting wire to strips *A*, *B*, *E*, *F* and *H* at the left-hand side of the circuit panel. Using different colours will reduce the possibility of wiring errors.

INTERWIRING

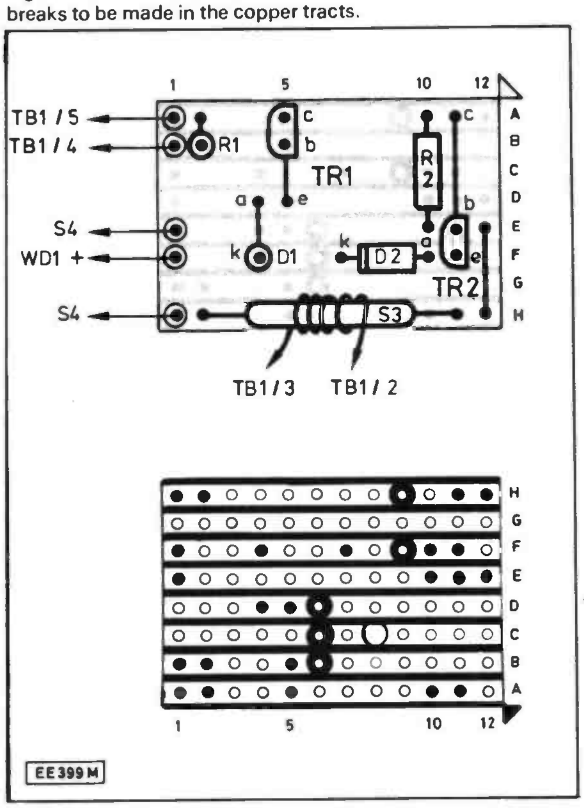
Make a hole in the side of the box for switch S4. Mount all remaining components together with terminal block TB1 in the rear panel (see photograph). TB1 *must* be of the heavy-duty pattern with a rating of 15A. It is not normally necessary to provide holes for the sound from the buzzer WD1 to pass through. Drill small holes near TB1 position for the connecting wires passing through from the circuit panel.

Complete the internal connections shortening any wires as necessary as shown in Fig. 3. The exact number of turns to be used for L1 will depend on the reed switch being used and the current requirement of the fridge – 4 turns was correct in the prototype unit.

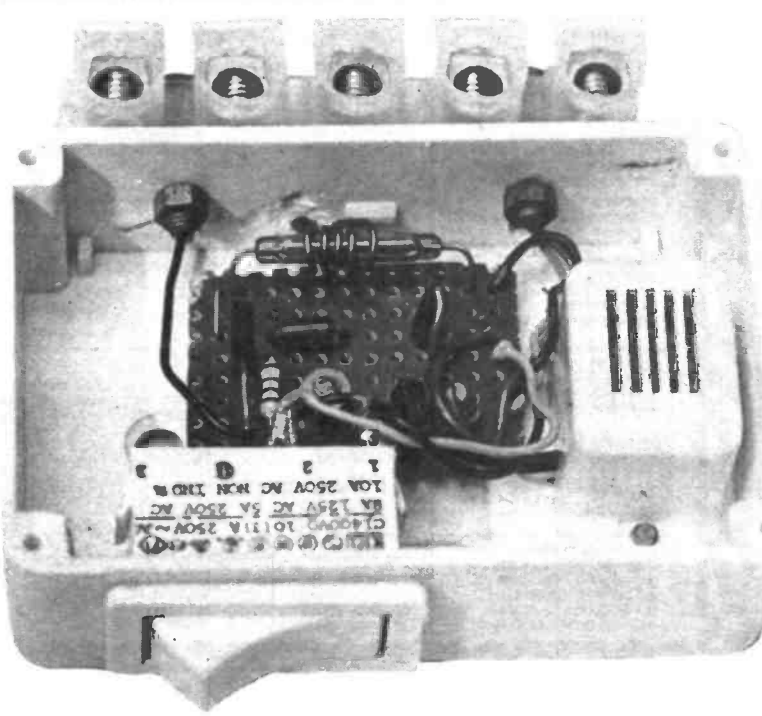
The coil must be wound with great care to avoid damage to the reed switch body. Allow a small space between successive turns. Note that the wire used must be of the specified type and thickness to avoid excessive local heating and voltage drop due to its resistance. For the same reason, it should be kept as short as possible. Twist it *once* at the reed switch body to secure it and pass the ends through the hole drilled for the purpose – this should be of sufficient size to allow the wire to pass easily. Scrape off the insulation at the ends before connecting to TB1/2 and TB1/3.

Construct and fit gas tap switch assembly as shown in Fig. 4. The lever arm should be carefully bent so that the knob presses it and the contacts are just heard to click when fully off.

Fig. 2. Circuit board component layout and details of breaks to be made in the copper tracts.



The completed unit with top removed to show layout of components inside the plastic case. Note that the reed switch is mounted well above the board.



INSTALLATION

Before installing the circuit, disconnect the car battery. Refer to Fig. 3 and make the external connections. Cut one of the existing feed wires to the 12V element at some convenient point as close as possible to the chosen place for the unit.

Do not extend the wires unless absolutely necessary and then only with a heavy-duty auto type having a cross-sectional area of $2mm^2$ minimum. Wire of a lower rating may introduce an excessive voltage drop leading to poor operation of the fridge. The free ends of the wires should be connected to TB1/2 and TB1/3 (polarity unimportant).

Connect one S2 normally-open contact to TB1/4 and the other to an "earth" point (battery negative). If the unit is to be fitted to a motor caravan, there will no difficulty with the S2 connections.

However, if it is being used with a *trailer* caravan having a single 7-pin drawbar plug and socket, there is no unused pin available for this. The best solution is to fit the later type of 7S (supplementary) socket in addition to the existing 7N (normal) one. This will give scope for future additions and bring the installation up to date. Use Pin 6 and Pin 3 on the 7S socket for the positive and negative fridge connections respectively. Use Pin 7 to connect S1.

Connect TB1/5 to a fuse which is live only while the ignition is switched on and TB1/1 to a nearby earth point (car chassis). Use proper auto-type wire of 3A rating for these external connections and use a rubber grommet wherever wires pass through a hole drilled in metal.

Turn the gas off and re-connect the battery. Switch the fridge and S4 on. Turn the gas on. Switch the ignition on and the buzzer should sound. Turn the gas off and the sound should stop. Switch off the fridge (to simulate a fault) and the buzzer should sound once again.

If the buzzer sounds continuously even when it is known that the fridge is working correctly, it will be necessary to increase the number of turns on coil L1. The coil will become warm in use but the heating should not be excessive – check after a period of operation.

