EVERYDAY ELECTRONICS

FEBRUARY 1990

INCORPORATING ELECTRONICS MONTHLY

£1.40

PROPHET IN-CAR IONISER

WEATHER STATION

QUICK CAP TEST

FIRST STEPS IN PROJECT BUILDING

ISSN 0262-3617

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The Magazine for Electronic & Computer Projects

BAKERS DOZEN PACKS

All packs are £1 each. Note the figure on the extreme left of the pack ref number and the next figure is the quantity of items in the pack, finally a short description.

BD2 5 13A spurs provide a fused outlet to a ring main where devices such as a clock must not be switched off.
BD9 2 6V 1A mains transformers upright mounting with fixing clamps.
BD11 1 6½in speaker cabinet ideal for extensions, takes our speaker. Ref BD137.
BD13 12 30 watt reed switches, it's surprising what you can make with these—burglar alarms, secret switches, relay, etc., etc.
BD22 2 25 watt loudspeaker two unit crossovers.
BD30 2 Nicad constant current chargers adapt to charge almost any nicad battery.
BD32 2 Humidity switches, as the air becomes damper the membrane stretches and operates a microswitch.
BD42 5 13A rocker switch three tags so on/off, or change over with centre off.
BD45 1 24hr time switch, ex-Electricity Board, automatically adjust for lengthening and shortening day. original cost £40 each.
BD49 5 Neon valves, with series resistor, these make good night lights.
BD56 1 Mini uniselector, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor, moves switch through one pole.
BD67 1 Suck or blow operated pressure switch, or it can be operated by any low pressure variation such as water level in water tanks.
BD103A 1 6V 750mA power supply, nicely cased with mains input and 6V output leads.
BD120 2 Stripper boards, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc.
BD128 10 Very fine drills for pcb boards etc. Normal cost about 80p each.
BD132 2 Plastic boxes approx 3in cube with square hole through top so ideal for interrupted beam switch.
BD134 10 Motors for model aeroplanes, spin to start so needs no switch.
BD139 6 Microphone inserts—magnetic 400 ohm also act as speakers.
BD148 4 Reed relay kits, you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets.
BD149 6 Safety cover for 13A sockets—prevent those inquisitive little fingers getting nasty shocks.
BD180 6 Neon indicators in panel mounting holders with lens.
BD193 6 5 amp 3 pin flush mounting sockets make a low cost disco panel.
BD199 1 Mains solenoid, very powerful, has 1in pull or could push if modified.
BD201 8 Keyboard switches—made for computers but have many other applications.
BD211 1 Electric clock, mains operated, put this in a box and you need never be late.
BD221 5 12V alarms, make a noise about as loud as a car horn. Slightly soiled but OK.
BD242 2 6in x 4in speakers, 4 ohm made from Radiomobile so very good quality.
BD252 1 Panostat, controls output of boiling ring from simmer up boil.
BD259 50 Leads with push-on ¼in tags—a must for hook-ups—mains connections etc.
BD263 2 Oblong push switches for bell or chimes, these can mains up to 5 amps so could be foot switch if fitted into pattress.
BD268 1 Mini 1 watt amp for record player. Will also change speed of record player motor.
BD283 3 Mild steel boxes approx 3in x 3in x 1in deep—standard electrical.
BD305 1 Tubular dynamic mic with optional table rest.
BD400 4 Books, useful for beginners, describes amplifiers equipment and kit sets.
BD653 2 Miniature driver transformers. Ref. LT44. 20k to 1k centre tapped.
BD548 2 3.5V relays each with 2 pairs changeover contacts.
BD667 2 4.7 µf non-polarised block capacitors, pcb mounting.

There are over 1,000 items in our Bakers Dozen List. If you want a complete copy please request this when ordering.

TOASTERS 2 slice toasters — may need slight attention. Only £3.00 each. Ref 3P84.

PERSONAL STEREOS Again customer returns but complete and with stereo head phones. A bargain at only £3.00 each. Our ref 3P83.

MICROWAVE CONTROL PANEL Mains operated, with touch switches. This unit has a 4 digit display with a built in clock and 2 relay outputs — one for power and one for pulsed power level. Could be used for all sorts of timer control applications. Only £6.00. Our ref 6P18.

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

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

COPPER CLAD PANEL for making PCB. Size approx 12in long×8½in wide. Double-sided on fibreglass middle which is quite thick (about 1/16in) so this would support quite heavy components and could even form a chassis to hold a mains transformer, etc. Price £1 each. Our ref BD683.

POWERFUL IONISER

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

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

REAL POWER CAR SPEAKERS. Stereo pair output 100W each. 4-Ohm impedence and consisting of 6½" woofer, 2" mid range and 1" tweeter. Each set in a compact purpose built shelf mounting unit. Ideal to work with the amplifier described above. Price per pair £29.96. Order ref: 30P7.

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

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

ELECTRONIC SPACESHIP. Sound and impact controlled, responds to claps and shouts and reverses when it hits anything. Kit with really detailed instructions. Ideal present for budding young electrician. A youngster should be able to assemble but you may have to help with the soldering of the components on the pcb. Complete kit £10. Our ref. 10P81

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

14" COLOUR MONITOR made by the American Display Tek Company. Uses high resolution tube made by the famous Japanese Toshiba company. Beautifully made unit intended for console mounting, but top and sides adequately covered by plated metal panels. Full technical spec. on its way to us. We have a limited number of these. All brand new still in maker's cartons. Price: £89 each plus £6 insured carriage. Order ref: 89P/1.

COMPOSITE VIDEO KITS These convert composite video into separate H sync, V sync and video. Price £8.00. Our ref 8P39.

BUSH RADIO MIDI SPEAKERS Stereo pair. BASS reflex system, using a full range 4in driver of 4ohms impedance. Mounted in very nicely made black fronted walnut finish cabinets. Cabinet size approx 8½in wide, 14in high and 3½in deep. Fitted with a good length of speaker flex and terminating with a normal audio plug. Price £5 the pair plus £1 post. Our ref 5P141.

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

10 MEMORY PUSHBUTTON TELEPHONES These are customer returns and "sold as seen". They are complete and may need slight attention. Price £6.00. Ref. 6P16 or 2 for £10.00. Ref. 10P77. BT approved.

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

ASTEC PSU. Mains operated switch mode, so very compact. Outputs +12v 2.5A, +5v 6A, ±5v .5A, ±12v 5A. Size: 7½in long × 4¾ in wide×2¼in high. Cased ready for use. Brand new. Normal price £30+, our price only £12.95. Order ref 13P2.

VERY POWERFUL 12 VOLT MOTORS. ⅓rd Horsepower. Made to drive the Sinclair C5 electric car but adaptable to power a go-kart, a mower, a rail car, model railway, etc. Brand new. Price £20 plus £2 postage. Our ref. 20P22.

PHILIPS LASER

This is helium-neon and has a power rating of 2mW. Completely safe as long as you do not look directly into the beam when eye damage could result. Brand new, full spec. £30 plus £3 insured delivery. Our ref. 30P1.
Mains operated power supply for this tube gives 8kv striking and 1.25kv at 5mA running. Complete kit with case £15. As above for 12V battery. Also £15. Our ref 15P22.

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

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

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

12 VOLT BRUSHLESS FAN. Japanese made. The popular square shape (4½in×4½in×1¾in). The electronically run fans not only consume very little current but also they do not cause interference as the brush type motors do. Ideal for cooling computers, etc., or for a caravan. £8 each. Our ref 8P26.

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

J & N BULL ELECTRICAL

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

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

POPULAR ITEMS — MANY NEW THIS MONTH

JOYSTICKS for BBC Atari, Dragon Commodore, etc. All £5.00 each. All brand new, state which required.

TELEPHONE TYPE KEYPAD. Really first class rear mounting unit. White lettering on black buttons. Has conductive rubber contacts with soft click operation. Circuit arranged in telephone type array. Requires 70mm by 55mm cutout and has a 10 IDC connector. Price £2.00. Ref. 2P251.

SUB-MIN PUSH SWITCHES Not much bigger than a plastic transistor but double pole PCB mounting. 3 for £1.00. Our ref BD688.

AA CELLS Probably the most popular of the rechargeable NICAD types. 4 for £4.00. Our ref. 4P44.

20 WATT 4 OHM SPEAKER With built in tweeter. Really well made unit which has the power and the quality for hifi 6½" dia. Price £5.00. Our ref. 5P155 or 10 for £40.00 ref. 40P7.

MINI RADIO MODULE Only 2in square with ferrite aerial and solid dia. tuner with own knob. It is superhet and operates from a PP3 battery and would drive a crystal headphone. Price £1.00. Our ref. BD716.

BULGIN MAINS PLUG AND SOCKET The old and faithful 3 pin with screw terminals. The plug is panel mounted and the socket is cable mounted. 2 pairs for £1.00 or 4 plugs or 4 sockets for £1.00. Our ref. BD715, BD715P, or BD715S.

MICROPHONE Low cost hand held dynamic microphone with on/off switch in handle. Lead terminates in 1 3.5mm and 1 2.5mm plug. Only £1.00. Ref. BD711.

MOSFETS FOR POWER AMPLIFIERS AND HIGH CURRENT DEVICES 140v 100watt pair made by Hitachi. Ref 2SK413 and its complement 2SJ118. Only £4.00 a pair. Our Ref. 4P42.
Also available in H pack Ref 2SJ99 and 2SK343 £4.00 a pair. Ref. 4P51.

TIME AND TEMPERATURE LCD MODULE A 12 hour clock a Celsius and Fahrenheit thermometer a too hot alarm and a too cold alarm. Approx 50×20mm with 12.7mm digits. Requires 1AA battery and a few switches. Comes with full data and diagram. Price £6.00. Our ref. 6P12.

REMOTE TEMPERATURE PROBE FOR ABOVE. £3.00. Our ref. 3P60.

A REAL AIR MOVER Circular axial fan moves 205 cubic foot per min which is about twice as much as our standard 4½" fans. Low noise mains operated 6½" dia, brand new. Regular price over £30.00. Our price only £10.00. Our ref 10P71.

600 WATT AIR OR LIQUID MAINS HEATER Small coil heater made for heating air or liquids. Will not corrode, lasts for years. Coil size 3" × 2" mounted on a metal plate for easy fixing. 4" dia. Price £3.00. Ref. 3P78 or 4 for £10.00. Our ref. 10P76.

EX-EQUIPMENT SWITCHED MODE POWER SUPPLIES Various makes and specs but generally +−5, +−12v ideal bench supply. Only £8.00. Our ref. 8P36.

ACORN DATA RECORDER Made for the Electron or BBC computer but suitable for others. Includes mains adaptor, leads and book. £12.00. Ref. 12P15.

PTFE COATED SILVER PLATED CABLE 19 strands of .2mm copper will carry up to 30A and is virtually indestructible. Available in red or black. Regular price is over £120 per reel. Our price only £20.00 for 100m reel. Ref. 20P21 or 1 of each for £35.00. Ref 35P2. Makes absolutely superb speaker cable!

NEW PIR SENSORS Infra red movement sensors will switch up to 500w mains, UK made, 12 month manufacturers warranty, 15-20m range with a 0-10min timer, adjustable wall bracket. Only £20.00. Ref. 20P24.

MITSUBISHI 3½" DISC DRIVES Brand new drives, ½ height double sided, double density warranted. Our price £60.00. Ref. 60P5.

NON-MEMORY PUSHBUTTON TELEPHONES. Same condition as above with redial £3.00. Our ref. 3P79. BT approved.

DEHUMIDIFIERS Domestic mains powered dehumidifiers these are customer returns and sold as seen. Price £30.00. Our ref 30P9. Callers only please. Also working dehumidifiers at £99.00 each.

SPECTRUM PRINTER INTERFACE Add a centronics interface to your Spectrum complete with printer cable for only £4.00. Our ref. 4P52.

SPECTRUM SOUND BOX Add sound to your Spectrum with this device. Just plug in. Complete with speaker, volume control and nicely boxed. A snip at only £4.00. Our ref. 4P53.

BBC JOYSTICK INTERFACE Converts a BBC joystick port to an Atari type port. Price £2.00. Our ref. 2P261.

TELEPHONE EXTENSION LEAD 5m phone extension lead with plug on one end, socket on the other. White. Price £3.00. Our ref. 3P70 or 10 leads for only £19.00! Ref. 19P2.

LCD DISPLAY 4½" digits supplied with connection data £3.00. Ref. 3P77 or 5 for £10. Ref. 10P78.

CROSS OVER NETWORK 8 Ohm 3 way for tweeter midrange and woofer nicely cased with connections marked. Only £2.00. Our ref. 2P255 or 10 for £15.00. Ref. 15P32.

REVERSING LIGHT ALARM Fits to car reversing light and sounds when reversing. Only £2.00. Our ref. 2P248.

BASE STATION MICROPHONE Top quality uni-directional electret condenser mic 600r impedence sensitivity 16-18KHz – 68db built in chime complete with mic stand bracket. £15.00. Ref. 15P28.

MICROPHONE STAND Very heavy chromed mic stand, magnetic base 4" high. £3.00 if ordered with above mic. Our ref. 3P80.

SOLAR POWERED NICAD CHARGER 4 Nicad AA battery charger. Charges 4 batteries in 8 hours. Price £6.00. Our ref. 6P3.

MAINS SOLDERING IRON Price £3.00. Our ref. 3P65.

SOLDERING IRON STAND Price £3.00. Our ref. 3P66.

PIR SENSORS Suitable for alarm systems etc. Nicely boxed. Priced at only £10.00. Our ref. 10P79.

SHARP PLOTTER PRINTER New 4 colour printer originally intended for Sharp computers but may be adaptable for other machines. Complete with pens, paper etc. Price £16.00. Our ref. 16P3.

CAR IONIZER KIT Improve the air in your car, clears smoke and helps prevent fatigue. Case req. Price £12.00. Our ref. 12P8.

NEW FM BUG KIT New design with PCB embedded coil 9v operation. Priced at £5.00. Our ref. 5P158.

NEW PANEL METERS 50UA movement with three different scales that are brought into view with a lever. Price only £3.00. Ref. 3P81.

STROBE LIGHTS Fit a standard edison screw light fitting 240V 40/min. flash rate available in yellow, blue, green and red. Complete witb socket. Price £10 each. Ref. 10p80 (state colour required).

ELECTRONIC SPEED CONTROL KIT Suitable for controlling our powerful 12v motors. Price £17.00. Ref. 17P3 (heatsink required).

EXTENSION CABLE WITH A DIFFERENCE It is flat on one side making it easy to fix and look tidy. 4 core, suitable for alarms, phones etc. Our price only £5.00 for 50m reel. Ref. 5P153.

METAL PROJECT BOX Ideal for battery charger, power supply etc. Sprayed grey size 8" × 4" × 4½". Louvred for ventilation. Price £3.00. Ref. 3P75.

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ABC

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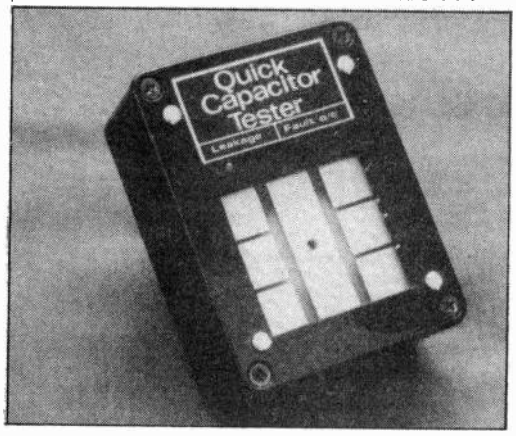
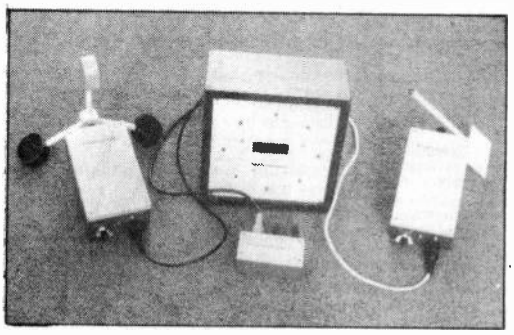
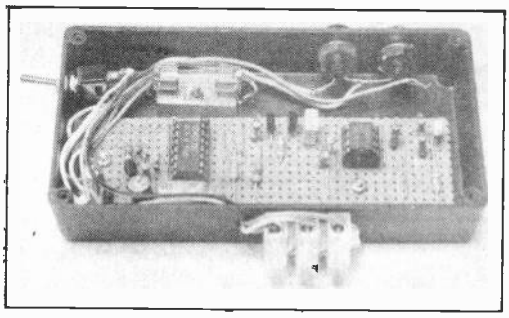
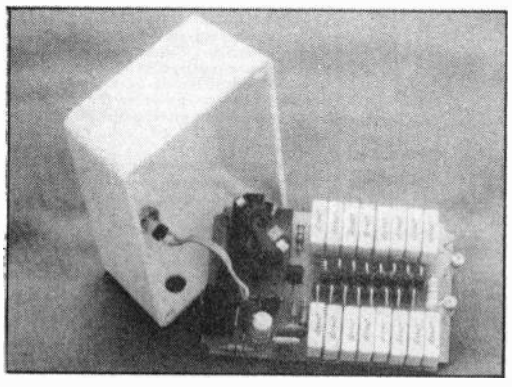
PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .









Projects

Series

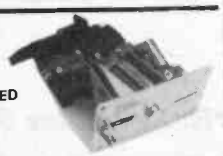
Features

Our March '90 Issue will be published on Friday, 2 February 1990. See page 79 for details.

1990 CATALOGUE

128 PAGES OF ELECTRONIC COMPONENTS AND EQUIPMENT. HUGE RANGE! AMAZING VALUE! DON'T MISS OUT — GET YOUR COPY NOW — ONLY £1.50 POST FREE!!!

A selection of products from our *BARGAIN LISTS*: Ring or write for a free copy of our latest list.



COIN-OPERATED MECHANISM Z652

Made by Coin Controls, this will accept various size coins by simple adjustment of 4 screws. Incorporates various security features – magnet, bent coin rejector, etc. Microswitch rated 5A 240V. Front panel 115 × 64, depth 130mm. Cost £10.85.
Our price..... **£4.00**

KEYBOARDS

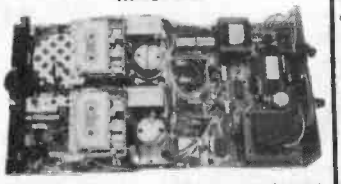
Z8852 Keyboard: Superb brand new keyboard 392 × 181 with LCD displaying 1 line of 10 characters and a further line with various symbols. 100 keys, inc. separate numeric keypad. Chips on board are 2 × 74HC05, 80C48. LCD + driver chips are easily removable from board. **£15.00**

Z8857 High quality Alphanumeric keyboard on aluminium frame 314 × 150mm. Contactless keys good for 20 million operations. Originally sold at over £100 each, they were used in a 'Printcom' portable terminal. Fully ASCII encoded output. Power supply + 5V and −12V @ 35mA. Supplied with comprehensive data. **£14.95**

Z8856 Cherry computer keyboard. Very slim model 340 × 130 by only 14mm deep, including keys. Matrix output. 67 keys in pale/dark brown..... **£4.00**

Z8863 Keyboard. High quality unit made by Micro Switch. 69 pale grey and blue keys. 6 red 5mm LED's, 15 various LS chips and socketed D8048 by Intel. Output via 7 way plug and there is a 4 way edge connector too. Keyboard frame is 317 × 128mm. PCB on which it's mounted is 285 × 170mm.
Price..... **Excellent value at £12.00**

TELEPHONE ANSWERING MACHINE



Z8874 Superb piece of German equipment. This uncased model looks complete & is believed to be working. Size overall 305 × 163 × 57mm. On the PCB is a mains transformer (220V), relays & associated components. There are 2 mini-cassette decks, 6 position switch, Mic + amp circuit to record outgoing message. 2m mains lead with 2 pin plug, + a 6 core lead for connection to Telecom socket. Excellent quality & value. **£12.50**

DISPLAYS

Z4243 Display panel 152 × 112mm with NEC 8 digit display (Z1731); 8279-5, MC146818, 3 × uPA80C, & a couple of LS chips, crystal, etc. **£2.90**

Z1731 NEC Vacuum Fluorescent Display FIP8BII. 8 digit multiplexed output 10mm high. Heater voltage 2V, grid/anode voltage 24V. **£2.00**

Z4115 8 digit 12.7mm high LCD and holder. These are 14 segment devices allowing alphanumeric display. Normally costing over £15.00 we are offering these for just **£4.50**

Z4148 LCD as Z4115 but 6 digit, 50 pins. Like RS 588-601. Their price 10.86. ..... **£3.00**

Z1732 Epson LCD 4 digit 8mm high. **£2.00**

Z1637 LCD Display – Direct drive 3½ digit similar to RS 588-572. 12.7mm high digits. Op voltage 4-12 RMS @ 32Hz typ. Supplied with data. ..... **£2.00; 10+/ £1.75; 25+/£1.50; 100+/£1.00**

Z1560 7 seg display, 20mm high. Common anode. ..... **Only 70p! 25+/50p; 100+/42p**

DL1416 Alphanumeric 4 character intelligent display 0.16" **£7.00**

DL3416 4 digit intelligent alphanumeric display with built-in drive and memory. ASCII ROM and multiplexing circuitry. TTL compatible inputs. +5V. Supplied with data.
List price £41.50. ..... **£8.00**

HIGH QUALITY TEST EQUIPMENT

HITACHI OSCILLOSCOPES
FOR QUALITY AND VALUE

V223 DC-20MHz, dual Channel, single timebase delayed sweep, DC offset, alternate magnifier, 6in screen, 5mV/div vert. sensitivity 0.2μs/div-0.2s/div sweep time. Complete with 2 probes, manual, mains lead. **£475**
Other models from **£339** – full details in catalogue. Ask for colour brochure.

METEX METERS

8 different models in our catalogue! !

- ★ 4½ digit 12mm LCD display
- ★ 30 ranges incl 20A ac/dc
- ★ Frequency counter
- ★ Capacitance test with zero adjust
- ★ Data hold switch
- ★ Diode test
- ★ Transistor test
- ★ Continuity test
- ★ Test leads with 4mm plugs
- ★ Rugged yellow case
- ★ Carrying case

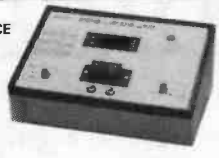
M4650 **£94.00**

Battery and instruction manual included.
AC volts 0-200m-2-20-200-750Vac ±0.5%
DC volts 0-200m-2-20-200-1000vdc ±0.5%
AC current 0-2m-200m-20Aac ±1.0%
DC current 0-200μ-2m-200m-20Adc ±0.5%
Resist 0-200-2k-20k-200k-2M-20MΩ ±0.15%
Capacitance 0-20p-200n-20μF ±2.0%
Frequency 0-20k-200kHz ±2.0%
Transistor hFE 0-1000 NPN/PNP
Dims 176 × 90 × 36mm

FREQUENCY COUNTER

FC5250 7 digit frequency counter for frequencies between 10Hz and 150MHz. Power on/off, ×1/×10 gate time and VHF/HF switches. Inputs via BNC sockets. Supplied complete with instruction manual and test lead. Requires an external 9Vdc nom 200mA power supply.
Price..... **£65.00**

DIGITAL CAPACITANCE METER



CM3300 High accuracy AUTORANGING 3 digit capacitance meter. High resolution measurement in the range 0.1pF to 99900μF with 10 auto ranges. Range hold switch for batch testing capacitors. Range zero control. Inputs via spring terminals or test leads (supplied). Complete with leads and instruction manual.
Price..... **£65.00**

AF GENERATOR/COUNTER

AG2603AD A combined audio frequency signal generator and frequency counter. A six character LED display allows direct reading of internally generated signal or signals from an external source. The frequency generator has a range of 10Hz to 1MHz with either square or sine waveforms and adjustable output level. The frequency counter has a range of 10Hz to 150MHz. Frequency range controlled by a 5-step selector and fine control. Adjustable ouput level with 0/20/40dB attenuator.

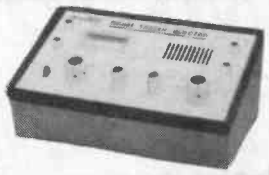
AUDIO GENERATOR
Frequency range..... 10Hz to 1MHz
Output impedance..... 600Ω unbalanced
Output control..... 0-20-40dB and fine adjuster
Output control:
Sine..... 8V rms max
square..... 10V p-p max

FREQUENCY COUNTER
Frequency range..... 10Hz to 150MHz
Input voltage..... Less than 50mV
Max input voltage..... 3V
Input impedance:
High frequency..... 1MHz
VHF..... 50Ω
Power..... 240Vac 50Hz
Dims..... 215 × 150 × 200mm
Price..... **£175.00**

RF GENERATOR/COUNTER

Similar in appearance to above with same frequency counter. Spec:
Frequency range..... 100kHz to 150MHz
RF Output..... 100mV rms (up to 35MHz)
Output control..... 0/20dB and fine adj.
Modulation..... Internal 1kHz, external 50kHz-20kHz at less than 1V rms
Price..... **£179.00**

SIGNAL TRACER/INJECTOR



Y133 For fault finding on Audio & RF Equip, VU meter and speaker. Level controls, 0-60dB atten. switch. I/P, O/P, ext spkr, and injector skts on Front panel. Size 200×140×96mm. Uses PP3..... **£55.00**

LCR BRIDGE

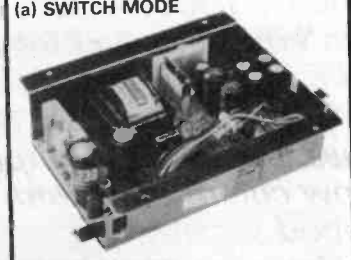
Y134C A fully transistorised AC bridge which allows accurate measurement of resistances, capacitances, inductances and transformer turns ratios.
Resistance range..... 0.1 to 11.1MΩ ±1%
Inductance range..... 1μH to 111H ±2%
Capacitance range..... 10pF to 1110μF ±1%
Power..... 9Vdc (PP3 battery)
Dims..... 200 × 138 × 90mm
Price £115.00

JUST ARRIVED

Big parcel of FETS/MOSFETS inc. 2N7000 Series, IRF150/250, J Series, etc., etc., from 10p each! Ring or write for Price List.

POWER SUPPLIES

(a) SWITCH MODE



ASTEC Model AA12531
I/P: 115/230V ac 50/60Hz. O/P: V1 + 5V 5A; V2 + 12V 0.15A. Size: 160 × 104 × 45mm. Partially enclosed panel with fixing holes in steel case on 120 × 125mm centres. Inputs and Outputs are on colour coded leads; there is also an EEC socket on a flying lead. **£6.95**

Z660 Astec switched mode PSU Type AA7271.

This small PCB, just 50 × 50mm will accept 8-24V input and give a stable 5V DC at up to 2A output. The 6 transistor circuit provides current overload protection, thermal cut-out and excellent filtering. Offered at the remarkably low price of just..... **£5.00**

(b) CONVENTIONAL

Z4215 Siliconix mains input, 4.5V DC 150mA output to 3.5mm jack plug on 2m lead. Built-in continental 2-pin plug. Size 62 × 46 × 35mm **£1.50**
Z4170 Plug in power supply. Built in 13A plug. Output 6V DC 300mA on 2m long lead terminated In a 3mm power plug. British made to BS415 ..... **£1.50**
Z4208 Oric Power Supply. Moulded plastic case with built in 13A plug. Output 9Vdc at 600mA delivered to 2m lead with 2.5mm power plug **£3.50**

FLASH GUN RETURNS

(Lots more on latest Bargain List)

Hanimex electronic flash units that have been returned by the consumer to the place where purchased. These are offered complete & in good condition (many in original boxes) but have not been tested by us, so are offered without any guarantee. 4 models available, as listed:
Z4259 Type X140. Hot shoe attachment. Size 75 × 60 × 25mm off/on switch & test button. Takes 2 × HP7. Originally sold at £7-£10. **£3.00**
Z4260 Type X215. Similar to above. **£3.20**
Z4261 Type CX330. Another with same features, + auto/manual switch, size 70 × 65 × 35mm. **£3.50**

BREADBOARDS

FREE, *if requested, with every breadboard sold this month! K574 wire link pack with about 250 links for use with breadboard or PCB's!*

PROTOBLOC 1
G708 Protobloc 1 has a total of 400 tie points consisting of two sets of 30 rows of 5 interconnected sockets plus 4 rows of interconnected sockets running alongside, suitable for use as power supply rails. All contact positions are clearly defined on an alphanumeric grid. ABS polymer board mounted on an adhesive foam base. Will accommodate up to three 16 pin devices. An ideal introduction to solderless circuit development systems. Size 80 × 60mm. **£2.50**

PROTOBLOC 2
G711 Protobloc 2 has a total of 840 tie points. Will accommodate up to seven 16 pin devices. Size 172 × 64mm..... **£3.95**

PROTOBLOC 2A
G712 As above, but mounted onto a rigid base plate complete with three 4mm terminals for power connections. A mounting bracket which clips into the base is also provided to accept a variety of components including switches and potentiometers, etc.
Price..... **£6.95**

PROJECT BOARD GL24
G724 2 of type G711 mounted onto a rigid baseplate with 3 coloured terminals, for power connections. Overall size 225 × 150mm.
Price..... **£13.95**

PROJECT BOARD GL36
G736 3 of type G711 and an additional strip of 100 tie points mounted onto a rigid base plate with 4 coloured terminals. Overall size 242 × 195mm.
Price..... **£19.95**

GREENWELD
ELECTRONIC COMPONENTS

All prices include VAT; P&P **£2.00** per order. Min Credit Card £5. No CWO min. Official Orders from Education welcome & min invoice charge £10.00 Our shop has enormous stocks of components and is open from 9-5.30 from Mon-Sat. Come and see us!
HOW TO CONTACT GREENWELD: By Post: Use the address below: **By Phone:** (0703) 772501/783740 (ansaphone out of business hours): **By Fax:** (0703) 787555: **By EMail:** MAG36026: **By Telex:** 94081101 GWELD

Payment is accepted by cheque, postal order, cash inc. foreign currency bank notes/book tokens/Access/Visa/Connect.

443D MILLBROOK ROAD, SOUTHAMPTON, SO1 0HX.

BROADCAST RECEIVER

An up to the minute design using a high tech. i.c. (NOT A ZN 414 — OR "41BORE"!) and ceramic filters for the i.f. stages — these give excellent performance without the need for alignment of the i.f.s. The radio tunes long and m.w. broadcast bands, has loudspeaker output, low curent drain and good sensitivity/ selectivity.

FREE! MARCO 1990 SPRING CATALOGUE

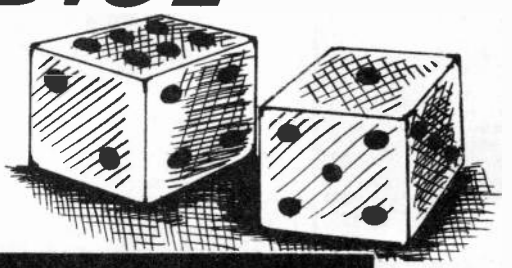
A whole host of goodies at sale prices from Marco Trading

GETTING YOUR PROJECTS WORKING

Don't be driven mad by projects that won't work, we show you how to go about sorting them out —without a hammer. Fault finding and testing is all part of the skill of successful project construction

ELECTRONIC DICE

An electronic simulation of the plastic cube! Just press the button and your luck will be displayed by l.e.d.s in the form usually shown on a dice.



NEXT MONTH

EVERYDAY ELECTRONICS

MARCH ISSUE ON SALE FEBRUARY 2 1990

ELV

Technik für Kenner - Made in Germany

We deliver from stock - The fastest way to order is a fax !

ULTRASONIC CAR ALARM

This system is specially designed to protect your car and its contents against potential thiefs. Low current consumption and high noise immunity are just two of its distinguishing features.

Complete Kit including case
44.367BKL £ 30.40

In addition the system has a voltage sensing device i.e. the alarm is also triggered if appliances are switched on by an unauthorised person (e.g. the interior lighting when the door is opened).

SPM 130 Decibel Meter

(Elektor Electronics September 89)

Depending on their physical and mental state, human beings respond subjectively to ambient noise. Objective, absolute sound pressure level measurements therefore invariably require a specially designed test instrument, the decibel meter.
This portable instrument gives an accurate indication of the sound pressure level (SPL). The three SPL ranges (40 to 130 dB), three response modes, and linear or A-weighted filtering provided by the meter enable many types of measurement to be carried out, from the tracing of ambient noise sources to establishing the sensitivity of a lousspeaker.

Complete kit
44.472BKL £ 99.50
Ready assembled module
44.472F £ 160.50

DIGITAL PROFESSIONAL ECHO 1000

(Elektor Electronics June 89)

This low cost echo unit is certain to impress music lovers - amateur and professional - everywhere. Excellent specification and top performance make the EU 1000 a winner and despite meeting professional requirements the unit will not make too big a hole in your pocket.
Working on the delta modulation principle on a digital base, delay times up to one second are possible at full bandwidth and large signal to noise ratio.

EU 1000, complete kit
44.255BKL £ 99.50
EU 1000, ready assembled
44.255F £ 134.50

Specification

Input sensitivity:
Input 1 : 2 mV
Input 2 : 200 mV
Dealy Time:
variable from 60 ms to 1 s
Bandwidth :
100 Hz to 12 kHz

Additional features:
- inputs mixable
- single and multiple echo
- adjustable delay level
- switchable vibrator
- switch-controlled noise suppression

Ordering and payment:

- all prices excluding V.A.T. (french customers add 18.6%T.V.A.)
- send Euro-cheque, Bank Draft or Visa card number with order. Please add £ 3.00 for p & p (up to 2 kg total weight)
- postage carged at cost at heigher weight Air/Surface -
- we deliver worldwide except USA and Canada
- dealer inquiries welcome

RFK 700 RGB-CVBS Converter

(Elektor Electronics October 89)

Nearly all computers supply as an output signal for colour monitors RGB signals. With the help of the RFK 7000 it is possible to record this signals with a videorecorder or to give them onto a colour TV.
The voltage supply is gained from a 12V/300mA-DC voltage mains adaptor.

Complete kit
44.525BKL £ 66.50

Ready assembled module
44.525F £ 119.50

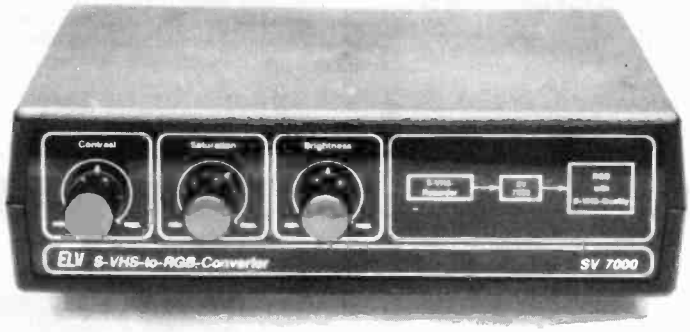
ELV France - B.P. 40 - F-57480 SIERCK-LES-BAINS - France - Tel.: (33) 82.83.72.13 - Fax: (33) 82.83.81.80

S-VHS-RGB-CONVERTER SVR 7000

(Elektor Electronics May 89)

Superb picture quality!

With the SVR 7000 video recorders and cameras of the new super VHS generation can be connected to colour TV sets which have a scart input socket, without adjusting the TV set itself. Connected between the S-VHS and TV, the SVR 7000 converts the separate luminance and chrominance signals of a super VHS into an equivalent, high-quality RGB signal.
Three controllers for contrast, colour and brightness optimise the picture quality even if input signals deviate from the norm.
A 4-pole mini-DIN input socket for the S-VHS picture signal, two BNC input sockets for left and right stereo-audio sound channels (only one BNC socket is required for mono) and a scart output socket are available to connect the unit. The voltage supply is gained from a 12V/300mA-DC voltage mains adaptor.

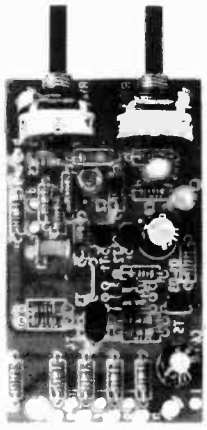


Complete Kit	**44.497BKL**	**£**	**76.25**
Ready Assembled Module	**44.497F**	**£**	**176.00**

VIDEO RECORDING AMPLIFIER

(Elektor Electronics April 89)

Losses can easily occur when copying video tapes resulting in a distinct reduction in quality. By using this video recording amplifier, with no less than four (!) outputs, the modulation range is enlarged and the contrast range of the copy increases.
Two level controllers for edge definition (contour) and amplification (contrast range) allow individual and precise adaptation.



Complete Kit
(including Box, PCB and all parts
44.324BKL **£** **14.75**

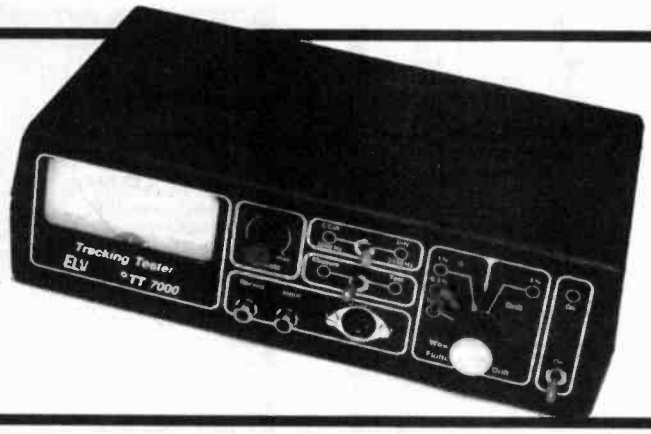
MG 7000 MINI-FUNCTION GENERATOR

- Frequency Range: 0.2Hz to 200kHz
- Functions: Sine, Triangular, Saw-Tooth Square Wave
- Output Voltage: max. 10V$_{pp}$ - adjustable via attenuator
- Distortion Factor: approx. 0.5% (1kHz)
- Power Supply: via 2 x 9V block batteries

Complete Kit	**44.238BKL**	**£**	**62.15**
Ready Assembled Module	**44.238F**	**£**	**123.95**

GLP 7000 TRACKING TESTER

(Elektor Electronics July/August 89)



Good wow and flutter characteristics are a mark of quality in tape decks, reel-to-reel tape and VCRs. This tester not only allows you to take quick and exact measurements of wow and flutter, but also of drift.

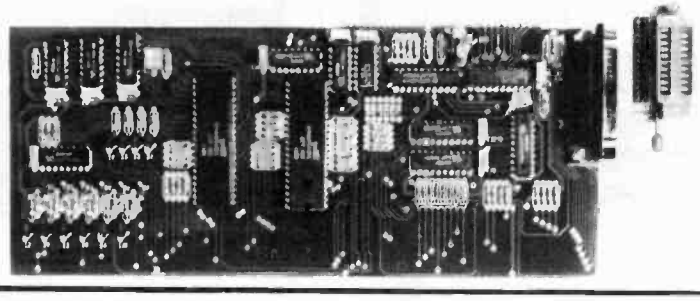
Here are the main features in brief:
- built-in, quartz-stabilised reference tone generator
- switchable frequencies for wow and flutter measurements for DIN (3150Hz) and CCIR (3000Hz)
- 1 additional range for drift measurements (+/-5%)

Complete kit
44.385BKL **£** **49.80**
Ready assembled modul
44.385F **£** **119.50**

Wow and Flutter Test Cassette
Side A: 3150Hz - 10dB (DIN)
Side B: white noise - 10dB for adjusting the sound head by ear
44.385MK **£** **11.00**

IC TESTER FOR IBM-PC-XT/AT

With the ELV IC tester logic function tests can be carried out on nearly all CMOS and TTL standard components, accommodated in DIL packages up to 20 pin. The tester is designed as an insertion card for IBM-PC-XT/AT and compatibles. A small ZIF test socket PCB is connected via a flat band cable. Over 500 standard components can be tested using the accompanying comprehensive test software.



Complete Kit including Textool sokket, connectors, sockets, Flat band cable, PCB, Software
44.474BKL **£** **60.85**
Ready Assembled Module
GB474F **£** **113.00**
Software, single
44.474SW **£** **17.85**

ELV France - B.P. 40 - F-57480 SIERCK-LES-BAINS - France - Tel.: (33) 82.83.72.13 - Fax: (33) 82.83.81.80

THE RTC MONITOR II

100 WATT SPEAKER KIT £60.00 +£3.50 P&P (pair)

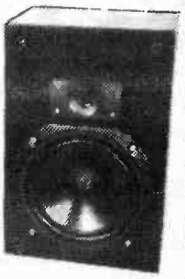
RESPONSE: 55Hz–20kHz

BASS POLYMER CONE D: 22cm

DOME TWEETER: 14mm

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

RECOMMENDED AMP POWER: 10-100 watts per channel



The performance standard achieved in this compact design is distinctively superior to anything else available at the price. The drive units used are of sophisticated design and have been carefully integrated with a Complex Crossover.

Stereo performance is exceptionally good with a well focussed sound stage and sharp resolution of detail. Distortion throughout the frequency range is low even at quite high power input and this gives a great sense of dynamic range and openness especially when used in bi-wired mode.

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

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

AMPHONIC 125+125 POWER AMPLIFIER

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

Output power .... 125W RMS max. per channel
Output impedance ..... 4 to 16 ohms (max. power into 4 ohms)
Sensitivity ..... 450V at 22K ohms
Protection .... Electronic short-circuit and fuses
Power ..... 220-240V a.c. 50Hz
Chassis dim ..... 435×125×280mm

£124.99+£7.00 p&p

GOODMANS 60W CAR GRAPHIC

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

LCD DIGITAL MULTI TEST METER AC DC

Volts resistance and DC Amps. Most of these units are new but have been returned or rejected by the store and sold with all faults at £11.00 each. Postage £1.00. (Made by Ross Electronics).