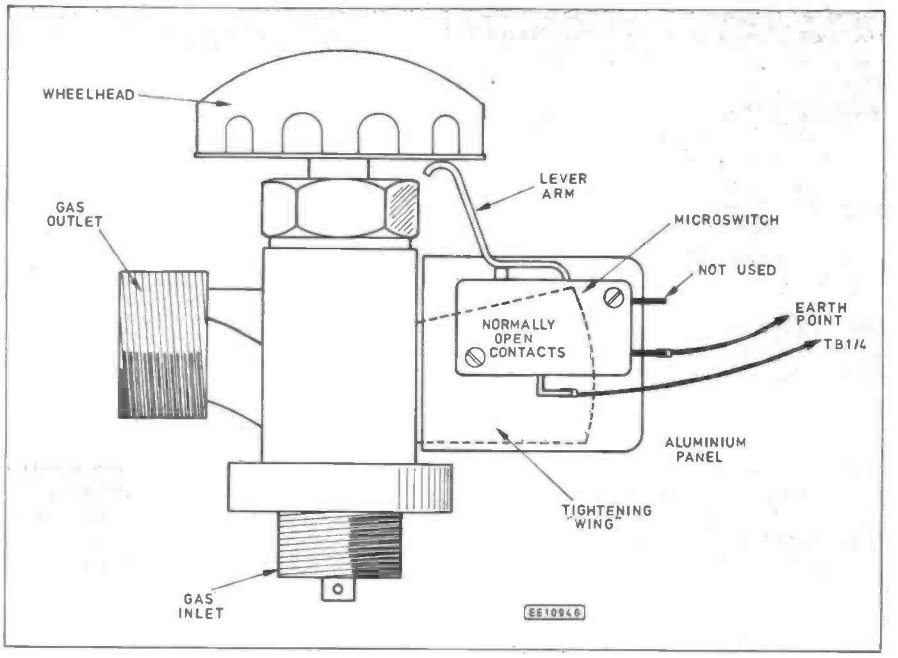


Fig. 4. Suggested method of mounting the microswitch below the gas supply "valve" control knob. The microswitch operating lever should be carefully bent so that adjustment of the gas knob operates the lever arm. ***If there is any doubt about being able to make a safe job, the assistance of a qualified caravan gas fitter must be sought.***

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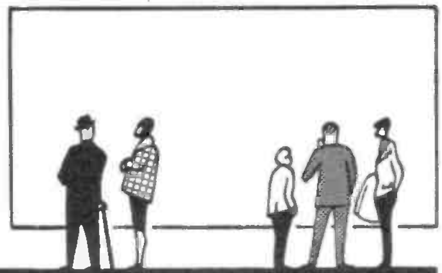

BY DAVID BARRINGTON

Video Controller

The plastic case, with metal sloping front panel, used in the prototype version of the *Video Controller* is a Bimbox 6006 type. However, most of our advertisers now stock excellent ranges of cases and a suitable one should be fairly easy to find.

When ordering the Gain and Balance controls, be sure to specify "log" and "lin" types respectively. The single and dual slider controls should be available as "off-the-shelf" items.

The printed circuit board for this project is available through the *EE PCB Service*, code EE581 (see page 571).

Simple Static Monitor

We have only been able to find two companies who list the 50μA-0-50μA centre zero panel meter specified for the *Simple Static Monitor*. This meter is currently being listed by **Marco Trading** and **Smith Electronics**.

Practically any type of meter rated at up to 1mA f.s.d. could possibly be used in this circuit, but would need to be off-set by VR1 potentiometer before installing in the case. The size of aluminium case used will, of course, depend on the final selection of meter.

Caravan Fridge Alert

It is important to use wire rated at 3A, or more where specified when constructing the *Caravan Fridge Alert*.

Reed switches are fairly common items and most good component suppliers should carry stocks. Ensure that a 15A type is specified when ordering the 5-way terminal block.

A suitable microswitch, with lever arm, is currently listed by **TK Electronics, Maplin, Electromail and Greenweld Electronics.**

Transtest

We cannot foresee any purchasing problems when ordering parts for the *Transtest*. However, one word of warning, when buying the transistor type BC184*L* it is important to purchase the one with the *L* suffix as pin connections vary for this device.

The printed circuit board for the *Transtest* is available through the *EE PCB Service*, code EE580.

Automatic/Manual Porch Light

The note above about buying the BC184*L* transistor also applies to the *Automatic/Manual Porch Light project*.

If the relay is to be mounted on the circuit board, it is *vitally* important that the mains connection to the contacts are fully isolated from other parts of the board by a series of breaks in the copper foil. For added safety, use nylon nuts and bolts to secure the mains transformer, terminal block, fuse and stripboard to the case.

Finally, remember to use mains cable for all high voltage wiring, including wires from the relay contacts.

Timer/Counter Interface

Readers intending to build the *Timer/Counter Interface* described in this month's *On Spec* feature may find that the Z80-CTC chip is in scarce supply in some areas. However, it is currently listed by **TK Electronics, Omega and Omni Electronics.**

All the components required for this month's *Exploring Electronics* investigations into Oscillators appear to be standard parts and should not cause readers any buying problems.

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OMNI ELECTRONICS are willing to give a 5% discount on all orders over £10.00, excluding VAT, if a valid voucher is enclosed. We stock a wide range of components—ideal for the hobbyist. Goods listed in our catalogue are generally in stock, orders will be sent by return post. Why wait?

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Robot Roundup

NIGEL CLARK

IT IS now more than a year since I began writing about robots in the columns of *Everyday Electronics*. In that time there have been a great many changes in the numbers and abilities of the devices which are on the market.

I therefore thought it would be worthwhile to recap this month and list the machines which are now available with a brief description. While every effort has been made to ensure that all items have been included I apologise if anything has been left out. All prices are approximate.

ARMS

Alfred ***(Robot City Technology)*** 5-axis plus gripper, servo-driven with toothed belts, lift 170gm. £275 + VAT. The constructional details for the early model of Alfred were first published in the November '85 issue of EE.

Armatrol II ***(Feedback Instruments)*** 5-axis plus gripper, servos with closed loop control, lift 1lb. Software: BBC B, C64, Apple IIe, ZX 81, IBM PC. £995 + VAT.

Atlas II ***(LJ Electronics)*** 5-axis plus gripper, stepper driven plus toothed belts. Lift 1kg. Update of the previous Atlas with improved software. On-board controller and wide range of operating software. Work cell also provided. £2,500 + VAT.

Beasty Arm ***(Commotion)*** 3-axis, gripper available, servo driven, lift 75gm. £120, + VAT. Interface available for the sum of £35.

Cyber 310 ***(Cyber)*** 5-axis plus gripper, stepper driven with belt and cable, lift 250gm. Software: BBC B, Apple IIe, IBM PC, Pet, C64. £695 + VAT.

EMU ***(LJ Electronics)*** 4-axis plus gripper, servo, lift 100gm. Software: BBC B and LJ's Emma. £325 + VAT.

HRA 934 ***(Feedback)*** 5-axis plus gripper, hydraulically powered. Software: On board processor, BBC B, Apple IIe, C64. £2,730 + VAT.

Minimover ***(Syke Instrumentation)*** 5-axis plus gripper, stepper motors, lift 1lb. Software: Apple II, TRS 80. £2,150 + VAT.

MA 2000 ***(Tecquipment)*** 6-axis plus gripper, servos with toothed belts, pneumatic gripper. Lift 1kg. Software: BBC B and Open University's Hektor. Gripper is fitted to take pneumatic tools and wired for sensors. £3,200.

Mentor ***(Cybernetic Applications)*** 5-axis plus gripper. Servo driven, lift 300gm. Can be controlled by small scale-model simulator. Software: BBC B, Vic 20 Spectrum. Work cell available, will work with other Cybernetic machines. £535 + VAT.

Naiad ***(Cybernetic Applications)*** 5-axis plus gripper, hydraulics (water). All axes powered by different kinds of hydraulic piston and all cylinders made of see-through acrylic, simulator, work cell, works with other Cybernetic machines. Software: BBC B, C64, Apple and IBM PC. £1,125 + VAT with controller £220.

Neptune 1 ***(Cybernetic Applications)*** 5-axis plus gripper, electro-hydraulic (water), lift 2.5kg. Software: BBC B, Spectrum, IBM PC and on board processor. Simulator and work cell extra. Works with other Cybernetic machines. £1,980 + VAT, controller £530 + VAT.

Neptune II ***(Cybernetic Applications)*** 6-axis plus gripper. Rest same as above. £2,910 + VAT, controller £745 + VAT.

Robotarm ***(Logotron)*** 5-axis plus gripper, bucket or magnet, servos, battery-powered and has two standard Atari joystick ports for control. Software: BBC B and Master series. £89 + VAT.

Scorbot ***(Syke Instrumentation)*** 5-axis plus gripper, servos plus optical encoders, lift 1kg. Comes with textbook and workbook but does not have machine-specific software. £2,800 + VAT.

Teachmover ***(Syke Instrumentation)*** 5-axis plus gripper, stepper motors, lift 1lb, on-board processor. £3,000 + VAT.

SCARA ARMS

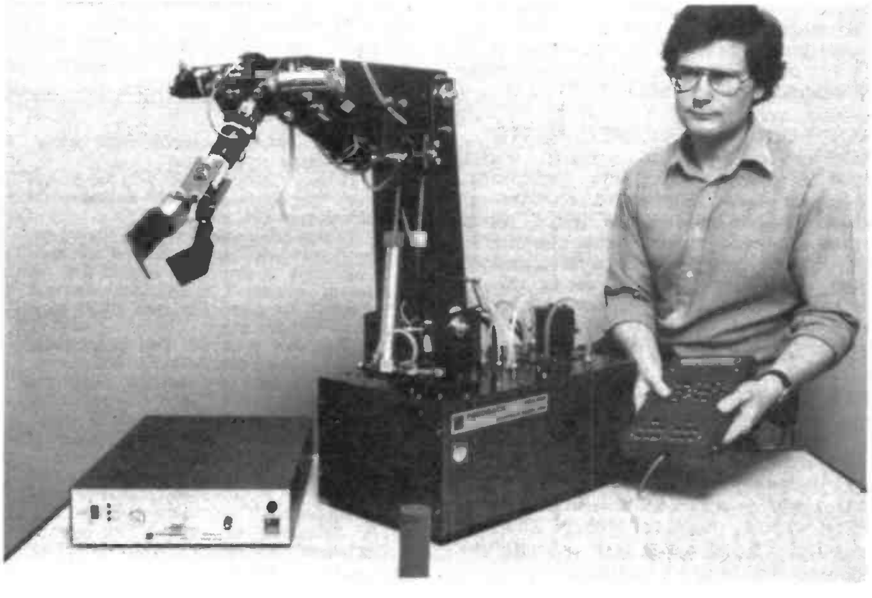
IVAX ***(Feedback Instruments)*** 4-axis plus pneumatic gripper, servo driven, lift 1kg. Software: on-board processor, IBM, BBC, Apple. Work cell available. £2,900 + VAT.

PW800 ***(Feedback Instruments)*** 4-axis plus gripper, servos on all axes except end rotation which has a stepper, lift 2kg. Software: on-board processor, BBC B, IBM PC, Apricot. Work cell available, interchangeable gripper jaws. £6,900 + VAT.

Serpent 1 ***(Cybernetic Applications)*** 4-axis plus gripper, servos and pneumatic power for vertical movement of gripper. Lift 2kg. Software: BBC B, Apple IIe IBM PC. Work cell available, can be linked to other Cybernetic devices, gripper can be replaced by vacuum pick-up pad, can be controlled by using a scale-model simulator. £1,395 + VAT, control box £775 + VAT.

Serpent II. Only difference from above is that the two limbs are longer. £1,980 + VAT, control box £775.

Feedback HRA 934



OTHERS

Tracer ***(LJ Electronics)*** Unique device based on *XY* plotter with a gripper which can be raised or lowered. Steppers power *XY* axes, servos on gripper. Comes with PCB assembly kit. Also supplied with pen carrier for conversion to plotter. £750 + VAT.

MOBILES

Jessop Turtle ***(Jessop Microelectronics)*** also known as the Edinburgh Turtle, it looks like an upturned mixing bowl, one of the earliest turtles controlled by a version of Logo. Servos with optical encoders. Includes pen. Linked to computer by umbilical cord. Software: BBC B, Apple II. £220 + VAT (Education discounts).

Penman Plotter ***(Penman Products)*** Developed primarily as a three colour plotter but uses same basis as a mobile. Servo driven, linked by umbilical cord to controller. Software: IBM PC, Apple II, BBC B. £450 + VAT.

Trekker ***(Clwyd Technics)*** Two-wheeled, servo-driven. Developed by children at North Wales school and given extensive in-service testing before being put on market. Substantial software and documentation. Software BBC B, Commodores. £150 + VAT.

Valiant Turtle ***(Valiant Technology)*** Two-wheeled servo-driven with pen. Remote controlled via infra-red link, designed to resemble a turtle. Uses version of Logo for instructions. Software: BBC B, Apple II, IBM PC and Spectrum. Microworlds being designed to expand uses. £250 + VAT.

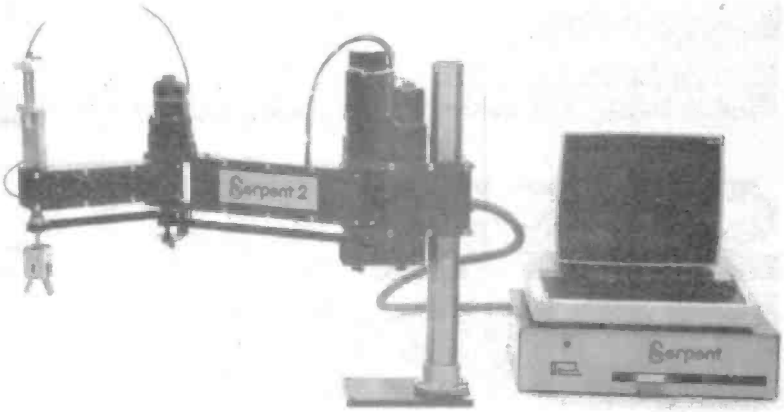
HEROS

Hero 1 ***(Maplin Professional Supplies)*** Large mobile. Has light, sound and motion detectors, rangefinder and speech. On-board processor, 4-axis arm driven by stepper motors, lift 8oz. Includes range of demonstration programs. Easily built and dismantled to show how it works. Imported from the US and one of the first machines on the small robot market. £1,200 + VAT (kit), £2,150 + VAT ready built.