ROSS DYNAMIC MICROPHONE BALL TYPE

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

J.B.L. BOLIVAR COMPONENT SPEAKERS

4½" 100W HI-FI MID RANGE 1" VOICE COIL, PAPER CONED AND DOPED CAMBRIC EDGE FITTED WITH A 3½" MAGNET. 6Ω IMPEDANCE **£5.33**

4½" HI-FI TWEETER ¾" VOICE COIL, 1¾" CONE WITH FOAM EDGE, 2¾" MAGNET, 6Ω IMPEDENCE **£6.33**

POSTAGE £4.70 PER ORDER

52W 2-WAY COMPONENT SPEAKER SYSTEM £3.95

Comprises 8in rolled surround bass unit and 2¼in tweeter for In-Car or Hi-Fi use. 4 ohm. *Made by Sanyo.*

8in SOUND LAB COMPONENT SPEAKER 60W £12.95

Res freq. 38Hz full range

12in DANTEX 100W £21.75

Res freq. 23Hz bass unit

Postage **£3.20** each order

★ SPECIAL PURCHASES

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

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

HILLS KITS IN STOCK ★ SEND FOR CATALOGUE

MAIL ORDER £1 BARGAIN PACKS BUY 10 GET 1 FREE

Please state pack(s) required

No	Qty. per pack	
BP010	2	6½" Speaker 8Ω 10 watt
BP012	2	6½" Speaker 4Ω 10 watt
BP013	3	8"×5" Speaker 4Ω 6 watt *made by E.M.I.*
BP015B	1	30 watt. dome tweeter. Size 90×66mil *JAPAN made*
BP016	6	2200μf can type Electrolytic 25V d.c computer grade *made in UK by PHILIPS*
BP017	3	33000μf 16V d.c. electrolytic high quality computer grade *UK made*
BP018	3	2000μf 50V d.c. electrolytic high quality computer grade *made in USA*
BP019	20	20 ceramic trimmers
BP020	4	Tuning capacitors, 2 gang dielectric a.m. type
BP021	10	3 position, 8 tag slide switch 3 amp rated 125V a.c. *made in USA*
BP022	5	Push-button switches, push on push off, 2 pole change over. PC mount *JAPAN made*
BP023	6	2 pole 2 way rotary switch
BP024	2	Right angle, PCB mounting rotary switch, 4 pole, 3 way rotary switch *UK made by LORLIN*
BP025	4	3 pole, 3 way miniature rotary switch with one extra position off (open frame YAXLEY type)
BP026	4	4 pole, 2 way rotary switch *UK made by LORLIN*
BP027	30	Mixed control knobs
BP028	10	Slide potentiometers (popular values)
BP029	6	Stereo rotary potentiometers
BP030	2	100k wire wound double precision potentiometers *UK made*
BP031	6	Single 100k multitune pots, ideal for varicap tuners *UK made by PHILIPS*
BP032	4	UHF varicap tuner heads, unboxed and untested *UK made by PHILIPS*
BP033	2	FM stereo decoder modules with diagram *UK made by PHILIPS*
BP033A	4	6"x⅜" High grade Ferrite rod. U.K. made.
BP034	3	AM IF modules with diagram UK made by PHILIPS
BP034A	2	AM-FM tuner head modules. *UK made by MULLARD*
BP034B	1	Hi-Fi stereo pre-amp module inputs for CD, tuner tape, magnetic cartridge with diagram. *UK made by MULLARD*
BP035	6	All metal co-axial aerial plugs
BP036	6	Fuse holders, panel mounting 20mm type *JAPAN made*
BP037	6	In line fuse holders 20mm type *UK made by BULGIN*
BP038	20	5 pin din, 180° chassis socket
BP039	6	Double phono sockets, Paxolin mounted
BP041	3	2.8m lengths of 3 core 5 amp mains flex
BP042	2	Large VU meters *JAPAN made*
BP043	30	4V miniature bulbs, wire ended, new untested
BP044	2	Sonotone stereo crystal cartridge with 78 and LP styli *JAPAN made*
BP045A	2	Mono Cassette Record and play heads. (Japan Made)
BP046	4	6-0-6 4VA mains transformers, P.C. mount *UK made*
BP047	1	24V 750mA mains power supply. Brand new boxed *UK made by MULLARD*
BP049	10	OC44 transistors. Remove paint from top and it becomes a photo-electric cell (or P12) *UK made by MULLARD*
BP050	30	Low signal transistors n.p.n., p.n.p. types
BP051	6	14 watt output transistors. 3 complimentary pairs in T066 case *(Ideal replacement for AD161 and 162s)*
BP052A	1	Tape deck pre-amp IC with record/replay switching No LM1818 with diagram
BP053	5	5 watt audio ICs. No TBA800 *(ATEZ)*
BP054	10	Motor speed control ICs, as used with most cassette and record player motors
BP055	1	Digital DVM meter I.C. *made by PLESSEY* as used by *THANDAR* with diagram
BP056	4	7 segment 0.3 LED display (R.E.D.)
BP057	8	Bridge rectifiers, 1 amp, 24V
BP058	200	Assorted carbon resistors
BP059	1	Power supply PCB with 30V 4V/A transformer. MC7818CT IC & bridge rectifier: Size 4"×2¾"
BP060	1	Transcription record player motor 1500rpm 240V a.c.
BP061	5	6.35mm Mono jack plugs
BP063	5	6.35mm stereo switched jack sockets
BP064	12	Coax chassis mount sockets
BP065	1	3mtr Euro-mains lead with a matching chassis socket

MULTIBAND RADIO

VHF 54-176 MHz + AM CB BANDS 1-80
Listen to: AIR TRAFFIC CONTROL, AIRCRAFT, RADAR PUBLIC UTILITIES RADIO AMATEURS AND MANY MANY MORE

£15.95

POSTAGE £2.85

SQUELCH CONTROL "RUBBER DUCK AERIAL"

RADIO AND TV COMPONENTS ACTON LTD
21 HIGH STREET, ACTON LONDON W3 6NG

MAIL ORDER TERMS. POSTAL ORDERS and or CHEQUES with orders. Orders under £20 add £3.00 service charge. Nett monthly accounts to Schools, Colleges and P.L.C. only. ACCESS - VISA. *Phone orders between 9.30 & 12pm please. Overseas readers write for quote on delivery. Phone: 01-723 8432 or 01-992 8430. Callers 323 Edgware Road, London W2*

30+30 WATT AMPLIFIER KIT

An easy to build amplifier with a good specification. All the components are mounted on the single P.C.B. which is already punched and backprinted.

- 30W×2 (DIN 4 ohm)
- CD/Aux, tape I, tape II, tuner and phono inputs.
- Separate treble and bass
- Headphone jack

Size (H.W.D.) 75×400×195mm

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

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

TV SOUND TUNER

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

£29.50 +£2,50 p&p

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

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

Size: 270×192×65mm. **£35.90** +£2.50 p&p

TV SOUND TUNER KIT £11.50+£1.30 P&P

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

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

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

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

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

£6.20 +£1.50 P&P 2 for **£10** +£2.50 P&P

EXTRACTABLE HOUSING FOR YOUR CAR STEREO ★ SIZE DIN E ★ HANDLE INCLUDED ★ SPACE FOR MEMORY BATTERY ★ 4 OR 2 SPEAKER SYSTEM.
ENABLES YOU TO REMOVE YOUR VALUED STEREO FROM YOUR CAR (WITHOUT THE AID OF A HAMMER AND CHISEL, CHAINSAW ETC). **£9.95 postage £2.50**

INSULATION TESTER

EE APRIL 85

A reliable electronic tester which checks insulation resistance of wiring appliances etc., at 500 volts. The unit is battery powered simple and safe to operate. Leakage resistance of up to 100 Megohms can be read easily. One of our own designs and extremely popular.

KIT REF 444 **£20.85**

PET SCARER

EE MAY 89

Produces high power ultrasound pulses. L.E.D. flashes to indicate power output and level. Battery powered (9V–12V or via Mains Adaptor).

KIT REF 812 **£13.80**

Mains Adaptor £1.98

DIGITAL CAPACITANCE METER

EE DEC 85

Simple and accurate (1%) measurement of capacitors from a few pF up to 1,000 μF. Clear 5-digit LED display indicates exact value. Three ranges – pF, nF, and μF. Just connect the capacitor, press the button and read the value.

KIT REF 493 **£44.25**

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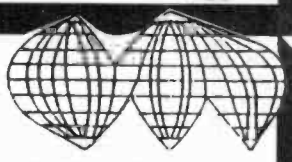

EE AUG 87

Covers 1.6–30 MHz in 3 bands using modern miniature coils. Audio output is via a built-in loudspeaker. Advanced design gives excellent stability, sensitivity and selectivity. Simple to build.

KIT REF 718 **£28.25**

DIGITAL FREQUENCY 200 MHz METER

EE NOV 86

An 8 digit meter reading from AF up to 200 MHz in two ranges. Large 0.5" Red LED display. Ideal for AF and RF measurements. Amateur and C.B. frequencies.

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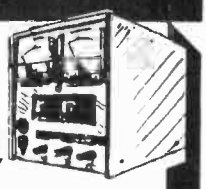


EE FEB 88

A superb design giving 0.25V and 0-2.5A. Twin panel meters indicate Voltage and Current. Voltage is variable from zero to 25V. A Toroidal transformer MOSFET power output device, and Quad op-amp IC design give excellent performance.

KIT REF 769 **£52.96**

MINI STROBE

EE MAY '86

A hand held stroboscope which uses 6 "ultra bright" LEDs as the light source. Designed to demonstrate the principles of stroboscope examination, the unit is also suitable for measuring the speed of moving shafts etc. The flash rate control covers 170–20,000 RPM in two ranges.

KIT REF 529 **£14.76**

ACOUSTIC PROBE

EE NOV '87

A very popular project which picks up vibrations by means of a contact probe and passes them on to a pair of headphones or an amplifier. Sounds from engines, watches and speech travelling through walls can be amplified and heard clearly. Useful for mechanics, instrument engineers and nosey parkers!

KIT REF 740 **£18.65**

MAINS TESTER & FUSE FINDER

EE MARCH '86

A handy unit which sounds an audible warning when the mains supply is disconnected and gives visual indication on three neon lamps of the connections to mains sockets. Designed for checking correct connections of mains wiring and for tracing which socket connects to which fuse in fusebox. Can detect no live, no neutral, no earth, L/N reversal, L/E reversal.

KIT REF 512 **£9.39**

EE EQUALISER

EE MAY '87

A mains powered loniser with an output of negative ions that give a refreshing feeling to the surrounding atmosphere. Negligible current consumption and all-insulated construction ensure that the unit is safe and economical in use. Easy to build on a simple PCB.

KIT REF 707 **£16.54**

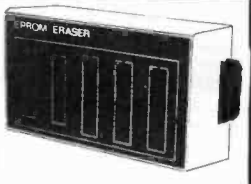
MUSICAL DOORBELL

EE JAN '86

This project uses a special I.C. pre-programmed with 25 tunes and 3 chimes. A Magenta design, the circuit is battery powered and only draws current whilst producing sounds. Two rotary switches select the tune required. Provision is made for three bell pushes, each of which sounds a different tune, so that three points of entry can be identified.

KIT REF 497 **£19.95**

EPROM ERASER



EE OCT '88

Safe low-cost unit capable of erasing up to four EPROM's simultaneously in less than twenty minutes. Operates from a 12V supply. Safety interlock. Convenient and simple to build and use.

KIT REF 790 **£26.57**

LIGHT RIDERS

EE OCT '86

Three projects under one title – all simulations of the Knight Rider lights from the TV series. The three are a lapel badge using six LEDs, a larger LED unit with 16 LEDs and a mains version capable of driving six main lamps totalling over 500 watts.

KIT REF 559 CHASER LIGHT	£14.52
KIT REF 560 DISCO LIGHTS	£20.89
KIT REF 561 LAPEL BADGE	£10.86

EE TREASURE HUNTER

EE AUG '89

A sensitive pulse induction Metal Detector. Picks up coins and rings etc., up to 20cms deep. Low "ground effect". Can be used with search-head underwater. Easy to use and build, kit includes search-head, handle, case, PCB and all parts as shown.

KIT REF 815 **£39.95**

Headphones **£1.99**

STEPPING MOTOR INTERFACE

EE AUG '85

This interface enables 4 phase unipolar stepping motors to be driven from four output lines of any computer user port. The circuit is especially suitable for the ID35 motor and our MD200 which are commonly used in buggies and robot arms. Supplied complete with ribbon cable and connector for the BBC user port.

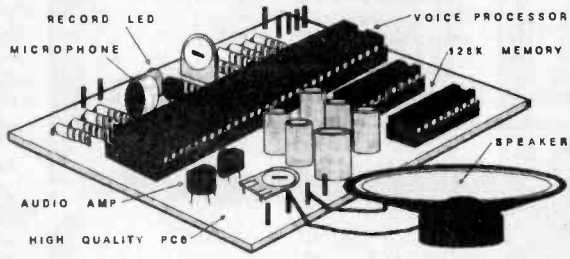
KIT REF 464 **£8.95**

KITS & COMPONENTS

ELECTRONIC GUARD DOG

One of the best burglar deterrents is a guard dog and this kit provides the barking. Can be connected to a doorbell, pressure mat or any other intruder detector and produces random threatening barks. All you need is a mains supply, intruder detector and a little time.
XK125 ..... £24.00

VOICE RECORD/PLAYBACK KIT



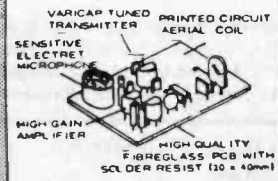
This simple to construct and even simpler to operate kit will record and playback short messages or tunes. It has many uses – seatbelt or lights reminder in the car, welcome messages to visitors at home or at work, warning messages in factories and public places, in fact anywhere where a spoken message is announced and which needs to be changed from time to time. Also suitable for toys – why not convert your daughter's £8 doll to an £80 talking doll!!

Size ..... 78×60×15 mm
Message time ..... 1 – 5 secs normal speed, 2 – 10 secs slow speed
XK129 ..... **£22.50**

TEN EXCITING PROJECTS FOR BEGINNERS

This kit 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.
XK118 ..... **£15.00**

SUPER-SENSITIVE MICROBUG

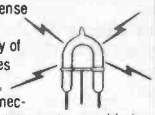


Only 45×25×15mm, including built-in mic. 88-100MHz (standard FM radio). Range approx. 300m depending on terrain. Powered by 9V PP3 (7mA). Ideal for surveillance, baby alarm etc. **£5.50**

DISCO LIGHTING KITS

DL8000K 8-way sequencer kit with built-in opto-isolated sound to light input. Only requires a box and control knob to complete **£34.60**
DL1000K 4-way chaser features bi-directional sequence and dimming 1kW per channel **£21.00**
DLZ1000K Uni-directional version of the above. Zero switching to reduce interference **£11.80**
DLA/1 (for DL & DLZ1000K) Optional opto input allowing audio 'beat'/light response **80p**
DL3000K 3-channel sound to light kit, zero voltage switching, automatic level control and built-in mic. 1kW per channel **£17.00**

POWER STROBE KIT



Produces an intense light pulse at a variable frequency of 1 to 15Hz. Includes high quality PCB, components, connectors, 5Ws strobe tube and assembly instructions. Supply: 240V ac. Size: 80×50×45.
XK124 STROBOSCOPE KIT **£15.00**

VERSATILE REMOTE CONTROL KIT

Includes all components (+transformer) for a sensitive IR receiver with 16 logic outputs (0 – 15V) which with suitable interface circuitry (relays, triacs, etc – details supplied) can switch up to 16 items of equipment on or off remotely. 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 (exc. transformer) 9×4×2 cms. 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).
MK12 IR Receiver (inc transformer) **£17.00**
MK18 Transmitter **£7.80**
MK9 4-way Keyboard **£2.40**
MK10 16-way Keyboard **£7.00**
601133 Box for Transmitter **£2.60**

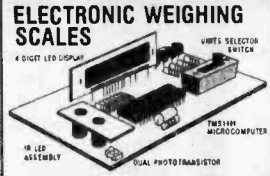
MULTIMETER BARGAINS

A high accuracy **Autoranging** meter with **Display Hold, Memory** features.
AC volts 0-2-200-750 1.2%
DC volts 0-0.2-2-200-1000 0.8%
AC current 0-2m-200mA 1.2% 0-10A 2%
DC current ..... as for AC
Resistance. 0-200-2K-20K-200K-2M 1%
Continuity. Buzzer sounds at /20 ohms
Size 127x69x25mm
405 207 ..... **£31.75**

A 15 range **Autoranging** multimeter with 4AC, 5DC and 6 resistence ranges. Only 8x55x108mm. Complete with wallet.
405 206 ..... **£19.50**

Ask for a leaflet on our range of meters

ELECTRONIC WEIGHING SCALES



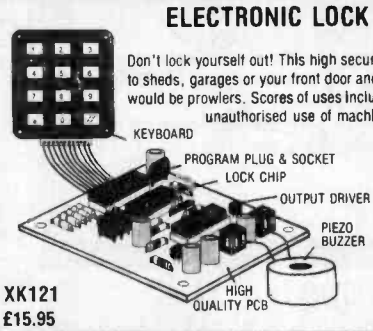
Kit contains a single chip microprocessor, PCB, displays and all electronics to produce a digital LEDreadout of weight in Kgs or Sts/lbs. A PCB link selects the scale – bathroom/ two types of kitchen scales. A low cost digital ruler could also be made.
ES1 ..... **£7.20**

SIMPLE KITS FOR BEGINNERS

Kits include all components (inc. speaker where used) and full instructions.
SK1 DOOR CHIME play a tune when activated by a pushbutton **£3.90**
SK2 WHISTLE SWITCH switches a relay on and off in response to whistle command **£3.90**
SK3 SOUND GENERATOR produces FOUR different sounds, including police/ambulance/fire-engine siren and machine gun **£3.90**

SPECIAL OFFERS ON KITS FOR SCHOOLS AND TRAINING CENTRES – contact Sales Office for discounts and samples

ELECTRONIC LOCK KIT



Don't lock yourself out! This high security lock kit will secure doors to sheds, garages or your front door and the built-in alarm will deter would be prowlers. Scores of uses including area access preventing unauthorised use of machinery or even disabling your car. One correct 4 digit code (out of 5000) will open the lock. Incorrect entries sound the alarm and disable the keyboard for up to 3 mins. Kit includes 12-way keypad, and operates from 9 to 15V (50uA) supply. Will drive relay or 701 150 lock mechanism.

XK121
£15.95

MICROPROCESSOR TIMER

Kit controls 4 outputs independently switching on /off at 18 preset times over a 7-day cycle. LED display of time/day easily programmed. Includes box.
CT6000K **£49.50**

XK114 Relay kit for CT6000 includes PCB, connectors and one relay. Will accept up to 4 relays. 3A/240V c/o contacts **£4.75**
701115 Additional relays **£1.80**

TK ELECTRONICS
13 Boston Road
London W7 3SJ
Tel: 01-567 8910
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PROJECT BUILDING

Over the next few months we will publish a series of individual articles aimed at helping the newcomer — and more experienced readers — to overcome some of the problems encountered when building electronic projects. The first article entitled *First Steps In Project Building* is in this issue — it covers all those things that experienced electronic buffs assume the newcomer knows and therefore never explain. We hope it will encourage a few more readers to have a go and build their first project.

Next month our feature article will be *Getting Your Projects Working*. Most readers will know how frustrating it is to have spent hours carefully constructing a project only to find it does not work. More often than not the fault is a simple one which is easily remedied, if only you knew where to look!

As the author Robert Penfold says in his introduction "Provided you set about things the right way it should be possible to get every project working properly. Inevitably things will not always go perfectly first time, and a little effort will sometimes be required. This can be regarded as all part of the fun though. If electronics was totally without challenge it would not be the interesting and stimulating hobby it is".

EVERYDAY ELECTRONICS DATA BOOK

I'm proud to announce that in association with P.C. Publishing *Everyday Electronics* is about to produce its first book. I know we have published our *Teach-In* books and now a *Project Book* but these have been reprints of past EE material and have been published as "one shots" through the newsagents. This book is a "proper" book — 256 pages packed full of data and worked examples — which I believe will become a standard text for students and technicians, both for those in the electronics field and others who need a working knowledge of electronics. Our well known contributor Mike Tooley has written it for us, more details are on page 125.

It's the sort of book that you will want beside you when you are doing any electronics work or study.

BAEC

Due to ill health Cyril Bogod has been forced to give up his role with the British Amateur Electronics Club. The BAEC are now looking for assistance to keep the club running. As many readers will know Cyril has for many years given his time and effort to the club as honorary Chairman and Editor of the BAEC Magazine — he will be sorely missed. Cyril has also made a generous donation to the club to keep it healthy.

It would be a great pity to see the BAEC diminish since it presents an excellent base for members to discuss electronics and problems with component buying, project building, etc. If you can help or would simply like to know more about the Club, please contact Mr. H. F. Howard, BAEC, 41 Thingwall Park, Fishponds, Bristol BS16 2AJ. Tel. (0272) 658191.

Mike Kenward

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We are unable to offer any advice on the use, purchase, repair or modification of commercial equipment or the incorporation or modification of designs published in the magazine. We regret that we cannot provide data or answer queries on articles or projects that are more than five years old. Letters requiring a personal reply must be accompanied by a **stamped self-addressed envelope** or a **self-addressed envelope and international reply coupons.**

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

COMPONENT SUPPLIES

We do not supply electronic components or kits for building the projects featured, these can be supplied by advertisers.

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

We regret that **we cannot provide data or answer queries on projects that are more than five years old.**

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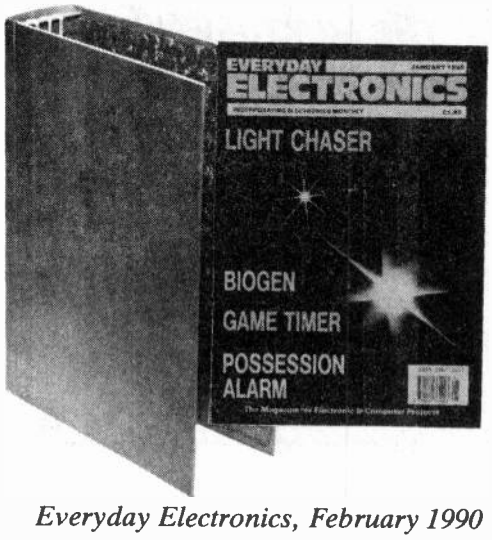

BACK ISSUES

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

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Constructional Project

PROPHET IN-CAR AIR IONISER

ANDREW ARMSTRONG

The Prophet PF3 In-Car Ioniser won't make you a better driver but it may make you more alert and keep you fresh.

WHAT would you say to a project that filled you with energy, made you bounce with health and even improved your brain power? All these claims and more have been made at one time and another for air ionisers. They are said to cure bronchitis and hay fever, improve concentration, turn insomniacs into deep sleepers, and even to speed up the healing of burns. Many of the effects are genuine and well documented, and although I'd hesitate to claim that the Prophet PF3 will actually make you brainier, with so much else going for it, it's got to be worth a try.

Air ions are simply gas molecules that have gained or lost an electron. Add an electron and you get a negative ion, or neg-ion for short. Subtract an electron and you end up with a pos-ion. They are generated naturally from a variety of causes; by the action of ionising radiations, from the friction of one layer of air on another, by water smashing into tiny droplets at waterfalls or in sea spray, by thunderstorms, and so on. The high concentration of neg-ions accounts for the invigorating effects of sea air and the fresh, alert feeling you experience after a thunderstorm.

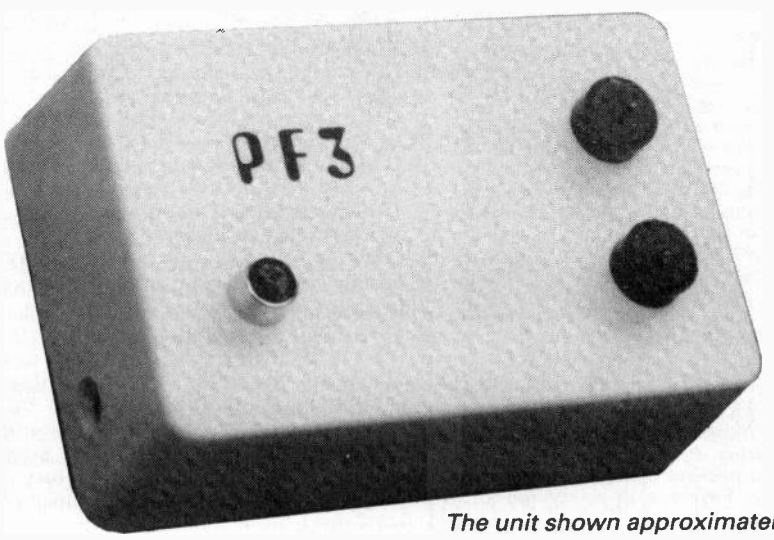
The natural ion density in open countryside varies from about 300 to 1000 ions per cc of air. Close to huge ion generators like the Niagara Falls or the sea, levels of 2000 ions per cc and above can be measured. But in your living room or your car, you'll be lucky to find 60 or 70 ions per cc and if you live in the city the count could be lower still. All of us suffer the consequences of living in ion starved air. Concentration is reduced, tiredness and irritability set in and there's a general feeling of being "under the weather". There's only one cure; restore the natural ion balance with an air ioniser.

SUPER SATURATION

In fact, the PF3 aims to do more than restore the balance; it super-saturates the air with ions. And it does it in the place where the effects of ion boosting will have the most effect: in your car. The importance of a proper ion level for drivers has been recognised by such diverse bodies as NASA (who were keen that their astronauts shouldn't fall asleep at the wheel of the space craft) and Mercedes Benz. Astronauts and motorists alike can benefit from a healthy dose of ions to remain alert, maintain fast reaction times, and drive to the best of their abilities.

There are several ways to ionise the air. Radioactive sources will do the trick, as will certain high energy EM radiations, or even water sprays. By far the safest and most convenient is to do it electrically. The principle is to create a high voltage (around 4kV) and apply it to one or more sharp points. Since charge density increases as radius of curvature gets less, the surplus electrons will be crammed tightly into the points and will gladly step off onto any passing air molecule. The molecule, now negatively charged, will be repelled from the point to make way for the next, and so the ionisation continues.

The PF3 ioniser uses a Cockcroft-Walton voltage multiplier configuration to produce its high output voltage. This is the same principle on which mains driven ionisers operate, but there are one or two differences in detail. The alternating voltage to drive the voltage multiplier is derived from an oscillator which runs at a much higher frequency than mains. It gives a higher output voltage, so that fewer stages are needed to reach the voltage at which ionisation occurs, and the raised frequency means that smaller capacitors can be used in the ladder network while still maintaining peak efficiency. This leads to a neat, compact circuit and a small and unobtrusive ioniser.



The unit shown approximately full size.

THE MULTIPLIER

The functioning of a voltage multiplier is one of those things which is obvious once you know how, but not until then. Fig. 1 shows a single voltage multiplier stage, with associated waveforms. To provide a simple example a square wave drive is assumed. The waveforms are drawn for conditions of no load on the output, and an initial condition of both capacitors uncharged.

On the first rising edge, C1 is rapidly charged with its left hand end reaching + 700V and right hand end remaining at 0V (diode drops will be ignored). To put it another way, the voltage on point A is − 700V relative to the input. The first negative edge tries to pull point A nega-

Fig. 1. (right). Voltage multiplier operation

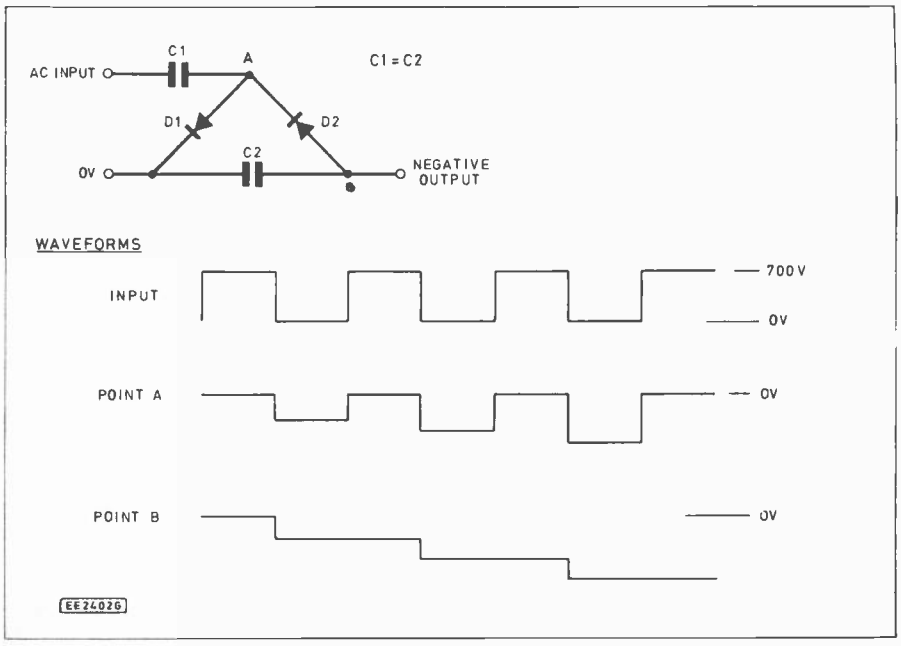
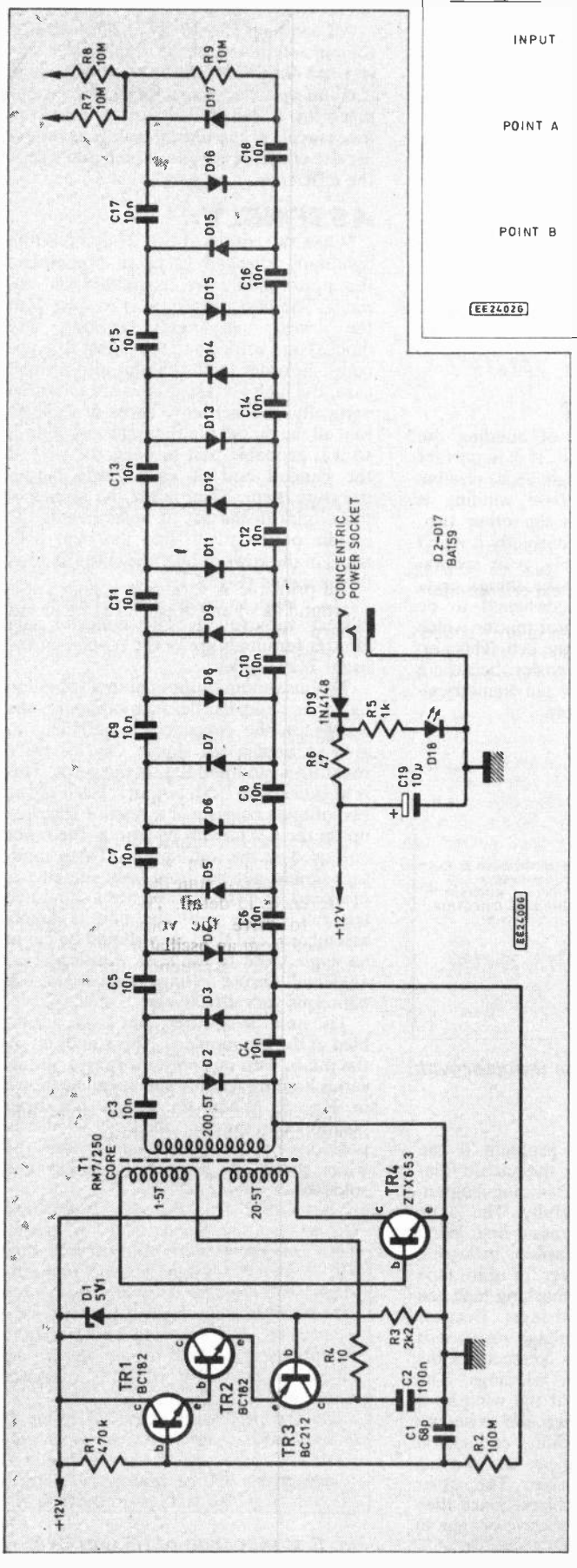


Fig. 2. (below) Circuit of the Prophet PF3 Ioniser



tive, transferring charge to C2 in the process. Because the same charge is stored in double the capacitance, the voltage is halved. The next input cycle transfers more charge to C2, and the voltage on C2 ramps in a stepped exponential manner towards −700V.

The same thing happens when more stages are connected. Because the charge on each capacitor is relative to the previous one, the next capacitor in the chain after C2 has −1400V on its output, and each subsequent stages adds another — 700V.

Of course, the second stage does not charge so fast as the first because it does not receive the full voltage waveform for several cycles, and following stages are delayed still further. The initial charging effect propagates through the chain like a pulse through a delay line. As long as there is no load, however, the capacitors all charge eventually.

FREQUENCY

When a significant load is applied it is altogether a different matter. Current drawn from the output loads all stages, so that the peak to peak voltage after the first capacitor is reduced. This reduces the effectiveness of the second stage, and in turn the effectiveness of the third stage is reduced further. The final stages of a multi-stage multiplier with a heavy load on it may be contributing almost nothing to the final output, while one with a light load may lose only a few percent of the final output voltage.

The definition of light and heavy loads depends on how much current the unit is capable of supplying. Clearly this is limited by how many times per second the charge on one capacitor is transferred to the next one. In a mains ioniser using the capacitor values shown for this circuit, the output voltage is significantly lower under normal operating conditions than a simple count of the number of stages would suggest. The 12V ioniser, however, works at a higher frequency (around 200kHz) so its final stages work well, and fewer stages are needed than might be the case with a mains driven unit.

The drawback to this (there is always one) is that the high voltage diodes have to work fast. Cheap ordinary diodes will not do. The diodes used in this circuit, BA159s, represent a good compromise between price and performance. There are faster diodes around, but they cost a lot more than BA159s.

LITTLE OSCILLATIONS

The oscillator circuit, shown in Fig. 2, is a variation on the flyback converter. When it is first switched on, TR1 and TR2 are conducting, which switches on TR3. This provides plenty of base bias for TR4, which switches on hard. As the collector current rises, a voltage is generated on the base winding which tends to switch on TR4 still harder. This continues until the core saturates. At this point there is no further base drive available from the base winding, because there is no change in flux to generate it.

By now the collector current is so high that the transistor cannot sustain saturation without the drive from the base winding. TR4 therefore starts to switch off. As the flux in the core starts to fall, a negative base drive is generated, tending to remove charge from the base region of the transistor and switch it off quickly. When the flux ceases to fall rapidly, because it is close to zero, the process repeats itself.

The oscillation is mediated by the self resonant frequency of the transformer, which starts the flux reversing at the extremes without any help from TR4. This tends to lock the oscillation to the self resonant frequency, and to improve its efficiency while this happens. The self resonant frequency is determined by the secondary winding, because this has the most self capacitance and stores the most energy. The secondary winding, of course, experiences the same flux changes as the other windings and thus generates a high voltage output waveform mirroring these changes.

When the output from the secondary winding has charged C4 to approximately −690V, the feedback via R2 starts to switch off TR1, TR2, and TR3. This occurs when the base of TR1 is approximately 1.8V above the base of TR3. As these transistors turn off, the base bias to TR4 is reduced, cutting the oscillator power. The purpose of this is to regulate the output voltage. Without this, TR4 would oscillate at full power all the time, and either blow itself up or destroy the voltage multiplier by overvoltage.

Simply reducing the base bias does not, however, reduce the power consumption by much. If the oscillator were to run all the time, most of the power it consumed would be dissipated in switching losses or core losses. The transistor would run warm, and the circuit would consume about 50mA. The current capacity of the unit at full stretch is far more than required for an ioniser, and the frequency is greater than is needed for reasonable multiplier efficiency. It only runs as fast as it does to be able to work with a small inductor.

BIG OSCILLATIONS

The answer to this problem is to make the voltage control loop oscillate, so that the output voltage is first raised a little too high, then allowed to sag back while the oscillator is held switched off. The addition of C1 to the original prototype added enough extra delay to make the control loop oscillate at a few hertz. The frequency is set primarily by the charge/discharge time of C4 under whatever load is drawn at the time — C1 simply ensures that the control loop does overshoot, and its value is not critical.

In normal operation the oscillator oscillates for a few cycles (perhaps only one) between 50 and 100 times per second, though this increases if the output is loaded. It is for this reason that the oscillator is not silent. Because the oscillator is stopping and starting, audible vibrations are caused by the flux in the core closing the gap. The normal current drawn from the 12V supply is under 10mA, so the oscillation of the control loop is beneficial.

The core itself is chosen to store enough energy per cycle to charge up the capacitors quickly. It has a gap between its middle faces to lower the flux density and hence raise the saturation point. This does reduce the inductance per turn, but the provision of a reasonable number of turns gives enough inductance for the system to work.

It looks strange to see the voltage regulation carried out relative to the positive supply, but because R1 and D1 are connected to the same voltage, the only effect this has is to subtract up to 12V from the 690V being regulated.

The voltage regulator transistors are not called on to do anything special, and almost any *npn* transistors will work. TR4 on the other hand, must be a ZTX653, because only this type of transistor will saturate hard enough while switching fast enough to oscillate efficiently. It is also chosen because its voltage rating is enough to withstand the peaks which occur on its collector.

Power for the unit is supplied via a standard p.c.b. mounting power socket. D19 protects the unit from inadvertent reversed connection, while R6 in conjunction with C19 prevents spikes on the car electrical system from damaging the circuit.

Resistor R6 also protects from the effects of radio frequency interference. I discovered that running the ioniser in the car at the same time as my 2m amateur radio transceiver with linear amplifier sent the control loop wild, but all that happened was that the unit drew more current, its supply voltage was dropped enough by R6 to prevent damage, and it went on ionising.

COIL WINDING

The only tricky part of building the ioniser is winding the coil. It is important to wind the coils in the right sense relative to one another. The base winding is reversed compared with the other two, and if this is not wound correctly it won't work. The transistor may even spontaneously combust. To make things easy, the inductor has been designed to be symmetrical, so it does not matter which way round it is fitted to the pcb. This also makes winding the coils easier, because a winding must finish at the pin diametrically opposite the starting pin.

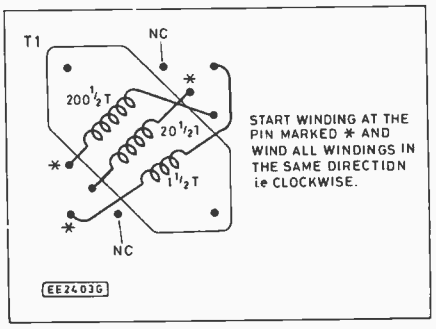


Fig. 3. Top view of the inductor with winding details

There should be no problem if the winding information on the circuit diagram (Fig. 2) and the coil winding diagram (Fig. 3) is followed carefully. The 200½ turn winding should be wound first. Wind this coil as neatly as possible, in layers, and insulate with a layer of thin tape (parcel tape is suitable, masking tape too thick) after every second layer. Because this winding has high voltage on it, it is important not to give its connections the chance to arc to other windings. The connection at the start of the winding is next to the plastic former and poses no problem, but the finishing connection should have a small piece of sleeving slipped over it if possible. The other windings present no problem. Once they are on the former, use adhesive or tape to hold them in place.

If you lose count on the long winding, all is not lost so long as you know approximately how many turns are on there. The specification of 200T is a *minimum*, so if you know the count to the nearest ten turns then wind until you think there are 210 turns. There will be no problem even if there are up to 230 turns, but more than this may take the self resonant frequency outside optimum design tolerance.

All windings should use 0.2mm wire or thinner, in order that the outermost windings are not too far from the core. Even if it could be fitted on, thicker wire would place the collector coil farther from the inner layers of the output coil, thus reducing the coupling between them and hence the efficiency.

ASSEMBLY

When the coil has been wound, and its continuity checked using an ohmmeter, the parts should be assembled on the p.c.b. The best procedure is to start with the lowest components (resistors and diodes) and work up to the tallest (the pot core). In order to fit the unit into a small case, the high voltage diodes are mounted vertically. It is harder to check at a glance that all the diodes are the right way round, so it is probably best to bend the wire at the banded end of each diode before inserting them. Then insert the bodies of the diodes in the set of holes nearer the middle of the p.c.b. and the bent over wires in the rows of holes next to the rows of capacitors (Fig. 4.).

Take care to insert the ZTX653 the correct way round. The collector and emitter terminals are in the reverse of the usual TO92 order.

The maximum output current is limited by series resistors, because otherwise the charge on the capacitors is sufficient to give an unpleasant shock. One of these resistors is mounted flat on the p.c.b. This is in series with both outputs. Each of the two outputs consists of a resistor standing up on the p.c.b. with its wire at the other end used as the ion emitter. These resistors should not be fitted until the case is prepared, and the resistor wires should be left full length until the unit is finally assembled, and then they should be cut at an angle close to the case. Cutting at an angle will ensure a sharp point which will emit ions very effectively.

The l.e.d. is another item to be assembled at the last moment. This stands up on the p.c.b. with one wire shortened and its series limiting resistor connected as shown in Fig. 5. When the p.c.b. has been positioned in the case, the l.e.d. should be positioned to protrude slightly, then the wires should be clipped to length and soldered.

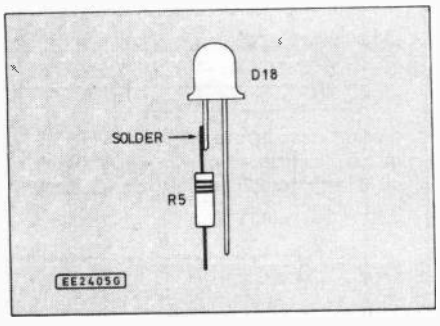
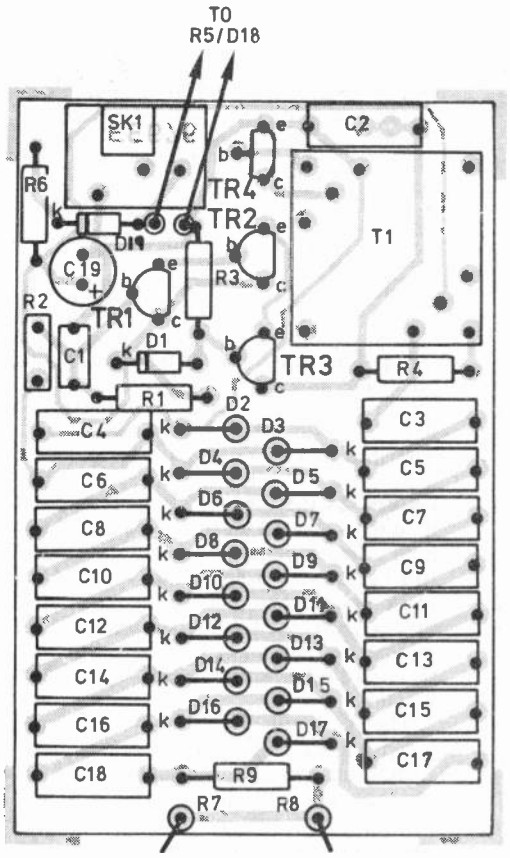


Fig. 5. Connection of R5 and D18.