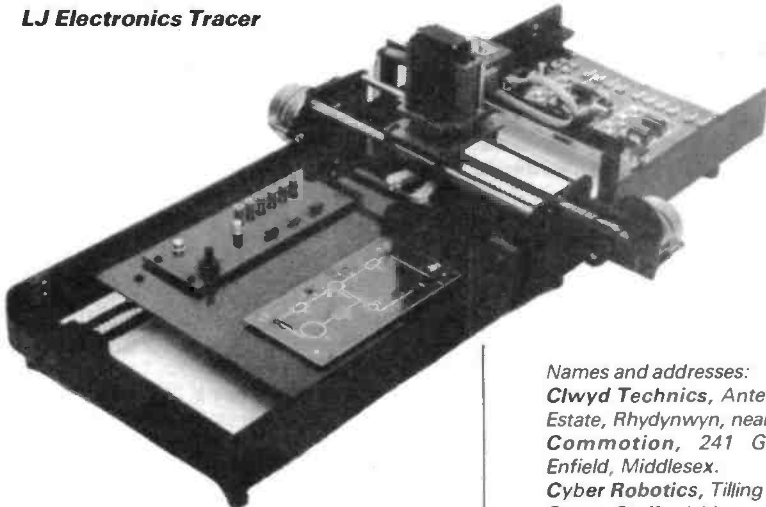
Hero 2000. More powerful version of Hero 1 with much larger memory and expansion options. Two-wheel drive system using servos and arm expanded to five axes. Gripper has touch sensor to adjust gripping force. Lift 1lb. Two specially-written courses. £2,000 + VAT for the kit, £2,500 ready built.

KITS

The computing kit from ***Fischertechnik*** includes two d.c. motors, two potentiometers,



Cybernetic Serpent



LJ Electronics Tracer

eight switches and a large selection of pieces for making computer-controlled models including plans for two arms. Interfaces and software available for BBC B.

Arm and plotter/scanner kits. Arm has three axes and uses more powerful servos than computing kit, drive by worm screws. Plotter uses stepper motors. Uses same interfaces and software as Computing kit. Prices vary.

The ***Lego-Technic*** series includes kits from which an arm, a plotter and a buggy can be made as well as a number of other devices which can be controlled by computer. Servos with optical encoders.

Programs and interface for the BBC B. Battery-powered controller also available. Extra software for buggy available from Pilot One. Prices vary.

The ***Meccano-Kits*** come in various complexities. Contain motors but no specific instructions for robot devices or computer interfaces. Prices vary.

Names and addresses:
***Clwyd Technics**, Antelope Industrial Estate, Rhydynwyn, near Mold, Clwyd.*
***Commotion**, 241 Green Street, Enfield, Middlesex.*
***Cyber Robotics**, Tilling Drive, Watson Stone, Staffordshire.*
***Feedback Instruments**, Park Road, Crowborough, East Sussex.*
***LJ Electronics**, Francis Way, Bowthorpe Industrial Estate, Norwich.*
***Logotron**, Dales Brewery, Gwydir Street, Cambridge.*
***Maplin Professional Supplies**, PO Box 777, Rayleigh, Essex.*
***Penman Products**, 8 Hazelwood Close, Dominion Way, Worthing, West Sussex.*
***Syke Automated Systems**, Lynchborough Rd., Passfield, Hampshire.*
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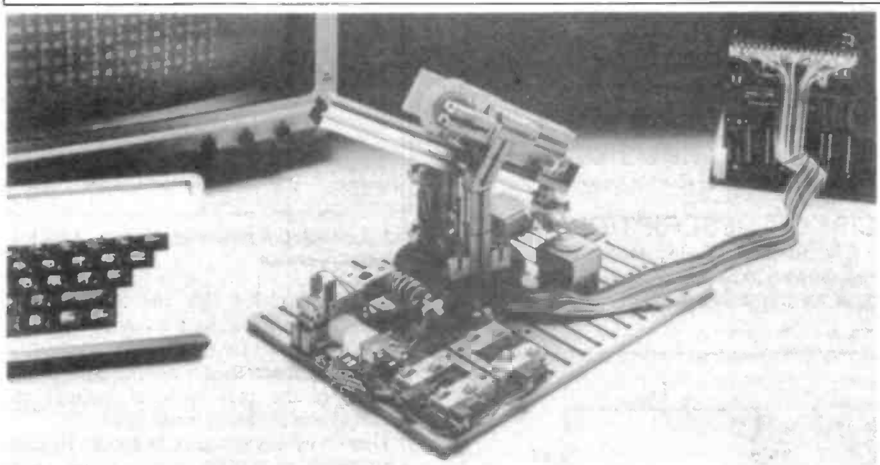
***Valiant Technology**, Gulf House, 370 York Road, Wandsworth, London SW18.*



Fischertechnik robot arm

SIMPLE STATIC MONITOR

G.T. THEASBY

A simple fun project that will make your hair stand on end!

AFTER receiving several nasty "electric shocks" from the most unlikely of objects, which, often on closer investigation, turned out to be nothing more serious than "static electricity discharges", the designer thought that it might make a fascinating project to produce a simple static electricity indicator. Although a meter is used to indicate the presence of static electricity, it is not calibrated, and the calibration and construction of such a meter would be both complex and expensive.

Apart from enabling the reader to entertain him or herself, it would be a cheap and useful project for a school science lesson.

CIRCUIT DESCRIPTION

The Simple Static Monitor is based on the well known Wheatstone bridge which in its basic form is shown in Fig. 1.

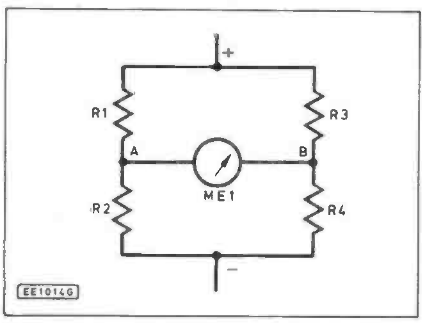


Fig. 1. Basic circuit for a Wheatstone bridge.

If a voltage is applied as shown, and the resistance combinations of R1, R2 and R3, R4 are equal, equal currents will flow in each arm of the bridge, and a meter placed between *A* and *B* will show no deflection as the voltages at these points will also be equal. Also, if resistors R1 and R3 are equal but different to R2 and R4 equal currents would still flow in each arm, and the meter would again show no deflection.

Now, if resistors R1 and R2 are combined into a potentiometer, and point *A* becomes the slider, then even if R3 and R4 are slightly different in resistance, adjustment of the potentiometer will "balance" the bridge so that the meter does not deflect. This condition is shown in Fig. 2.

If resistor R3 is varied slightly, the meter will deflect, and this is the way that the static electricity indicator works. We do not wish to balance the bridge, but to observe the amount of unbalance occurring. Resistor R3 is therefore replaced with a field effect transistor (f.e.t.) such as the 2N3819 or its equivalent and the resistance of that device will vary according to the voltage applied to its gate terminal.

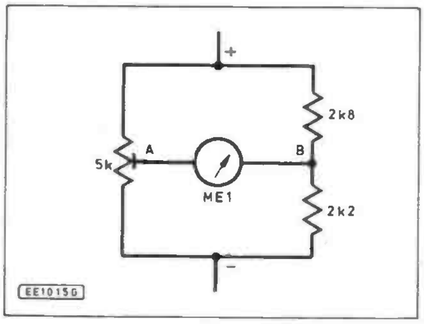


Fig. 2. Adding a potentiometer to "balance" the bridge circuit.