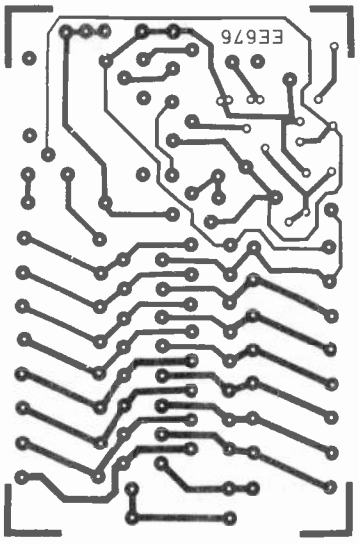
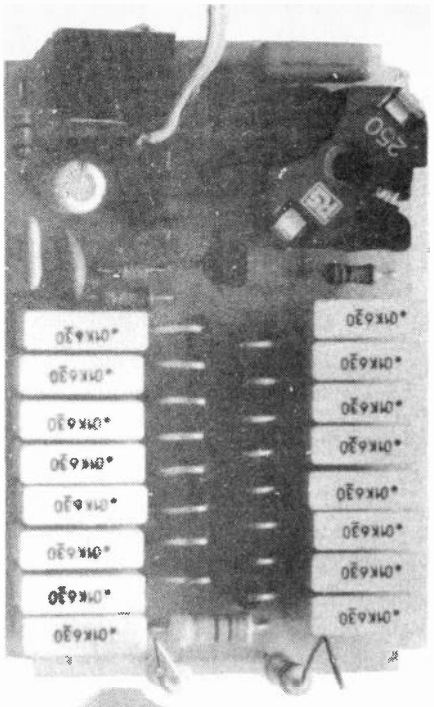
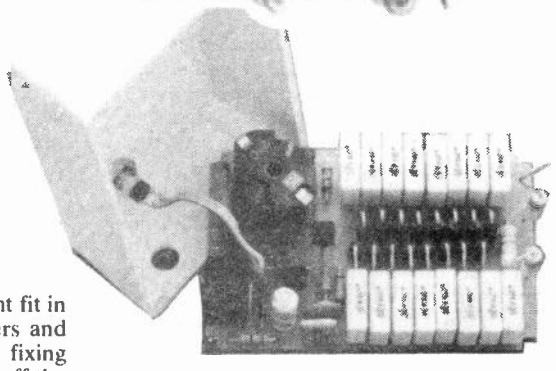


Fig. 4. P.C.B. layout and wiring and the track pattern, shown the correct size above.





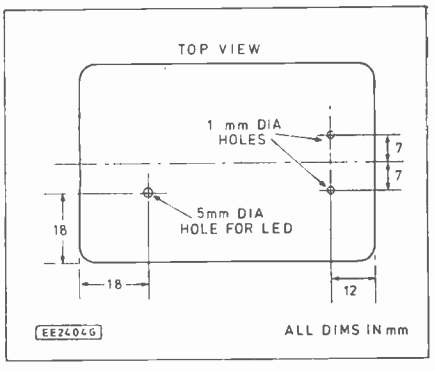


Fig. 6. Case drilling details

COMPONENTS

Shop Talk
see page 131

Resistors

R1	470k
R2	100M
R3	2k2
R4	10
R5	1k
R6	47
R7 to R9	10M high voltage rating e.g. VR37 type (3 off)

Capacitors

C1	68p
C2	100n
C3 to C18	10n 630V min. (16 off)
C19	10μ radial elect. 16V

Semiconductors

TR1, TR2	BC182 *npn* transistor (2 off)
TR3	BC212 *pnp* transistor
TR4	ZTX653 *npn* transistor
D1	5V1 Zener diode
D2 to D17	BA159 (16 off)
D18	0.2 inch l.e.d.
D19	1N4148

Miscellaneous

T1 RM7/250 pot core and 0.2mm enamelled copper wire. SK1 power socket 2.1mm concentric type. Plastic case approx 25×50×76mm; p.c.b.; connecting wire; 90V neon and 4n7 to 22n capacitor for test purposes.

Approx. cost guidance only £22

BOXING

The p.c.b. is designed to be a tight fit in the case, mounted with the emitters and l.e.d. on the face without the fixing screws. The corners should be filed off the board a little at a time until it can just be pushed into the case far enough for the soldered joints on the back of the p.c.b. not to foul the lid.

When the board fits correctly, holes should be drilled in the case for the l.e.d., the ion emitters, and the power socket. The hole positions used for l.e.d. and emitters on the prototype are shown in Fig. 6. The hole for the power connector must be positioned by eye, so it is a good idea to drill it undersize and then file it to size and position.

To make the unit a bit smarter, the resistor leads which emit the ions can be held in place with epoxy resin contained in l.e.d. retaining rings. This was done on the prototype, and proved successful. The procedure is to drill the ion emitter holes as before, then to glue the l.e.d. rings in place with super glue. When this has set, fill the rings with quick setting epoxy adhesive. When the adhesive is set, but has not fully hardened, drill holes in the centre of each ring through to the hole already present in the case. On the prototype the positions matched, but if not it does not matter. Just remember which hole to feed the wire through when fitting the p.c.b.

FINAL ASSEMBLY

When all holes are drilled, the 10M resistors and the l.e.d. should be fitted as detailed above. The output wires from resistors will need to be bent back to match the emitter positions shown on the drilling chart and give the finished project a balanced and pleasing appearance. The p.c.b. should be positioned carefully, with the power connector inserted to ensure that it lines up with the hole. It is now time to test the unit. If it has been built correctly, then it should work first time.

Place the ioniser right side up on an insulating surface (not an antistatic bench mat!) and connect a source of 12V power. If a bench power supply is not available, a fresh 9V radio battery is suitable. Check that the l.e.d. lights. If not, reverse the power connection. If it still does not light, unsolder the l.e.d. from the p.c.b. and connect it the other way round and try again. **NOTE:** Once power has been connected, it is possible that the capacitors are charged to a high voltage even if the l.e.d. did not light. To avoid a painful shock, connect a piece of wire to the negative (0V) power connection and touch the ion emitters with the other end for about half a minute, to leak away the charge.

TESTING

Now to check that the ioniser ionises. Connect a neon and capacitor as shown in

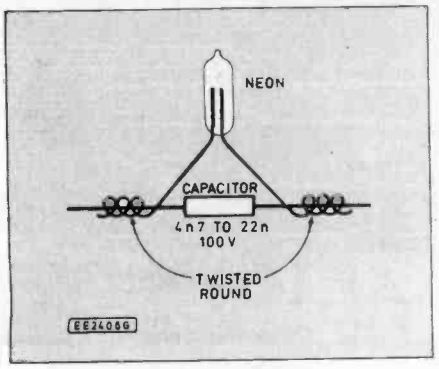


Fig. 7. Simple test circuit

Fig. 7, and ground the negative power supply to the ioniser to a radiator, water pipe, mains earth, or to any large metal object such as a filing cabinet. The neon should flash when one is held in the hand, and the other end is held about 1cm from the emitters. It won't flash brightly, so shade the test area from sunlight if necessary.

If it does not work, discharge the capacitors to be on the safe side and then inspect the board to make sure that every component is correctly inserted, and that all solder joints are good. If everything looks OK then measure the current consumption. If it is too high then perhaps the circuit is not oscillating. In this case, carefully unsolder the inductor and reverse the winding direction of the 1½ turn base winding, just in case this was wound the wrong way by mistake.

INSTALLATION

In its preferred habitat, your car, the PF3 is simply attached to the dashboard with double sided pads. Have the emitter points as close as you can to the outlet of the air conditioning system, and if you can place it so that an air vent drifts a steady stream of ions towards your face, that's ideal. In any case the air in your car will be up to mountain top ion levels within minutes.

There's no reason why the PF3 shouldn't be permanently installed in the ventilation system of your car. Several sharp needles with their points in the air flow will make excellent ion emitters, and they can be connected to the prophet p.c.b. with a length of well insulated wire. Connections between the lead and pins should be insulated and waterproofed — a dob of epoxy resin (Araldite or similar) should do the trick. The p.c.b. can be mounted anywhere there's room for it. Not too far from the emitters, or the leakage from the wire will reduce the efficiency. And avoid places where it's likely to be subjected to high temperatures or dampness. It's a good idea to use the case anyway — it will at least give the circuit some protection.

If you don't already own a mains powered ioniser, the PF3 can be used in your home too. You'll need a 12V power supply or a battery eliminator. The best place for the ioniser is by your bedside, where you'll breathe in the ions for eight hours or so at a time. The design is easily portable, so you can take it to work with you or move it to the living room during the day. The power supply need not be regulated, because the ioniser incorporates its own output voltage regulation. So long as the voltage remains between 9V and 16V all will be well.

BENEFITS

Improvements in general health take place over several days, but some benefits occur at once. One consequence of ionising the air is that the ions attach themselves to any dust, dirt or pollen particles that may be floating around. The particles are then attracted to the nearest neutral surface (so don't put the ioniser too close to your expensive new wallpaper!), usually the floor, and will be cleared up during normal household cleaning.

Removing dust and pollen from the air is of immediate benefit to asthma and hay fever sufferers, and let's face it, it won't do any of us any harm to breathe clean air for a change. The cleaning action also provides one of the most spectacular demonstrations of an ioniser's powers; the magic smoke trick.

VANISHING SMOKE

To perform the vanishing smoke trick you'll need a glass jar, a lighted cigarette and an ioniser. Puff cigarette smoke gently into the jar until the air inside is a thick, grey smog. Invert the jar over the ioniser, the smoke swirls around and ... vanishes! A variation on the trick is to fill the jar with smoke, then invert it over the ioniser while it's turned off. As soon as you flip the switch, no more smoke!

With a large jar, preferably with neck wide enough to encircle the ioniser so's no smoke can escape from the bottom, the effect is quite dramatic. Now you're in the mood for tricks, here's a few more.

Take a few inches of woven carbon fibre, wrap the bared end of a piece of single core connecting wire around the bottom of the fibres, then carefully separate out the strands. With the PF3 turned off, attach the other end of the connecting wire to one of the ionising wires. When the PF3 is activated, the carbon fibres become emittters, and will move about when you put your hand within a few inches of them, almost seeming to be alive! If you can't get hold of any carbon fibre, a 7" length of stranded connecting wire with the insulation removed from the last 6" will give a similar effect. The thinner the strands, the better the results will be.

Try this one. Stand a potted plant, preferably one with sharp, pointy leaves, on an insulated surface or a polythene bag. Hook a length of connecting wire from the PF3's emitter to the soil in the plant pot. The plant will now act as the emitter. In the dark you may see a faint blue glow around the leaf tips, and if you hold a finger close to one of the leaves it will be drawn towards you. Some plants work better than others, so try it with several different types. The plant's don't mind at all, and many types actually seem to grow better with a good dose of high voltage!

The PF3 can be used as an EHT generator for all kinds of applications. Here's one idea: a Kirlian camera. Kirlian photography is the process that produces those electric photographs with all the swirls and lightning effects. Here's how you do it with the PF3.

You'll need a piece of single sided p.c.b. material, some bromide paper, developer, fixer, and developing trays. The paper, developer and fixer you can get from any photography shop; for the developing trays you could use plastic lunch boxes. A red safelight bulb is also useful so's you can see what you're doing — otherwise you'll have to grope about in the dark!

To make the Kirlian camera you simply attach the wire from the PF3's emitter to the copper of the p.c.b. material. With the lights off, place a piece of bromide paper face upwards on the p.c.b., place the object to be photographed on top, switch the PF3 on then touch the object. The paper is now exposed, and ready to develop according to the instructions on the developer and fixer bottles. Coins and small metal parts photograph well, and so do leaves (although I've never yet managed to get the "phantom leaf" effect, whereby you're supposed to be able to see the missing part of a torn leaf on the photograph. □

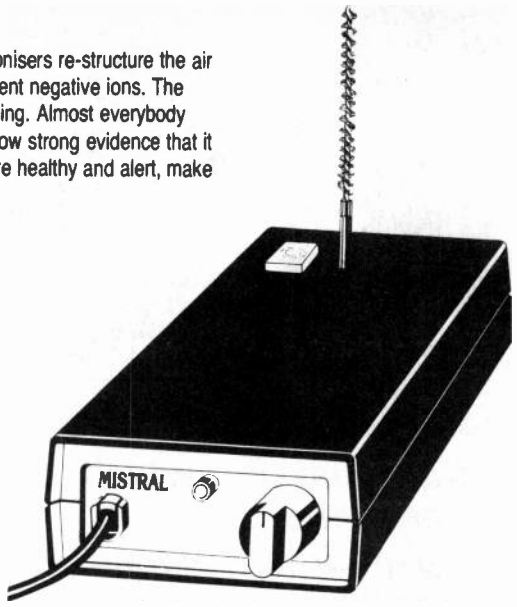
AIR IONISERS

By means of points raised to a very high voltage, ionisers re-structure the air you breathe, turning ordinary air molecules into potent negative ions. The effects of breathing in these ions can be quite startling. Almost everybody reports that it makes them feel good, and there is now strong evidence that it can also improve your concentration, make you more healthy and alert, make you sleep better, and even raise your IQ.

THE MISTRAL AIR ▷ IONISER

The ultimate air ioniser. The Mistral has variable ion drive, built-in ion counter and enough power to drive five multi-point emitters with ease. Its nine main drive stages, five secondary drives and four booster stages give an immense 15 billion ions per minute output – enough to fill the largest room in a matter of seconds.

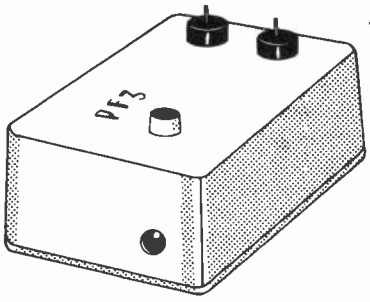
The parts set contains everything you need to build the Mistral: components, PCB, case, emitter and full instructions. If you're keen to increase the output still further, there's an optional eight-point internal emitter set to give extra ionising capability, and an almost silent piezo-electric ion fan to drive the ions away from the emitter and into the room.



MISTRAL IONISER PARTS SET **£32.66** ☐

INTERNAL EMITTER PARTS SET (optional) **£3.22** ☐

ION FAN (optional) **£11.27** ☐



◁ PROPHET PF3

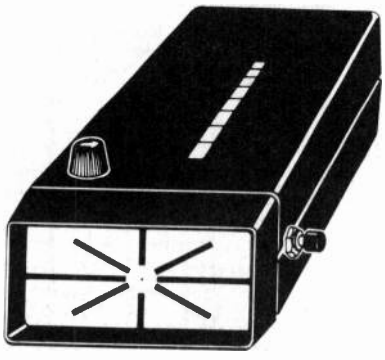
The Prophet performs its own special miracle on the dashboard of your car. First reports are most impressive: driving becomes a positive pleasure, easier to stay alert on long motorway journeys, a child cured of travel sickness. The ion effect is not to be underestimated. Don't forget the experiments either: there's the smoke trick, triffids, the living emitter, and more. The Prophet can be used anywhere with a supply of 9V to 12V DC, so don't restrict it to the car alone!

PROPHET PF3 PARTS SET **£21.39** ☐

THE Q-ION ▷

Check out the ion levels around your house. The Q-Ion will measure the output of any ioniser, test the air to see where the ions are concentrating, help you set up fans and position your ioniser for best effect, and generally tell you anything you want to know about ion levels in the air. The readout is in the form of a bar graph which moves up and down as the Q-Ion sniffs the air in different parts of the room. Readings up to 10^{10} ions per second, positive or negative.

Q-ION COMPLETE PARTS SET **£21.16** ☐



IONISER EXPERIMENTS

* The Vanishing Smoke Trick

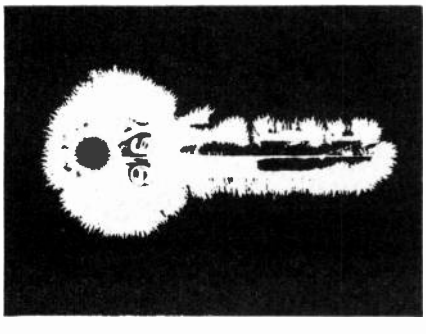
Light up a cigarette and gently puff smoke into a glass jar until the air inside is a thick, grey smog. Carefully invert the jar over the ioniser so that the emitter is inside. Within seconds the smoke will vanish! This is one of the best demonstrations of an ioniser's air cleaning action and with a large jar the effect is quite dramatic.

* Triffids

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

* The Electric Handshake

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



◁ KIRLIAN CAMERA

Bioplasmic fields, auras, or just plain corona discharge? No matter how you explain them, the effects are strange and spectacular. Can you really photograph the missing portion of a torn leaf? Can you really see energy radiating from your finger tips? Most researchers would answer 'yes' to both questions.

Our Kirlian photography set contains everything you need to turn the Mistral into a Kirlian camera, your bedroom or spare room into a darkroom, and to expose, develop and print Kirlian photographs (photographs made with high voltage electricity instead of light). The set includes exposure bed, safelight bulb, developing and fixing chemicals, trays, imaging paper and full instructions. A Mistral ioniser parts set is also required.

KIRLIAN CAMERA SET **£19.78** ☐

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Constructional Project

QUICK CAP TESTER

MARK RAVEN

A low-cost, handheld audio/visual unit which can identify short, open and working capacitors quickly and with a minimum of fuss. Also gives some indication of leakage current, especially useful for electrolytics and for diode and transistor junctions.

ON MANY occasions in the course of work at a small but well known electronics shop, customers often ask if we could check a certain capacitor from their "repair jobs" to see if it is faulty or not.

If the capacitor is suspected "short-circuit" it can be easily checked using a multimeter on its Ohms range in the usual way, and although this gives an accurate indication of a short-circuit capacitor, it is a little slow, setting-up the range switch, adjusting the meter to read zero and holding the probes onto the leads of the capacitor under test. (Often a hopelessly clumsy procedure, especially if the leads of the capacitor have been cut short).

The "open-circuit" types are considerably more difficult to identify, as values from a few picofarads (pF) to one or two microfarads (μF) read the same on the multimeter test whether open-circuit or OK.

The best tester for a capacitor is, of course, a wide range capacitance meter, (e.g. *Digital Capacitance Meter* — EE December 1985 — and reprinted in the *Electronic Projects, Book 1* — £2.45 plus 75p p&p) but these are by no means cheap and are not always to hand. What was needed, was a cheap, handheld unit which could identify *short*, *open* and *working* capacitors quickly, and with a minimum amount of fuss. The following design not only does this, both audibly and visually, in a matter of seconds, but also gives some indication of leakage current, especially useful for electrolytic capacitors and also for diodes and transistor junctions.

PRINCIPLE OF OPERATION

The tester described here works by making the "test" capacitor part of an audio oscillator circuit. A good capacitor will enable the circuit to oscillate, an open or short circuit capacitor will not. The frequency of oscillation gives an indication of the capacitor value.

A second part of the circuit checks the oscillator output and indicates, via an l.e.d., if a short circuit capacitor prevents oscillation. To enable leakage currents to be measured a separate circuit which acts as a simple continuity tester has been added. The oscillator is a Schmitt-trigger oscillator built around one of six inverters on the 4584 CMOS hex Schmitt trigger (Fig. 1).

The difference between a standard inverter and a Schmitt trigger is important in this circuit, as it is the Schmitt action which promotes the oscillation. A simple inverter gives an output which is the opposite logic level to that at its input. As the voltage on the input rises, the output will stay high until the input reaches the threshold level, at which point the output changes state and goes low. If the input voltage is now reduced the output will not go back to its high state until the input voltage has again reached the threshold level.

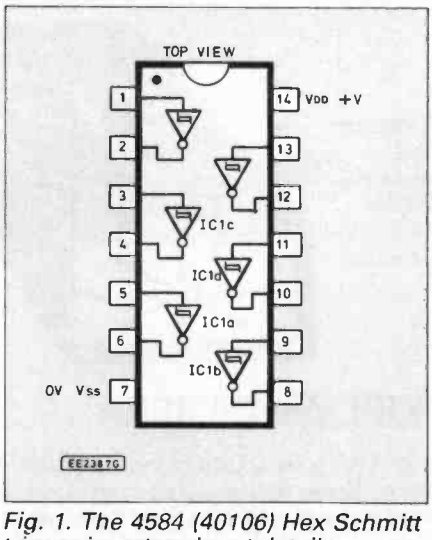


Fig. 1. The 4584 (40106) Hex Schmitt trigger inverter pinout details.

The important thing to remember is that a simple inverter has only one threshold level. The Schmitt trigger inverter however, is peculiar in that it has two threshold levels (see Fig. 2). When the input reaches the upper threshold the output goes low in the usual way, but if the input voltage is now reduced, the output will not change state until the input has dropped to the lower threshold level.

In the simplified oscillator circuit (Fig. 3) we can see how the Schmitt trigger effect is utilized. As with all astable oscillator type circuits, we must first of all decide on the initial state of the circuit before we can describe its operation.

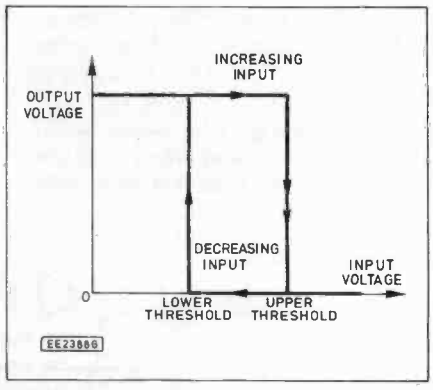


Fig. 2. Graph of the Schmitt trigger threshold levels.

Let us assume to begin with that the capacitor, C, is discharged and that the output of the Schmitt trigger is therefore high. Capacitor C then begins to charge via resistor, R at a rate defined by the value of resistor R. When the voltage at C, and therefore at the input of the Schmitt trigger, reaches its upper threshold, the output goes low. The capacitor then discharges through R, until the voltage at the input has dropped to the lower threshold level, causing the output to charge back to its high state once again.

The process then repeats and continues indefinately. The output is therefore, a square-wave, and its frequency is determined by the values of C and R.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Quick Cap Tester is shown in Fig. 4. There are two quite separate circuits in this design, each built around different parts of the same i.c., so for clarity each section will be described individually.

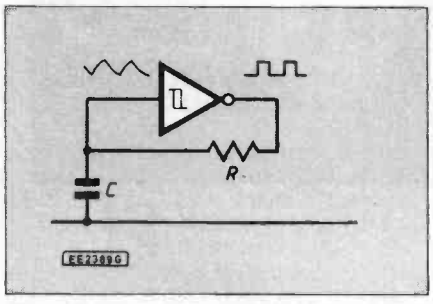


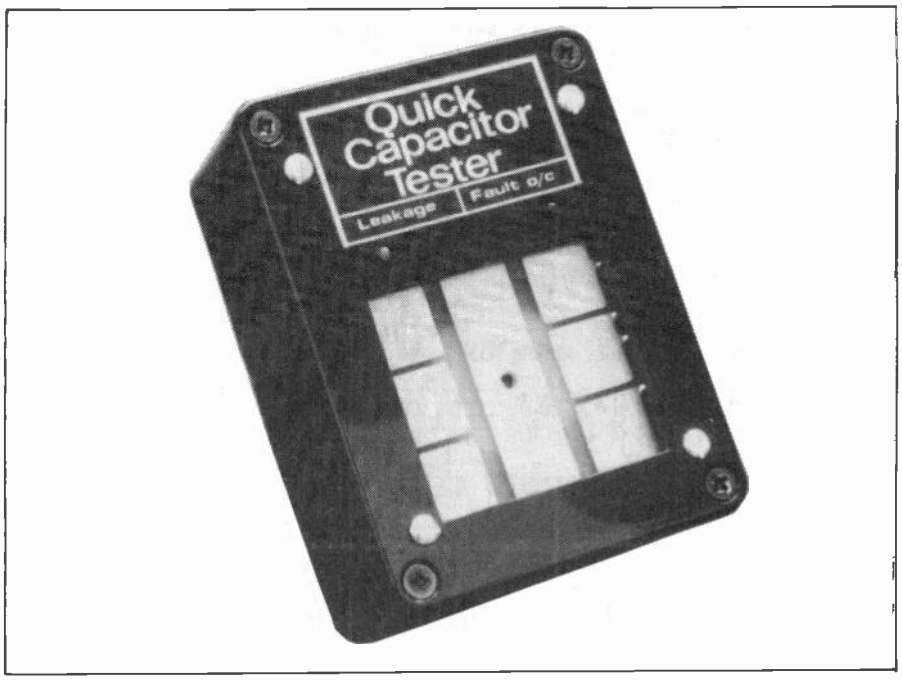
Fig. 3. Simplified Schmitt trigger inverter oscillator circuit.

The capacitor under test, Cx(a), is placed across one of three test pads and the common pad on the printed circuit board (p.c.b.). Assuming that the capacitor is OK it completes the Schmitt trigger oscillator, giving a square-wave output at pin 6 of IC1a. This is buffered by IC1b to give a signal to drive the piezoelectric buzzer WD1.

The frequency varies according to which pad is chosen and the value of capacitor used. The series arrangement of resistors R1, R2 and R3 means that an audible note can be heard for a large range of different values of Cx(a). Resistor R4 protects the input of IC1a from damage which may be caused by attempting to test a charged-up capacitor.

Capacitor C1, reduces the maximum frequency of oscillation to about 100kHz. This is because the nature of CMOS devices is such that they draw more current the more often their outputs change state. Without C1 the circuit oscillates merrily at about 8MHz causing considerable current drain, and possible interference problems.

It is also worth noting that the audio frequencies produced when this unit is being used are considerably less than the 100kHz produced when it is in its "stand-by" mode. This makes for an interesting paradox, a unit which uses less current when it's being used than when it isn't. So if you want to extend the battery life of your tester, use it as often as possible.



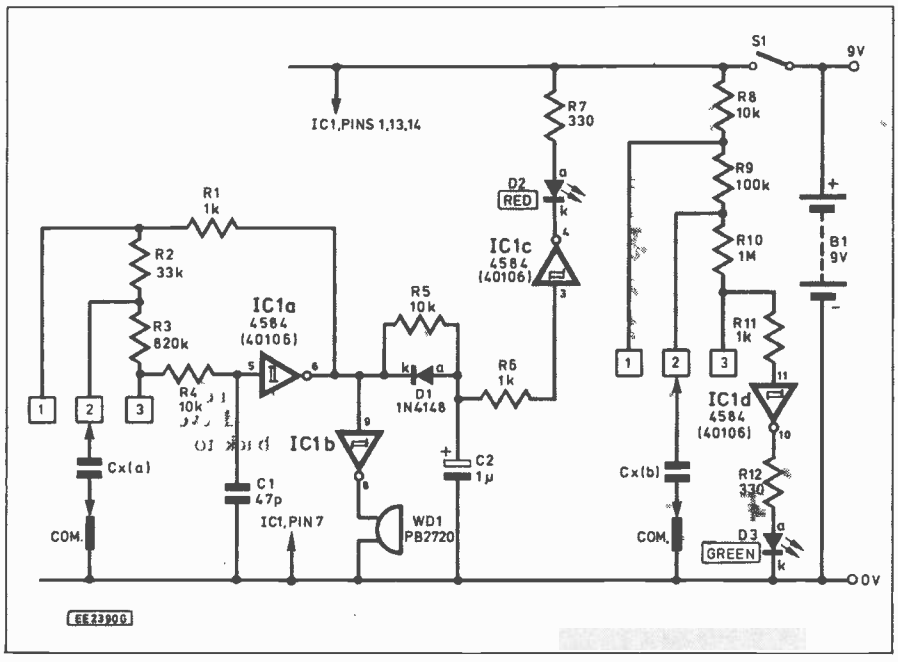


Fig. 4. Full circuit diagram for the Quick Cap Tester.

Returning to the circuit, when pin 6 of IC1a is oscillating, capacitor C2 attempts to charge up via resistor R5, but as soon as pin 6 goes momentarily low diode D1 becomes forward biased and quickly discharges C2. Thus, during oscillation C2 never charges to a high enough potential to operate the inverter at IC1c and the l.e.d. D2 remains off.

If a short-circuit is placed between any of the test-pads and the 0V (COM.) however, pin 6 will go high for long enough to charge capacitor C2 to the upper threshold of IC1c and the short circuit indicator D2 will light. At very low frequencies, caused by large values of capacitors being tested, the l.e.d. may flicker or flash on and off as the capacitor charges and discharges. This is easily distinguishable from the result given by an actual short-circuit capacitor.

LEAKAGE

The second part of the circuit is the leakage current test. The capacitor under test is placed across another set of test-pads (1, 2, 3) in a similar way. Initially the input to IC1d is held high by resistors R8, R9 and R10, and therefore the l.e.d. D3 is off. If the capacitor (or diode or transistor junction) "leaks" more current down to ground (0V) than that initially flowing through the combinations of R8, R9 and R10, the input to IC1d will be pulled low, causing the l.e.d. D3 to light.

The series arrangement of resistors R8, R9 and R10, with the tap-offs to the three pads (1, 2, 3) means that different "leakages" can be measured (approx 4µA, 40µA and 400µA with the resistor values given). Large value electrolytics, which look like a short-circuit when they are charging-up will cause the l.e.d. D3 to light for a couple of seconds or more depending on the value used. When charged however, the unit indicates just the remaining leakage current.

COMPONENTS

Resistors

R1, R6, R11	1k (3 off)
R2	33k
R3	820k
R4, R5, R8	10k (3 off)
R7, R12	330 (2 off)
R9	100k
R10	1M

All 0.25W 5% carbon

Shop Talk see page 131

Capacitors

C1	47p ceramic
C2	1µ radial elec. 50V

Semiconductors

D1	1N4148 signal diode
D2	3mm red l.e.d.
D3	3mm green l.e.d.
IC1	4584 or 40106 CMOS Hex Schmitt trigger inverter

Miscellaneous

S1	S.P.S.T. min. rocker switch
WD1	PB2720 piezoelectric buzzer
B1	9V battery (PP3)

Plastic case, 102mm × 78mm × 40mm; printed circuit board, available from the *EE PCB Service* code EE668; 14-pin d.i.l. socket; battery connector (PP3); M3 screws, nuts and washers; solder etc.

Approx. cost Guidance only **£10**

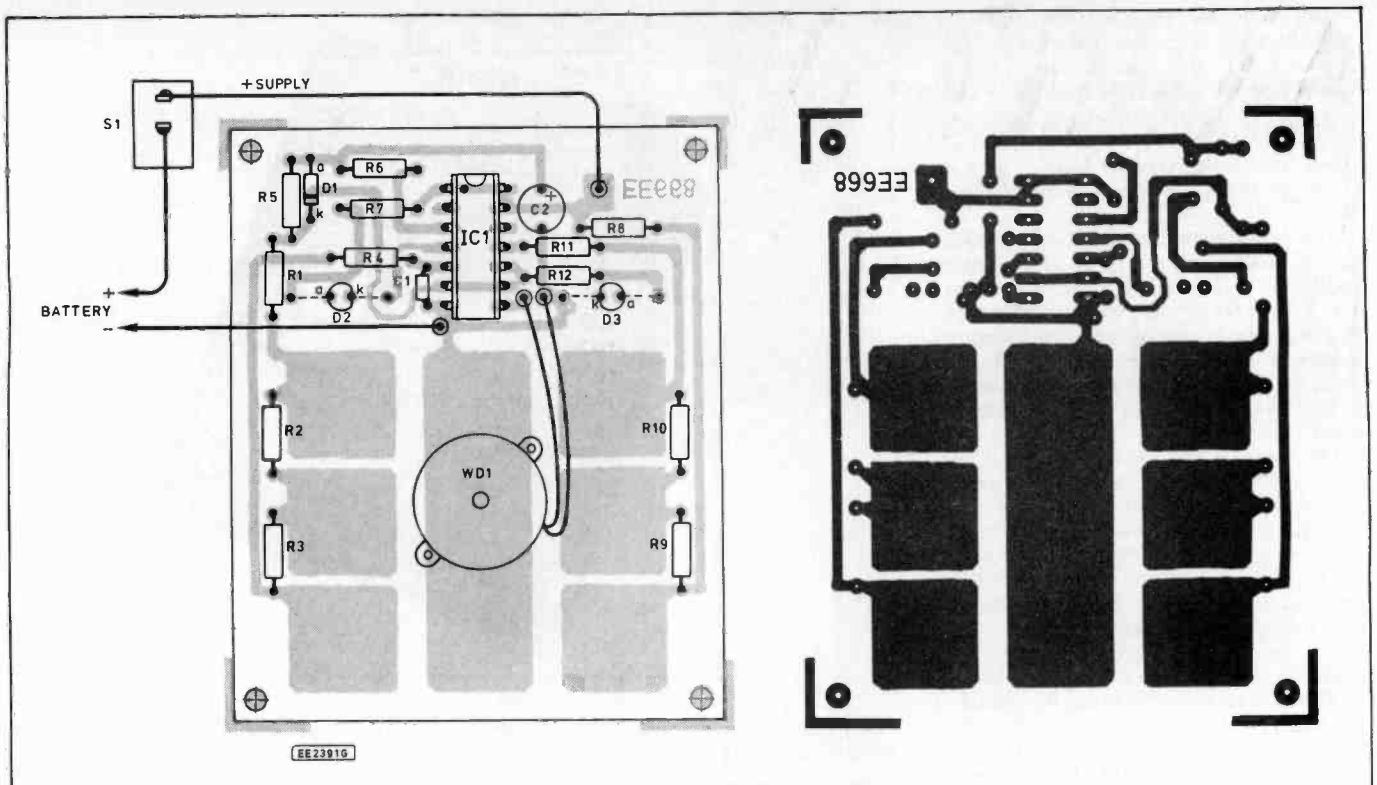


Fig. 5. Printed circuit board component layout and full size copper foil master pattern. The diodes D2 and D3 are mounted on the track side, see Fig. 6.

CONSTRUCTION

The circuit for the Quick Cap Tester was built on a printed circuit board, available from the *EE PCB Service*, code EE668. The component layout and full size copper foil master pattern is shown in Fig. 5.

Assembly should be reasonably trouble-free as there are very few components and no wire-links. Provided all of the visual precautions are taken, diode D1 and the l.e.d.s are the correct way round, and the polarity of capacitor C2 is carefully observed the unit should work first time.

The only difficulty some constructors may have is in the somewhat unconventional mounting of the l.e.d.s D2 and D3, see Fig. 6. Because the large pads on the trackside of the board are used as the test pads, the l.e.d.s need to be mounted on the trackside with the "legs" or leads going through the board and then looped back on themselves to be soldered to the board.

This can be achieved using a pair of long nosed pliers, but care must be taken not to bend the legs until the l.e.d. is seated firmly into position on the track side of the board as they break very easily. Also, care must be taken not to let your soldering iron come too close to the body of the l.e.d. as the plastic used in their construction is particularly susceptible to high temperatures.

In the prototype model, the piezo electric sounder WD1 was also placed on the component side of the board over a hole in the large "common" pad. This gave the best sound quality and convenience of positioning.

CASE

The whole board when completed should be tested before final assembly. The board should be mounted in a plastic case 102mm×78mm×40mm by means of four M3 screws with extra nuts used as spacers. Four hole positions are marked on the board.

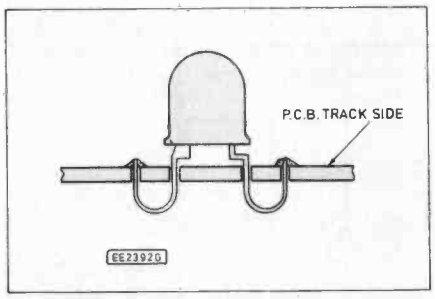


Fig. 6. The leads of diodes D2 and D3 are passed through one set of holes and soldered to adjacent pads, see Fig. 5.

The lid of the case should have a cut out as shown in Fig. 7 to reveal the test pads. Using Fig. 7 as a guide, the corners of the cut out can be drilled and the four holes joined up to form the test pad "window" using an Abraframe type saw and finished carefully with a small flat file.

Drill the l.e.d. holes 3mm diameter to be a close fit on the l.e.d. body. This is neater and more convenient than using l.e.d. clips.

Finally, a square hole must be cut in the side of the case for the miniature rocker on/off switch. These were found to be cheaper and less obtrusive than toggle types, and clip in very easily to a rectangular hole, the flange around the switch nicely covering any rough edges.

TESTING

Because of its simplicity, testing of the unit need be nothing more than just using it

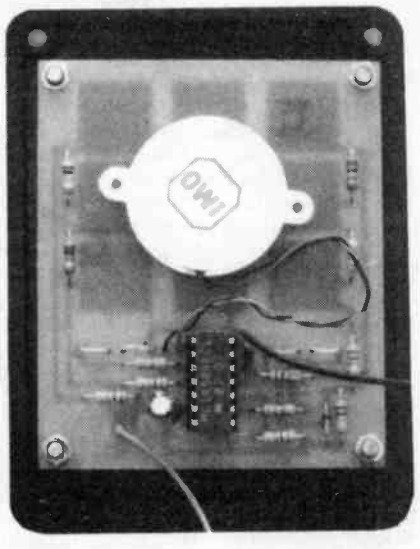
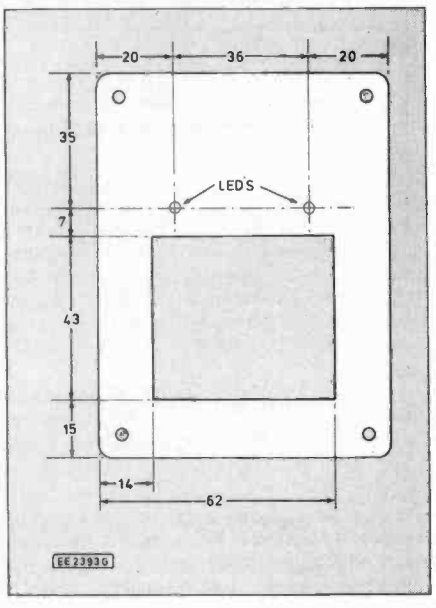
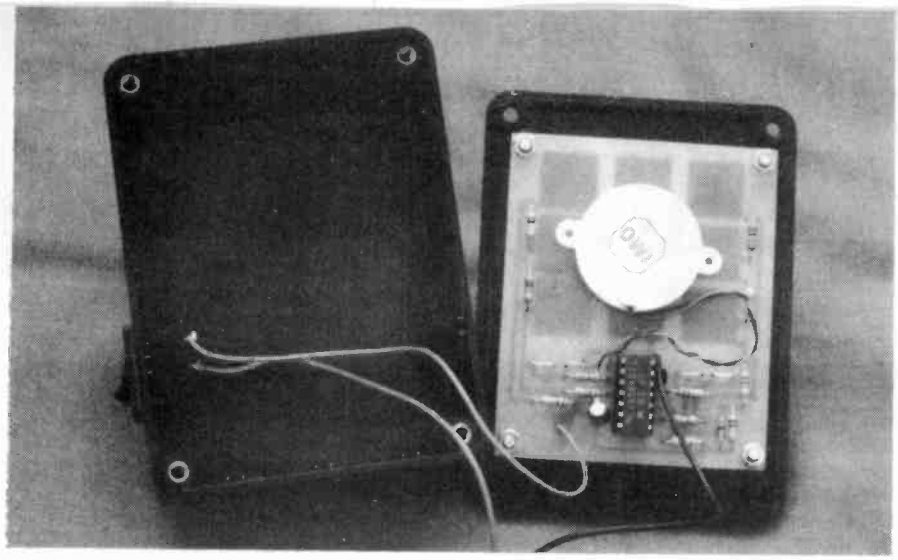


Fig. 7. Front panel drilling dimensions and details of the test-pad cutout.





as no setting-up is required, but a few simple procedures will ensure that all of the functions are working OK.

First try out the Short/Open test, which uses the three pads on the right hand side of the p.c.b. as you look at it from the front. Use a piece of wire to short out each pad in turn with the large central "common" (0V) pad. On all three pads, there should be a click from the sounder WD1 as the wire makes contact and the l.e.d. above them should stay lit whilst the pads are shorted. If you hear the click but l.e.d. D2 does not light-up, check that it has been soldered in the correct way round with its cathode (k — short lead) towards the centre of the board.

Next, check out the ranges using capacitors which you know to be OK. A 10 nanofarad (nF) will bleep on the bottom and middle pads, but will be virtually inaudible on the top one. A 100nF (0.1μF) will buzz on the bottom pad and the l.e.d. may flicker, but will operate nicely on the top two ranges. A one microfarad (1μF) capacitor will work OK on the top ranges but will click and cause the l.e.d. to flash on the bottom pad.

When you are satisfied that a good range of capacitors can be tested and that this part of the circuit is operational you can go onto the leakage test on the left hand side of the board. For this you will need three resistors, a 1k, 100k and 1M.

The 1M (one megohm) will light l.e.d. D3 on the top pad (4μA) but not on the others. The 100k will light it on the top and middle (400μA) ranges and the 1k should light it on all ranges, as will a short circuit. Again, if D3 fails to light, check it is the right way round with its cathode (k) towards the centre of the board.

In the unfortunate event that you get nothing at all from your unit, check your board for solder bridges etc, and with a multimeter check the obvious points for power; for example pins 1, 13 and 14 of IC1 should be at 9V (supply voltage) and pin 7 should be at 0V, as should the central common (earth) pad. The unit draws approximately 100mA in its standby mode.

Table 1: Capacitor Short/Open Test (Values that give audible output)

Value	Test Pad
560p — 1n	1
1n — 4n7	1 or 2
4n7 — 220n	2
220n — 33μ	3
Above 33μ l.e.d. flashes on Pad 3	

IN USE

After a little time using the capacitance tester, you quickly get to know how to interpret results. The current leakage detector side speaks for itself. The top pad detects leaks at up to 4μA the middle up to 40μA and the top 400μA.

On the Short-Open test however, Table 1 may help you get used to the different ranges, though it does not take long to try your "test capacitor" on all three ranges.

CONCLUSION

The Quick Cap Tester has been invaluable in the components shop, not only for testing capacitors, but also the leakage current in diodes and transistor junctions. On another note the budding electronics experimenter may want to try to use the remaining two Schmitt trigger inverters on the 4584 i.c. for other tests or facilities. They are very useful devices and some very interesting possibilities could be explored. □

MICRO ...Beeb...Beeb...Beeb...Beel

. . . Add-Ons . . . Bus Incompatibilities . . . Add-Ons . . .

IN LAST month's article we started to look at the problems likely to be encountered when trying to interface the BBC computers to projects designed for other computers. As we saw, projects designed to be fitted onto a user port, or other 8-bit input/output port, can usually be accommodated by the BBC machines without too much difficulty. Projects that connect to the busses of a computer are a different prospect.

Ins And Outs

If you examine the circuit for a project that is designed to connect to the expansion bus of a computer, you will sometimes find that it breaks down into two main sections. One of these is an address decoder plus tri-state buffers and latches to provide input and output lines, and then the main circuit — speech synthesiser, audio digitiser, or whatever.

In cases like this you might find that the user port can be used in place of the project's input/output ports, with the address decoder, latches, and tri-state buffers being omitted. The main section of the project would then be connected direct to the user port lines which would be set up to provide the appropriate functions.

For the more complex projects the eight input/output lines plus two handshake lines of the user port might be insufficient. However, adding a 6522 or similar device to the 1MKz bus will provide sufficient inputs and outputs in most cases.