The final circuit for the Simple Static Monitor, including an f.e.t. transistor, is shown in Fig. 3. Such an f.e.t. is, in fact, so sensitive that it will react to a static electric charge induced in the gate terminal without any electrical contact being made at all.

There is no advantage to be gained by using a MOSFET or IGFET in this circuit as the induced charge is so high that it would most probably destroy the device. If not, the gate leakage current is so low that a charge would take much too long to leak away. The leakage current of a junction f.e.t. such as the 2N3819 (about 2 nanoamps) is such that the charge leaks away in a few seconds, automatically preparing the circuit for the next experiment.

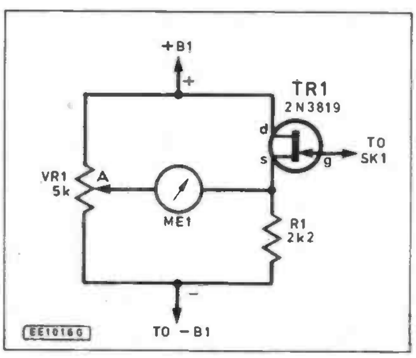


Fig. 3. Complete circuit diagram for the Simple Static Monitor.

The meter can be any type of 1mA full scale deflection or less. It should preferably be a centre-zero type, but if not a normal meter can be set at centre scale by unbalancing the bridge with the potentiometer VR1 beforehand. This is because static electricity can be of either polarity.

COMPONENTS

Components

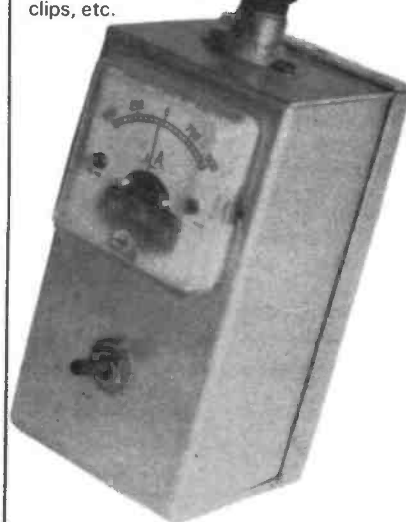
See Shop Talk

Resistor
R1 2k2
0.25W 5% carbon

Potentiometer
VR1 4k7 miniature skeleton preset

Semiconductor
TR1 2N3819 f.e.t. transistor or similar

Miscellaneous
S1 S.P.S.T. toggle switch
ME1 50μA to 1mA, centre zero, panel meter; aluminium case to suit meter used; PP3 battery and battery clips, etc.



Approx. cost Guidance only **£7.50**

CONSTRUCTION

The construction of the Static Monitor is fairly straightforward and should not cause any problems. It could, for instance, be built on a scrap piece of stripboard or on some spare tag strip.

The components in the author's unit were mounted directly on the meter terminals. The layout and wiring is shown in Fig. 4 and the meter is mounted in an aluminium case scarcely larger than the meter itself.

Almost any small battery, such as a PP3, can be used and in fact this circuit will run from a battery which is too tired to run anything else.

The static electricity charge is picked up by an insulated wire from the f.e.t. gate terminal and brought out through the box side via a coaxial socket. A similar insulated wire is mounted in a coaxial plug to form a removable probe and should be about three inches long.

IN USE

Static electricity is easily generated by friction between many different types of insulating materials. For instance switch on the indicator and rub a plastic comb on the sleeve and then approach the probe with the comb whilst watching the meter.

Other possibilities are: remove an item of artificial fibre clothing, shuffle the feet whilst standing on a mat made from artificial fibres, operate a gas cooker spark igniter near the probe, or a Zerostat pistol (LP record static discharger). Other possible interesting applications would be to leave it near the window during a thunderstorm, approach the screen of a television set slowly, stroke a cat or to remove a record from its sleeve, and then observe the action of the Zerostat pistol.

No doubt other experiments will suggest themselves to readers. □

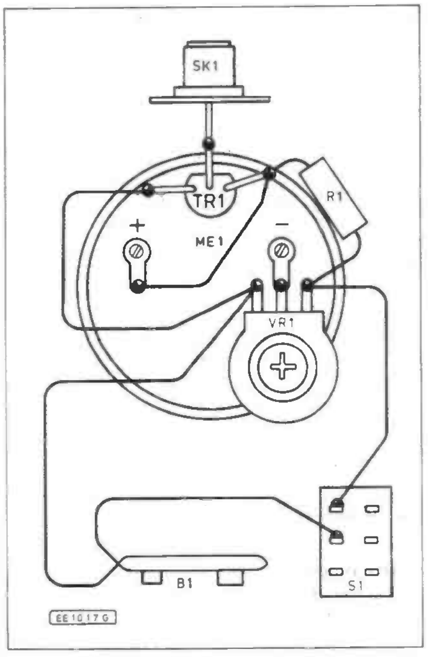
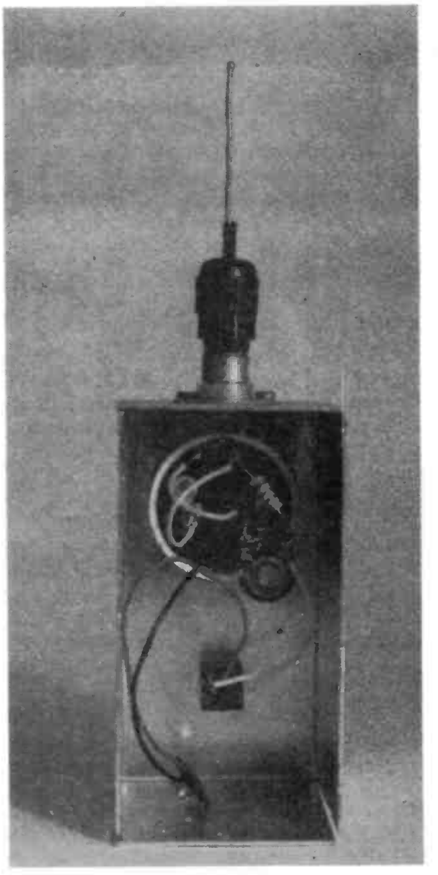


Fig. 4. Wiring details for the prototype model. The f.e.t. transistor is mounted directly on the coaxial socket.



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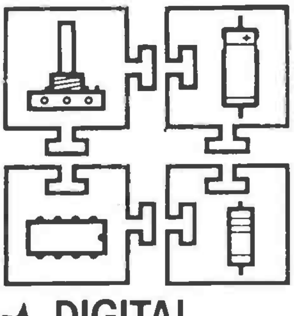

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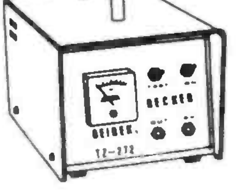

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Actually Doing it!!

MAKING your own printed circuit boards is a subject that was covered in an *Actually Doing It* article some time ago, but at that time we dealt with only the most basic methods of production. In other words, the methods where the track pattern is marked onto the copper clad board using either rub-on transfers or an etch resist pen.

These are really quite adequate for producing most boards, but they can be very difficult to use with complex boards. They are at least a little awkward when producing any printed circuit board, due to the difficulties in accurately copying the design onto the board.

MASTERING THE TECHNIQUE

The alternative method is to use photo-sensitive copper clad board together with a simple photographic technique. This type of board is covered with a thin coating of photo-sensitive etch resist, and the unwanted areas of resist are removed by exposing them to ultraviolet light and then developing the board in caustic soda solution.

In order to expose the board a 1:1 master artwork is required. This must be on a transparent or translucent backing material, with the track pattern drawn using something that is suitably opaque to ultraviolet rays.

There are several ways of producing the master artwork, and some are quicker than others. All generally offer good accuracy, and a very faithful copy of the original design can be made using this photographic method of board production. Here we will consider several methods of producing the master artwork.

Many printed circuit boards are drawn up using computer based systems these days, but in the pre-computer aided design era the standard technique was to first draw the design in pencil on translucent drafting film. The design is drawn as a component side view, with a backing grid (similar to graph paper) being used to aid accurate placement of pads and tracks. The finished pencil drawing is turned over, and then used as a guide when drawing up the final artwork.

Originally the final artwork was done in ink using a technical pen, but these days it is more usual for rub-on transfers or crêpe tapes and diecast pads to be used. As a matter of interest, many computer p.c.b. design systems produce the final output via a plotter, which produces an "old style" artwork drawn in ink using a technical pen!

It is possible to draw up a master artwork using what is basically the same technique to the one outlined above. A piece of translucent drafting film is taped over the design that is to be copied, and then rub-on transfers or tapes/diecast symbols are used to copy the design as accurately as possible.

I find this job much easier using the tapes and diecast symbols rather than rub-on transfers, but many people seem to prefer the transfer method. Tapes and diecast symbols certainly seem to provide a tougher finished article, although the master artwork should always be treated with care.

With both systems the general method of production is to first fit all the pads in place, and then to join them up with the track transfers or tapes. Obviously a certain amount of skill is involved in the copying process, and it is not a bad idea to start off by copying any fairly simple design just to give yourself some practice before progressing to the "real thing".

It is not essential to use track widths and pad sizes/shapes that exactly match the drawing you are copying. However, there are less likely to be any problems if you stay quite close to the original design in both respects.

Take great care with accurate positioning of the pads. Any lack of accuracy here will be reflected in the finished board, and at best will give a less than professional appearance. At worst, some printed circuit mounting components could be difficult to fit into place, or might not fit at all!

The problem is eased with some components, particularly transistors and integrated circuits, as clusters of pads can be obtained. Using these virtually guarantees that the relative placing of each pad in the cluster will be correct. With the rub-on type though, take care not to move the transfer sheet during the rubbing-down process.

Many readers will probably be unfamiliar with the diecast pads. These are mostly supplied on long rolls of backing paper or on cards. They are made from a self adhesive plastic material, and the easiest way of using the small types required for 1:1 artworks is to pick each pad off the card or paper backing using a modelling knife or scalpel, carefully position it on the drawing, and then press it into place. As always when using anything with a sharp blade, take due care to avoid injuring yourself or others.

The clusters of pads are different in that they consist of a transparent self-adhesive backing material, with the pads marked in ink. The paper backing is in two halves, and only one half is removed initially. This enables the cluster to be easily manoeuvred into position and semi fixed in place. The other half of the backing paper is then removed so that the cluster can be fully fixed in position.

Rub-on tracks are quite easy to use when copying designs that only have straight tracks. The main point to note with these is that they should be cut to size prior to putting them in place on the drawing. This is just a matter of placing the track in position, marking the position of the required cut, and then cutting through the track with scissors or a modelling knife. When applying rub-on transfers it is usually much easier to get really good results if the proper spatula tool can be obtained, rather than improvising something.

Curved tracks are a little more difficult to deal with. Sheets of curved track transfers can be obtained, but might not always match up with precisely the curve that the drawing calls for. If necessary, curves can be made up from several short pieces of track. This can be a little slow, but with patience it is possible to produce any curve, and quite neat results can be obtained.

The crêpe tapes can be taken round any reasonable curve if necessary. With these the basic method is to first press one end of the tape in place, then carefully route the track along to the second pad, and then cut the tape to length. A very sharp knife or scalpel should be used.

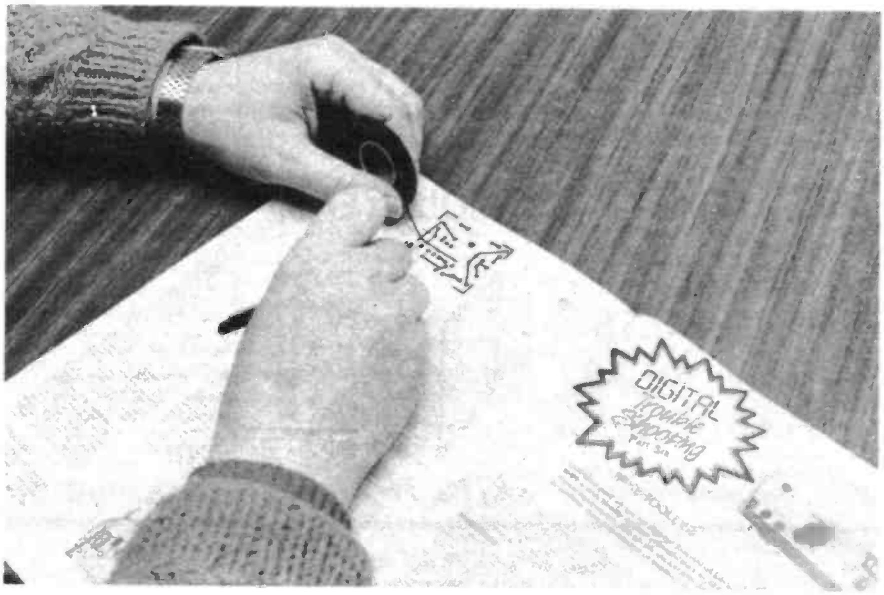
Whatever type of track material you use, make sure that the hole in the middle of each pad is not covered over by any track. With the crêpe tapes try to avoid cutting right through the pads as well as through the tape. Angle the blade slightly so that it cuts away from the centre of the pad and under-cuts the tape slightly; in this way, if you should happen to cut through the pad, it should fail to produce a break in the copper on the finished board.

The pads in clusters are more easily damaged, and where possible tracks should be started at these pads. This minimises the number of track cuts at these more vulnerable pads. Make sure that the tracks are properly pushed down onto the drafting film over their full lengths.

SHORT CUTS

This method of master production has the advantage of only requiring inexpensive and easily obtained materials, and provided due care is taken it gives a very high quality end product. It is not a particularly quick method, but I find it quite an interesting and enjoyable task, and a worthwhile part of the hobby.

Producing a tape master from a magazine article.



Items from the CM100 kit.

A point in favour of this method is that you can easily make minor modifications to the original design if you should wish to do so for some reason. It is not everyone's cup of tea though, and you may well prefer to try a somewhat faster method.

Probably the easiest and quickest method of all is to use a photocopier. Not all types are suitable, but some can produce an accurate 1:1 copy onto drafting or tracing film, and I have seen some very fine copies made in this way.