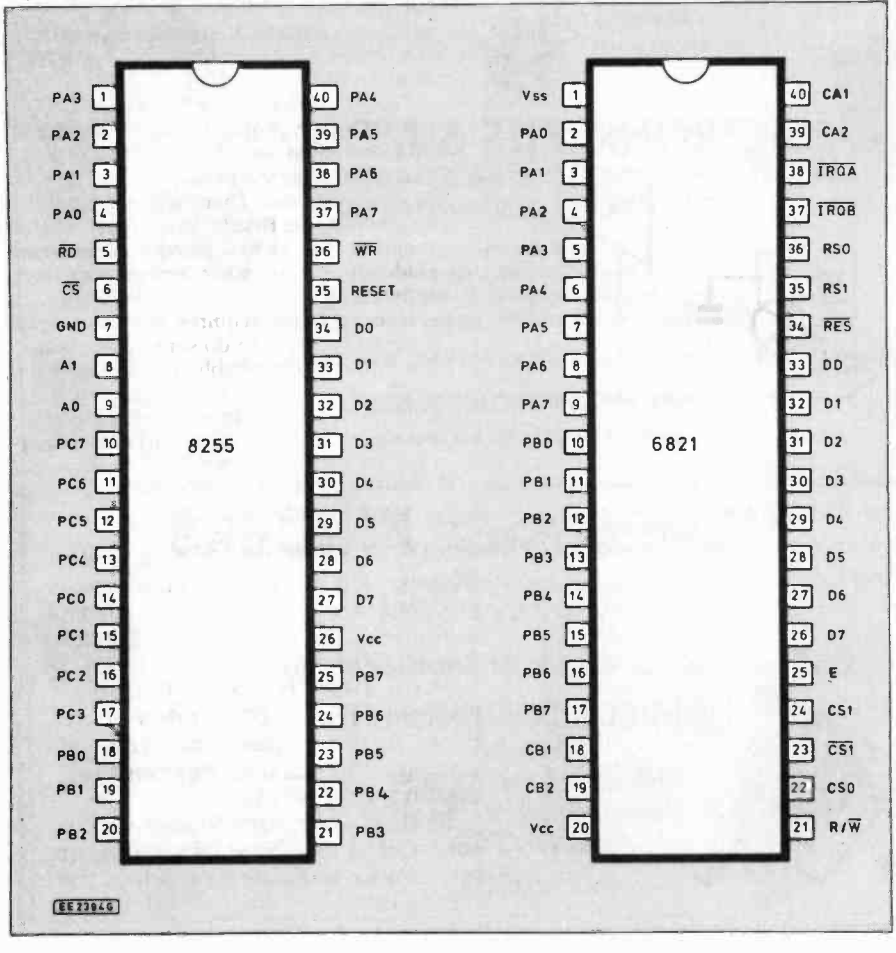
If the project you are trying to convert uses standard 65** and (or) 68** peripheral chips to provide its input/output lines, then there should be no difficulty in interfacing it to the 1MHz bus. Simply leave out the address decoder section of the project, and use the cleaned-up NPGFC and NPGFD outputs of the 1MHz bus instead. Some address decoding involving these lines plus A0 to A7 can be used to provide more address outputs if necessary, or to map the add-on into a specific part of page &FC or &FD.

Power

Power supply requirements should not be a difficulty. Most projects only require +5 volts at a few hundred milliamps or less, and this can be tapped off the analogue port, user port, or power port.

Provided the computer is used with a cassette recorder or a self-powered disc drive, the other supply outputs on the power port are available as well. Alternatively, you can always do things in the approved manner for the 1MHz bus, and provide the add-ons with their own mains power supply units!

Fig. 1. Pinout details for the 8255 and 6821. The main differences in the control pins are the separate read and write lines of the 8255, which also lacks an "E" input for the clock.



Bus Incompatibilities

Where a project breaks down into what are essentially input/output ports plus the project proper, it is generally best to use devices that interface well with the 1MHz bus to provide the input and output lines, rather than to use any interface devices in the original circuit which do not interface easily with a 6502 based computer. This will not always be a viable way of tackling things though, and you might be faced with having to interface 82** series or Z80 peripherals to the 1MHz bus. It is certainly possible to interface most of these devices to the BBC computers, or to interface 65** and 68** peripherals to computers based on the Z80 and 80** series of microprocessors come to that.

In both cases it is unlikely to be a straightforward matter though. Unfortunately, fitting a 65** or 68** peripheral to a Z80 style bus is generally easier than fitting an 82** device to a 6502 style bus.

When trying to fit any computer project onto the wrong computer you should bear in mind that there is no guarantee that what you are attempting is actually possible. It is really only something that should be tried by those who are fairly adventurous and have a reasonable amount of experience at computer interfacing.

Pinout details for the 6821 and the 8255 devices, both of which provide parallel input/output ports, is shown in Fig. 1. These are fairly typical of their genre, and help to highlight the differences between the two types of bus. In this case we will ignore the input/output port lines, and concentrate on the lines on the computer side of the components.

One area that is not likely to give any problems is the data bus. In theory there may be potential problems with incompatibilities due to different logic 0 and logic 1 levels etc., but in practice these do not seem to cause any problems.

Similarly, it is unlikely that there will be any difficulty with the address inputs, which are equivalent to the register select ("RS") inputs on the 65** and 68** series chips. These can be driven by the appropriate address lines without any problems.

Neither are the chip select line or lines likely to give any difficulties. It is just a matter of ensuring they are fed with pulses of the correct polarity. Remember that the page select outputs of the 1MHz bus are negative active types, and will require inversion if they are to drive a positive chip select input (i.e. a chip select pin which does not have the "bar" over its identification letters and number).

There could be a problem with the reset inputs of peripheral chips. The BBC computers have a negative active reset line, but some computer chips (including the 82** series) require a positive reset signal.

Simply inverting the reset output of the 1MHz bus should cure the problem. Alternatively, the add-on circuit could be fitted with a simple R-C (resistor/capacitor) timing circuit to provide a suitable positive reset pulse at switch-on.

Note however, that this second method will not provide a reset signal if the computer is reset by pressing the "BREAK" key. If inverting the reset output of the 1MHz bus gives satisfactory results, then this is probably the best method to use.

Trying Time

Most 65** and 68** series peripherals have an enable ("E") input. I always think that this name is a bit misleading, since it seems to suggest that this input is the one which should be fed with the chip enable pulses from the address decoder. In fact it is fed from the system clock, and is needed in order to provide timing information during read and write operations.

There is no equivalent to this on Z80 and 82** series peripheral chips, which makes life a little difficult when trying to connect 65** and 68** series peripherals to a computer based on a Z80 or 82** series microprocessor. In practice this can usually be overcome with minimal difficulty though. Fortunately, when trying things the other way round it simplifies matters — the system clock can simply be left unconnected. As we will see later though, this does leave a related problem.

Simply leaving the system clock unconnected is fine provided the add-on does not require a clock signal from the computer for other purposes, such as to drive counter/timers. If a clock signal is required to act as a timebase for an add-on circuit, and not for any form of synchronisation of data transfer between the add-on and the computer, there should be no great difficulties. If the 1MHz clock signal of the BBC computer is at the required frequency, then it should be suitable.

There are a lot of Z80 based computers which operate with a clock frequency of about 3MHz to 4MHz, and in most instances the clock output of the 1MHz bus will be at too low a frequency. It is possible that changes in the software could compensate for the lower clock frequency. In most cases though, it will be necessary to include a clock generator circuit in the add-on.

The circuit for a simple crystal oscillator that will operate with virtually any crystal having an operating frequency of between about 1MHz and 6MHz is shown in Fig. 2. With a crystal of the correct frequency fitted in the X1 position, this circuit should provide a suitable clock signal for most purposes.

The Write Solution

The main problem when using 82** peripherals with 6502 busses is that the 6502 has a combined read/write line, whereas the 82** chips have separate (*negative active*) read and write lines. On the face of it, the R/W line of the 1MHz bus could act as the write line, while an inverted version of it could act as the read line. This will normally work quite well on read operations, but is less successful for write operations.

As pointed out previously, most 65** and 68** series peripherals have an input for the system clock, even if this is not needed to drive timer/counters or something of this nature. The clock signal is needed in order to provide timing information that helps to latch valid data into the peripheral chips during write operations.

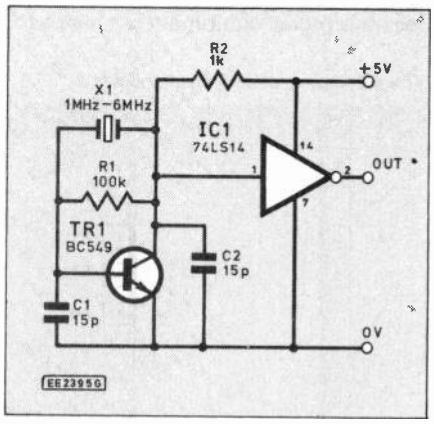
On the 82** bus peripherals there is a more conventional arrangement which has the write line returning to the high state providing the timing information that ensures the latched date is valid. The problem in using the read/write line of the 6502 control bus as the write line for a 82** series chip is that it returns to the high state slightly too late, and the data written to the peripherals is usually totally invalid as a result of this. Possibly some gating with the system clock signal or other lines of the control bus would cure this problem, but I have never managed to pursue this approach successfully.

In some cases it might not be necessary to provide any additional signal processing, apart from the inverter to generate the RD line from the R/W one. This is due to the BBC computer's method of running the expansion bus at 1MHz, and the noise on the page select output lines that results from this.

Even when the standard clean-up circuit is used, there is still a certain amount of noise on the page select lines. This can actually result in an alteration of the control bus timing that gives satisfactory results with 82** series chips. Ironically, the Master 128 has fully de-glitched page select lines, and 82** series chips are not likely to work properly with this computer as a result!

A simple but usually effective solution to the problem is to include a monostable to shorten the pulses from the write line slightly. A suitable circuit diagram appears in Fig. 3. This is just a basic 74121 monostable using external timing capacitor C1 and preset potentiometer VR1 plus resistor R1 to act as the timing resistance. Preset VR1 is given any setting that gives reliable results, and a bit of trial and error is called for here.

Fig. 2. A simple crystal clock generator circuit. X1 can have an operating frequency between 1MHz and 6MHz or so.



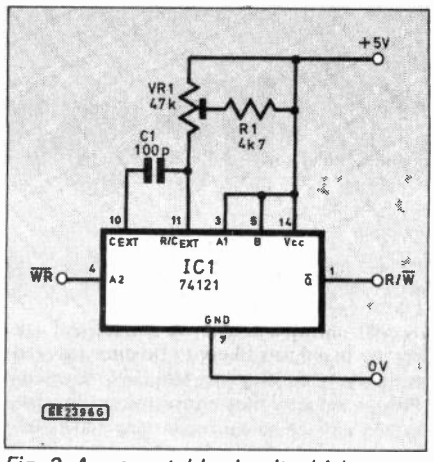


Fig. 3. A monostable circuit which generates a $\overline{WR}$ signal from the R/$\overline{W}$ line. An inverter is all that is needed to produce a suitable $\overline{AD}$ signal.

The monostable operates in the negative edge triggering mode, and it is the not Q output that is used to provide the WR signal. The circuit therefore triggers at the beginning of a write cycle as the R/W line goes low, and returns to the high state after a duration controlled by the timing component values.

Finally

Here it has only been possible to give a few useful hints for anyone contemplating the conversion of a project for operation with the BBC computers. Provided you understand the project concerned, and the methods of interfacing to the BBC computers, your chances of success should be reasonably good.

You should also be able to spot projects that are grossly unsuitable for conversion to BBC use. A project designed to operate with a 16-bit bus would be a likely candidate for this category, as is any project which uses a device that has an unusual bus arrangement such as multiplexed address/data bus lines.

Do not overlook the main problem when converting any project for operation with a different computer. Any software listings that accompany the project are unlikely to be of any real use. There are so many variations from one BASIC to another that the programs will at best provide some basic guidelines for use when writing your own software.

If the project requires only a simple program in order to do something useful, then this will probably not matter too much. If it requires a lot of complex software in order to function properly, then you need to think carefully about whether it will be worth the effort involved.

Robot Roundup

NIGEL CLARK

LACK OF RESOURCES

John MacGregor, the education secretary is cast perfectly for his role, even more so than his predecessor, Kenneth Baker. Inform him that education standards in this country are suffering because of the lack of resources in buildings and equipment and he will probably smile, agree and then, with no supporting information, claim that the situation is now improving because of some unspecified Government action.

One of the latest areas to get the treatment is the introduction of the National Curriculum. It is suffering from a lack of resources, both time and financial, across the full range of subjects. Teachers, who are also having to cope with a whole series of changes introduced in the Education Reform Act, are trying to fit in training for the new courses as best they can.

But MacGregor cheerfully assures the public that everything will be all right while appearing to do nothing to ensure that it will be. Of course we all know that anyone when faced with drastic changes in their lives will do their best to limit those changes. One of the ways to try and do this is to complain that resources are insufficient to achieve the desired effect.

However no-one who has taken an interest in education in recent years can be in any doubt that any complaints about the resourcing of schools are more than justified. Books which long ago parted company with their covers and buildings which would have difficulty remembering when they last had a covering of paint are the rule rather than the exception.

Which brings me to the point of this month's column. If resources are stretched in the traditional subjects, how is a new subject which requires much more in the way of equipment and training to get under way? Craft and technology may be a core element in the National Curriculum but when resources are scarce priorities have to be set and a new resource-hungry subject is likely to lose out.

CDT places pressure on equipment, premises and time. The ideal is for a computer for every child in a class, as in the highly-expensive City Technology Colleges. But most schools have difficulty raising enough computers to give more than a handful of children any meaningful use. And there is only so much which can be raised by the tireless school fundraisers.

Some additional options can be provided by controllers such as SEQ, Ezi-Dun's simulator or Valiants Roamer spin-off, allowing pupils to get some idea of building up control sequences which can be replayed, tested and adjusted. But why should pupils have to put up with second or third best? What is thought essential for a City Technology College student should be the basic right for everyone taking CDT.

Premises can also be a problem. Ideally systems should be set up and ready to go when needed. It happens in the best schools but there is a yawning gap between them and those which have not yet begun to get organised.

TRAINING

Training can make or break any attempt at teaching the subject properly. It is no use having the best equipment and the best premises if the staff are unable to make the best use of the facilities.

The interim report on the introduction of CDT into the National Curriculum recognised this, recommending thorough training for staff. Unfortunately this was watered down in the final report which said that on-the-job training would be sufficient for most teachers with the experienced staff passing on their knowledge. But if there are no experienced staff where does the knowledge come from then?

LOOSING INTEREST

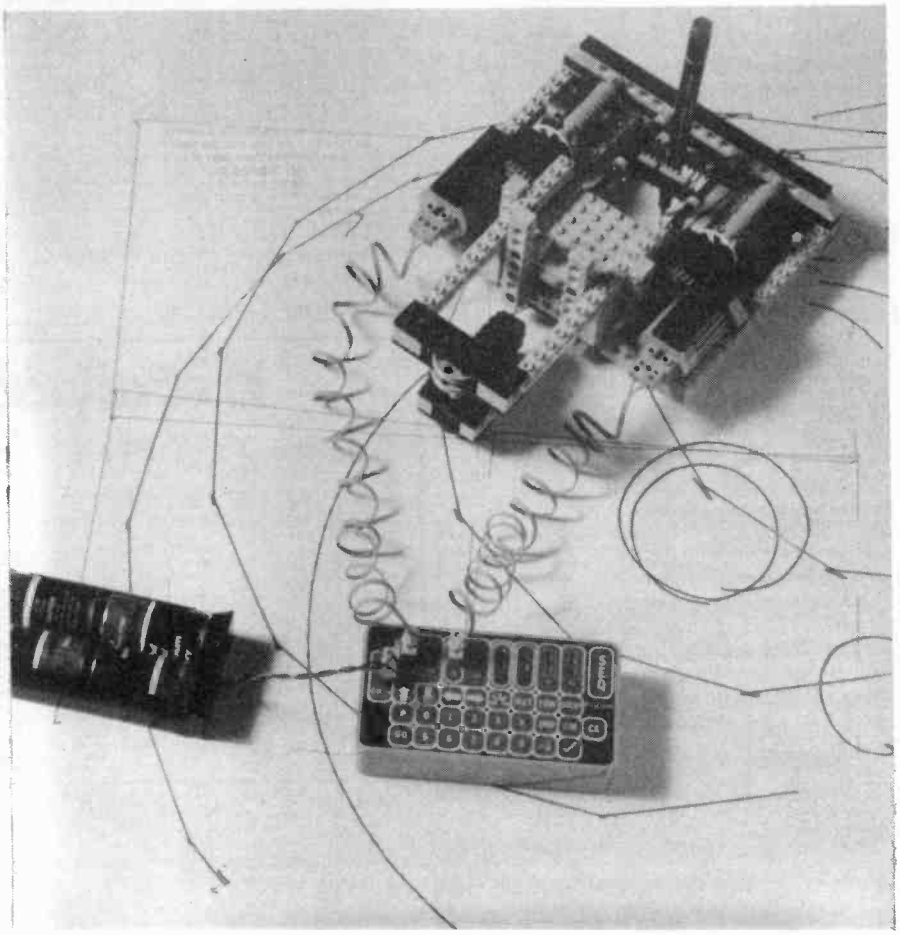
Trying to provide some sort of course without the proper resourcing could do more harm to a pupil's interest in the subject than not doing it at all. Demoralised teachers, teaching with less-than-ideal equipment is a recipe for quickly losing pupils interest. That would be disastrous even from a purely educational viewpoint. In a subject which is intended to be project-based, with term work counting greatly towards the assessment of the pupils ability at the end of the year, a lack of interest by pupils would result in poor course work with no opportunity to redress the balance by cramming for an examination.

It could also be seen as a disaster for those who view the teaching of technology as an essential grounding in providing the skill for the country's future economic development. To compete in the new high technology industries of the future, so the argument runs, we need a highly technologically literate workforce. The first stage in achieving this workforce must be provided by the formal education system.

The danger is that we could be poisoning the minds of a whole generation of schoolchildren against technology. With the subject now being taught throughout the children's school careers, from infants school onwards, if pupils are put off at an early age then it could be almost impossible to get them interested later in their careers.

That would be a shame. Taught properly in the best surroundings with the necessary equipment technology can generate great enthusiasm which can enable pupils of all abilities to develop those abilities to the full.

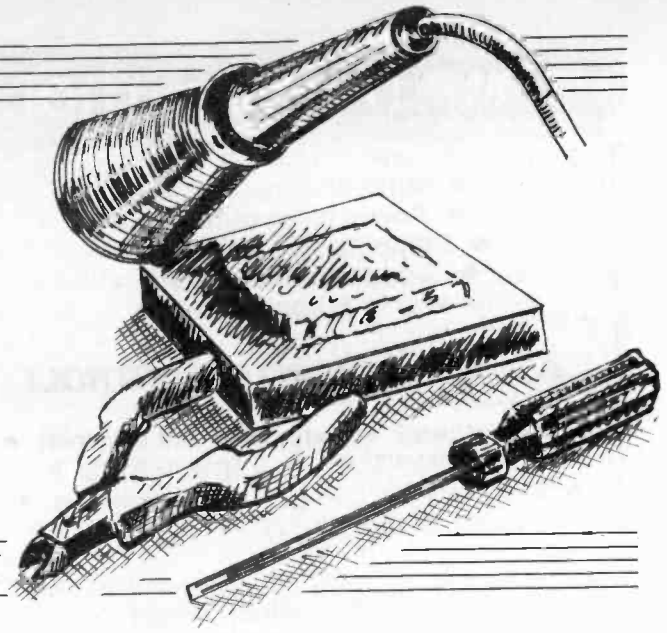
The SEQ controller from Procom



Special Feature

FIRST STEPS IN PROJECT BUILDING

ROBERT PENFOLD



With five or more projects in nearly every issue of *Everyday Electronics* isn't it about time you started building some? We show you how to go about it.

SETTING about building your first project can be a very daunting task, with so many unfamiliar terms, names, and tools to contend with. Knowing where to start can be difficult. Where do you buy the components, what tools do you need, how much will it all cost, and what do you do once you have assembled everything you need? Reassurance from the experts that it is all quite straightforward is probably not all that reassuring!

Like many hobbies, electronic project construction is not a highly complex task requiring years of training, but it does require a certain amount of skill and knowledge. If you set about things in the right manner, provided you are a reasonably practical sort of person, you should not have too much difficulty in pursuing the hobby successfully.

A point well worth making right at the start is that things will often not be entirely clear until you have all the components and tools needed to complete a project and you are ready to start work. Something that was as clear as mud when initially reading the instructions is likely to be very obvious once you have all the parts to hand. If you wait until everything is perfectly clear cut before ordering the components for a project you might never get started!

You should obviously try to avoid "biting off more than you can chew", but you need to have some spirit of adventure. Sorting out minor problems as they arise is half the fun, and electronics construction would be a pretty boring hobby if there were no difficulties to add a degree of challenge to project building.

Do's and Don'ts

Your chances of success with your first project will be greatly enhanced if you select a suitable project. Although it is tempting to dive straight in and build something quite complex, it is best to avoid the temptation. A simple project is a much better choice, and it is really a matter of the simpler the better.

It might be difficult to find a really simple project that will do something worthwhile and be of interest to you. If this should be the case, you are probably better off choosing a simple project for which you have no immediate need, than selecting a useful but complex one.

It is important that you fully understand what the project is supposed to do. A simple household gadget is better than something like an obscure piece of test equipment with an advanced function only understood by the designer and his mother.

A prerequisite for the electronics constructor is a bundle of mail order catalogues. The current range of components is so vast that no one supplier lists everthing. Although at one time it was possible to obtain most of your requirements from the local electronics shop, this is no longer the case. Even if you happen to live near one of the larger retail component stores, you will still need to buy a ceratin percentage of your requirements by mail order.

Component catalogues are particularly useful for the beginner. They are full of useful information, such as basic data, connection diagrams, and photographs that will help to familiarise you with the various types of component. Some of these catalogues cost a couple of pounds or thereabouts, but you are unlikely to regret buying them.

Try to become as familiar as possible with electronics in general before commencing your first project. Buy a few magazines and books on the subject and study them thoroughly. A study of some publications, including the mail order catalogues mentioned previously, will familiarise you with the terminology and nomenclature of electronics. Project construction articles for beginners are usually made as jargon-free as possible, but you can not completely avoid the "techno-speak".

Learn to solder before you start on your first project. Alternatively, be prepared to write-off your first set of components against experience! Make sure you have at least a basic tool kit that will enable you to tackle the project without having to resort to any "Heath Robinson" style tactics.

Initially, you will probably have to improvise a bit to compensate for some omissions in your tool-kit, but you should at least have the basic tools needed for soldering, drilling holes, filing irregular shaped cutouts, etc.

Soldering and tools are two important aspects of project construction, and ones which will therefore be dealt with in some detail in their own sections.

Soldering On

For project construction the best type of soldering iron is a small electric type. One having a rating of about 15 to 25 watts is suitable, and most of the larger component catalogues list a few irons of this type.

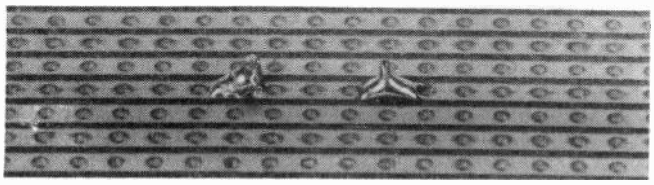
An inexpensive soldering iron will suffice, and initially there is probably no point in buying something exotic like an iron with an electronic thermostat. Your money would be better spent on a simple iron and other tools or components. All small electric soldering irons seem to have interchangeable bits with a range of sizes available. One of around two millimetres in diameter shoule be about right.

Some form of soldering iron stand is essential, and for most irons there is a matching stand available. Apart from providing a safe haven for the iron when it is not in use, these are also designed to drain away excess heat so that the iron does not overheat.

Most soldering iron stands seem to be equipped with sponges. These should be kept moist, and the bit of the hot iron can then be cleaned by wiping it against the sponge. If the sponges are not wet enough they will simply melt!

A more recent development is a sort of cleaning block against which the bit can be scraped clean. These have the advantage that they do not need to be kept wet.

The standard bit shape. This is the best type for general project building work.



The right hand joint is a good one, with the solder covering the wire and track nicely. The joint on the left looks suspect.

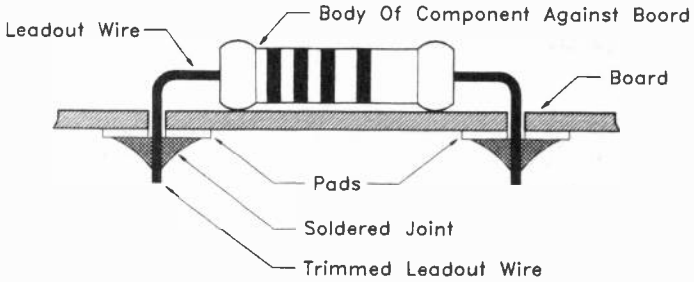


Fig. 1. Mount components with their bodies flat against the board. The solder should flow nicely over the pad and leadout wire as shown. If the component leads are bent slightly (in line with the copper track) they will hold the component in place but should not prevent later removal.

It must be emphasised that keeping the bit *clean* is important. Apart from encouraging corrosion and the destruction of the bit, soldering can be difficult if the bit is allowed to become covered with oxidised solder, flux, etc. There can be a tendency for the solder to flow where you do not want it, and in an extreme case you might find that insufficient heat gets through to the solder, resulting in its refusal to melt!

It is also important to keep the end of the bit "tinned" with solder. In other words, from time to time the end of the bit should be cleaned off, and some fresh solder should be applied to it.

If the solder on the bit has a dull appearance, then it needs to be replaced. Having a layer of fresh solder on the bit aids good heat transfer to joints, and makes it easier to rapidly produce neat, and reliable joints.

It is important to use the right type of solder, which is a ***60/40*** per cent tin/lead type having multiple cores of flux. The flux helps the solder to flow nicely over the joint, and also helps to produce a good electrical contact between the solder and the surfaces being connected. Solder of the appropriate type is available from the larger component suppliers, and will probably be available locally from your nearest hardware shop or DIY centre.

There seems to be some variation in the quality of electrical solders, but these days they are mostly quite good and easy to use. Avoid types which have a 40/60 per cent tin/lead content. These solidify relatively slowly, making it very difficult to produce reliable joints.

Solder is available in a wide variety of quantities, varying in price from a matter of pence for a small pack up to several pounds for a large (about 500g) reel. The purchase of a large reel is strongly recommended. This is likely to be much cheaper than buying numerous small packs, and you will then be in no danger of continuously running out of solder with projects 90 per cent finished.

There are two common thicknesses for solder, which are 22s.w.g. and the much thicker 18s.w.g. type. For most modern electronic work the 22s.w.g. type is the easier to use. On the other hand, larger joints such as connections to the large tags of mains transformers etc., are more easily made using the thicker gauge. Probably the best solution is to have a large reel of thin solder, plus a small pack of the thicker gauge for the occasional larger joint.

Practice Makes Perfect

Modern project construction requires two different types of soldered joint. Most connections are in the form of soldering components to some form of printed circuit board. A printed circuit board is simply a piece of insulated board having small holes through which the component leads are passed.

The components are mounted on the top side of the board, the leads are trimmed on the other copper side using wire cutters, and then the leads are soldered to copper pads on the underside of the board. This is shown in Fig. 1, which shows the correct mountain-like shape for the joints. Copper tracks on the underside of the board (and sometimes on both sides) provide the interconnections between components.

It is important that the component is pressed down flat against the board when it is soldered in place. The mounting should then be very strong physically, with the component sort of rivitted in place. A gap brings the possibility of pressure on the component ripping the pad away from the board, and probably breaking any tracks that connect to it.

The correct way of making this type of joint is to first apply the bit to the joint, and then feed in the solder. Do NOT place the solder in position and then try to melt the solder over the pad and lead. This is a common mistake, and it does not work well as the solder tends to solidify as soon as it touches the cold pad and leadout wire.

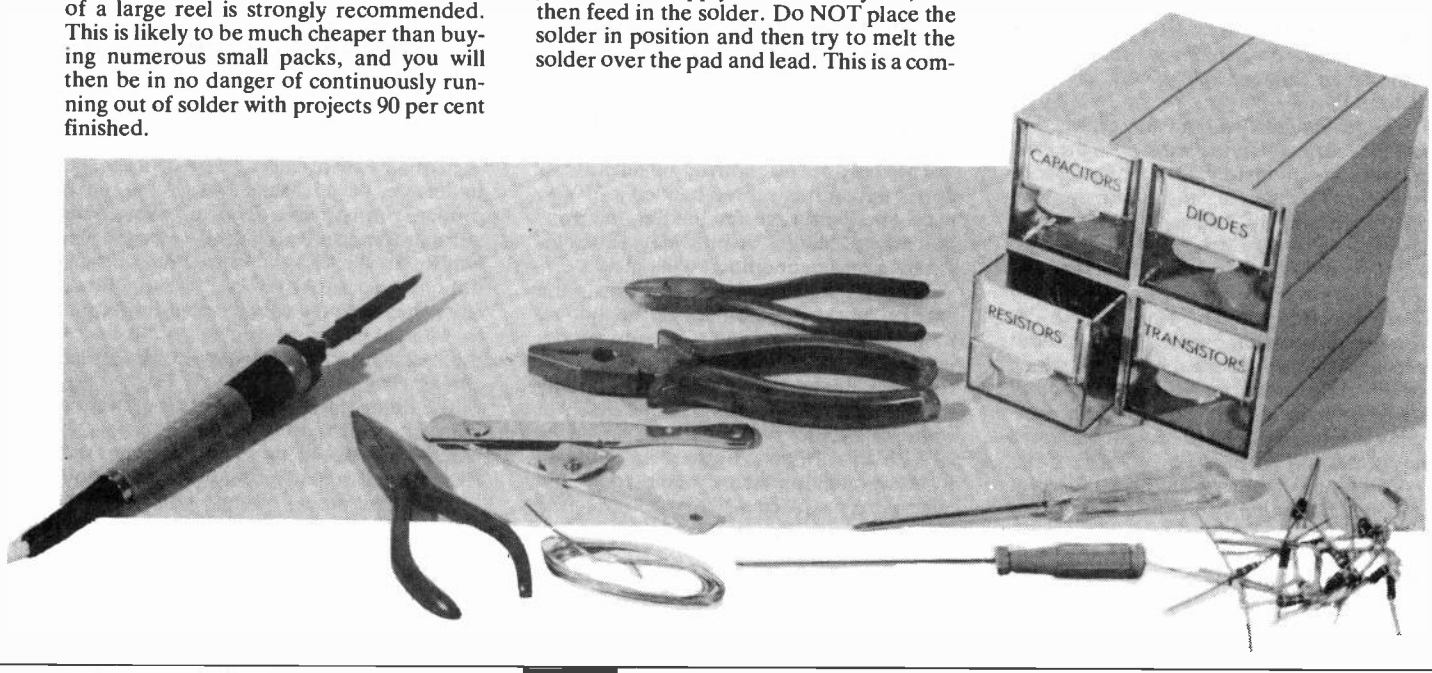
Placing the bit in position first heats up the pad and lead so that the solder will flow over them better. A good joint will have the shape of Fig. 1, whereas a "dry" joint will normally have a globular appearance.

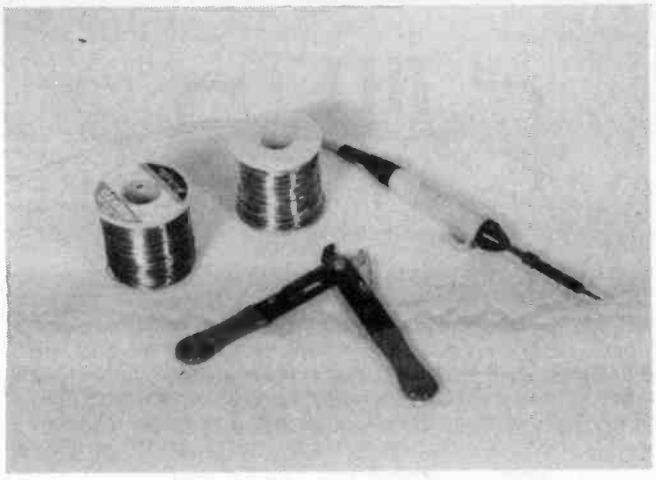
The solder should have a fairly shiny surface. A bad joint will usually have a dull finish, probably with a lot of semi-burned flux around it as well. Modern components are mostly quite heat resistant, but you need to learn to produce connections quite quickly so that there is absolutely no risk of damaging components when soldering them in place.

Probably the best way to learn this type of soldering is to buy a piece of stripboard and some cheap resistors or capacitors. Stripboard is a form of proprietary printed circuit board which has component holes drilled in a 2.54 millimetre (0.1 inch) matrix, and which has copper strips running along rows of holes on one side of the board.

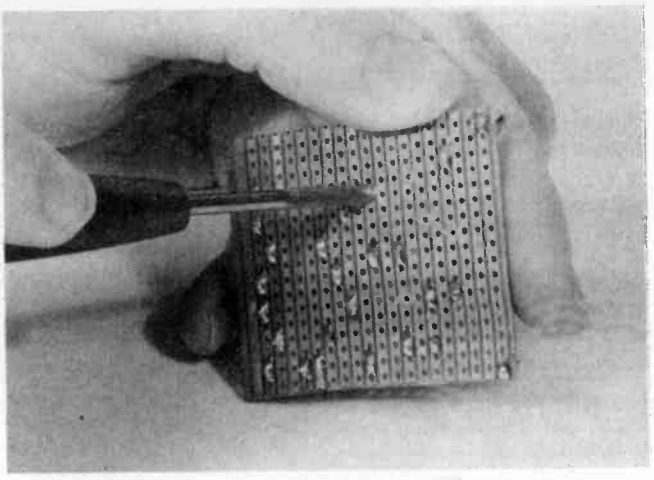
This type of board can be used to wire up virtually any circuit, with breaks in the strips and link wires on the component (non copper) side of the board being used where necessary. A piece of stripboard and some components to solder to it should only cost a pound or two.

A typical selection of tools and a small cabinet containing components. An iron stand would also be required.

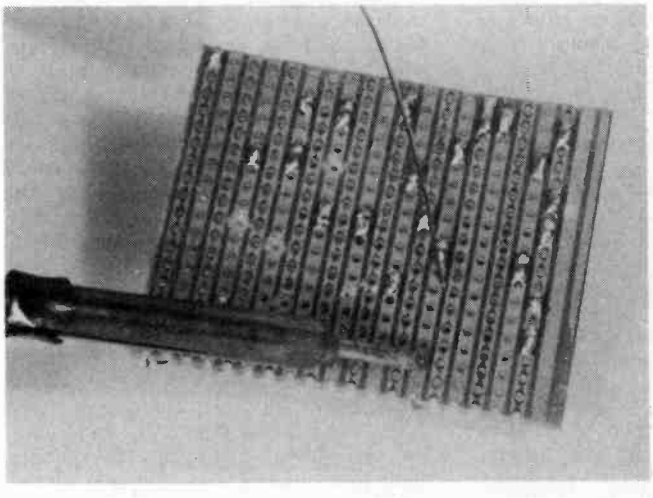




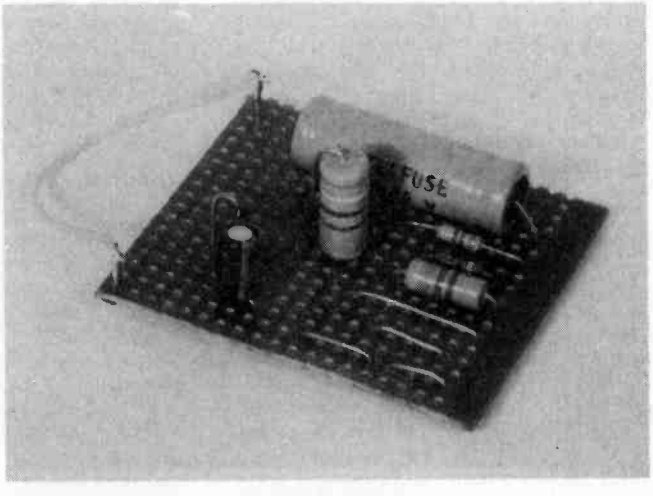
The basic soldering equipment; two sizes of solder, a 17W iron fitted with a miniature bit and combined wire cutters/ strippers (these are not ideal for circuit board work).



Stripboard (or Veroboard) tracks can be cut using the special tool available or a small (7mm or 8mm) hand held drill bit.



Apply the bit to the joint first, then feed in the solder. The joint should be made in a couple of seconds.



Some cheap components and a piece of stripboard will enable you to practice soldering.

Although it might seem rather wasteful, the experience gained from this should prove to be well worth the small monetary outlay. Like most manual skills, the only way to learn soldering is through practice, and learning from your mistakes.

Pin-Up

The second type of soldered joint is where a lead has to be connected to a component tag, or to a solder pin on a printed circuit board. These solder pins are normally fitted to boards at the positions where off-board connections will be made, rather than connecting the leads direct to the board.

The main advantage of using pins is that you can normally fit the board into the case and then wire it up to the front panels, controls etc. This is much easier than making direct connections to the underside of a loose board and then fitting it in place.

The main point to watch with this form of soldering is that the two surfaces to be soldered are *clean* and *well "tinned"* with solder. Modern components have leadout wires that are made from materials which do not corrode easily, and which do accept solder quite readily. It is only on rare occasions that you will encounter leads that will not take a coating of solder.

When this does happen, the usual result is either no solder on the lead at all, or a blob of solder which can be knocked off with little difficulty. The cure is to scrape the lead clean with the blade of a penknife or a small file, and to try again.

Component tags are more likely to give problems, and it is again a matter of scraping them clean and trying again if the solder refuses to flow over them properly. If a tag is obviously corroded or dirty, clean it prior to making any attempt to make a connection to it.

In order to practice this type of soldering try fitting some solder pins to a piece of stripboard, and then wire pairs of them together with some multi-strand hook-up wire. For this type of joint to be physically strong you need to be reasonably generous with the solder.

The real difficulty with any electrical soldering is that it is a three-handed job! You need one hand each for holding the iron, holding and feeding in the solder, and holding the items to be soldered in place.

When soldering leads to tags, the method most people use it to either hook a loop of wire around the tag, or to wind a few turns of wire around the tags. I prefer the hook method since this is more easily disconnected if this should be necessary at some later date.

With circuit boards there are special frames available which can be used to hold everything in place while you solder the components in position. These are quite expensive though, and are prabably not worthwhile initially but should certainly be considered as you become more proficient.

At this stage, it is probably better to improvise something. Bostik Blue-Tack is good for holding components in place while the connections are made. Most constructors soon work out their own systems for handling this little difficulty.

Tools Of The Trade

As far as the electrical side of project construction is concerned, apart from a soldering iron and stand the only other essentials are a pair of wire clippers and some wire strippers. Do NOT be tempted to use scissors for either task.

In order to trim leadout wires close to the underside of a circuit board you need proper wire clippers. Also, a proper wire stripper tool can be adjusted so that it will almost cut through the insulation, but will not quite do so. As you pull the tool away from the wire, the thin layer of insulation that has not been cut simply breaks under the strain, and the unwanted insulation comes away with the tool.

The point of this is that there is no risk of stripper blades cutting slightly into the wire. This would seriously weaken the wire, and it would probably fatigue and break at that point before too long.

Incidentally, when wiring up projects it is usually best to use multi-strand p.v.c. insulated wire rather than a single core type. Multi-strand wires are more flexible and easier to use, as well as being less prone to fatigue and breaking.

A good pair of small wire clippers and a separate wire stripper will probably cost a few pounds each, but should last a good many years. If money is tight, a combined wire cutter and stripper tool will only cost two or three pounds, should prove perfectly satisfactory, and should last for a few years of moderate use.

The mechanical side of project construction requires quite an array of tools if you wish to be in a position to cover all eventuallies. Initially you can get by with quite a modest collection of tools though. In fact you could opt to build only small battery powered projects at first, and with these it is often not essential to put them into cases. You can build up the boards, wire the controls etc. to them, and then switch on and see how they work. This might not be everyone's idea of project construction, but you can have a lot of fun and learn a lot about electronics in this way.

Assuming you wish to tackle the mechanical aspects of construction, the following list represents about the minimum tool-kit that will enable you to tackle most projects.

Small power drill or hand-drill.
Small hammer.
Centre punch.
Range of drill bits from about 2mm to 10mm.
Set of miniature files.
Hacksaw or junior hacksaw.
Set of electrical screwdrivers, including flat blade and cross-point types.
Small vice.
Small adjustable spanner.
Electricians pliers.
Long-nosed pliers.

Much project construction revolves around cutting holes in cases and mounting components in them. A drill and a good range of drill bit sizes are therefore essential.

Many controls and sockets require 10 millimetre diameter mounting holes, but some miniature types require 5mm or 6.35mm holes. You should therefore ensure that these sizes are present in your collection.

Some smaller sizes (about 2.5, 3, 3.5, 4, and 4.5 millimetres diameter) are needed for drilling holes for mounting bolts, and you need a good selection of these smaller sizes. A centre punch and a small hammer (or an automatic centre punch) are needed to make small indentations for the drill bits, so that they do not drift, and holes can be positioned accurately.

Some components require quite large cutouts, and possibly mounting holes that are not circular. There are some very expensive gadgets for handling this type of thing, but there is a low cost solution in the form of miniature files. In particular, a miniature round file can be used to make virtually any large panel cutout. It may not be especially quick, but it will do the job and costs very little.

A hacksaw is needed for, amongst other things, trimming the spindles of controls to the right length. When doing this, fit the spindle into a vice. Do NOT fit the body of the component in the vice. Apart from the fact this will leave the spindle free to rotate, making it difficult to work on, the pressure from the vice could damage the component.

Screwdrivers are needed for tightening mounting bolts for boards, adjusting preset resistors, tightening the grub-screws in control knobs, and dozens of other tasks. For many of these you will need very small types. As electrical screwdrivers are not very expensive it will not break the bank if you obtain several, covering a good range of sizes in both flat blade and cross-point varieties. An adjustable spanner is useful for fitting the mounting nuts to controls and sockets, or a pair of pliers can be used to perform this task.

Pearls of Wisdom

These tools will cover most requirements, and many of them, are the type of thing that will be present in the tool boxes of most households anyway. There are plenty of other tools that will prove useful but are less than essential.

Chassis punches are useful for making large holes, or a reamer can be used to enlarge a smaller hole to the required size. A pearl catcher is a device that can be used to hold screws while they are manoeuvred into awkward positions, or to retrieve screws, nuts, etc. that have fallen into an inaccessible part of a project.

Articles on project construction often list tweezers as an essential tool. In my experience they are virtually useless in the present context, and a pearl catcher is vastly more useful.

Other tools likely to prove useful include box spanners, a modelling knife, and a hand nibbler. The latter is a very useful tool for making large and irregular shaped cutouts in panels. It literally nibbles away bits of the panel, and probably represents the quickest means of making large holes in a panel.

You will find that many component catalogues include a high power magnifier in the tools section. These are very useful when checking printed circuit boards for short circuits due to slivers of copper from incomplete track breaks and minute solder blobs and splashes. These are often very difficult to see with the naked eye even if you have very good eyesight.

Last but by no means least, it is advisable to obtain a desoldering tool sooner rather than later. There are various types available, but the spring-loaded suction type probably represents the cheapest type that will work really well.