Any minor imperfections could probably be corrected by hand, with gaps being inked in and unwanted spots scratched off with a sharp blade. However, for this method to be practical it is essential that the copy should be of a reasonably high quality, and it must be accurately to scale.

An alternative is to use a special spray (such as ISOdraft) on the original drawing. This has the effect of making the white paper translucent, but leaving the black ink opaque. In this way the drawing is effectively turned into a master artwork. Often this method will not be practical as you will not want to cut up the book or magazine from which the design is being taken, and there will be printing on the opposite side of the page which will show through after the page has been treated.

These problems can be overcome by photocopying the drawing, and then giving this copy the spray treatment. Again, it is important that the photocopy is at an accurate scale of 1:1. I must admit that I have not yet tried this method, and I cannot comment on how well (or otherwise) it works in practice.

There are many photographic methods for copying printed circuit designs onto film having a transparent backing material suitable for our present purposes. These mostly require expensive equipment to which few people will have access. Presumably anyone who has the necessary equipment available to them will be able to carry out the copying process without too much difficulty. It would probably be possible to get a photographic studio to produce an accurate 1:1 positive copy having good contrast, but I suspect that the cost of doing things this way could be excessive.

There are some relatively simple methods of making a photographic copy though, and the one used in the CM100 "Circuit Maker Kit" is probably the most simple of all. The exposure is made onto a positive film having low sensitivity and high contrast, using the basic set up shown in Fig. 1.

The film can be handled in subdued light incidentally, and a darkroom is not required when using this system. This method of exposing the film is an unusual one, with the light source on the non-emulsion side of the film. Presumably the film is subjected to a higher light level over the white areas of paper where a much greater proportion of the light is reflected back through the film, and the high contrast of the film gives a good quality copy from this relatively small difference in light level.

Being a high contrast process the exposure has to be made very accurately, but provided everything is done meticulously it seems to be possible to obtain consistent results using this method. Like hand-copying a design, it represents an interesting pursuit which adds a new dimension to the hobby, and it is a practical way of doing things if you are going to produce a fair number of boards.

Of course, producing the master artwork is only the first stage of producing the board. Converting this artwork into a finished board will be the subject of the next *Actually Doing It*.

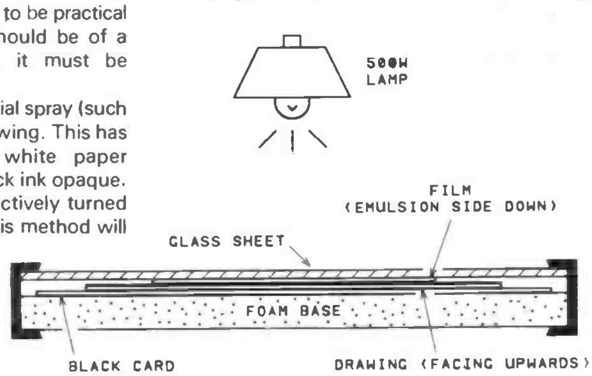


Fig. 1. Basic set up used by the CM100 kit.

Robert Penfold

MARKET PLACE

WANTED: Working ZX81 issue 3 p.c.b. (if possible with removable ROM, ULA and Z80) £10. Mohammed Tahir, 34 Meadowhill, Newton Mearns G77 6SX.

WANTED: Two cassette type microphones and two ULN 2283B microchips, all wanted for £3. Write to: N. Childs, 25 Wood Road, Tettenhall Wood, Wolverhampton, West Midlands WV6 8NG.

WANTED: 48k upwards Spectrum with microdrives, music RAM data, recorder, word processor, all leads, printer, etc. Mr Ivan Comiskey, 33D Nth Gt. Clarence Street, Flats, Dublin 1, Ireland.

WANTED: Damaged/broken BBC computer for student project. Write/ring stating extent of damage, price, etc. Mr Musa, 141 Olive Lane, Darwen, Lancs. BB3 3DQ. Tel: (0254) 776586.

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WANTED: 20 or 21 KHz transducers and D40D4 power Icb or Tip47. Reward cash paid. M.R. Sheppard, 76 Letterston Rd., Rumney, Cardiff CF3 8PU.

WANTED: PET 200 equipment, obsolete or broken by penniless student. Please write now: Mr Graham Mitchell, 43 Cranbrook Avenue, Odsal, Bradford BD6 1JF.

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...REPORTING AMATEUR RADIO...

TONY SMITH G4FAI

ILLEGAL OPERATION

The Radio Investigation Service (RIS) is the enforcement arm of the Department of Trade and Industry's Radio Communications Division. The RIS works to prevent interference to and jamming of licensed radio communications throughout the radio frequency spectrum, and figures published by the DTI for 1986 show the extent of this work. For example, over 10,000 private mobile radio (PMR) transmitter base stations were checked, and many were found to deviate in some respect from the licence conditions imposed on them to prevent interference to other users.

Under the Wireless Telegraphy Act 1949, unlicensed radio users face fines of up to £2000 and/or three months imprisonment, plus forfeiture of the equipment used. During the year the RIS issued 2800 formal warnings about unlicensed radio use, mainly to users of CB equipment, illegal cordless phones, PMR and marine radio. Continued unlicensed use resulted in 727 convictions, of which 601 were for CB misuse, 18 for PMR, 16 for cordless phones, and 5 for illegal operation on the amateur bands.

RAIDS

The RIS carried out 209 raids on 70 unlicensed pirate broadcasters, and 74 people were convicted for illegal broadcasting. 19,200 users of CB and marine radio were contacted in two nation-wide campaigns to counter licence evasion, and 5000 complaints were dealt with from householders concerning TV and radio interference and reception problems.

Fortunately, few cases relating to amateur radio ever appear in the courts, although there have been some rare examples of people illegally sitting for the Radio Amateur's Examination on behalf of others, the occasional pirate, or interference caused to neighbours by amateur transmissions.

VARIOUS REMEDIES

Because amateurs have to pass an examination which requires, among other things, a detailed knowledge of the licence regulations and the importance of not causing interference to others, they are very conscious of the latter problem. However, the fault often lies in the radio or TV receiver itself and with the co-operation of the householder there are a number of remedies which can be applied without a need to "go inside" the domestic equipment. There is usually no insurmountable reason why the amateur can't practise his or her hobby while the neighbours continue to enjoy *Dallas* or Radio Three's latest offering.

It should be stressed that the vast majority of amateurs will not continue transmitting when they know they are causing interference. They *want* to co-operate with the affected parties in eliminating the problem. The world is not perfect of course, and there will be some unfortunate occasions when tempers run high on one or both sides, and the RIS exists to come in at that time.

This used to be a free service. Nowadays it costs £21 to call them in. So if you do get interference from the "ham" next door, try having a friendly chat with him first. He can probably sort the problem out on an amicable basis, and avoid you being involved in unecessary expenditure and aggravation.

GOOD NEIGHBOUR

I had personal experience of this when I first started in amateur radio. Coming home one day I was greeted at my front gate by the lady next door who said, "I hope you don't mind me telling you, but I can hear you speaking sometimes on my television."