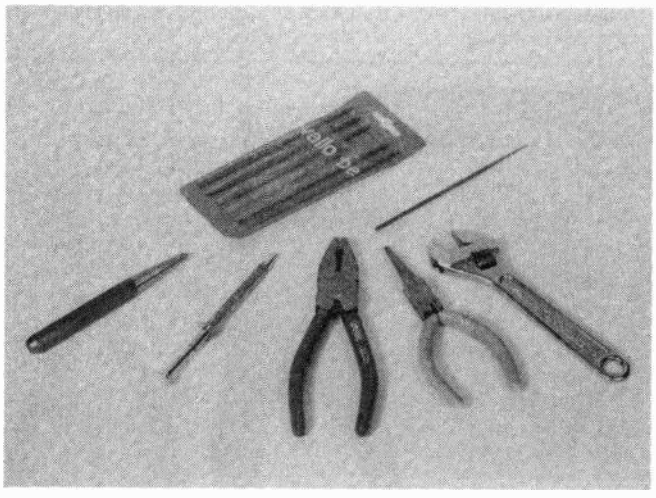
Desoldering something like a resistor is not difficult even without the aid of a desoldering tool. Simply apply the soldering iron to one joint, pull the leadout wire free, and then repeat the process with the second lead.

This process is not practical with most multi-lead components, such as d.i.l. integrated circuits. You have to remove the solder from each pin in turn and then pull all the pins clear of the board simultaneously. Removing all the solder from a joint is very difficult without the aid of proper desoldering equipment.

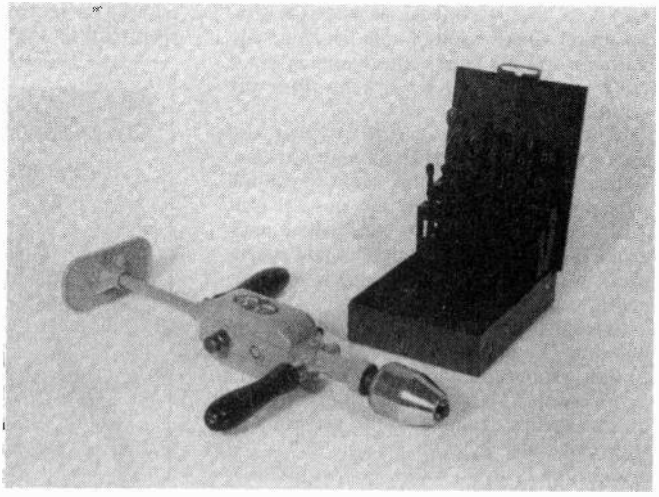
Remember that there is no need to go out and buy lots of tools before getting started. This is probably not a very good way of tackling things. It is probably better to get a few basic tools initially, and then buy more equipment as the need arises.

Code Breaking

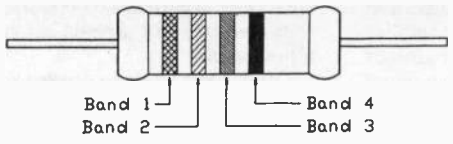
As your first project you should choose one that is accompanied by explicit construction diagrams and instructions (which means any *Everyday Electronics* project). This will have wiring diagrams, etc. that should leave little room for doubt about where each component fits, and which points need to be wired together. Probably the areas which are most likely to cause confusion are components marking and



Some of the tools you will need for project construction. The miniature files (top) and pearl catcher (second left) are very useful.



A full size hand drill plus a set of drills will cover most of your hole cutting requirements. Power drills can be difficult to use with thin and soft case materials.



COLOUR	BAND 1	BAND 2	BAND 3	BAND 4
Black	0	0	X1	-
Brown	1	1	X10	1%
Red	2	2	X100	2%
Orange	3	3	X1000	-
Yellow	4	4	X10000	-
Green	5	5	X100000	0.5%
Blue	6	6	X1000000	0.25%
Violet	7	7	-	0.1%
Grey	8	8	-	-
White	9	9	-	-
Gold	-	-	X0.1	5%
Silver	-	-	X0.001	10%
None	-	-	-	20%

Fig. 2. Details of the standard four band resistor colour coding

A miniature vice can be very useful for holding small items.

components that are available in more than one style.

Taking the component markings first, the two main causes of problems are resistor colour codes and the rather cryptic markings on some capacitors. These days virtually all resistors use a four colour code of the type detailed in Fig. 2. The first two bands (which are the two bands nearest to one end of the component's body) indicate the first two digits of the value. As an example, red and violet respectively represent 2 and 7 when they appear in the first two bands, giving 27 as the start of the value.

The third band is the multiplier, and you simply multiply the first two digits by the figure represented by this band. As an example, suppose the colour of this band is orange. This represents a multiplier value of 1000, and multiplying the first two digits of 27 by this gives a final value of 27000 ohms.

Another way of looking at it is to take the number represented by the multiplier band if it was in the first two bands (e.g. 3 in the case of orange), and then add this many zeros to the first two digits. Adding three zeros to 27 again gives an answer of 27000 ohms.

The fourth band is the tolerance marking. The actual value of a component will always differ slightly from its marked value, and the tolerance figure is simply the maximum percentage error. A gold band for the tolerance for instance, indicates that the actual value is within 5 per cent of the marked value. The only point to watch here is that the tolerance rating of the resistors you use is at least as good as that specified in the components list (e.g. you can use one per cent components in place of five per cent types, but not the other way round).

A few resistors have a fifth marking, and there are two types of five band marking. Current components only seem to use the type which is effectively the normal four band coding plus a fifth band which indicates the component's temperature coefficient (which is not something you will normally need to bother about).

Resistor values are often expressed in kilohms (k) and megohms (M). These are simply a thousand ohms and a million ohms respectively. Thus the value of 27000 ohms in our earlier example would normally be expressed as 27k.

Capacitors

Capacitor values can look a little odd due to the practice of using the letter that shows the units in use to also indicate the position of the decimal point. For example, a 2.2 nanofarad capacitor could be marked 2n2.

Capacitor values can be marked in picofarads (p), nanofarads (n), or microfarads (μ). A nanofarad is equal to one thousand picofarads, and a microfarad equals one thousand nanofarads. Thus a 2.2 nanofarad capacitor could also be marked 2200p or 0.0022μ.

A confusing method of marking used on some capacitors, and on ceramic types in particular, is the type which is reminiscent of resistor colour coding. The first two digits are simply the first two digits of the value. The third figure is the multiplier, and is the number of zeros to be added to the first two digits. The value is in picofarads. Going back to our example of a 2.2n component, with this method of coding it would be marked"222" (22 + 00 = 2200pF = 2.2nF).

Different styles of component giving problems is most likely to occur with sockets, where it is not uncommon for there to be several variations on a basic type. Most sizes of jack socket are available as open and insulated types for example.

This type of problem does not take the experienced constructor long to sort out with the aid of a test meter, but for the beginner prevention is better than cure. Study the article and the component catalogues closely, and try to ensure that the components you obtain are as much like those used in the prototype as possible.

Final Points

If you have learned to solder proficiently and you have the necessary tools, putting a simple project together is not too difficult. Remember that while some components such as resistors can be fitted either way round, some components must be fitted the right way round. It is mainly semiconductors (diodes, transistors, and integrated circuits) that fall into this second category.

Do not be in a hurry to fit all the components, and study the diagrams carefully. They should make it perfectly clear which way round each component should fit, if the polarity is important.

Fit integrated circuits in holders. If one should be fitted the wrong way round, it is then an easy matter to remove it and refit the device the right way round.

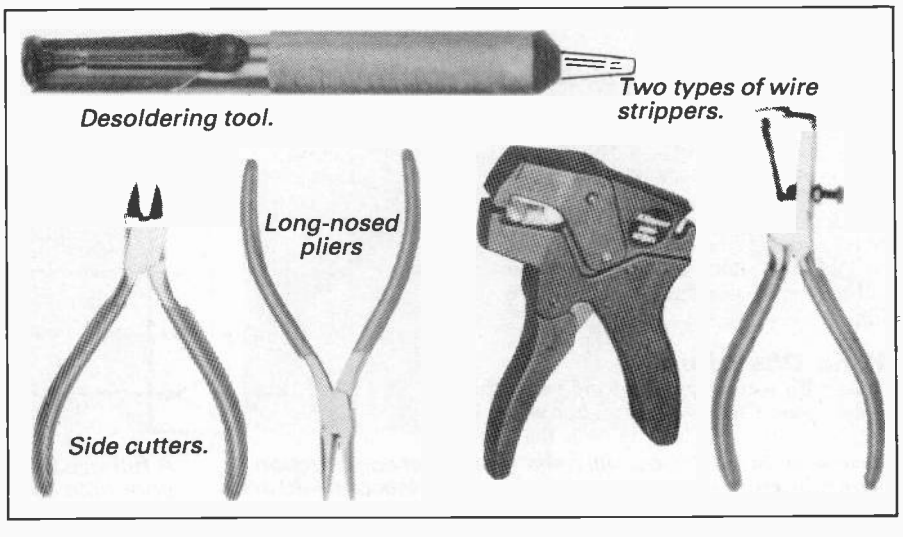
Prior to final wiring and powering-up, it is most important to check the finished circuit board very carefully for short circuits due to solder blobs or splashes, preferably using a magnifier. Also look very closely at the soldered joints.

If *any* solder joint looks to be a bit dubious, clean away the solder, clean the end of the leadout wire, and try again. By far the most common cause of newly constructed projects failing to work is a probelm with either a bad joint os an accidental short circuit on the component panel.

Above all else, read the article through thoroughly a couple of times before you start work on the project. It is by no means unknown for readers to write in requesting information that was supplied in the article in question.

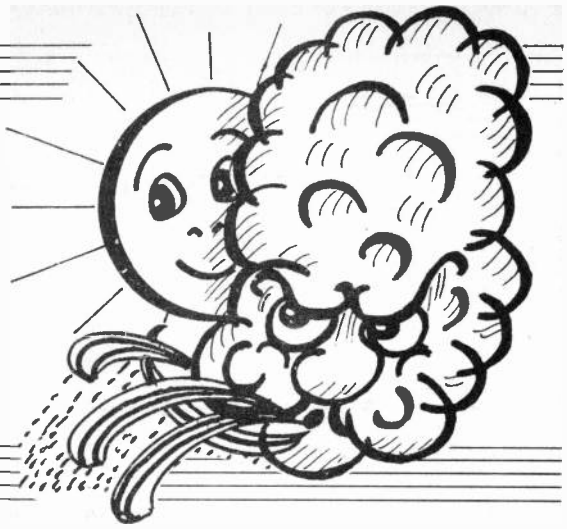
If you have buying problems, refer to the components list to see if it gives sources of supply for any unusual components. In the case of *Everyday Electronics* projects, refer also to the *"Shop Talk"* feature which should sort out most buying difficulties.

Buy a set of components and give it a try — its a great hobby. □



Constructional Project

EE WEATHER STATION PART ONE



MIKE FEATHER

With the effects of the environment becoming more important each year, why not add some high-tech to your weather forecasting.

FOLLOWING a request from a school Geography department for the development of some form of electronic anemometer, the author began to investigate what other meteorological "quantities" might be measured using electronic techniques.

The electronic Weather Station described is the culmination of the work of these investigations.

SYSTEM OVERVIEW

From the outset, it was decided that the following quantities should be measured:

Wind Speed	***Humidity***
Wind Direction	***Rainfall***
Temperature	***Sunlight***

An obvious omission from this list is atmospheric pressure. This can be measured relatively easily using one of the various forms of pressure transducer currently available, this will be covered in a separate article later.

The remaining quantities have been investigated and operational systems for the measurement of the first four are outlined below, with a full description of the construction of the weather station forming the remainder of this article. Systems for measuring the remaining quantities will be described in a future article.

Wind Speed

The Wind Speed or Electronic Anemometer uses a conventional three cup rotating arm arrangement. Speed sensing of the rotating shaft can be achieved by a variety of techniques, but for economy and simplicity of construction, it was decided to employ a disc with peripheral holes rotating in the gap of a slotted opto switch. An outline block diagram for the Electronic Anemometer is shown in Fig. 1.

Wind Direction

As with a conventional wind vane, this sensor uses a lightweight pointer which is free to rotate and line up with the wind direction. In this case, the electronic sensing has to detect not the speed, but the angular position of the shaft and vane.

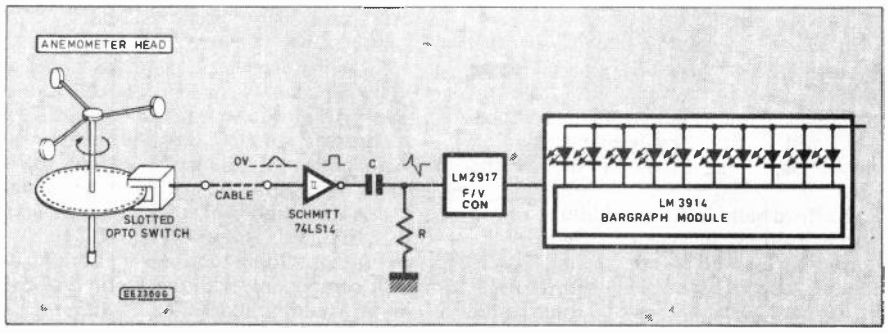


Fig. 1. Block diagram for the Electronic Anemometer (wind speed).

Once again, opto electronic sensing is employed, but this time a coded disc is used which, together with four opto sensors, develops an excess 3-bit Gray code representing the vane position. An explanation of this code and the reason for its use is given in the detailed description of the wind vane section of the weather station. An outline block diagram of the Wind Direction Indicator is shown in Fig. 2.

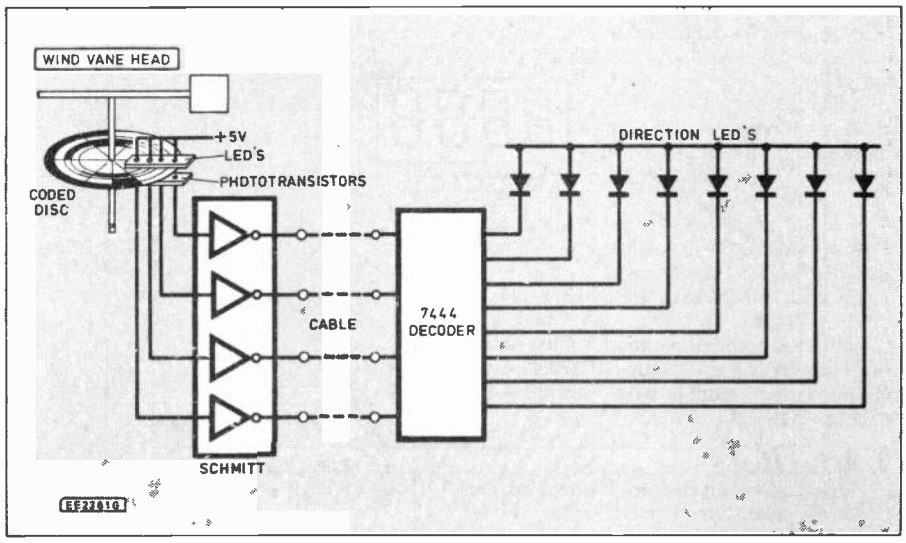
In both the wind speed and direction sensors, the freedom of movement of the shaft is important and a simple low friction bearing system is described in the detailed construction notes.

Temperature/Humidity

There are several different forms of temperature sensor available and the choice of which technique to employ depends upon cost, accuracy, resolution and ease of use.

The best compromise seemed to be to use the relatively new LM35 semiconductor temperature sensors manufactured by National Semiconductors. These devices, coupled with simple circuitry, can be made to develop 10mV/degC over a wide range of temperatures and an important advantage (compared with earlier semiconductor sensors) is the fact that at 0°C, the sensor output is zero — thus obviating

Fig. 2. Block diagram for the Wind Direction unit using a coded disc.



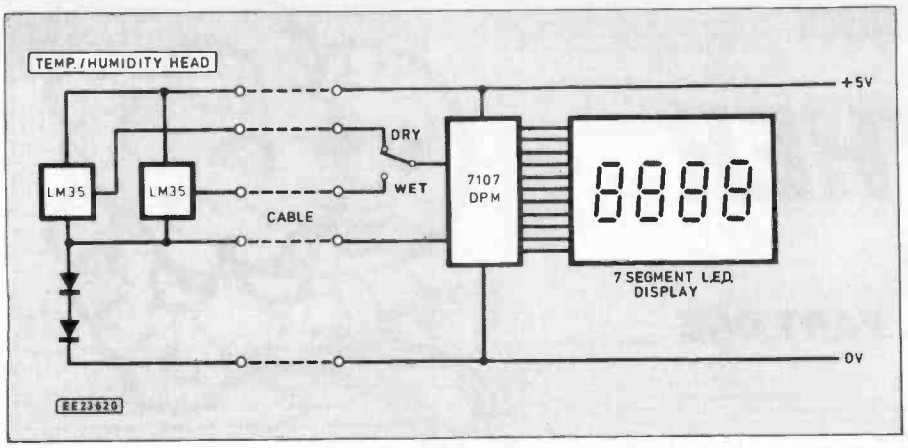


Fig. 3. Block diagram for the Temperature/Humidity unit (Part 2 — next month).

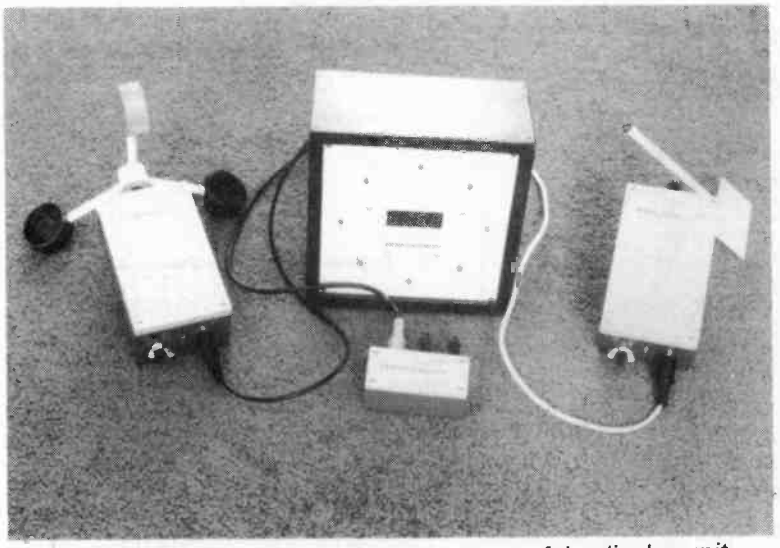
the need for providing a large voltage to offset the usual 273mV at 0°C.

A second temperature sensor is employed for humidity measurements and the system resembles a conventional wet and dry bulb hygrometer. The humidity is derived from the depression of the "wet bulb" sensor.

The general arrangement of the Temperature/Humidity sensing sections of the Weather Station is shown in Fig. 3.

Station Displays

The Weather Station Display unit provides for instantaneous "readout" of all the various parameters just outlined and it includes displays, power supplies and any necessary signal conditioning circuitry. A block diagram of the internal circuitry used is shown in Fig. 4 whilst a possible panel layout is given in Fig. 5.



The three sensor heads plugged into the rear of the display unit.

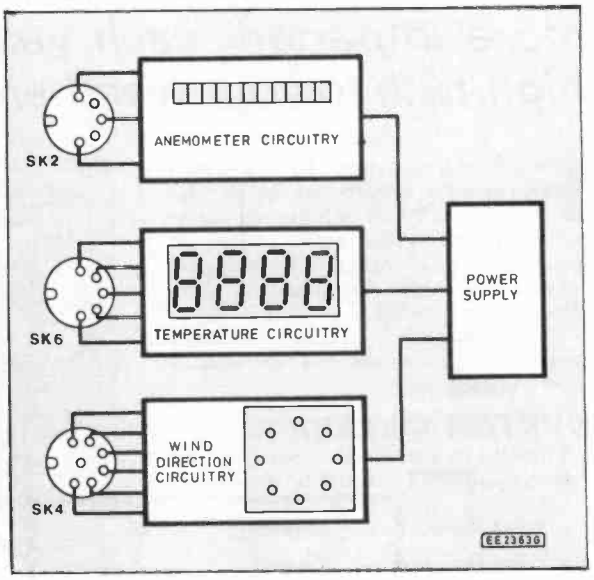
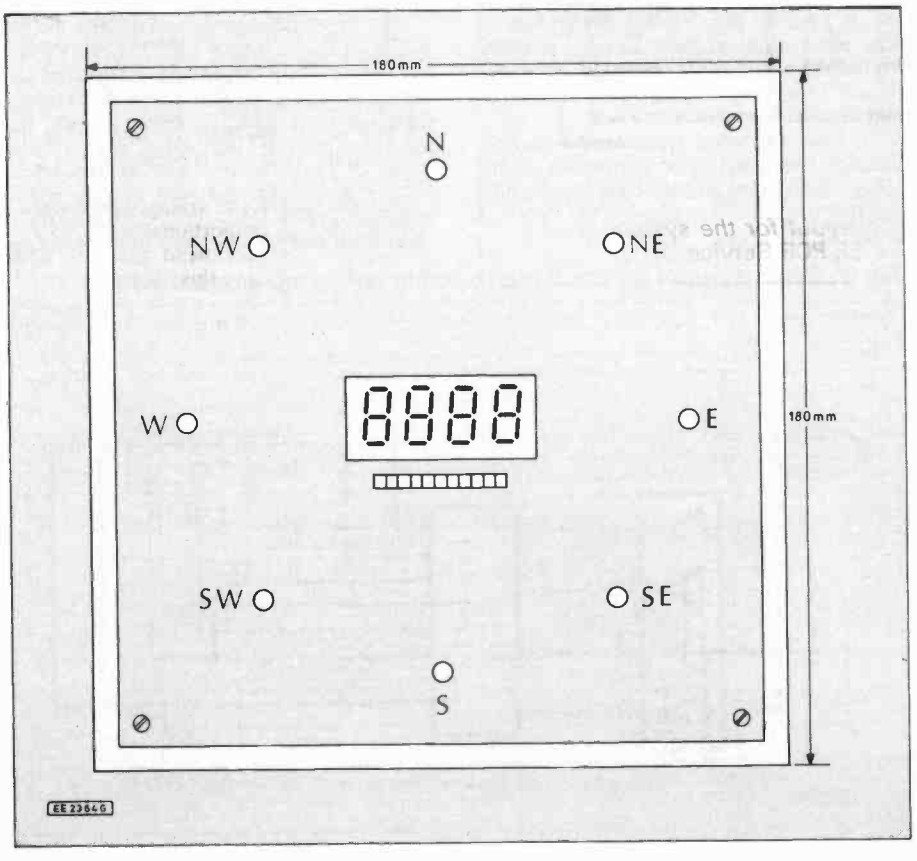


Fig. 4. Overall block diagram for the EE Weather Station displays.

Fig. 5. Suggested weather station front panel display layout.



POWER SUPPLY

The system power supply circuit diagram for the Weather Station is shown in Fig. 6. This is a conventional bridge rectifier circuit and provides an unregulated dual rail supply at approximately ± 20V.

The +5V output is obtained from the voltage regulator IC1. Some smoothing of the two 20V supplies is accomplished by electrolytic capacitors C1 and C2.

The printed circuit board component layout and full size copper foil master pattern for the Power Supply is shown in Fig. 7. This board is available through the *EE PCB Service*, code EE675.

The only points to watch out for are that the two capacitors and the voltage regulator IC1 are inserted on the board correctly.

ANEMOMETER

The full circuit diagram for the Anemometer section is shown in Fig. 8. The circuit is divided into three sections and consists of the remote head or sensor; pulse shaping and frequency to voltage converter; and bargraph display.

The phototransistor of the slotted optoswitch X1 develops crude pulses, the frequency of which is proportional to the shaft speed (see Fig. 1.) and hence the "wind speed". The pulses are transferred, via SK1/PL1 — PL2/SK2 and cable, to the

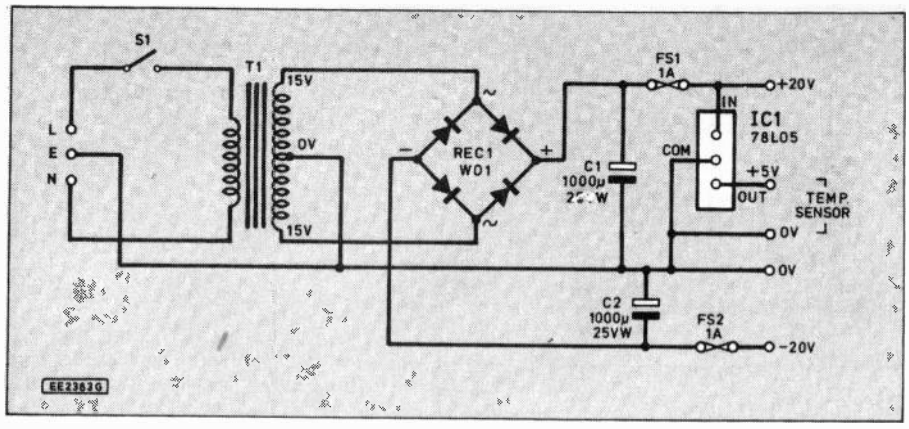


Fig. 6. Circuit diagram for the dual power supply for the EE Weather Station.

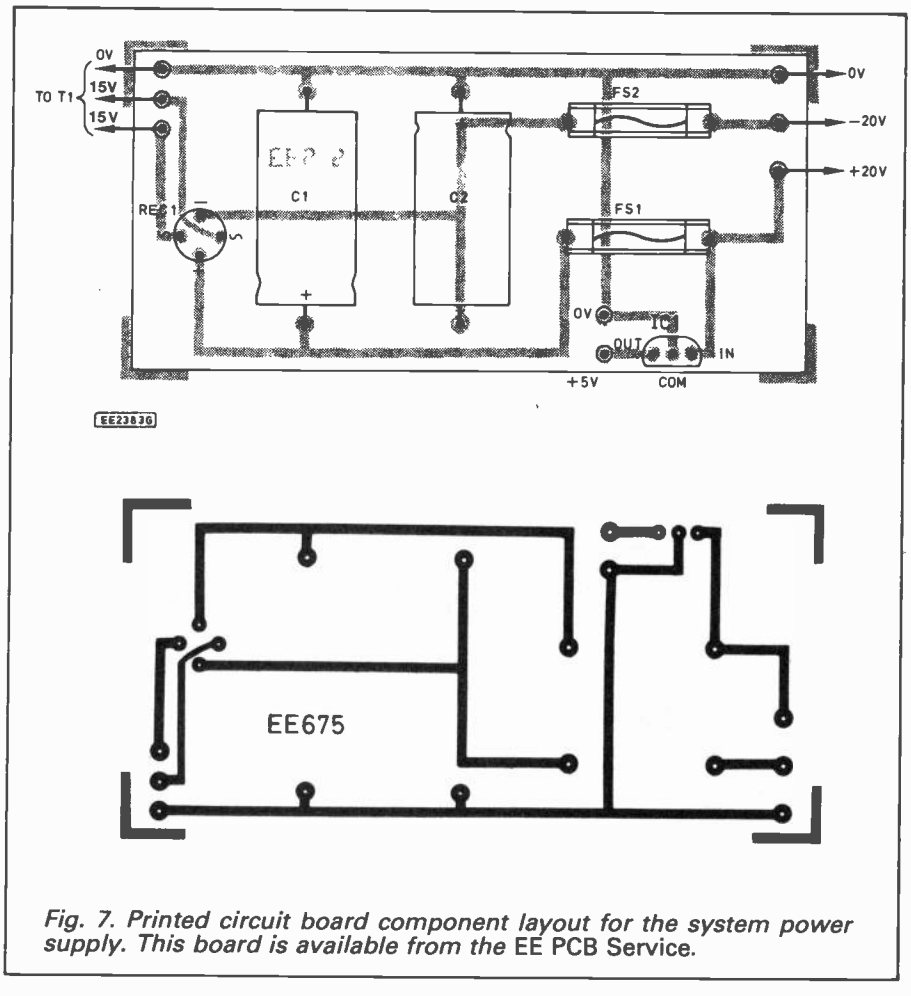


Fig. 7. Printed circuit board component layout for the system power supply. This board is available from the EE PCB Service.

COMPONENTS

POWER SUPPLY

Capacitors

C1, C2	1000µ axial elec. 25V

Semiconductors

D1-D4	W01 50V 1A bridge rec
IC1	78L05 +5V 100mA voltage regulator

Miscellaneous

T1	20VA mains transformer, 15V-0V-15V sec.

Printed circuit board, available from the *EE PCB Service*, code EE 675; FS1, FS2 1A fast blow fuse (2 off); pcb mounting fuse holders (2 off); connecting wire; solder etc.

Approx. cost guidance only **£10**

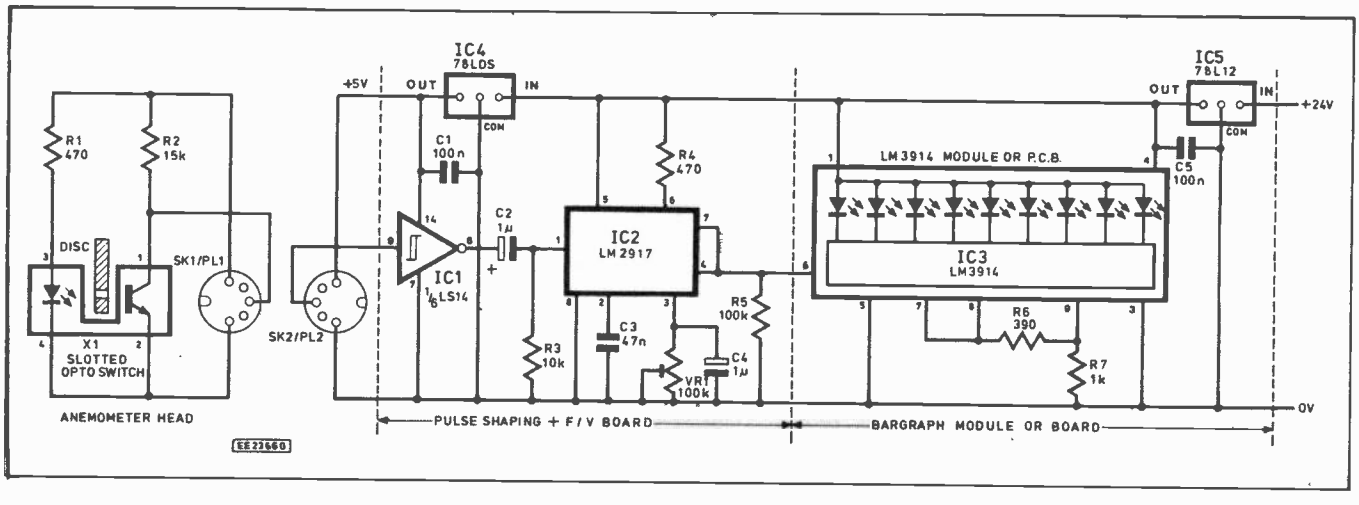
display unit where they are applied to the input of one section of a 74LS14 HEX Schmitt inverter, IC1. This produces "clean" rectangular TTL level pulses at its output which is passed to the frequency to voltage converter IC2. A 78L05 voltage regulator IC4 provides the +5V supply to the slotted opto-switch and IC1.

The LM2917 frequency to voltage converter IC2 provides an output voltage which is proportional to the frequency of the input pulses and hence to the speed of the Anemometer head. The input to IC2 must swing above and below 0V in order that the converter can function correctly. This is achieved by the resistor capacitor network C2/R3 which produces an output consisting of positive and negative going spikes of a frequency equal to that of the input pulses.

The relationship between the input frequency and the size of the output voltage produced by IC2 depends upon capacitor C3 and preset VR1, the latter being made variable in order to provide a calibration facility. A 100k preset is used here in order to achieve an output voltage range of 0V to 5V over the full range of the Anemometer "vanes" speed. Capacitor C4 provides a measure of smoothing of the output voltage by reducing any ripple present in it.

We now have a d.c. voltage, the magnitude of which is proportional to the speed of the anemometer head and all that remains is to measure this. A conventional

Fig. 8. Complete circuit diagram for the Anemometer. The numbers around the outer outline of IC3 are for the single printed circuit board Module.



ANEMOMETER (WIND SPEED)

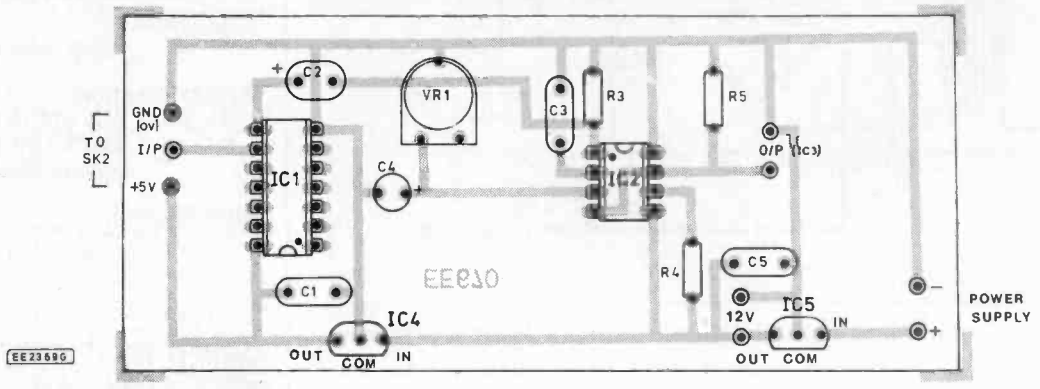
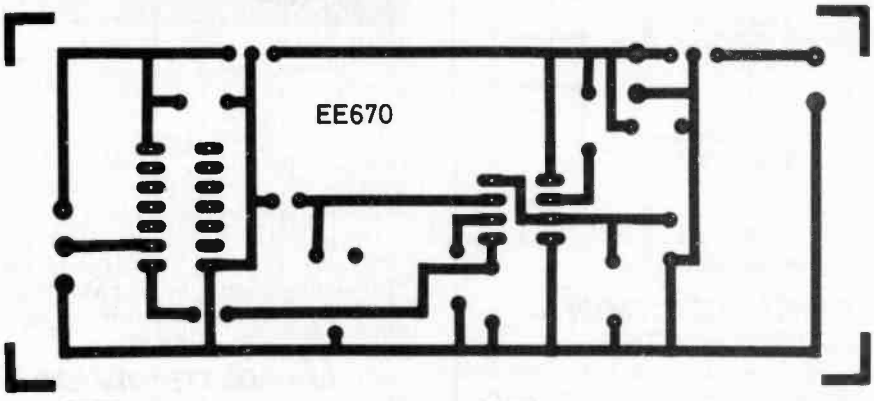
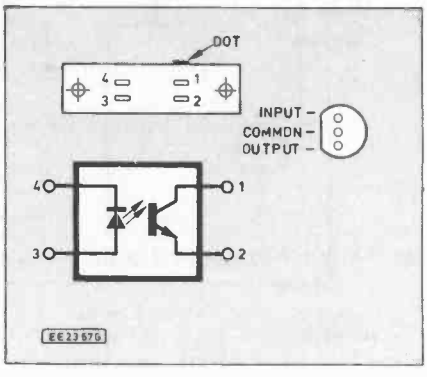
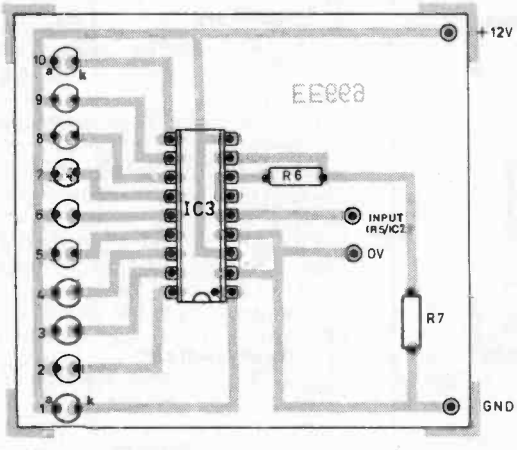


Fig. 9. Printed circuit board component layout and full size copper foil master pattern (below). Connections for the opto-switch X1 and regulators IC4/IC5 are shown below right.







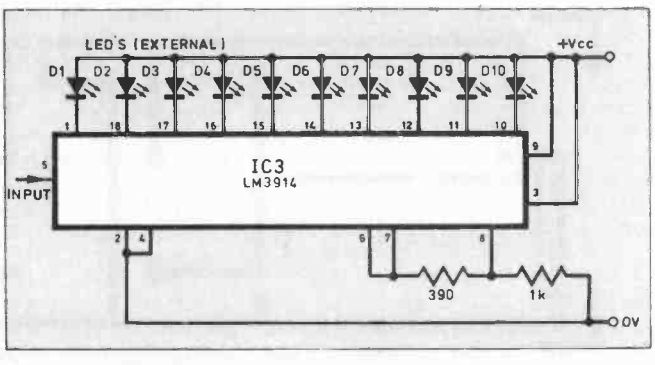


Fig. 10a. Anemometer circuit diagram using the LM3914 i.c. and individual l.e.d.s.

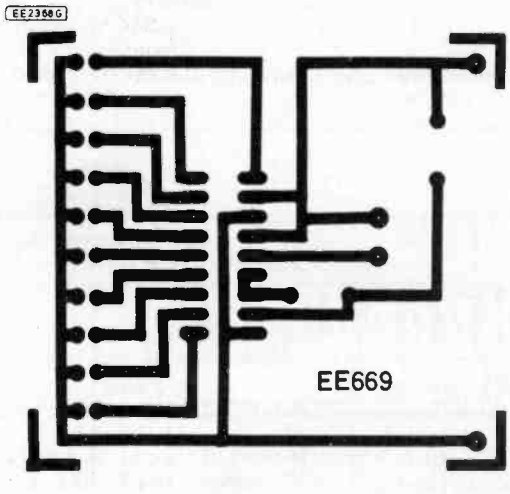
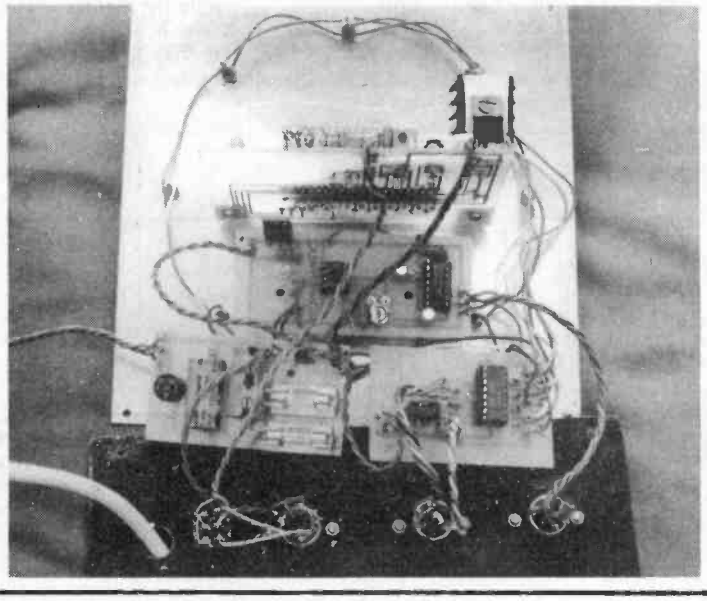


Fig. 10b. Printed circuit board component layout for bargraph display using the LM3914 i.c. and not the module.



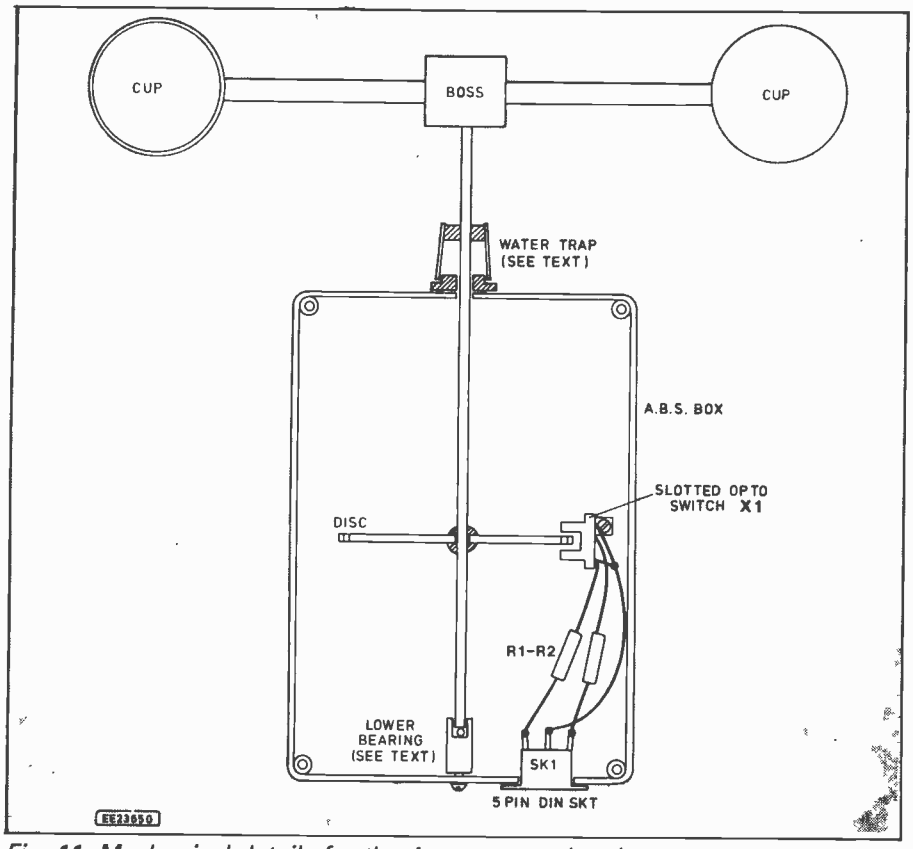


Fig. 11. Mechanical details for the Anemometer head.

d.c. voltmeter (0V-5V) could be used but in view of the fact that wind speeds are normally determined only approximately, it was decided to employ an LM3914 ten-segment l.e.d. bar display for this quantity.

The LM3914 bargraph displays are available in two forms, either as an 18-pin d.i.l. chip requiring separate l.e.d.s. or as a complete module including both the driver i.c. and the display l.e.d.s. The prototype employs the latter (IC3), although there is no reason at all why the separate chip and l.e.d. alternative should not be used. A suitable printed circuit board design for this arrangement is given in Fig. 10.

The LM3914 i.c. and module contain a resistor divider network consisting of ten precision resistors. A 1.25V reference voltage (developed internally) can be connected across the string and, in this case, each 125mV increase in the input voltage will switch on another of the l.e.d.s.

The resistor string voltage can be changed in order to alter the range of the device and resistors R6, R7 achieve this. The values used result in the tenth l.e.d. being turned on by an input voltage of 5V. Resistor R6 also determines the display brightness and the selected value gives a l.e.d. current of approximately 20mA.

It should be noted that the display can be used in either dot or bar mode. With several l.e.d.s. switched on, the bar mode of operation draws a considerable current and it was decided to employ the dot mode in order to avoid this. Pin 10 of the module (pin 9 of i.c.) determines the mode selection and it should be left unconnected for a dot display; connecting it to +V will turn on the bar mode.

The LM2917 and LM3914, IC2 and IC3, are operated on a +12V supply and IC5, a 78L12 voltage regulator, provides this from the main unregulated 20V power supply line.

CONSTRUCTION — ANEMOMETER

The printed circuit board component layout and full size copper foil master pattern for the Anemometer section is shown in Fig. 9. This board is available from the *EE PCB Service*, code EE670.

In the prototype, this board was mounted on the back of the display module (IC3) using short 6BA spacers. The whole assembly was then mounted on the front panel of the Weather Station display with the row of l.e.d.s. positioned in a rectangular cutout, see Fig. 5. and photographs.

Connections to the remote Anemometer head unit are made via a 5-pin DIN socket and plug on the rear panel of the unit. Only three wires are needed in fact (0V, +5V and the pulsed signal) and lightweight 3-core mains cable can be used here.

The mechanical details of the Anemometer head are given in Fig. 11. The construction of the head should not present any significant problems, but as stated previously, it is important that the shaft/disc/arms assembly should rotate freely.

The lower end of the shaft rests on a 4mm ball bearing resting at the bottom of a drilling in a short length of nylon rod. Perspex or other plastics materials would provide suitable alternatives.

The upper "bearing" is merely a carefully drilled hole in the top of the ABS box. The shaft used in the prototype was a length of 4mm silver steel rod, but a piece of Mecanno spindle or even a length of 3mm welding rod would no doubt suffice.

The water trap was fabricated from a cheap plastic push-on knob. The cap is drilled large enough to clear the shaft and then glued to the top of the box. Whilst the body of the knob is also drilled through and fixed to the shaft with Araldite.

The boss supporting the arms was cut from 1in. wooden dowel and drilled to accommodate the arms themselves (⅜in dowel) and the shaft. The tops from used aerosols provided the "wind" cups and these were fixed to the arms with small wood screws.

The disc was cut from glass fibre printed circuit board and the positions of the 48 holes were marked using dividers. Next 2mm holes were then carefully drilled at these positions. The disc is fixed to the shaft using Araldite.

The gap of the slotted opto-switch X1 is quite narrow and some provision for adjusting its position relative to the disc should be made. A 5-pin DIN socket was used for connections to the Anemometer head unit.

COMPONENTS

ANEMOMETER HEAD

Resistors

R1	470
R2	15k

All 0.25W 5% carbon film

Miscellaneous

X1	Slotted opto switch
SK1/PL1	5-pin 180° DIN socket and plug

Fibreglass "interrupt" disc, see text; push-on control knob for water trap; case; materials for bearing, shaft, arms and wind cups —see text; 4mm ball bearing; connecting wire; solder etc.

ANEMOMETER DISPLAY

Resistors

R3	10k
R4	470
R5	100k
R6	390
R7	1k

All 0.25W 5% carbon film

Shop talk
see page 131

Capacitors

C1, C5	100n polyester (2 off)
C2, C4	1μ radial elec. 16V (2 off)
C3	47n polyester

Potentiometer

VR1	100k skeleton horiz. preset, lin

Semiconductors

IC1	74LS14 HEX Schmitt trigger inverter
IC2	LM2917 frequency to voltage converter
*IC3	LM3914 i.c. or module (see text)
IC4	78L05 +5V 100mA voltage regulator
IC5	78L12 +12V 100mA voltage regulator

* Ten 5mm l.e.d.s required if i.c. used

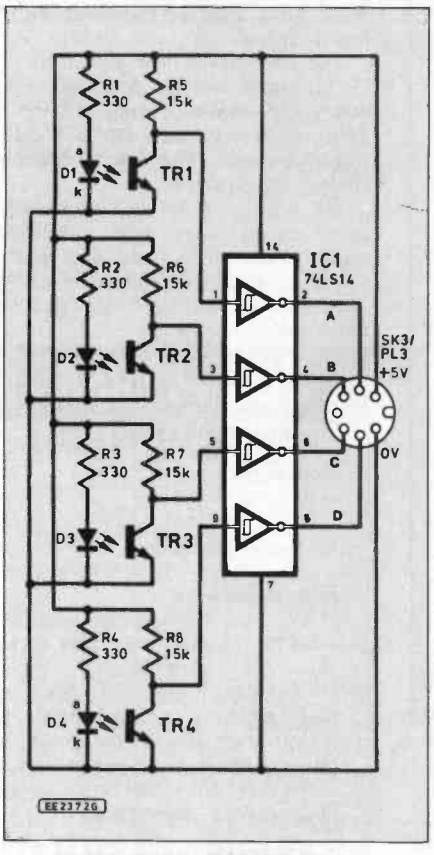
Miscellaneous

SK2/PL2	5-pin 180° DIN socket and plug

Printed circuit board, available from the *EE PCB Service*, code EE669/70; 8-pin d.i.l. socket; 14-pin d.i.l. socket; 18-pin d.i.l. socket; connecting wire; solder etc.

Approx. cost Guidance only **£24**

WIND DIRECTION INDICATOR



D1-D4 OP160 TR1-TR4 OP500

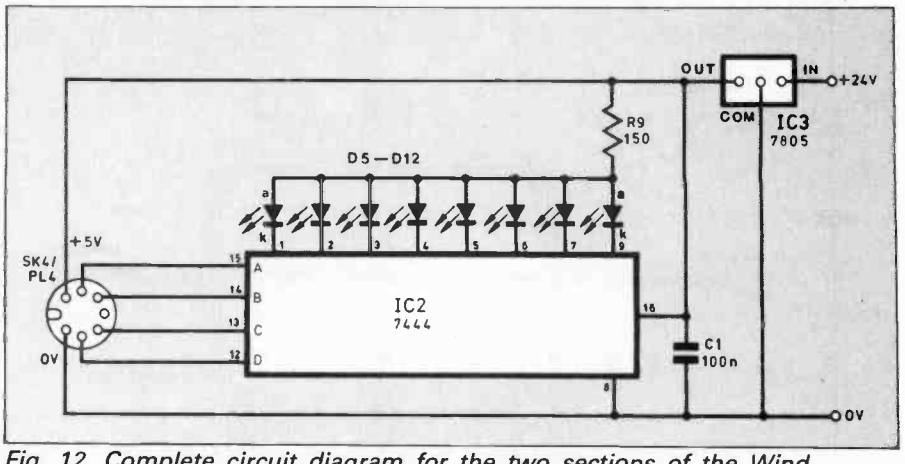
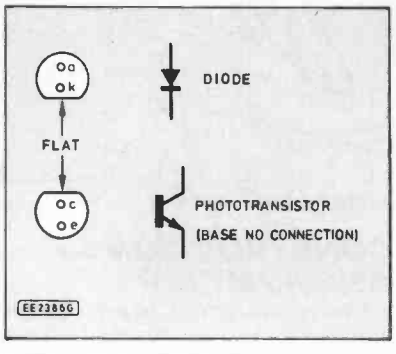


Fig. 12. Complete circuit diagram for the two sections of the Wind Direction Indicator. The connection details for the diodes and photo-transistors are shown below.



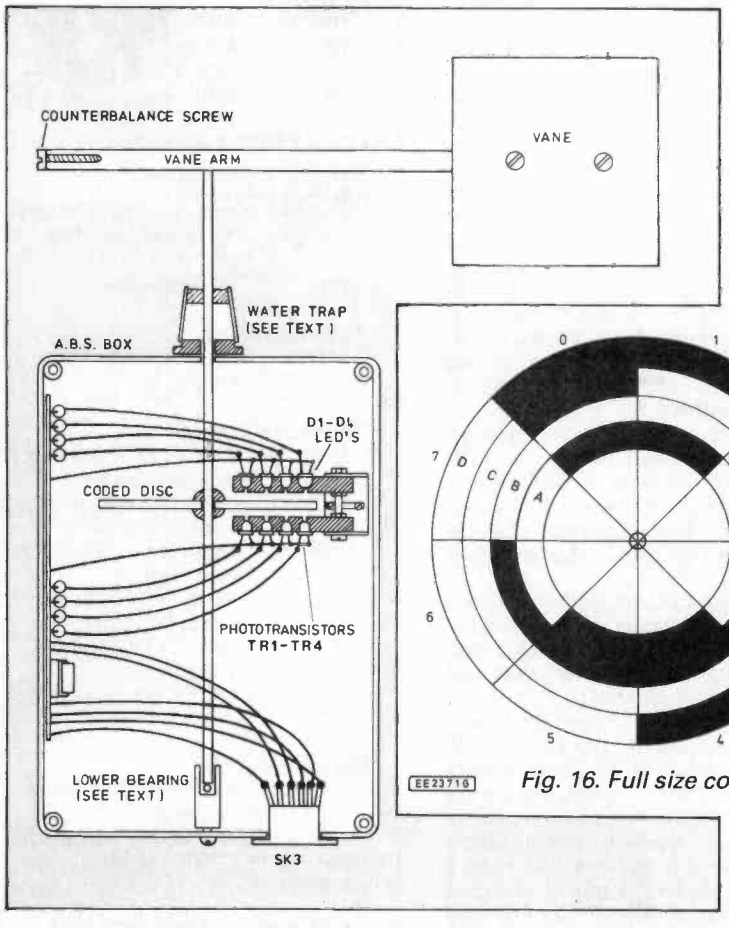


Fig. 15. Mechanical details for the Wind Direction vane head. The sensor bracket holding D1-D4 and TR1-TR4 should be adjustable for aligning with the coded disc.

Fig. 16. Full size coded disc.

COMPONENTS

WIND DIRECTION VANE

Resistors

R1-R4	330 (4 off)
R5-R8	15k (4 off)

All 0.25W 5% carbon film

Semiconductors

D1-D4	OP160 3mm infra red l.e.d. (4 off)
TR1-TR4	OP500 3mm photo-transistor (4 off)
IC1	74LS14 HEX Schmitt trigger inverter

Miscellaneous

SK3/PL3 7-pin 270° DIN socket and plug

Printed circuit board, available from the *EE PCB Service*, code EE674; case for vane head; 14-pin d.i.l. socket; strips 5mm Perspex (see text); coded disc (see text); mounting bracket for sensor strips; materials for vane "pointer", see text; connecting wire; solder etc.

WIND DIRECTION DISPLAY

Resistors

R9 150

0.25W 5% carbon film

Capacitor

C1 100n polyester

Shop Talk see page 131

Semiconductors

IC2	7444 Excess 3-bit Gray to decimal decoder
IC3	7805 +5V 100mA voltage regulator
D5-D12	5mm red l.e.d. (8 off)

Miscellaneous

SK4/PL4 7-pin 270° DIN socket and plug

Printed circuit board, available from the *EE PCB Service*, code EE673; 16-pin d.i.l. socket; l.e.d. clips (8 off); connecting wire; solder etc.

Approx. cost Guidance only £20

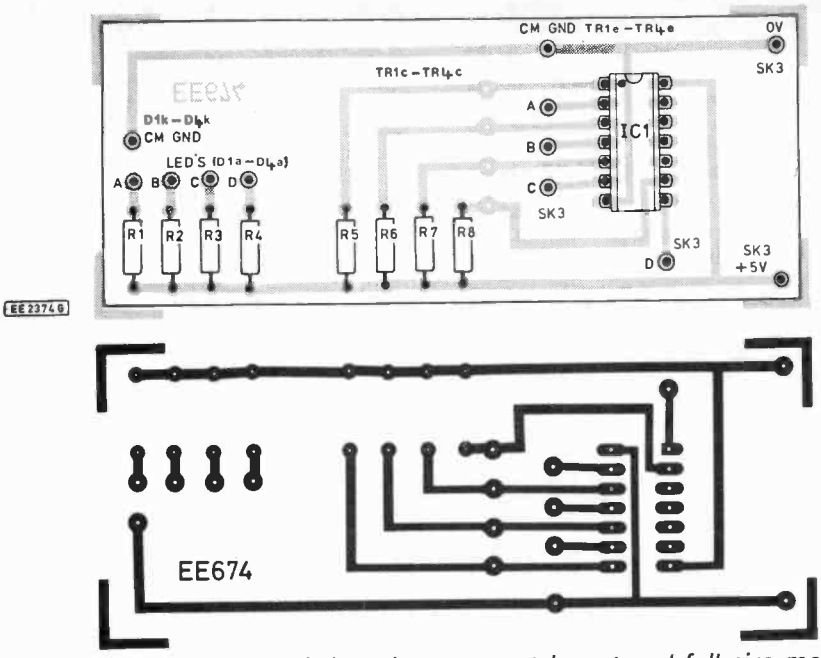


Fig. 13. Printed circuit board component layout and full size master pattern for the wind vane head.

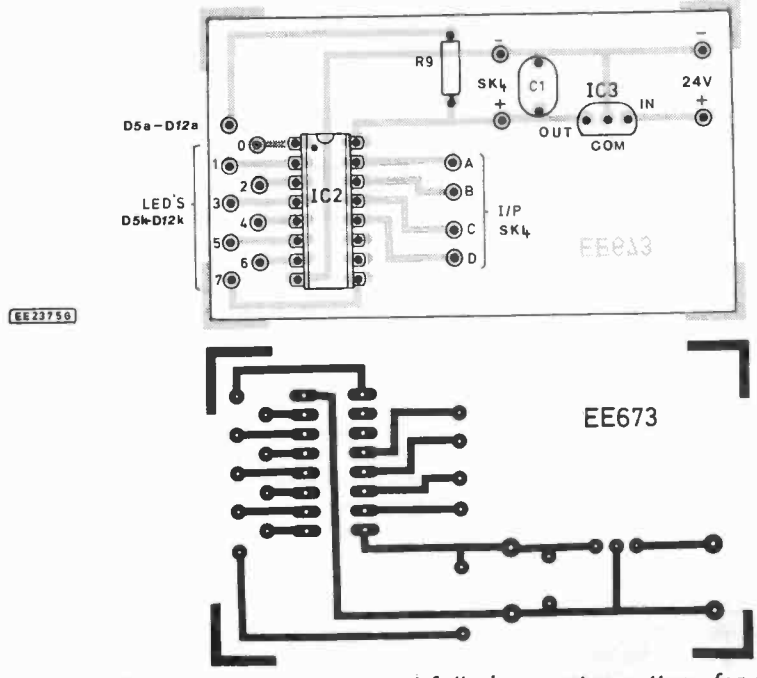
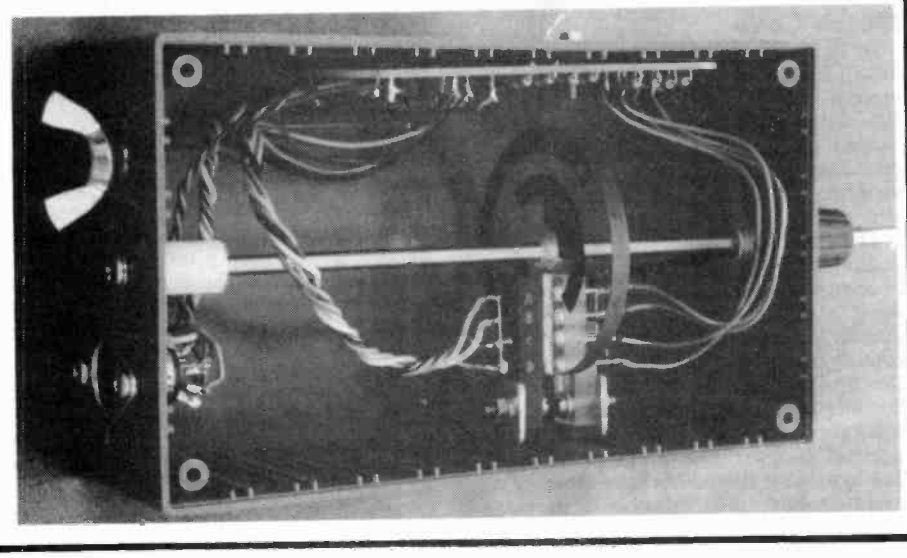


Fig. 14. Component layout and full size master pattern for the wind direction display board.



WIND DIRECTION INDICATOR

As mentioned previously, the Wind Direction Indicator employs optical sensing of the wind vane position. The shaft of the vane carries a four band coded disc which rotates between four corresponding opto-sensors.

An excess 3-bit Gray code, rather than the natural binary code is used. In this, only one digit at a time changes as the disc rotates from one position to the next and such an arrangement is less likely to introduce errors than the binary code, in which two or more digits can change simultaneously. The system used provides an indication of wind direction to within a 45° arc.

The full circuit diagram for the Wind Direction Indicator section of the Weather Station is shown in Fig. 12. The circuit is split into two stages; wind vane head and direction "compass" or display.

Taking the Vane Head first, diodes D1 to D4 are the infra red l.e.d.s., which are sited one side of the code disc, whilst TR1 to TR4 are the associated phototransistors sited the other side of the disc. The opto-switching outputs from the transistors are fed to four sections of IC1, a 74LS14 HEX Schmitt inverter. The inverters are used to develop the required TTL level outputs for transferring to the display decoder IC2. The signals are transferred via 7-pin DIN sockets and plugs (SK3/PL3 — PL4/SK4) and a six-core cable, which also carries the 5V d.c. supply, to the vane head.

In the display unit, IC2 is responsible for decoding the Gray code into one of the eight possible directions. The 7444 Gray to decimal decoder IC2 is used to turn on the appropriate "direction" l.e.d. (D5-D12) according to input code. A 7805 voltage regulator IC3 provides the +5V supply for both the display and head units.

CONSTRUCTION — WIND DIRECTION INDICATOR

The printed circuit board component layouts and full size copper foil master patterns for the Wind Direction Indicator section are shown in Fig. 13. and Fig. 14. These boards are available from the *EE PCB Service*, codes EE674 and EE673.

The mechanical arrangement of the disc and opto-sensors is shown in Fig. 15 whilst a full size diagram of the disc and its code is given in Fig. 16. Each sensor consists of an infra red l.e.d. and phototransistor combination, mounted in 3mm holes drilled in small strips of 5mm Perspex. Care should be taken with the construction of this assembly in order to ensure correct alignment of each l.e.d. with code bands and the associated phototransistor.

The disc itself is cut from 3mm *clear* Perspex and the sectors are then marked out using dividers. The appropriate sectors are then blacked out using good quality black paint.

The construction of the remainder of the wind vane head is similar to that of the Anemometer and Fig. 15 should be consulted. Once again, some provision should be made for adjusting the position of the sensor array relative to the disc.

Next Month: Circuit and construction details for the Temperature/Humidity unit, plus testing and calibration of the system.

a regular feature for the Spectrum Owner...

by Mike Tooley BA

THIS month, *On Spec* will be of particular interest to those of you involved with radio applications. This is an unusual topic for *On Spec* but, judging from recent correspondence, it is nevertheless one which appears to attract a great deal of interest. Before we begin, it is perhaps worth mentioning that *On Spec* celebrates its fifth birthday this month.

Sixty, not out!

When *On Spec* together with its sister column, *BBC Micro*, first appeared in *Everday Electronics* it was the result of a great deal of discussion between the authors concerned (David Whitfield and myself) and the Editor (Mike Kenward) aided and abetted by the (then) Assistant Editor (David Shortland).

At the time (Autumn 1984) we felt that we were breaking new ground for an electronics magazine. We did not want to follow the plethora of computer magazines devoted to games and software reviews but, at the same time, we were conscious that very few of the computer magazines dealt properly (if at all) with the control and instrumentation side of computing. We all agreed that many electronics projects could benefit (quite literally!) from a "computer input" and that the Spectrum and BBC Microcomputers would be the systems that most readers would have access to.

It is very gratifying to find that this situation still persists to the present day and that both the "Beeb" and "Speccy" are still going strong in one form or another. The BBC Microcomputer was followed by the BBC Master (and by several other machines offering levels of compatability with "BBC BASIC") whilst the Spectrum line continued with the Spectrum Plus, 128K, Plus Two and Plus Three machines. Amstrad have underwritten the future of the Spectrum, not "killed it off" as some hinted when Amstrad took over this part of the Sinclair operation. Now, eight years on, the MGT SAM Coupe has arrived to carry on the line into the 1990s.

The writer of technical articles generally receives very little feedback from readers. Surprisingly, this has not been the case with *On Spec* as the column has produced several thousand letters from readers during the past five years. Without doubt, this has been the most pleasing part of the whole operation. Indeed, without your input the series would not have been worthwhile!

Weather Picture Reception

Steven Knight writes from Birmingham with some very useful information concerning weather picture reception. Apparently, it is possible to receive weather pictures which are broadcast in FAX (using single sideband) on the short wave bands. Steven writes:

"In the November issue of On Spec *there was a plea from P. J. Taljaard regarding weather picture receivers. A short program is available for the Dragon 64 which will decode Weather FAX pictures sent out on the short wave band into 9 screens (256 × 192) for printing and viewing.*

"From reading various articles, it seems that the FAX is sent out as 2300Hz for white and 1500Hz for black. All that is necessary (on the Dragon) is to connect the signal to the earphone input and check the relevant bit in memory flipping up and down in order to determine the frequency. Some good machine code programmer should be able to write such a program — even with only a mere Z80 in use!"

Steven has provided some further details of the program in question (known as WEFAX). The program (**for the Dragon 64**) is available, complete with printer dump routines and manual, from **Chris Rouse**, 18 Gregson Close, Bridgmary, Gosport, Hants. It is important to state the DOS version and printer dump required when ordering. The modest price of £5 includes postage and packing.

Several stations around the world transmit FAX weather pictures. The picture rate is normally 120 lines per minute and, in the UK, signals from Bracknell (on 3.29MHz and 4.78MHz) are likely to be the most reliable. It should be noted that these pictures are presented in normal meteorological format and are not "satellite pictures".

Hopefully, Steven will not "get shot for being a traitor to the Dragon" for this gem of information which, I am sure, will be of interest to a number of our readers. In any event, I now expect to be overwhelmed with letters of protest concerning the superiority of the Z80 over the 6809 (or should it be the other way round?).

Morse Code

Dr Brian Brown has very kindly sent me details of several articles on morse decoding and radio teletype (RTTY). The June 1986 issue of *Radio and Electronics World* carried an excellent article on morse decoding which describes two distinct methods of tackling this particular problem.

The first method involves applying the audio frequency morse code signal to the Spectrum's "ear" connector and then using a software routine to perform the decoding. A representative software routine is included and this makes use of the Spectrum ROM routine present at decimal address 5633. Unfortunately, the software routine is presented in hexadecimal format. The program occupies 311 bytes so it should not take too long to enter (as hex), then disassemble in order to find out exactly how it operates!

The second (and somewhat superior) method makes use of a phase locked loop tone decoder based on the XR2211. This circuit requires interfacing to the Spectrum bus and a simple one-bit interface circuit is also provided. Alternatively, a parallel interface (along the lines of those previously described in this column could be employed. A software routine (again presented in hex.) is included for use with the interface.

A reader from Kent, **W. H. Hammond**, has also spotted the *Radio and Electronics World* article and enclosed some listings (complete with a BASIC loader) based on the easier method — though he does not indicate whether the program was successful!

Paul Webster writes from Liverpool with his experience of attempting to solve the same problem, Paul writes:

"I was most interested to read about Derek Dillon's problems attempting to decode CW via the EAR socket of his Spectrum. I have tried the same approach with little success.

The answer is to use a CW (audio) filter followed by a phase locked loop detector which produces two distinct logic signals (e.g. logic 1 for 800Hz, logic 0 for anything else).

Newnes Short Wave Listening Handbook, *by Joe Pritchard G1UQW, gives details of such a circuit and a BASIC listing of a CW decoding program for the BBC Micro.* **Technical Software** *of Caernarfon produce a program for the Spectrum that will decode RTTY, CW, SSTV and AMTOR. They also producec a "software only" version that is driven by the EAR socket".*

Paul is a sefl-confessed believer in "homebrew solutions" and doubtless is now making progress with his own phase-locked loop detector.

RFI

The most unfortunate bugbear of using a computer in conjunction with a radio receiver is the unpleasant level of radio frequency interference (RFI) which it generates. By virtue of the fast rise and fall times of digital signals coupled with the high frequency clocks used by microprocessors, most computers generate a very significant level of noise which occupies a spectrum stretching from a few tens of kilohertz to well over 100MHz.

The Spectrum is no better than any other machine in this respect and can effectively wipe out reception on a nearby receiver. Since most of the fun in radio is associated with signals of relatively small amplitude (100μV, or less) the level of noise radiation from a computer can be crucial in determining which signals are heard and which are not!

Unfortunately, there is no simple solution to this particular problem (short of stopping the microcomputer's clock!). There are, however, a few points worth checking which, collectively, can help to reduce RFI to such a level that it can at least be bearable. The following checklist is presented for the benefit of readers who may be confounded by this particular nightmare:

1. The receiving aerial should be placed as far away as possible from the computer and monitor/TV receiver. The aerial should, if at all possible, be properly constructed (e.g. a dipole) and situated where it will produce maximum signal levels.

EDITORIAL NOTE

The *Shortwave Listening Handbook* is available from our *Direct Book Service* — order code NE16, price £12.95 plus postage — see the *Direct Book Service* pages for ordering information.

We published a *Morse Decoder* project, which produced a 4 Bit Binary output, in our January 1987 issue (we have sold out of back numbers but photostats are available for £1.50 including p&p — see the Editorial page for ordering details). This unit was designed for BBC Micro and Commodore computers and the software given is for those types only.

Readers may also be interested in the *Morse Tutor* that we will publish in two or three months time.

2. The receiving aerial should be connected to the receiver using the correct type of feeder. If the aerial is balanced (i.e. a dipole), ribbon cable may be used. If the aerial is unbalanced (and no unbalanced-to-balanced transformer is incorporated) the feeder should be coaxial and the outer screen should be earthed.
3. Where a telescopic or ferrite rod aerial *has* to be used, it should be orientated in the direction that minimises reception of noise from the computer and maximises the signal. Most ferrite rod aerials exhibit a very sharp null in their directional response and this can be useful in rejecting noise radiated from the computer (but not that which is radiated by the house mains wiring!).
4. Computer leads should, if at all possible, be screened. This rule should apply to printer cables and RS-232 signal leads. Power leads should be kept short or coiled tightly to prevent radiation.
5. A mains filter (e.g. 13A plug-type) can be fitted to the computer power supply in order to prevent radiation of noise from the mains wiring. Such filters are commonly also fitted with transient supressors which can also help prevent mains spikes entering and damaging the computer.
6. Attention should also be focussed on earthing since currents flowing in ground connections or screens can result in an increased noise level. It is worth experimenting with earthing at various points (note that one should ***never*** attempt to make an earth connection to a TV receiver which may potentially have a "live" chassis).
7. Finally, it may be worth partially screening the equipment using tin-foil, tin-plate, or aluminium (which should be connected to earth). An internally lined open-top wooden enclosure can be constructed to accommodate the Spectrum keyboard unit, leaving access to the keyboard. This should be considered the last resort and will normally be unnecessary if the previous steps have been followed.

Slow Scan TV

Finally, **Russell King** (G4VXD) writes from Ware with a problem which is affecting reception of slow scan TV pictures. Russell writes:

"I wrote my firsts slow scan TV receive program in 1987 for the Spectrum 48K. Most pictures obtained are spoilt by vertical shading bars. Looping is used to measure cycle (or half-cycle) lengths at the input. Unfortunately, the looping time seems to increase by 6 per cent during the Spectrum screen output to the TV — having spent so much time on this project, I am reluctant to give up now!"

Russell has provided me with a number of waveform sketches and the problem seems to be associated with the Spectrum video interrupt. Can anyone provide some further food for thought on this?

Next Month: *On Spec* will include a bumper crop of hints and tips for proud owners of the new MGT SAM Coupe. In the meantime, if you would like to receive a copy of our Update sheets, please drop me a line enclosing a large (250mm × 300mm) adequately stamped (currently 42p for UK postage) and addressed envelope. Please note that I am unable to provide individual replies to readers' queries. Instead, I will do my best to provide answers in future instalments of *On Spec*. Mike Tooley, Faculty of Technology, Brooklands College, Heath Road, Weybridge, Surrey, KT13 8TT.

NEWS

. . . from the world of electronics

EXPECTANT LASER CARDS

EXPECTANT mothers at a major London hospital are now getting the best possible ante-natal care under a trial there of British Telecom's personal medical record cards on which data is optically printed by laser.

This is the first trial in Europe of personal medical records based on optical memory cards. These credit-card-sized pieces of plastic can hold up to 800 pages of text or eight TV pictures. They can be carried easily in wallet or handbag.

Known as RecallCards, they contain all the relevant details of the prospective mother and child-to-be, to enable doctors and midwives at the hospital to track the pregnancy as it develops and thus ensure that they give the best possible care.

Each time the expectant mother attends the ante-natal clinic she hands the card to the midwife or doctor, who inserts it into a card reader attached to a BT M5200 personal computer. Data is displayed on the computer's TV monitor screen, showing pregnancy history, records of previous visits and the results of tests. New information available since the previous visit, or changes, would also be entered.

Technical Note

RecallCard is based on optical memory card technology licensed by BT from the Drexler Technology Corporation. The card is identical in size to a conventional credit card, but instead of a magnetic stripe, it contains a large optical storage area on which up to 2 Mbytes of data may be held in the form of tiny spots of low reflectivity. Data is written onto the card by a low-powered laser contained in the RecallCard drive, which interfaces to a personal computer and can also be used to read data from the card.

The storage mechanism is Write Once, Read Many Times (WORM). Once written, data cannot be erased, making the card ideal for applications where a permanent record of every entry is required, as for a medical record. A special directory structure allows records to be updated, but previous entries always remain on the card for reference if required.

MAPLIN MEGA STORE

MAPLIN RECENTLY officially opened their new warehouse in Wombwell, South Yorkshire. The little Yorkshire town now boasts one of the most up-to-date mail order processing warehouses in the country, together with over 100 new jobs for the area and plans to double that number.

To the odd "Hi De Hi" and "holes in the ground" jokes (the warehouse is on the site of an old mine) the official opening ceremony was performed by Mr. Terry Patchett MP on Monday, 11 December 1989.

The 85,000 sq.ft. warehouse boasts the third largest free standing mezzanine floor in Europe at 35,000 square feet and now houses all of Maplin's stock. It is linked by computer to Maplin's head office at Hadleigh where incoming orders are received and computerised.

Not content with the gradual and relentless expansion of their mail order business (Maplin have gone from three partners to over 240 full-time staff in 17 years of trading and now have an eight figure annual turnover) Maplin also plan to expand their retail outlets from the present 11 to 30 shops by 1993. It is a tribute to the Directors that in all their years of trading not one senior staff member (of which there are now 15) has left the company. Maplin say they have built up the company by providing quality products and first-class service, something which the new distribution set-up will allow them to continue to do.

Video to Combat CFCs

The North East Regional Electronics Centre (NEREC), base at Sunderland Poly, has been awarded £25,000 by the Department of Trade and Industry to make an educational video to combat the use of environmentally damaging chlorofluorocarbons (CFCs) in the electronics industry.

Large quantities of the damaging CFCs are used in the electronics industry to clean flux from printed circuit boards (p.c.b.s), and the new video will show how more environmentally friendly methods can be used. It will show companies how to assess their p.c.b. cleaning needs and will give step-by-step instructions on setting up a cleaning process which removes the flux from p.c.b.s effectively without damaging the environment.

John Whaley, Director of NEREC, said: "Many companies feel that they do not have the resources and expertise to set up a more environmentally friendly cleaning process. We hope that our video will reassure them and show that it is possible to run a profitable business without unnecessarily damaging the environment we live in".

The video will retail at around £115 when completed.

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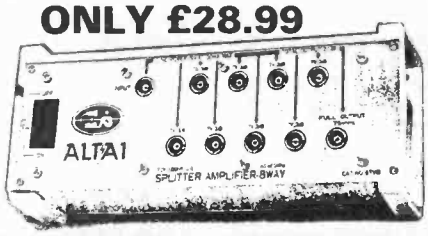

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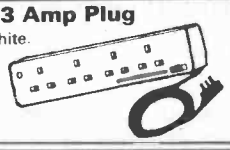

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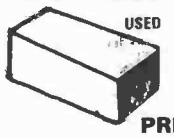

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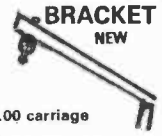

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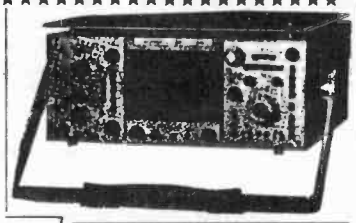

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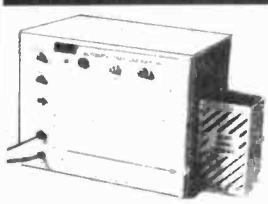

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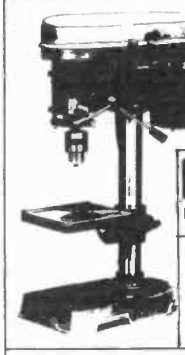

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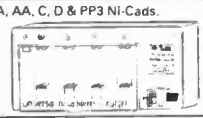

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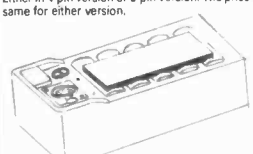

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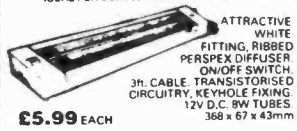

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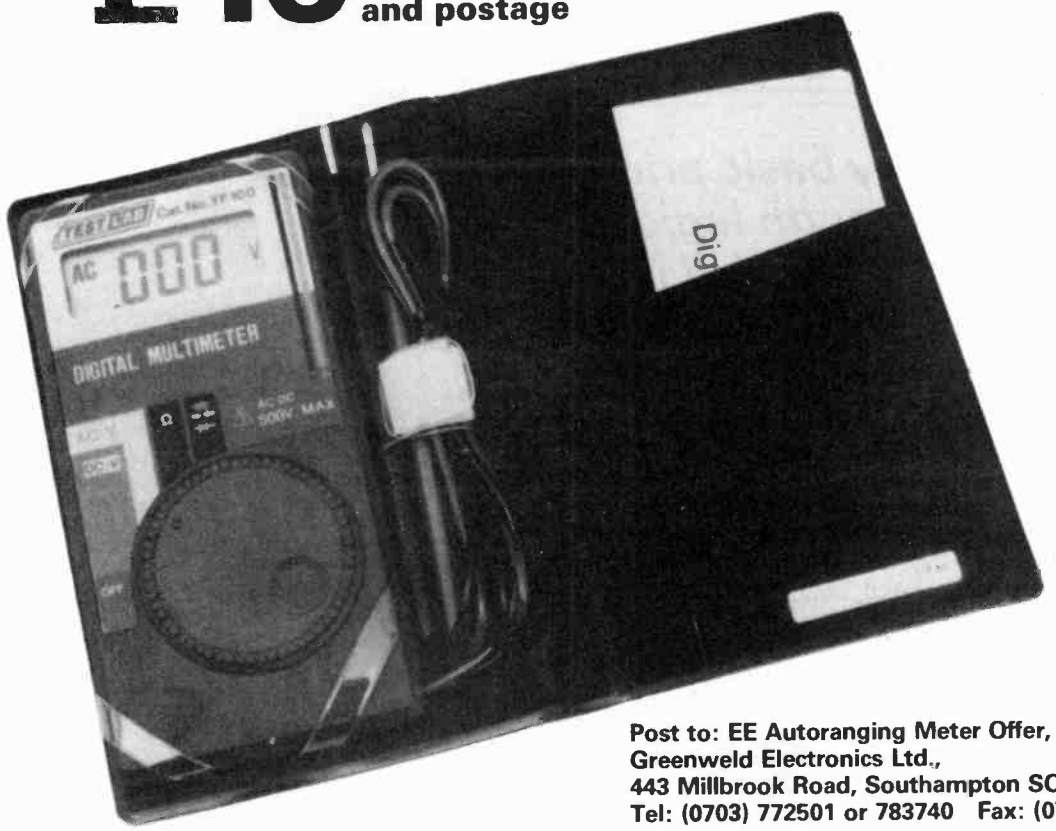

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HAVING discussed the basic operation of a transistor and an LDR **T** now reinforces the idea and moves on to talk about relays and logic.

EXERCISE 7 On and Off

T We have seen how a transistor can enable a small current to control a much larger current. This model may help to fix the idea in our minds (shows transistor action model (Fig. 3.1)). By reducing this very high resistance in the base circuit, I can allow a trickle of current to enter the base. You can just see the little lamp (B) glowing faintly.

But see the flood of current now going through the collector circuit. There are (counts) ... twenty lamps. Can you see how they are connected?

S *IN PARALLEL*

T ... in parallel, yes, so all their individual currents add up and join as they reach the collector. OK?

So half a lampsworth (agreed?) is controlling twenty lamps worth in this case. The CURRENT GAIN is ... what?

S *About forty.*

T Yes indeed. This is a so-called "power transistor" and is handling larger currents than the one on your bread board. In fact, the lamps are of the same type as yours. Both circuits are having a similar effect. What could we say that the electrical signals are being ... any offers again?

S *Amplified?*

T Exactly. The circuits can be called "amplifiers".

I can make the current large or small, and cause the lamps to dim or to be fully on or fully off. See?

S *Using a variable base resistor*

T Right, Sometimes, however, we're not interested in any "in-between" settings, only ON or OFF (changes quickly from on to off and back again a few times). Like a switch. So we can use the transistor as a switch OR as a variable control. Keep this in mind, for it illustrates two kinds of control approaches. Anyone guess what they are?

S *Analogue and Digital?/Logic and Linear?*

T You're both spot on. Both names are used.

We can regard our currents (and the corresponding voltages) as ELECTRICAL SIGNALS.

An ANALOGUE SIGNAL is one whose value can fluctuate between minimum and maximum thus (turns control slowly up and down), and represents some physical effect by analogy. It might be light level, or temperature, for example, as we've seen.

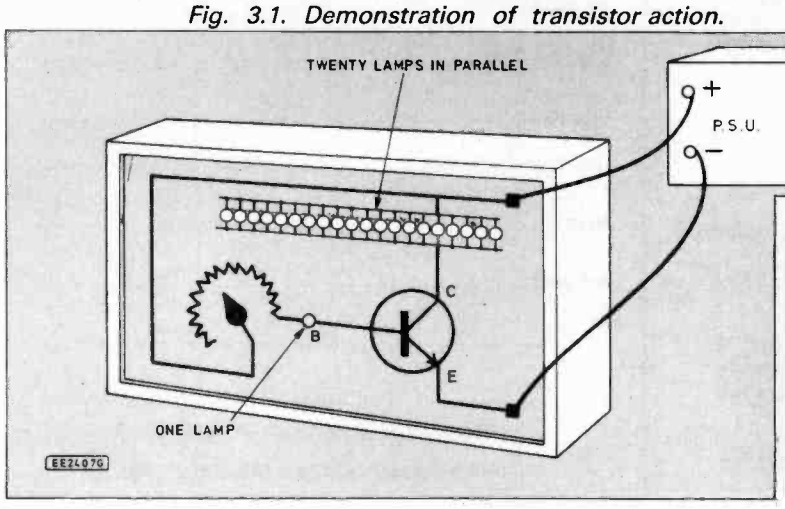
Systems whose OUTPUT corresponds to the input in this way are often called LINEAR circuits.

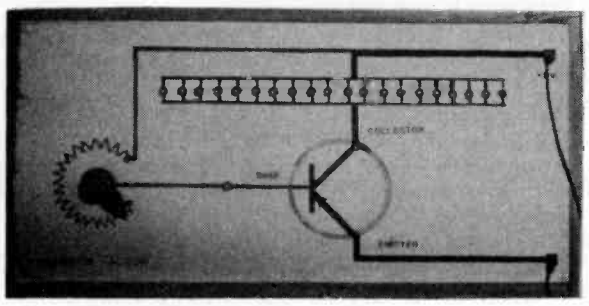
The other kind, also called a SWITCHING or DIGITAL circuit, is used only for ON/OFF applications, and in LOGIC systems, which we shall meet very soon.

S *Do they use binary numbers too?*

T Yes they often do. But now let's meet a useful, if slightly old-fashioned device, for which we shall be able to find plenty of applications. It's the "electromagnetic relay". Just a magnetically operated switch in fact. Here's a large one to have a look at (Fig. 3.2). We shall be using a smaller, neater version.

Fig. 3.1. Demonstration of transistor action.





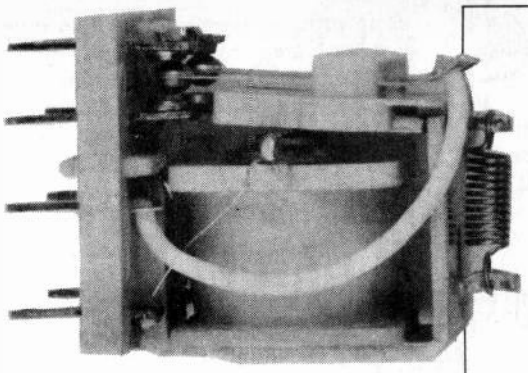


Photo of an open type relay

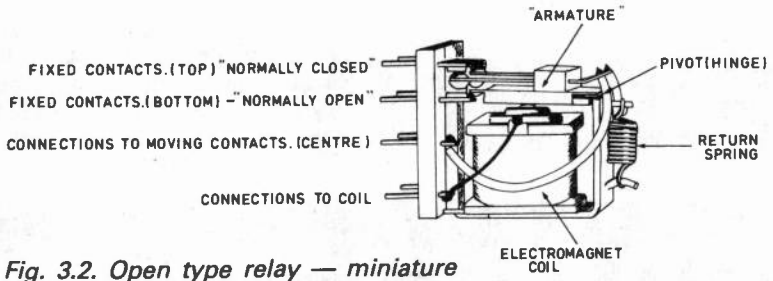


Fig. 3.2. Open type relay — miniature relays are usually enclosed.

You can think of it as a switch with contacts which are closed when this "armature" moves down under the pull of this electromagnet whenever current is sent through the coil wrapped round it (the iron piece is called the "core" or "yoke"). When the current ceases to flow, this spring pulls the armature back and the contacts open again.

S *Can they have more than just the two contacts?*

T Yes, in fact most relays have more, and some types have been made with a whole array of contacts. Sometimes the contacts are arranged as "NORMALLY OPEN", but they could just as easily be arranged "NORMALLY CLOSED" and are often made to "CHANGEOVER", to have a "TWO-WAY" action (Fig. 3.3). The ones we shall use are of this type. We can say they are "two pole, two-way" types. You'll spot them in the catalogues marked 2P2W.

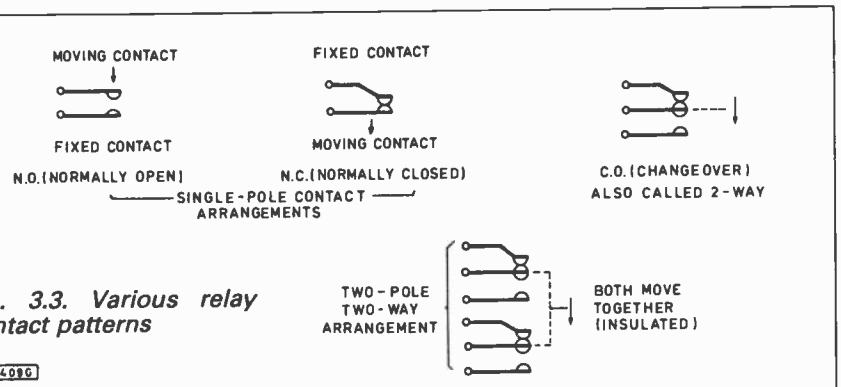


Fig. 3.3. Various relay contact patterns

The one in your kit is a miniature type which can be connected to the breadboard with connecting wires, or possibly plugged straight into the breadboard. Switch off, and carefully insert it so that the coil is in the collector circuit INSTEAD of the lamp (Fig. 3.4). Then see if the relay "clicks" as you make the current change by covering (completely) and uncovering the cell as before. Check your circuit carefully if necessary. These relays are designed for a 5 or 6 volt supply, so they should be OK in our 5 volt circuit.