I asked if she would mind if I carried out a few tests, and she gladly agreed. I immediately suspected that the problem lay in the proximity of my two metre band antenna to her TV aerial. My son, also a licensed amateur, thereupon operated the transmitter upstairs, rotating our antenna as he did so. I sat downstairs at the telephone speaking to my neighbour while my son called down to me, via our home intercom, reporting the directions in which the antenna was firing.

I would say to the neighbour, "anything now?", and she would say "No". We went round the compass like that, and we finally established that the trouble only occurred when the two antennas were virtually pointing at each other.

I made up a small filter – just a coil and a trimmer capacitor tuned to 145MHz inside a small can, with a short length of coaxial cable at one end terminated by a standard TV plug. The other end of the can had a coaxial socket. I plugged the unit into the TV antenna socket, and the antenna cable into the socket on the filter.

We repeated the experiments and found, as I expected, that while the filter happily allowed the TV signals to pass, it blocked the 2m signals. I suppose I was lucky, but my neighbour quite enjoyed all this experimenting, and thought I was terribly clever sorting out the problem so quickly.

A little later she told me she quite missed hearing my conversation over the air! Of course, it's not always as easy as that, but it does give some idea of what can be done with a little goodwill on both sides.

PUBLIC SERVICE

I have previously mentioned the work of volunteer members of the Radio Amateur Emergency Network, RAYNET, in providing communications when the "official" systems are overloaded or are not available for any reason.

There is, in fact, another form of involvement open to amateurs, through the Civil Defence arrangements of County Emergency Planning Teams. As an example, I have just been looking at a leaflet issued by Wiltshire County Council, "Volunteers – the practical approach to Civil Defence in Wiltshire".

This says that although the risk of war in Europe is low, the Government requires County and District Councils to plan for all possibilities, from conventional air raids to nuclear attack. One aspect of this preparation is the formation of a volunteer survival network in the county consisting of people trained for various wartime tasks, among which are Wartime Volunteer Radio Operators. These operate their own amateur radio or CB equipment to enable the authorities to assist towns, parishes or other communities when telephones and other communications have failed.

A short Civil Defence familiarisation course is provided for network members who have not already received other training, and representatives of the radio volunteers help the Emergency Planning staff work out communication procedures and run exercises for the network. There's nothing secret about all this. Some people are greatly in favour of it, and others object strongly. No matter how one regards the broader issues, the existence of the radio volunteers *is* yet another aspect of today's amateur radio scene.

USA NOVICE LICENCE

In the June column I referred to the campaign for an amateur radio novice licence in this country, allowing newcomers with a limited qualification to operate with Morse code. In the USA, not only have they had such a novice licence for many years, but as from 21 March 1987, it has been expanded to permit operation on extra bands, with voice and other modes, including packet radio, on some of them.

Previously, the country's 80,000 plus novice licensees had access to limited parts of the 80, 40, 15, and 10 metre bands. Now they can also use the 1.25 and 0.23 metre bands. While Morse can still be used, all other emission modes are permitted on the two new bands, with packet and single sideband as additional modes on 10 metres.

Becoming a novice operator is relatively simple. The examination is administered by any two existing amateurs holding the General Class licence or above, and novices can then go on to upgrade to higher class licences, attracting greater privileges, or remain as permanent novices if they wish.

In recent years there has been concern in many countries that the hobby is not attracting enough newcomers. In the USA at least it is now hoped that this new arrangement, particularly with its potential for world-wide voice communication on 10 metres, will begin to reverse the trend.

PCB SERVICE

Printed circuit boards for certain constructional projects (up to two years old) are available from the PCB Service, see list. These are fabricated in glass-fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Add £1 per board for overseas airmail. Remittances should be sent to: The PCB Service, *Everyday Electronics* 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.**

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Tape 1 (Teach-In parts 1, 2 and 3), Tape 2 (parts 4, 5 and 6) and Tape 3 (parts 7, 8 and 9) are available for £4.95 each (inclusive of VAT and postage) from Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH. **IMPORTANT State BBC or Spectrum;** *add 50 pence for overseas orders;* ***allow 28 days for delivery.***

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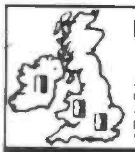

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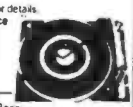

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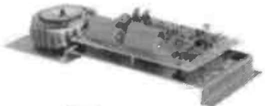

OMP100 Mk II Bi-Polar Output power 110 watts R.M.S. into 4 ohms, Frequency Response 15Hz - 30KHz —3dB, T.H.D. 0.01%, S.N.R. —118dB, Sens. for Max. output 500mV at 10K, Size 355 × 115 × 65mm.
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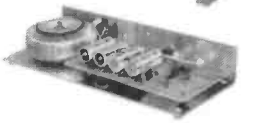

OMP/MF100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, Frequency Response 1Hz - 100KHz —3dB, Damping Factor 80, Slew Rate 45V/uS, T.H.D. Typical 0.002%, Input Sensitivity 500mV, S.N.R. —125dB. Size 300 × 123 × 60mm. PRICE
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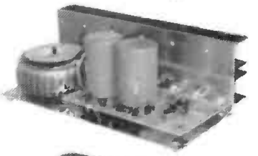

OMP/MF200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, Frequency Response 1Hz - 100KHz —3dB, Damping Factor 250, Slew Rate 50V/uS, T.H.D. Typical 0.001%, Input Sensitivity 500mV, S.N.R. —130dB. Size 300 × 150 × 100mm. PRICE
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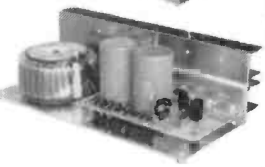
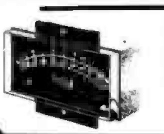


OMP/MF300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, Frequency Response 1Hz - 100KHz —3dB, Damping Factor 350, Slew Rate 60V/uS, T.H.D. Typical 0.0008%, Input Sensitivity 500mV, S.N.R. —130dB, Size 330 × 147 × 102mm. PRICE
PRICE £79.99 + £4.50 P&P.

NOTE: Mos-Fets are supplied as standard (100KHz bandwidth & Input Sensitivity 500mV). If required, P.A. version (50KHz bandwidth & Input Sensitivity 775mV). Order — Standard or P.A.



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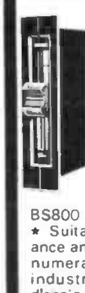

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Res. Freq. 45Hz. Freq. Resp. to 14KHz. PRICE £31.49 + £3.00 P&P ea.
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$1\frac{1}{4}$" voice coil. Res. Freq. 38Hz. Freq. Resp. to 20KHz. Sens. 89dB. PRICE £12.99 + £1.50 P&P ea.
10" 60 WATT R.M.S. Hi-Fi/Disco etc.
$1\frac{1}{4}$" voice coil. Res. Freq. 35Hz. Freq. Resp. to 15KHz. Sens. 89dB. PRICE £16.49 + £2.00 P&P

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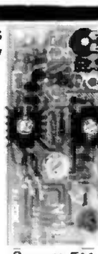

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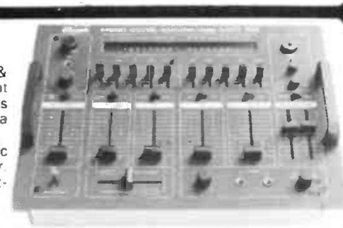
STEREO DISCO MIXER



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