S *Can I try connecting the coil straight across the 5V supply to make sure it works?*

T Sure, it's not a bad idea to check in this way.

Now put your breadboard to one side for a moment. I want to introduce something else. (shows small motor and battery). Will you just connect the motor to the battery to make sure they're both OK? Don't use the breadboard because I want you to be sure that this A SEPARATE CIRCUIT ENTIRELY. I know you COULD keep it separate on the board, but let's do it this way for now (Fig. 3.5).

By the way, can you check that reversing the battery makes the motor go the other way? Not all motors do, but these do.

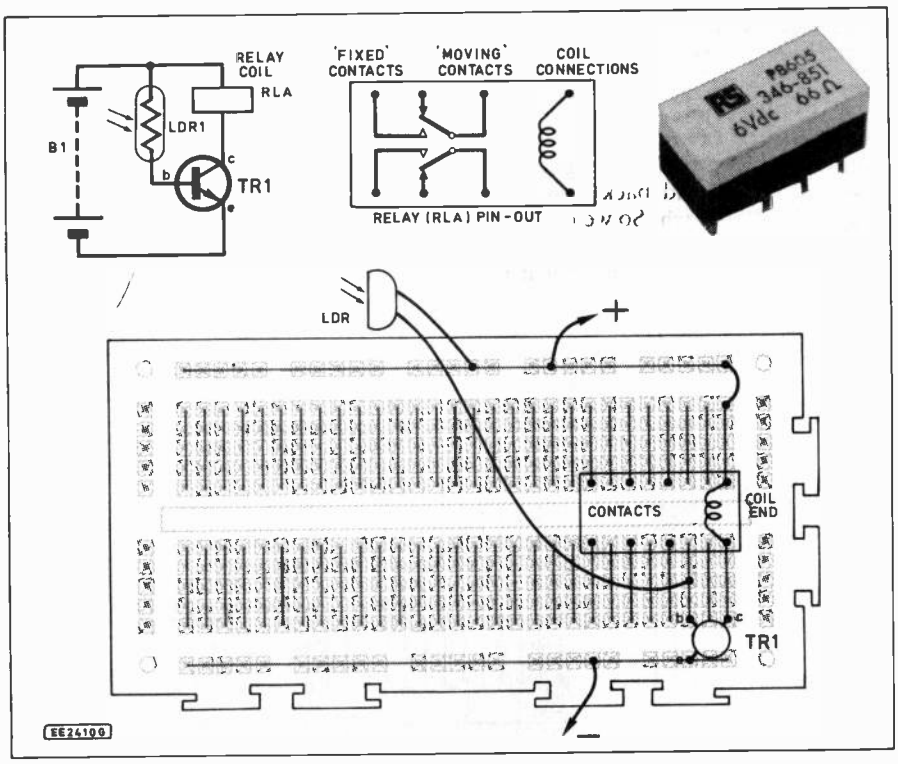


Fig. 3.4. Relay control using an LDR via a transistor

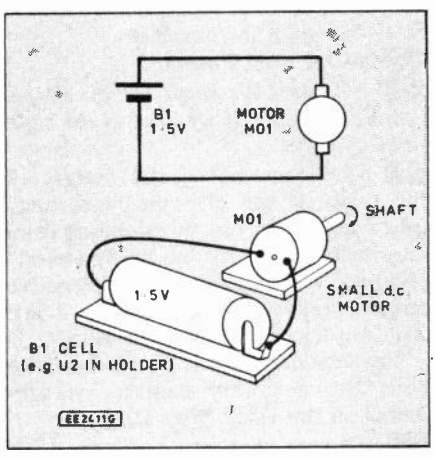


Fig. 3.5. Basic motor/battery circuit

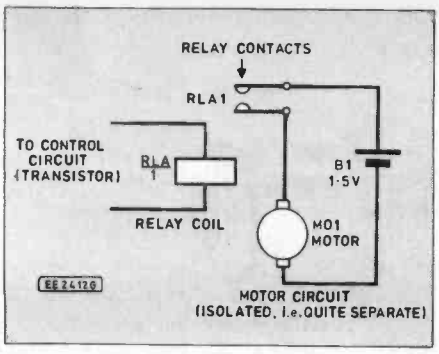


Fig. 3.6. Relay contacts included in the motor circuit

S *OK/All systems go/etc.*

T This type of motor is used in all kinds of models and toy vehicles, and a relay provides an easy way to make our transistor switch them in response to small electrical signals.

Can you see how the relay CONTACTS can now be included in the MOTOR circuit so as to do the switching? Yes, by putting the contacts in series with the motor and battery, as in this diagram (Fig. 3.6). Notice especially that the relay COIL forms part of the transistor CONTROL circuit, and is entirely separate from the motor circuit itself. They are not connected electrically in any way, and are "isolated" by the relay, (because its coil is insulated from its contacts). This is one of the great advantages of a relay.

S *Is this how an "opto-isolator" works?*

T Yes, in so far as it, too, isolates a "controlled" device from the "controlling" device. It does it by using light-sensitive devices, of course, not magnetic ones.

S *The relay also allows a small current to control a large one, doesn't it?*

T Right again, so we can see it can be very useful. Now we'll build up our system to arrange for the motor to run ONLY when light falls upon the LDR. We have all we need to do this, don't we? Try to sketch your own circuit idea first.

S *We can use the "parking light" arrangement, with the motor instead of the lamp.*

T It would be better to put the relay coil instead of the lamp, and allow the relay to switch the motor on.

S *That's what I meant.*

S *(another) We could use the simple "candle" circuit, if we choose the right relay contacts.*

T That's another useful feature of the relay. It can give the "inverting" effect we sought just by swopping from "normally open" to "normally closed" contacts. Here are the two alternative circuits you've thought up (Fig. 3.7a). You can try one of them out now.

The "candle" one is simpler and we have the necessary contact arrangements on this relay (Fig. 3.7b).

S *It's easy to make it work the other way round, just by changing the contacts.*

T Exactly. The extra contacts could also be used if we needed them, for example to operate an indicator light.

Incidentally, there's a point to be made now. Imagine that we left our circuit running with the cell exposed to daylight, so that the motor would stop when it got dark. Can you see the snag?

S *How dark/What about shadows, street lamps etc.?*

T Yes. And, as it gets darker, the current in the relay coil circuit (the collector circuit) will slowly diminish, and the relay contacts may release gradually, or even tremble between on and off for some time.

To avoid this, a special circuit is often used. We'll meet it later on. It has a special name, too, the "Schmitt trigger circuit", and it ensures that the transistor switches over from "on" to "off" (and back) almost instantaneously. This avoids the problem we just mentioned. Bear it in mind.

EXERCISE 8 "Answer yes or no"

T Now that we're looking at on/off type signals, we may as well take a look at the principles of logic, as used by electronic engineers, at least in their circuits.

Digital Logic circuits can be designed using principles which were laid down two or three centuries ago, by the philosophers and mathematicians of the day. However, these ideas have suddenly become important to many circuit designers, so let's sum them up as we proceed:

S *Are these circuit called "gates"?*

T Some of them are, because they can allow a signal through or they can stop it, as we'll see. But first, we'll list the THREE fundamental LOGIC FUNCTIONS, upon which the rest can all be built.

The first is simply the "NOT" function. The ideas of logic were built upon the TRUTH or FALSEHOOD of a STATEMENT, and the rules are designed to show how statements are related to each other. For example, if we have a statement 'A', and another statement 'Z', then they will be related by the NOT function if, when 'A' is TRUE, 'Z' is NOT true.

'A' might be: "It's raining" (which can be true or false), 'Z' might then be: "It's a fine day", (also could be true or false). We can then say:

Z equals NOT A.

This is the kind of relationship we deal with in logic, and it is sometimes useful to write it as above, like a kind of

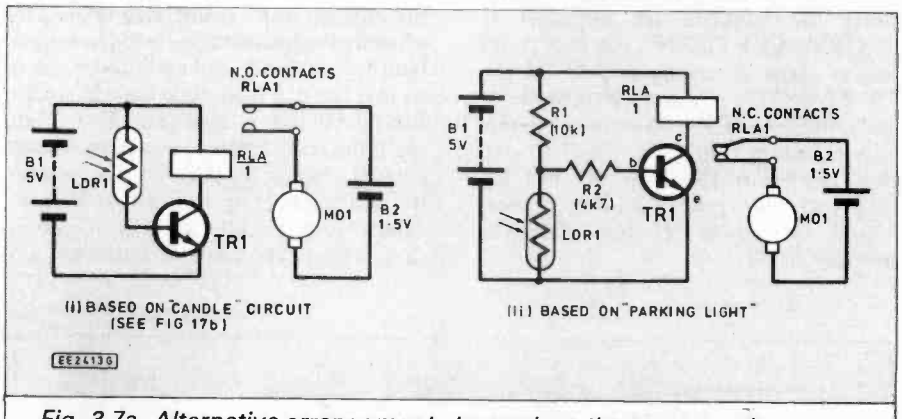
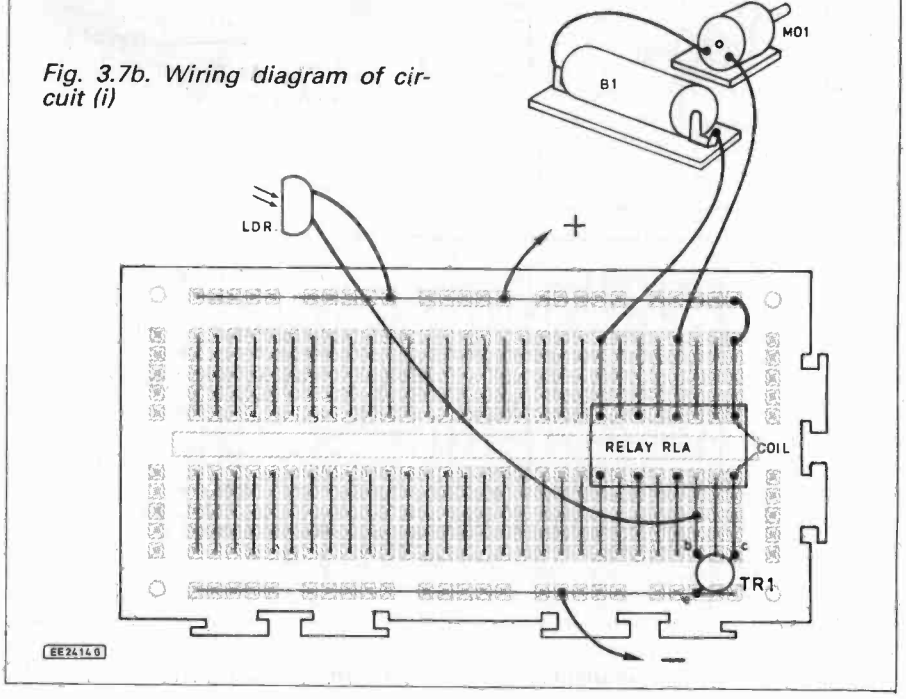


Fig. 3.7a. Alternative arrangements to produce the same result

Fig. 3.7b. Wiring diagram of circuit (i)



"equation". The "algebra" of logic was developed by George Boole over a century ago. It was first applied to circuit design in 1938 by C. E. Shannon, and "Boolean Algebra" is now part of the armoury of all logic circuit designers. We shall use it occasionally when it helps.

The above equation would be written thus in Boolean algebra:

$$Z = \overline{A}$$

Remember, it reads: "Z equals NOT A". (Or, more strictly: "Z is true if A is NOT true")

S *Is a "Truth Table" to do with all this?*

T It is indeed. It's yet another way of describing the action of a gate. What we do is simply draw up a table of ALL the possible inputs, then write alongside each one the corresponding output.

For the NOT circuit it's so trivial it's hardly worth writing, but we'll do it for completeness. Here it is:

TRUTH TABLE FOR 'NOT' FUNCTION

	Input A	Output Z	
These are the only possible input values	0	1	These are the only possible output values
	1	0	

Notice that, for this gate, there are only TWO possible input arrangements, TRUE or FALSE, so the table will have only two rows. Notice also that we have used, as most people do, the binary digits 0 and 1 to represent respectively FALSE and TRUE.

S *How can this relate to a circuit?*

T Well, if we accept that LOGIC circuits are strictly those in which signals are ON or OFF (no halfway stages allowed), then we could have a "NOT" circuit (sometimes called a NOT GATE) whose OUTPUT is always OFF when its INPUT is ON and vice versa.

It helps at this stage if we agree on the type of signal we're talking about. The "standard" type used in most circuits today is nominally 5 volts (hence our 5V supply).

In order to allow for variations, most logic devices are quite tolerant, and will regard any signal between about 2.5 volts and 5 volts as being "on" (i.e. 5V), and anything below about 0.5V as "off" (0V). So, in our circuits, the only "no man's land" is around the 1 to 2 volt range, and it's fairly easy to avoid these ambiguous values (Fig. 3.8). 6V is really too high for the chips we shall be using, as most of them are designed for a 5V supply.

Thus a "NOT" gate has just one input and one output lead. It is often shown in diagrams as a triangle (the usual symbol for an amplifier circuit) with a "ring in its nose". This ring or disc signifies the inverting ("not") action of the circuit (Fig. 3.9).

The second fundamental logic function is the "AND" function. In this case there is more than one "input" statement (or signal). We might, for example have two statements:

statement 'A' might be: "It's raining"
statement 'B' might be: "I am outside".

We could then relate to them a third statement 'X' which is:

"I'm getting wet".

Each of these could be TRUE or NOT TRUE (FALSE), but we can always relate them thus:

'X' will be true (and only if) 'A' is true and 'B' is true.

In Boolean Algebra: X = A.B (sometimes written X = AB).

In words, it reads:
"X equals A AND B"

S *I've heard of an "AND GATE".*

T Good. Here is the symbol for a "TWO-INPUT AND gate" (Fig. 3.10).

Finally, we have the "OR" function (and the OR gate). This can be illustrated by these statements:

statement 'A': "I'm standing in the rain" (not singing)
statement 'B': "Fred threw a bucket of water over me"
statement 'Y': "I'm wet" (again)

Clearly, 'Y' is true if 'A' is true OR if 'B' is true. OK?

S *Or if they're BOTH true.*

T Yes indeed. This is the "OR" relationship.

The symbol is also in the diagram (Fig. 3.10), and we can write in Boolean terms:

$$Y = A + B$$

which reads: "Y equals A OR B".

S *It looks like "A plus B".*

T It does, and in some ways it behaves (algebraically) like "A plus B", rather suprisingly, perhaps. But remember that the rules of this "algebra of logic" are not altogether the same as those of "proper" algebra, as we'll find out. But they do make sense, eventually.

These three, AND, OR and NOT, need to be understood, as they underpin all the circuits which follow.

Next month: More Logic.

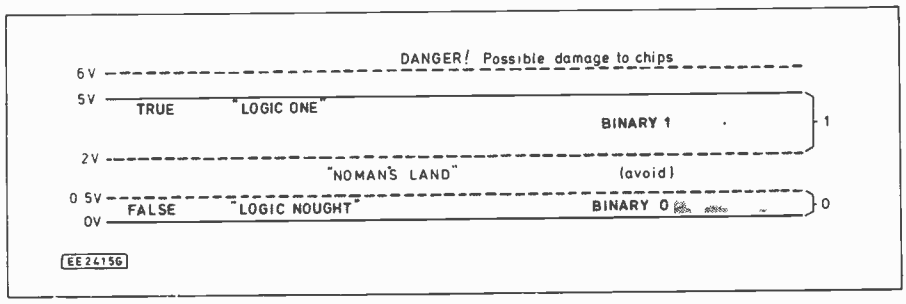


Fig. 3.8. Digital circuit voltages. Most circuits and chips are quite tolerant, fortunately.

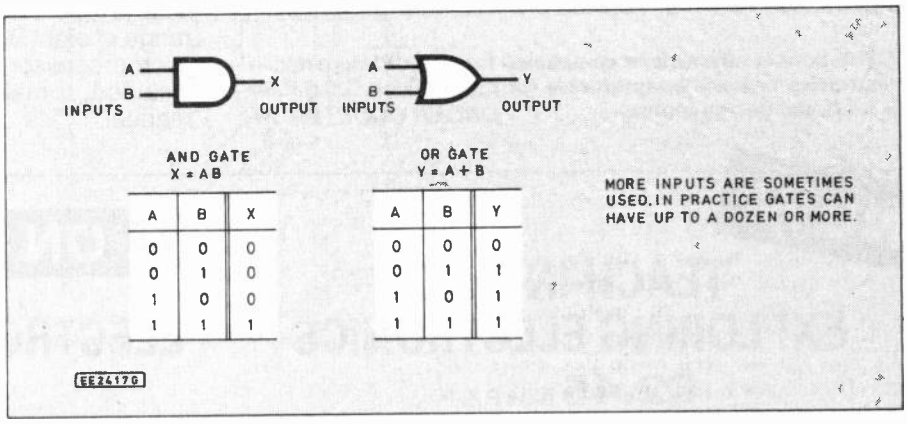


Fig. 3.10. The AND and OR basic functions and gates. Two-input types are shown.

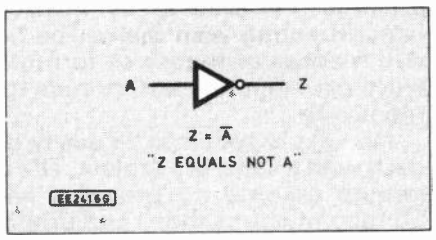


Fig. 3.9. The NOT gate, also called an INVERTER

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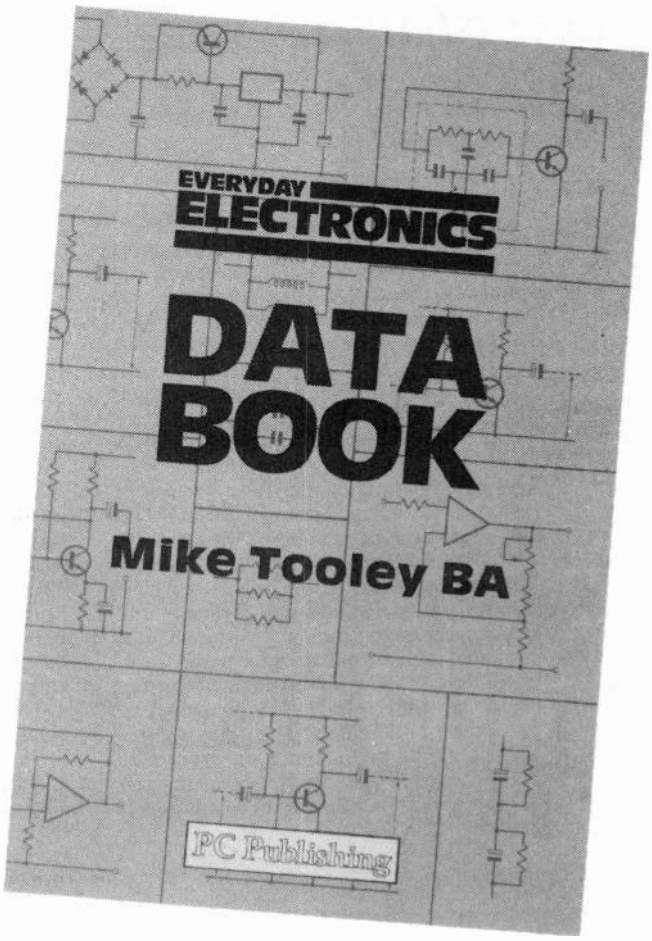

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FALSE ALARM

T. R. de VAUX-BALBIRNIE

Deter the casual car thief at minimum cost

MANY CIRCUITS have been published for car alarms. These range from the extremely simple to sophisticated (and expensive) systems. Motor accessory shops also sell a bewildering array of such devices—again, over the full range of price and complexity.

However, many cars are stolen by casual and opportunist thieves. If these can be deterred they will move on and try their luck elsewhere. It follows that a real alarm is not required at all—just some electronic "mystery box" which will confuse the would-be thief. If used with a well made alarm warning sticker in the windscreen, the car is unlikely to be touched.

Professional thieves are a different matter and are not so easily deterred. They will have a full knowledge of current alarm systems and how to disarm them. Readers with expensive and particularly desirable cars will need to seek professional advice on matters of security.

One of the problems with car alarms is that owners often do not bother to arm them when leaving the vehicle for short periods. Perhaps they once suffered the embarrassment of a false triggering and have never used the alarm again.

This is foolish since the opportunist thief is always on the prowl. The False Alarm described here operates whenever the ignition is switched off so no action need be taken to arm or disarm it. False triggering is impossible, current consumption negligible and constructional costs a fraction of that of a real alarm. Although normally left on, a switch is fitted to allow the circuit to be switched off when the car is garaged.

The False Alarm is built into a small plastic box attached on or beneath the dashboard in a prominent position. This is mounted with the narrow edge to the front. Two l.e.d.s appear on this edge. One is red and in operation flashes briefly every two seconds approximately. The other is green and lights for two seconds on every fifth flash of the red one. This gives the impression that an armed alarm—of an unfamiliar pattern—is being used.

CIRCUIT DESCRIPTION

The circuit diagram for the False Alarm is shown in Fig. 1. IC1 is a C-MOS timer configured as an astable multivibrator. With switch S1 (On-Off) on, a supply is established from the car battery and a continuous train of pulses is delivered from its output, pin three.

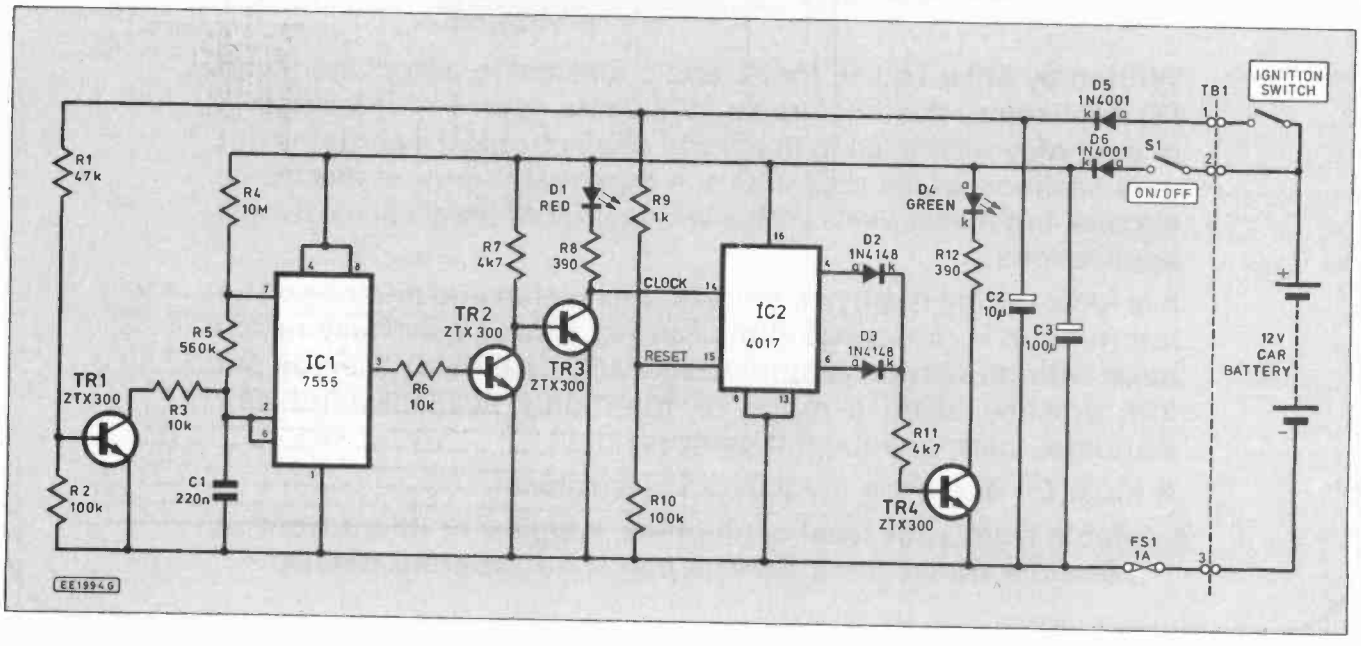
The frequency of these pulses depends on the values of resistors R4, R5 and capacitor C1. With the values specified, this will be one every two seconds approximately. No adjustment is provided here since the exact timings are unimportant.

The output pulses are of long duration with short spaces between (large mark-to-space ratio), see Fig. 2. However, in this application, it is better to have short on states (small mark-to-space ratio).

This is achieved by transistors TR2 and TR3 together with associated components in the following way. With the arrival of a pulse from IC1 pin three, transistor TR2 base goes high (positive supply voltage) with current entering through resistor R6. This turns on transistor TR2 with collector current flowing through resistor R7.

The collector of TR2 is thus made low and this low state is applied to transistor TR3 base. TR3 is therefore off and with it the red l.e.d., D1, in the collector circuit.

Fig.1. Complete circuit diagram for the False Alarm "break-in" deterrent.



The operating current of D1 is limited to the correct working value by resistor R8.

In the periods between pulses, TR2 base is no longer driven so this transistor remains off and no collector current flows. The collector is therefore high. Transistor TR3 now turns on with base current entering via resistor R7 and D1 illuminates.

In this way, the pulses delivered by IC1 have been inverted—they are off for a longer time than they are on. D1 therefore gives brief flashes of light which attract attention well and also save power. Note that a high brightness l.e.d. is specified for D1—this gives a better effect than a standard one.

As well as operating D1 in the manner described above, the pulses from TR3 collector clock IC2, a C-MOS decade counter i.c. This device has 10 outputs called 0 to 9 and on the arrival of pulses to the clock input, pin 14, each output goes high in turn.

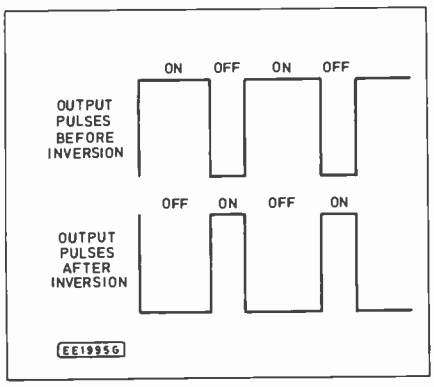


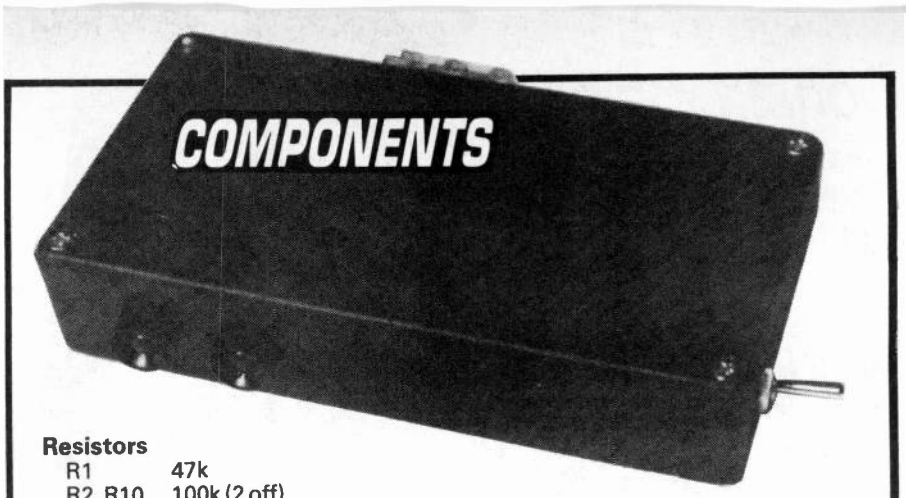
Fig. 2. Output pulses from the timer before and after inversion.

In this application, however, only two outputs are used—No. 2 and No. 7 (pins four and six respectively). When either of these is high, current flows through diodes D2 or D3 as appropriate and transistor TR4 turns on. This operates the green l.e.d. D4, via current-limiting resistor, R12. The effect is to operate D4 on each 5th flash of l.e.d. D1.

With the vehicle ignition switched on, the circuit is de-activated. This happens because a supply is now established to transistor TR1 base through resistor R1 so making the collector low. This keeps IC1 pins two and six low also and prevents capacitor C1 from charging. IC1 output, pin three, is thus kept high continuously. When this high state is inverted by transistors TR2 and TR3, D1 remains off and no pulses are delivered to IC2 pin 14 (clock input).

With the ignition off, transistor TR1 base is kept low via resistor R2. If the ignition were to be switched off while IC2 output two or seven was on, D4 would operate continuously. To prevent this, IC2 is disabled by making the reset input, pin 15, high through resistor R9. Note that pin 15 is normally kept low through resistor R10 allowing the i.c. to operate.

It is necessary to smooth the "noisy" output from the car generating system as this could cause false operation. This is the purpose of diodes D6 (for the direct positive feed to the circuit) and D5 (for the feed via the ignition switch) in conjunction with capacitors C3 and C2 respectively. The fuse, FS1, is incorporated in the *negative* battery wire to provide protection on both supply inputs—that is, direct from the car battery and through the ignition switch.



COMPONENTS

Resistors

R1	47k
R2, R10	100k (2 off)
R3, R6	10k (2off)
R4	10M
R5	560k
R7, R11	4k7 (2 off)
R8, R12	390 (2 off)
R9	1k

All 0.25W 5% carbon

Capacitors

C1	220n
C2	10μ radial elec. 16V
C3	100μ radial elec. 16V

Semiconductors

TR1, TR2, TR3, TR4	ZTX300 *npn* silicon
D1	5mm red high-brightness l.e.d.
D2, D3	1N4148
D4	5mm green l.e.d.
D5, D6	1N4001
IC1	ICM 7555 CMOS timer
IC2	4017BE CMOS decade counter

Miscellaneous

S1	Min. toggle switch with 1A "make contacts"
TB1	Three-way 3A terminal block
FS1	20mm chassis fuse holder and 1A fuse to fit

Stripboard, 0.1in. matrix size 12 strips×38 holes; ABS plastic case, size 107mm×53×18mm; small fixings; 3A auto-type wire and connectors; solder etc.

Approx. cost Guidance only **£10**

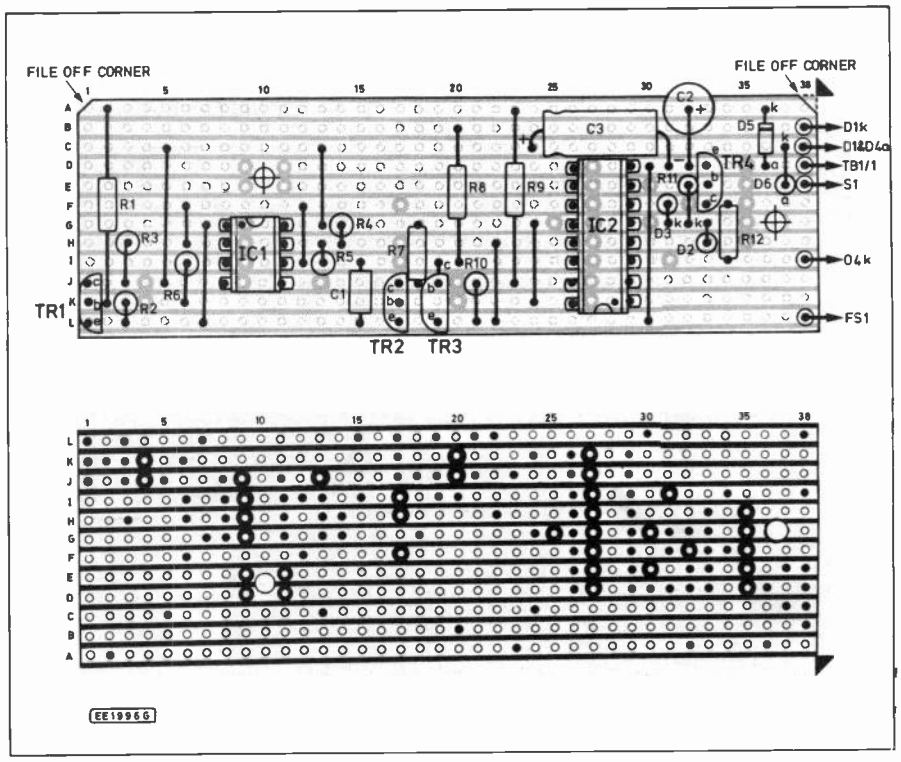
CONSTRUCTION

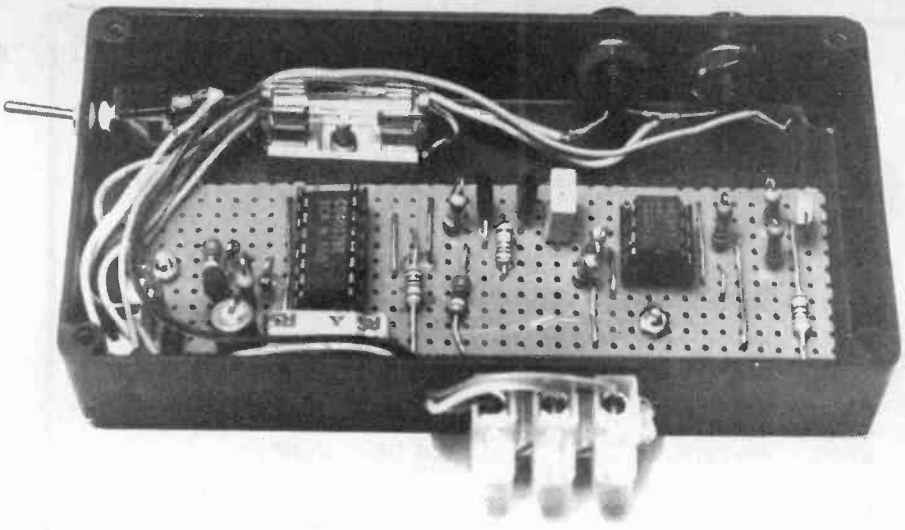
The component layout and underside details of the circuit board used in the prototype unit is shown in Fig. 3. This uses a piece of 0.1in. matrix stripboard, size 12 strips×38 holes.

Begin construction by cutting the board to size and drilling the two mounting holes. Follow with the inter-strip link wires and breaks in the copper tracks as indicated. File off the corners at strip A to enable the panel to locate in the plastic box. Make a careful check for any errors—particularly for accidental "bridging" of adjacent copper tracks.

Solder all on-board components into position taking care over the polarity of the diodes and capacitors C2 and C3—do not

Fig. 3. Component layout and underside details of breaks in copper strips.





Completed unit showing positioning of components within the plastics case. All wiring should be at least 3A rated auto-type cable.

insert the i.c.'s themselves into their sockets until the end of construction, however. Solder 12cm pieces of light-duty stranded connecting wire to copper strips B, C, D, E, I and L on the right-hand side of the panel.

PREPARING THE CASE

It is important to remember that the desired effect will be obtained only if the finished project has a "professional" appearance. To this end, the case should be chosen with care. The one used in the prototype had a crackle effect rather than a glossy black finish.

The l.e.d.'s were mounted on the narrow edge of the case (see photograph) with the switch on the side and the three-way terminal block TB1 on the rear. Although l.e.d. indicators are specified in the parts list, ordinary 5mm l.e.d.s could be used but they should be mounted using l.e.d. clips. Pushing them through holes in the front panel without such clips will give a poor appearance.

Drill holes in the case for circuit board mounting, l.e.d.s, on-off switch, fuse and terminal block. Drill a small hole for the wires passing through the box to the three-way terminal block, TB1. Secure the circuit panel and remaioning components.

Refer to Fig. 4 and complete the internal wiring noting the polarity of the l.e.ds. Insert the fuse and, finally, place the i.c's into their holders—since these are CMOS devices and therefore vulnerable to damage by static charge, this should be done without touching the pins. Note that IC2 is "upside down" compared with IC1.

TESTING AND INSTALLATION

Before making external connections, disconnect and remove the car battery. Note that all wiring must be done with light-duty auto-type cable of 3A rating minimum. Also, any connectors used must be of a proper automotive pattern—taped joints are unsuitable. If any wire passes through a hole in metal, a rubber grommet must be used.

Find a suitable position on the dashboard for the unit and make the terminal block connections. Locate the fusebox. Connect TB1/2 to a fuse which is live all the time and TB1/1 to a fuse which is live only while the ignition is on. Connect TB1/3 to an earth point (car chassis "negative earth"). Note that the fuse connections should be made on the outlet side of the fuse. Attach the box in position using adhesive fixing pads or a small bracket.

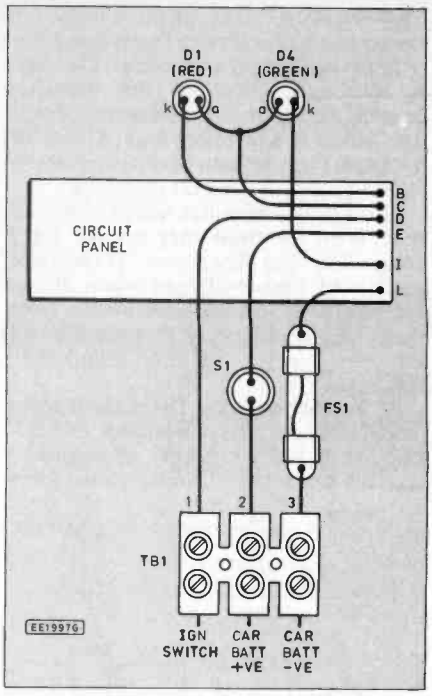


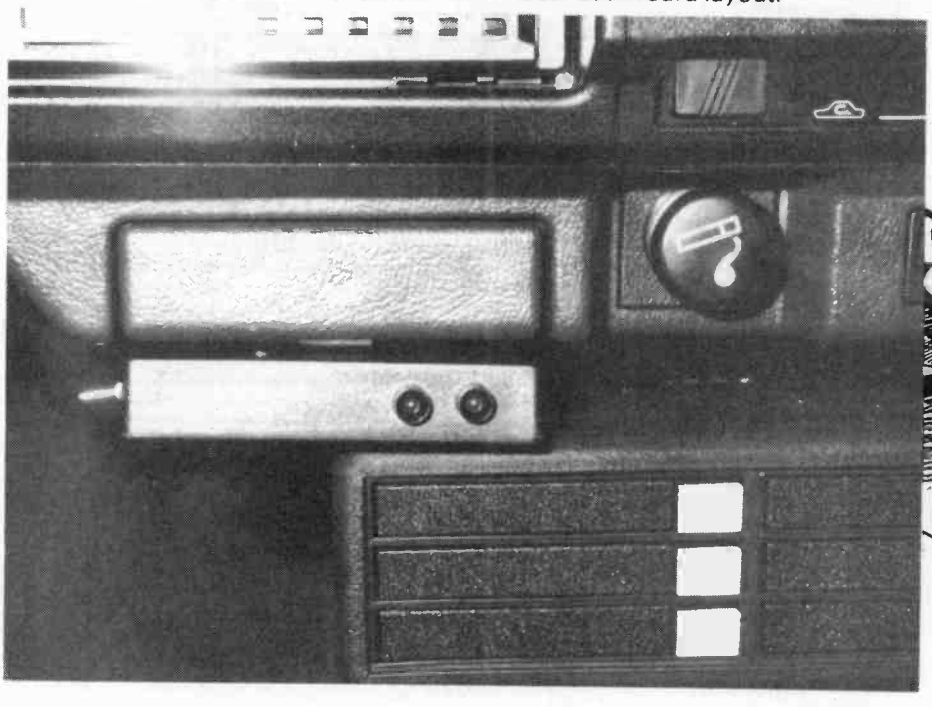
Fig. 4. Interwiring from the circuit board to the case mounted components.

Re-connect the car battery and check operation of the unit. Switch on S1, after a brief delay and, possibly, a few seconds of erratic behaviour the red l.e.d. should flash at approximately two second intervals and the green one periodically for two seconds. Switch on the ignition, the l.e.ds should go off.

It only remains to buy or make a windscreen sticker and leave the unit to do its job. When the car is parked in a secure place, S1 may be switched off to minimise current consumption. However, the circuit could operate continuously for several weeks from a well-charged car battery.

Keep thieves at bay with the False Alarm! □

Blending the False Alarm in with the car dashboard layout.



FOR YOUR ENTERTAINMENT

BY BARRY FOX

New S-type for Dolby

Dolby Laboratories believe that the first audio cassette recorders using the new S-type noise reduction system will be unveiled at the *Consumer Electronics Show* to be held in Las Vegas this month (January). In a typically guarded manner — Dolby have always steered clear of hype — Dolby claims that S-type can give digital sound quality from analogue cassettes.

First demonstrations of the system given to the manufacturers of cassette recorders and cassette tapes in Tokyo (October 30/31) and London (November 6) justify this claim. Even on high quality reproduction equipment (Quad power amp and B and W speakers) in George Martin's Air Studios, it was well nigh impossible to tell the difference between direct CD replay and off-tape monitoring. Even more important, the demonstration backed Dolby's claim that the system is compatible with existing tape recorders.

Justification of the compatibility claim is vital to Dolby's sales pitch for S-type. The Dolby B-type noise reduction system has now become the de facto standard for domestic cassette recorders and pre-recorded musicassette tapes.

More than 270 million cassette recorders with B-type noise reduction have been manufactured, and virtually all pre-recorded musicassette tapes sold by the record companies use the system. It would be suicidal for a record company now to sell tapes with a new system that would play back only on a new type of recorder.

Domestic level

Dolby-S is a domestic version of the professional studio system called Spectral Recording, SR, which Dolby introduced in 1986. Like all previous Dolby systems (the original A-type professional, and both domestic B and domestic C), it monitors the music being recorded and artificially increases the level of weak signals.

On replay, a mirror circuit reduces their level again. In the process, any unwanted background noise, such as hiss from tape or hum from electronic circuitry, is reduced.

Dolby-B reduces the noise of hiss by 10dB, which makes it sound half as loud to the human ear. The record industry embraced the system, because tapes recorded in Dolby-B still sound good on cassette recorders without any Dolby circuitry — of which around 750 million have now been made.

The Dolby-C system, introduced ten years ago, reduces hiss more dramatically (by around 20dB) and is used by hifi buffs to make home recordings. But C-type has not been adopted by the record industry for musicassettes because tapes recorded in C-type do not sound good when played on recorders without C-type circuitry.

The new S-type system gives 24dB noise reduction at high frequencies and 10dB at low frequencies. When a tape is replayed on a recorder with S-type circuitry, background hiss and hum is completely inaudible. Dolby Vice-President Ed Schummer, says the performance of analogue cassettes with S-type is "equivalent to digital media under home listening conditions".

Limiting Factor

"The limiting factor" says inventor Ray Dolby "is now the source material".

The key concept is that the S-type encoder monitors the sound over a wide band of frequencies and only doctors the signal at those frequencies where it is weak and needs help. Where the signal is stronger, at other frequencies, it is left untouched. Inventor Ray Dolby describes this as the "principle of least treatment".

Professional SR relies on ten stages of signal processing, six acting on high frequencies and four on low frequencies. Domestic S-type has five stages, one acting on low frequencies, two working on a fixed band of high frequencies and two working on variable bands of high frequency.

Going public

Dolby has already proved that SR is compatible, by using it for feature films which are shown in all cinemas, only a few of which have SR reproduction equipment. After unannounced trials, the film industry decided that the public did not notice any difference when SR tracks were played in non-Dolby cinemas. Now Dolby has to convince the record companies that they can safely start releasing musicassettes in S-type for the public to play back on any kind of recorder.

To prove the point Ed Schummer made recordings in S-type from CD using a modified Pioneer cassette deck. He then replayed them (by monitoring off-tape during recording) while switching between S-decoding, B-decoding, C-decoding and no decoding at all, without telling people what they were hearing.

In the worst case situation, an S-type recording was played back through a hi fi system without any Dolby decoder (which is in practice comparable to listening through headphones to S-type tapes played on a portable stereo without any Dolby circuitry), the result was suprisingly acceptable. The sound is compressed, so that quiet passages are artificially made louder, like a piano with the sustaining pedal on. But there is none of the nasty "pumping" sound heard when recordings made using the similarly powerful dbx system are played back without a decoder.

Although Dolby does not recommend this extreme case of missmatch, it may even be an advantage, for instance in a car where there is a constant drone of loud background noise which drowns quiet musical subtleties.

There is similar, but less exaggerated, compression when S-type recordings are played back on B-type equipment, but barely any discernible effect on C-type playback. On S-type equipment, the sound of course suffers no modification, other than the absence of unwanted noise.

The Chips are Down

Sony has been working with Dolby on the design of integrated circuits. The first chips set needed six i.c.s. This has now been reduced to three. The three-chip set is ready and Dolby is incorporating them on prototype S-type circuit boards which have already been sent out to cassette recorder manufacturers for evaluation.

This should mean that production "demonstration" prototypes are up and running and ready for showing at this month's (January) *CES* Las Vegas Show. There is no professional S-type encoder yet, for musicassette duplicators to test.

"People are feverishly working on circuit boards back in San Francisco, even as I speak", said Schummer. "We do not yet have enough demonstration boards for everyone who wants one".

If the music industry adopts the system, Schummer believes that mass production of musicassettes can start in mid-1990. Sony is already working on a single chip version of S-type. Schummer quotes "Spring 1990" for delivery.

The first chip sets need 10 volts to operate, which makes them difficult to incorporate in portable units. It took six years to produce a low voltage version of the C-type circuit, which is why portable stereos with C-type have only become available over the last two years. A single, low voltage chip for S-type is thus several years away.

Portables will need circuits which raise the voltage (and draw more power from the batteries). The single chip i.c. will have at least 48 pins, meaning that it cannot be used as a plug-in replacement to fit on existing circuit boards.

Schummer says there has been "interest from everyone — both hardware and software companies, but we cannot make any positive announcement on commitment until they do". Sony has however nailed colours to the flag by developing the chips and Pioneer by developing a prototype player.

Schummer believes B-type will go on "probably for ever", but there is clearly less confidence in the future of C-type, if S-type takes off.

Licencing

Manufacturers taking a licence to manufacture S-type recorders will pay nothing extra in royalty fees but will have to meet new, higher standards for decks incorporating S-type. Schummer admits that "the most difficult job is to agree a standard for azimuth — how to measure it, where to measure it — on the pancake, or in the finished cassette shell?"

The existing extra licence, which allows use of Dolby circuitry and — most important — use of the Dolby trademark, is indexed to the cost of living but currently varies between 25 cents per channel for high volume producers and $1 for low volume.

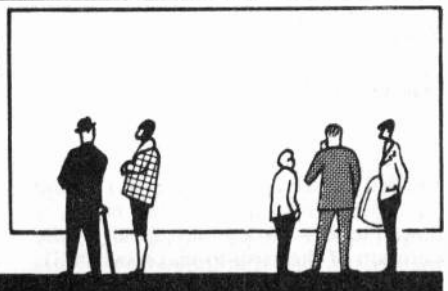
Schummer quotes the likely price of the three i.c. S-type chip set at between three and five times the cost of C-type, and the likely cost of the single i.c. as between two or three times C-type. A dozen manufacturers already manufacture Dolby i.c.s of B/C-type including Hitachi, NEC, Toshiba, National, Signetics and Matsushita, at a ballpark price of around 1000 yen (£4).

Although Dolby has given private demonstrations to duplicators in the US, no full scale trade or press launch is planned because there are no native cassette deck manufacturers. The European launch, in London, was staged a week after five presentations in Tokyo, each to around 45 Japanese manufacturers and press. Dolby saw the European launch as important, because there are several licensed manufacturers in Europe, for instance Philips, Nokia, Bang and Olufsen and Studer.

Ray Dolby is refreshingly pragmatic about the future, compared with the bull approach so often adapted by many major manufacturers ("This is what *will* happen ...").

"No-one really knows what will happen when you launch a new system", says Ray Dolby. "All you can do is have a hunch, give it a good try and see what happens".

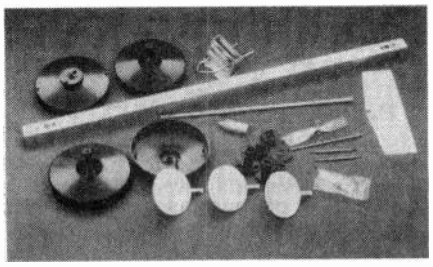
SHOP TALK



BY DAVID BARRINGTON

Catalogue Received

On receiving the latest 1990 **Maplin** catalogue, and thumbing through 570-odd pages, we found it contains some good news and some bad. Even so, it is still one of the best, if not the best electronic components catalogues on the market today and is well worth spending £2.25 (plus postage — 50p UK, £4 overseas) for a copy.



The good news is that new products can be found throughout the 30 major sections. The communications section has been increased by one third and includes a range of Mobile transceivers. Also of special interest to any would be constructors of the *EE Weather Station* is a hardware kit (code LM90X (wind hardware kit) £34.95) for a wind speed and direction indicator housing that will be ideal for housing the circuits published in this issue of EE.

The bad news! In our opinion, the most important and used semiconductor listing section has been set so small that it is very difficult to read and can be easily misinterpreted.

In Brief

We hear that after trading for over 25 years in Hertfordshire, making them one of the longest trading electronics companies, **BiPak** are now operating from Southampton offering the same value-for-money packs at even lower prices!

The new 1990 Catalogue, which is available free on request, is claimed to contain details of hundreds of BiPak bargains. Just ring 0703 231003, Fax 0703 787 or write to **BiPak, PO Box 267, Southampton, SO9 7XW** for your free copy!

The excellent **Crotech** oscilloscope "special offer" has been extended by one month. This offer covers their Testation 4445, 3133 25MHz dual-trace and the 3031 single-trace scopes. Ring 0480 301818 for prices or see last month's issue.

CONSTRUCTIONAL PROJECTS

Prophet In-Car Air Ioniser

The high voltages present in the *Prophet In-Car Air Ioniser* make it important that only good quality components are used throughout this project. This applies particularly to the high voltage capacitors and diodes.

The small ferrite pot-core, type RM7/250, could prove to be very difficult to locate locally. The one used in our model was purchased from **Semiconductor Specialists.**

For those readers who may experience problems in obtaining all the parts for this project, a complete kit. (£21.39), plus details of additional "experiments" using the ioniser, may be purchased from **Specialist Semiconductors, Dept EE, Room 111, Founders House, Redbrook, Monmouth, Gwent.** Add £1.15 for UK p&p, and £5 overseas (deduct VAT).

The small, single-sided, printed circuit board is available from the *EE PCB Service*, code EE676 (see page 144).

EE Weather Station

One or two problems could be thrown up when sourcing components for the *EE Weather Station*. The slotted opto-switch used in the Anemometer head is the standard type and *not* the version with an integral Schmitt trigger.

The standard version should be available from most component suppliers. However in case of difficulty, it is currently listed by **Electromail *(☎ 0536 204555)***, order code 306-061.

The 10-segment bargraph Module used in the Anemometer display is also listed by Electromail, code 304-611. For those readers who wish to construct the display from separate components, the LM3914 i.c. is currently listed by most semiconductor suppliers.

Having searched high and low for a source of the OP160 infra red l.e.d. and the OP500 phototransistor, we referred back to the designer who informs us they were purchased from **Rapid Electronics.** However, although we have not tried them in the model, we feel sure that the TIL78 infra red l.e.d. and the TIL32 phototransistor will do the job here. These two devices are fairly common and most semiconductor suppliers should carry stocks.

The only source we have found for the 7444 3-bit Gray to decimal decoder is **Cricklewood Electronics *(☎ 01-452 0161)***.

The five printed circuit boards, required for this installment of the Weather Station, are available from the *EE PCB Service*, see page 144 for prices.

Quick Cap Tester

We do not expect any component purchasing problems to arise for readers undertaking the construction of the *Quick Cap Tester*. The low power solid-state buzzer is now stocked by most of our advertisers.

A complete kit of parts (£9.69), including p.c.b., may be purchased from **Magenta Electronics, Dept EE, 135 Hunter Street, Burton on Trent, Staffs, DE14 2ST.** Add £1 for p&p per order.

The "touch pad" printed circuit board is obtainable from the *EE PCB Service*, code EE668 (see page 144).

Tune Generator

The only component called for in the *Tune Generator*, this month's Easiwire "pocket money" project, that we feel readers will have some difficulty locating is the pre-programmed melody i.c. type UM66. This appears to be only available from **Maplin** and comes in four versions.

The melodies available are numbered from one to four and are as follows: 1-Christmas melodies; 2-birthday; 3-wedding march and 4-Elvis' Love Me Tender. When ordering it is most important to quote the suffix number, i.e. UM66/**3** (wedding march).

The Easiwire matrix board is now stocked by quite a few of our advertisers and readers should have little difficulty sourcing the wiring connectors or pen. For details of local stockists readers can contact **BICC-Vero *(☎ 0489 788774)*** direct.

False Alarm

We cannot foresee any component buying problems for readers wishing to build the *False Alarm* project. However, it is ***most important*** to use only correctly rated auto-type wires and connector where specified.

Prior to installing the unit in the car, it is advisable to disconnect the car battery. When installed the wiring should be double-checked "before" reconnecting the battery.

Easiwire/Pocket Money Project

TUNE GENERATOR

CHRIS BOWES

A very simple "fun" circuit that can be used as a warning output for many projects

THIS is a novelty project making use of a special integrated circuit, of the type used in greeting cards, which has all of the necessary circuitry to produce a pre-programmed tune. It may be used in its own right as described in this article, or may be incorporated with one of the sensor circuits from this series so that the tune may be played automatically when a certain set of conditions arises.

HOW IT WORKS

The basis of this very simple circuit is a UM66 integrated circuit, which in fact looks like a small signal transistor. There are in fact four versions of this device available, each one producing a different tune or set of tunes. The integrated circuit contains all of the tone generating circuits plus the pre-programmed sequence necessary to generate the tune already built into it.

As soon as power is applied to the positive and negative inputs of the UM66 then the tune generating circuit starts and the tune is fed to the output of the i.c. This output is sufficiently large to drive a small piezo transducer but the sound produced is somewhat "tinny". A very simple emitter follower amplifier has therefore been incorporated into this project so that the i.c. can drive a loudspeaker.

CIRCUIT DESCRIPTION

The circuit diagram for the Tune Generator is shown in Fig. 1, IC1 is the UM66 tune generator integrated circuit. When power is applied to pins 2 (+ ve.) and 3 (−ve), the tune generator starts to operate and an output, corresponding to the tune pre-programmed into the circuit is provided at the output (pin 1).

In order to produce an adequate level of sound the output from pin 1 of IC1 is fed to a simple emitter follower amplifier comprising TR1, R1, R2 and LS1. This causes the loudspeaker to output the tones generated by IC1. R2 and R1 are protection resistors included into the emitter follower circuit to restrict the flow of current through the transistor and loudspeaker to safe values.

This project, unlike most of the other circuits in the *Pocket Money Projects* series, uses a supply of only three volts, provided by two 1.5 volt batteries (B1 and B2). The current to drive the circuit is allowed to flow through the circuit by the operation of the push-to-make switch S1. In this circuit S1 is placed in a somewhat unusual arrangement, by being connected between the two battery holders.

This arrangement was chosen because the battery holders used for the prototype were supplied with flying leads and the positioning of S1 between the two batteries, made for ease of wiring when constructing the circuit. If other arrangements are required there is no reason why S1 cannot be fitted in any convenient place in the battery supply circuit.

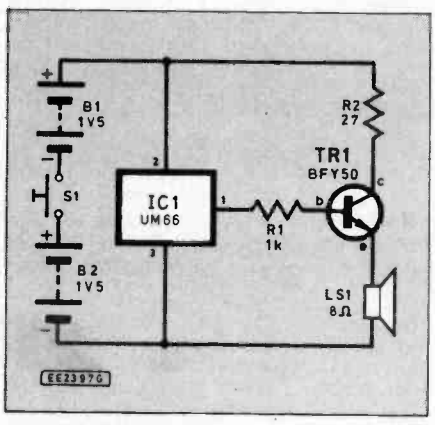


Fig. 1. Complete circuit diagram for the Tune Generator.

CONSTRUCTION

This circuit has been designed to be constructed using the Easiwire board supplied on the front of the Dec '89 issue. The board needs first of all to be cut to the correct size to accommodate the components. The layout shown in Fig. 2, was designed to use a piece of Easiwire board which is 38 by 10 holes, this is the correct size to fit into the specified case. If your requirements call for a smaller piece of board you should be able to adapt the layout to suit your specific needs since the components require very little space.

Once the board has been cut then the next stage is to insert the components into the correct places as shown in Fig. 2. It is important that IC1 and TR1 are inserted in the board the correct way round, since these are polarised components and incorrect placement and/or polarity will cause the circuit not to work and may cause them to be permanently damaged.

Once the components have been inserted the board can be turned over and the component leads cropped to approximately 3mm length using, a small pair of cutters. The components are then wired together using the Easiwire pen.

At the start of a wiring run a small length (approximately 10mm) of wire should be pulled out from the pen and held in contact with the circuit board by means of finger pressure. The wire is then pulled to the first component and wound up the component's tail for four or five turns, using the pen. The wire is then wound down the component tail for another four or five turns, keeping a slight amount of pressure on the wire. The pen is then moved to the next component's tail where the process is repeated.

This process continues until all of the connections in that particular wiring run have been made. The wire is then cut, using the cutter built into the pen, reasonably close to the last component tail. The excess wire at the beginning of the run can also be cut off using the cutter. This process is repeated until all of the wire links shown in Fig. 2. have been made. This circuit is particularly easy to wire up since there are no occasions where the wiring crosses or comes close to other wiring.

Before the circuit can be tested the external components should be wired up using soldered joints in the conventional manner with the leads to the batteries and loudspeaker being terminated with the special connectors required for the "spring" connectors fitted to the Easiwire board.

TESTING

Before the batteries are inserted into the battery holders the circuit should be thoroughly checked to ensure that the two polarity sensitive components, IC1 and TR1 are both correctly inserted into the board and wired up as shown in the diagrams. The batteries can then be inserted into their holders and S1 operated. The appropriate tune should then be heard from the loudspeaker. After the tune has played once the sound should

stop and the tune should not restart until S1 has been released and then pressed again.

This is a very simple circuit so it is unlikely that any problem should be experienced when it is tested after construction. If the circuit does not operate as described above then it will be necessary to find the fault(s) preventing the circuit from working. The first stage is to visually check once more for incorrectly inserted or wired components. If the visual check reveals nothing amiss then it will be necessary to use a multimeter to search further for the fault.

but this voltage then falls markedly when the batteries are connected to the circuit board, it must be suspected that there is either a short circuit in the wiring of the circuit board or that IC1 or TR1 have been inserted into the board the wrong way round.

Once a reliable 3 volt supply is available at the power supply rails the next stage is to check that this voltage is available across pins 2 and 3 of IC1 (with pin 2 being at +3 volts with respect to pin 3). If this voltage is not measurable across pins 2 and 3 of IC1 then the resistance of connection between positive input to the Easiwire board and pin 2 should be checked, using the resistance setting of the multimeter. A similar check should also be made between the negative input and pin 3 of IC1.

With 3 volts available between pins 2 and 3 of IC1 then the appropriate sound should be available at pin 1, unless the i.c. has been damaged by incorrect connection. It is difficult to check that this output is actually available unless the emitter follower amplifier of the project is working properly. It is therefore advisable to check that the emitter follower circuit is functioning correctly before discarding IC1 as faulty.

When testing it is important to remember that the i.c. automatically ceases to produce an output at the end of the tune programmed into it. The tune should however restart if the supply voltage is removed and then reconnected.

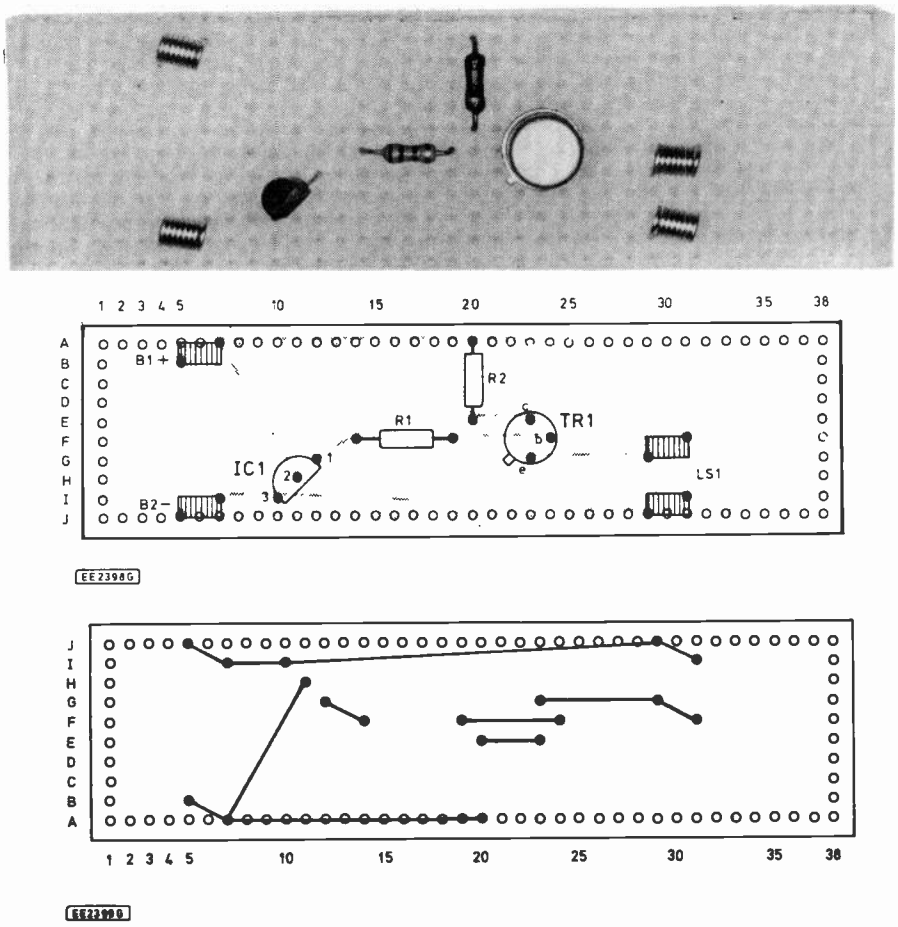


Fig. 2. Easiwire board component layout and details of the underside wiring. Note that a lead from the negative of battery B1 should be taken to one side of push switch S1 and a lead from the positive connection of B2 to the other terminal of S1.

COMPONENTS

Resistors

R1	1k
R2	27

All ¼ watt carbon film 5% tolerance

Shop Talk see page 131

Semiconductors

TR1	BFY50 (or any medium power *npn* transistor)
IC1	UM66 tune generator (see text)

Miscellaneous

LS1	8 ohm loudspeaker
S1	push-to-make s.p.s.t. switch
B1, B2	AA cell and holder (2 off)

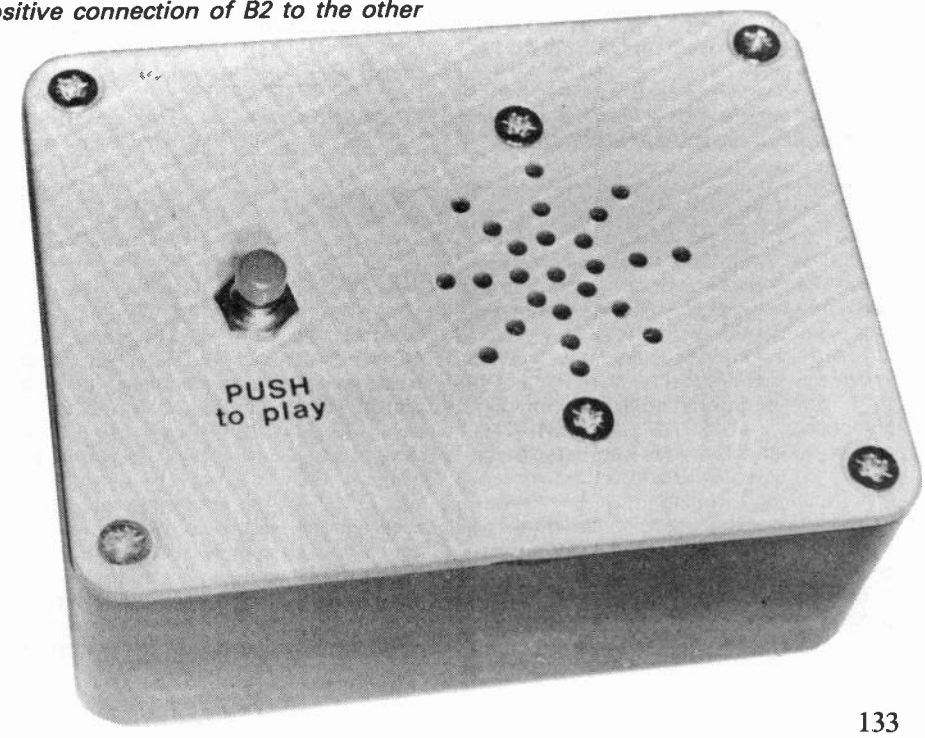
Easiwire board (as supplied free with Dec. '89 issue of EE); Easiwire connectors (4 off each type); suitable plastic case approx 100×75×40mm; connecting wire etc.

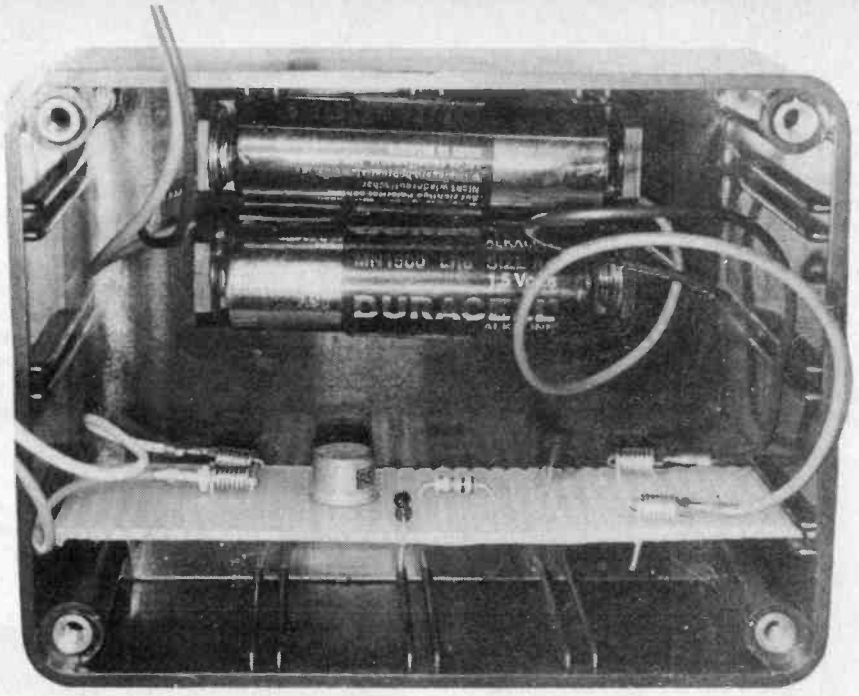
Approx. cost Guidance only **£4**

The next stage is to check that the two batteries are each giving out 1.5 volts or something very close to this, by connecting the voltmeter directly across each battery in turn. If this test reveals no problem then the next stage is to check, that when S1 is operated 3 volts is available between the positive and negative input connections to the Easiwire board.

If the battery voltage is not measured at this point when S1 is operated then the battery connectors should be removed from the connecting springs on the Easiwire board and the test repeated with the voltmeter connected across the battery connectors. If pressing S1 does not produce the battery voltage across the battery connectors then the power supply circuit should be checked through to find the fault.

If 3 volts is available at the output connectors from the batteries to the circuit board when S1 is operated with the battery input connectors disconnected,





The completed circuit board slotted into a small plastic case.

EMITTER FOLLOWER

Fault finding on the emitter follower circuit starts with a voltage check to ensure that the battery voltage is measurable between the negative battery input to the board and the top end of R2. A similar check should be made between the positive battery input and the negative connection to LS1. If these voltage tests reveal that the battery voltage is available across the power supply rails of this part of the circuit but no output is heard from LS1 it will be neccessary to check the emitter follower circuit.

Unless sophisticated test gear, such as an oscilloscope, is available it is best to fault-find on this circuit as if it were a d.c. circuit. Before doing this it is essential that the link between pin 1 of IC1 and R1 is removed before any further checks are commenced to prevent the risk of damaging IC1. The end of R1 which has now been disconnected from pin 1 of IC1 should be temporarily connected to the positive supply rail. The negative lead to the voltmeter should be connected to the negative battery input and the positive lead of the voltmeter should be connected to the end of R1 which is now connected to the positive power supply rail and if all is well the battery voltage should be measured here.

The positive meter lead should then be moved so as to measure the voltage present at the junction of R1 and the base of TR1. If all is well a voltage of around 1.3 to 1.5 volts should be measured. If, however, the voltage measured at this point is virtually the same as the battery voltage then it is likely that there is an open circuit somewhere in the connections either between R1 and the base of TR1 or between the emitter of TR1 through LS1 to the 0 volt supply rail.

The next step is to measure the voltage across LS1 which should be about 0.7 volts less than that measured at the base of TR1. If no voltage is measurable across LS1 but a voltage is measured between 0 volts and the base of TR1 then the loudspeaker should be disconnected and its resistance checked.

If the resistance of the loudspeaker is correct and a voltage is measurable between 0 volts and the base of TR1 then the voltage at the collector of TR1 should be measured. This voltage should be slightly higher than that measured at the base of TR1 and should be the same as that measured at the end of R2 not connected to the power supply rail. If these two voltages differ then the connection between R2 and the collector of TR1 should be checked to ensure that it is sound.

If the emitter follower circuit is functioning properly then the voltage measured across the loudspeaker should follow the voltage measured at the base of TR1 but should be approximately 0.7 volts less than it. When the end of R1 which should normally be connected to the output of IC1, is connected to the positive supply rail then the voltage at the base of TR1 should rise, causing the voltage across the loudspeaker to rise and the loudspeaker to make a click. When R1 is disconnected from the power supply rail the voltage across LS1 should fall to 0 volts and a second click should be heard.

The current necessary to drive the loudspeaker is provided from the positive power supply rail through R2 and the collector/emitter of TR1.

CASE

Although this project may be made "free standing". If it is intended for the tune generator to be used on its own then it is advisable to fit it into a case. The first stage of this process is to find suitable places in the case where the circuit board, loudspeaker, battery holders and S1 can be mounted. Once these positions have been decided upon they should be marked in the case and appropriate holes drilled.

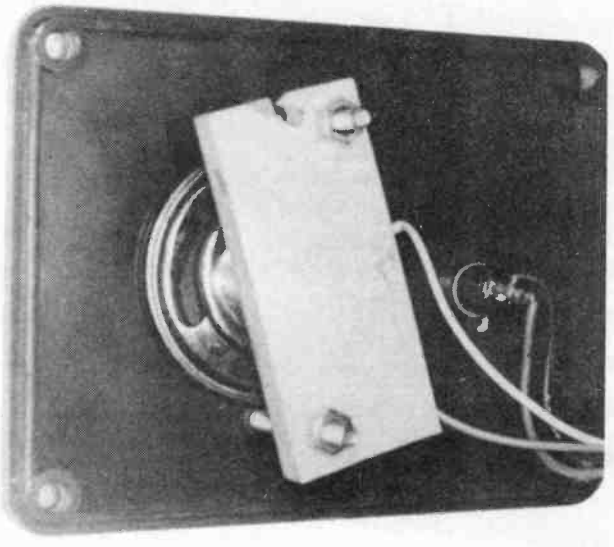
It will also be neccessary to drill holes through which the sound from the loudspeaker can reach the outside world. Some loudspeakers are provided with mounting holes already drilled in the base. In which case the position of these should be marked on the case and appropriate holes drilled. If the loudspeaker is not provided with mounting holes then it is possible to mount it onto the case, either by sticking it with "Araldite", or a similar strength adhesive, or by using a clamp arrangement as shown in the photographs.

Once the case has been drilled, it may be lettered, if desired, using rub down lettering. This should be secured in place with several layers of spray-on clear varnish which must be allowed to dry thoroughly before the case mounting components are fitted.

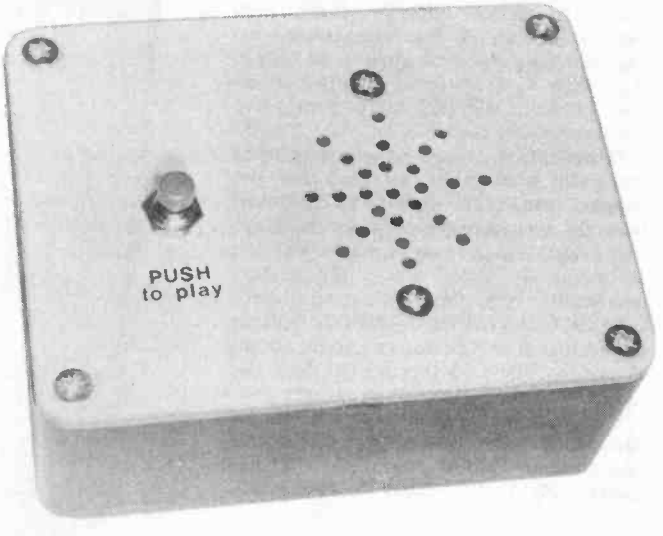
IN USE

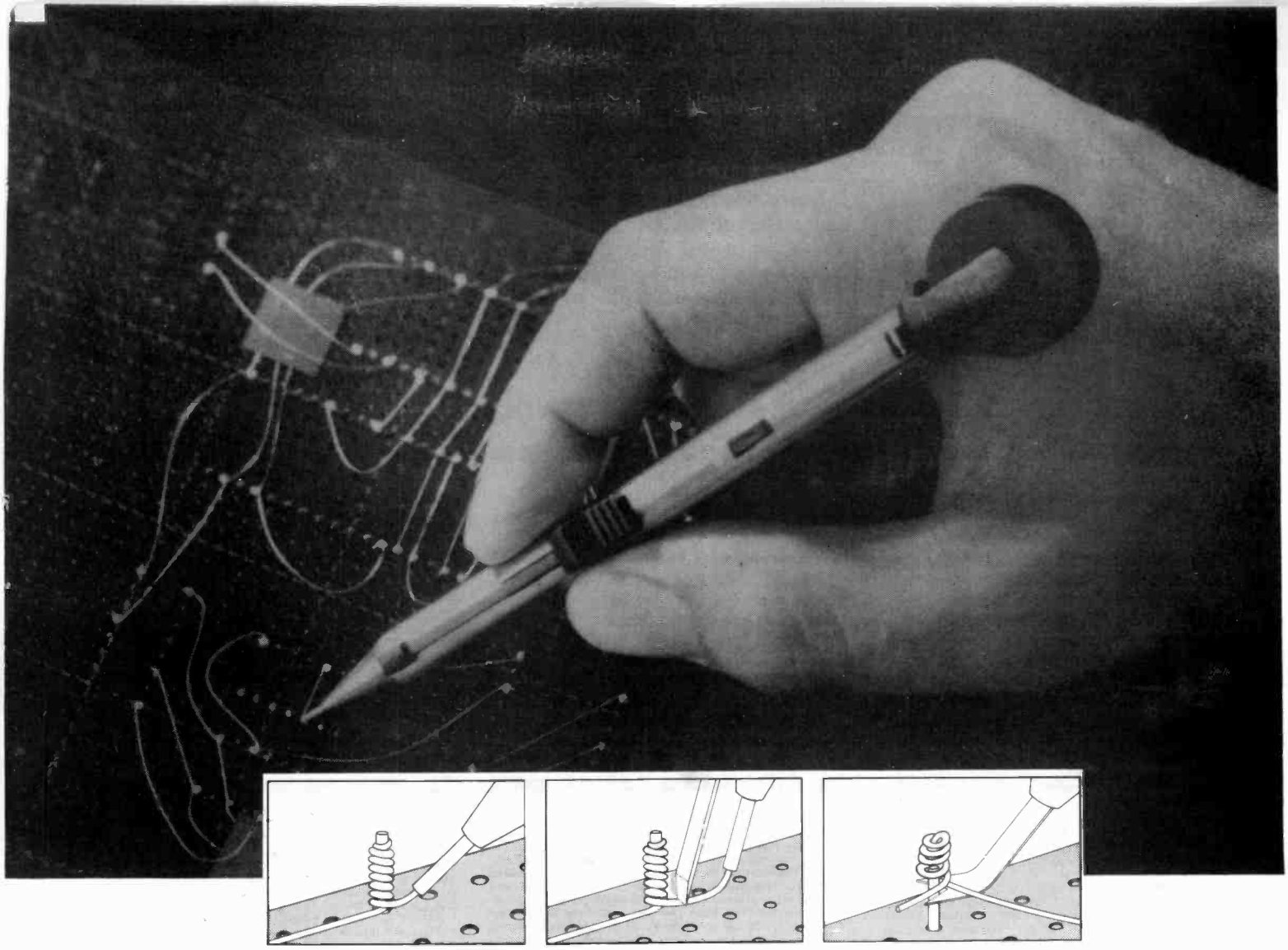
The circuit is extremely easy to use. All that is required to start the tune playing is to operate S1. The tune will continue to play until either S1 is released or the programmed tune is finished. Before the tune can be heard again it is necessary to release S1 momentarily. □

A rather crude but effective method of mounting the loudspeaker on the case lid.



The completed Tune Generator showing the speaker "grille" and push switch S1.





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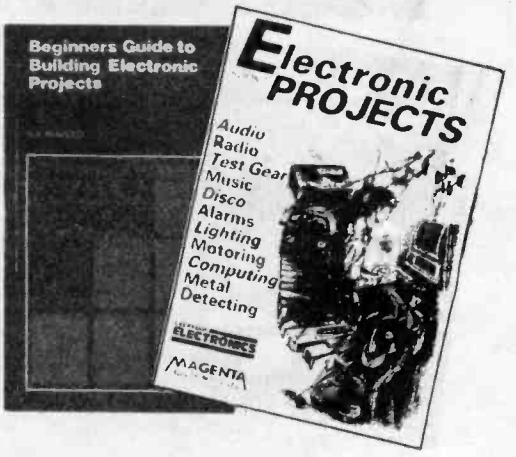

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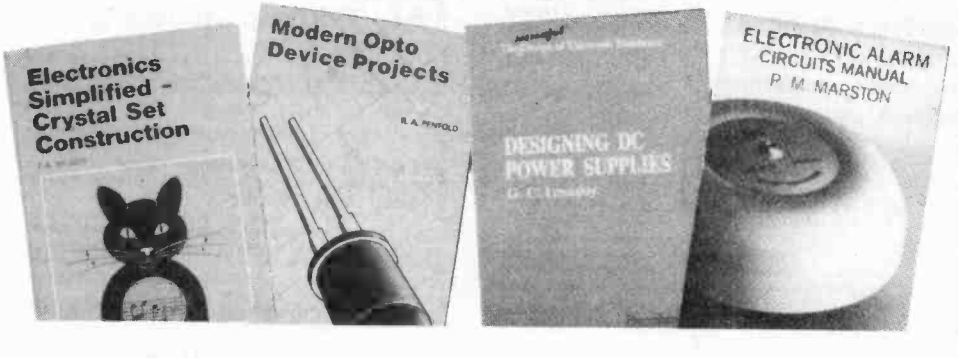

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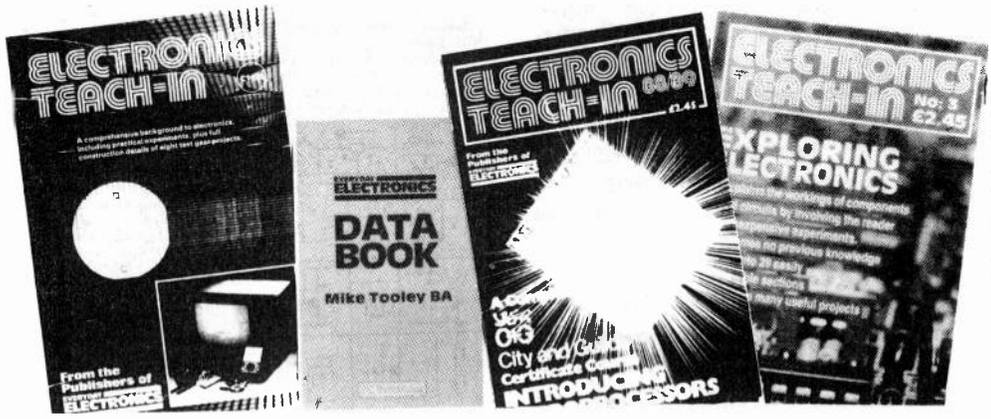

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G. T. Rubaroe, T.Eng (C.E.I.), Assoc.I.E.R.E.
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COMPUTING

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R.A. Penfold
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This book will help you learn the basics of computing, running applications programs, wiring up a MIDI system and using the system to good effect, in fact just about everything you need to know about hardware and the programs, with no previous knowledge of computing needed or assumed. This book will help you to choose the right components for a system to suit your personal needs, and equip you to exploit that system fully.
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AUDIO & MUSIC

BEGINNER'S GUIDE TO HI-FI
Ian Sinclair
The *Beginner's Guide to Hi-Fi* will appeal to the audio enthusiast, whether newly won over by advances in technology or well established and wondering whether to update equipment. The book deals with the sound from its sources in the studio to its ultimate end in your ears, and shows what sound is, how it is recorded and how it is reproduced.
Every aspect of Hi-Fi, from pickup cartridges to loudspeakers, has been covered, and the emphasis has been on explaining design aims. Cassette systems have been given considerable prominence, including the more modern Dolby C and dbx noise reduction systems. The CD record has been covered in detail so that you can find out just why this system of sound reproduction is so superior.
194 pages **Temporarily out of print.**

AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN
V. Capel
This book explores the various features, good points and snags of speaker designs. It examines the whys and wherefores so that the reader can understand the principles involved and so make an informed choice of design, or even design loudspeaker enclosures for him or herself. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them. Finally there is a step-by-step description of the construction of the *Kapellmeister* loudspeaker enclosure.
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R. A. Penfold
The Atari ST's are now firmly established as *the* computers to use for electronic music applications. The range and sophistication of these applications are much greater than most people may realise, but there are still a lot of misconceptions about just what can and cannot be achieved. This book will help you sort out the fact from the fallacy and to get the most musically from the ST's.
A wide selection of topics are covered, including the internal sound chip; MIDI; applications programs such as sequencing and score writing, etc; simple but useful add-on projects and MIDI programming.
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R.A. Penfold
The Musical Instrument Digital Interface (MIDI) is surrounded by a great deal of misunderstanding, and many of the user manuals that accompany MIDI equipment are quite incomprehensible to the reader.
The Practical MIDI Handbook is aimed primarily at musicians, enthusiasts and technicians who want to exploit the vast capabilities of MIDI, but who have no previous knowledge of electronics or computing. The majority of the book is devoted to an explanation of what MIDI can do and how to exploit it to the full, with practical advice on connecting up a MIDI system and getting it to work, as well as deciphering the technical information in those equipment manuals.
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K. H. Recorr
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A. Michaels
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A. Michaels
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RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
B. B. Babani
Although this chart was first published in 1971 it provides basic information on many colour codes in use throughout the world, for most radio and electronic components. Includes resistors, capacitors, transformers, field coils, fuses, battery leads, speakers, etc. It is particularly useful for finding the values of old components.
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Ian Hickman
Oscilloscopes are essential tools for checking circuit operation and diagnosing faults, and an enormous range of models is available. But which is the right 'scope for a particular application? Which features are essential, which not so important? What techniques will get the best out of the instrument?
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I.D. Poole
Amateur radio is a unique and fascinating hobby which has attracted thousands of people since it began at the turn of the century.
This book gives the newcomer a comprehensive and easy to understand guide through the subject so that the reader can gain the most from the hobby. It then remains an essential reference volume to be used time and again. Topics covered include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics covered include propagation, receivers, transmitters and aerials etc.
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P. Shore
Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed to guide him or her around the ever more complex radio bands. This new edition has been completely revised and rewritten and incorporates much more information which is divided into the following sections:
Listening to Short Wave Radio; ITU Country Codes; Worldwide Short Wave Radio Stations; European, Middle East and North African Long Wave Radio Stations; European, Near East and North African Medium Wave Radio Stations; Canadian Medium Wave Radio Stations; USA Medium Wave Radio Stations; Broadcasts in English; Programmes for DXers and Short Wave Listeners; UK FM Radio Stations; Time differences from GMT; Abbreviations; Wavelength/Frequency Conversion.
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R. A. Penfold
The subject of aerials is vast but in this book the author has considered practical aerial designs, including active, loop and ferrite aerials which give good performances and are relatively simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided.
Also included are constructional details of a number of aerial accessories including a pre-selector, attenuator, filters and tuning unit.
96 pages **Order code BP105** **£2.50**

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F.A. Wilson
As a definitive Introduction to the subject this book is presented on two levels. For the absolute beginner or anyone thinking about purchasing or hiring a satellite TV system, the story is told as simply as such a complex one can be in the main text.
For the professional engineer, electronics enthusiast, student or others with technical backgrounds, there are numerous appendices backing up the main text with additional technical and scientific detail formulae, calculations, tables etc.
There is also plenty for the DIY enthusiast with practical advice on choosing and installing the most problematic part of the system—the dish antenna.
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F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.
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256 pages **Order Code BP89** **£2.95**

COMPUTERS AND MUSIC
— see computer section

MORE BOOKS NEXT MONTH

ACTUALLY DOING IT!

by Robert Penfold

OVER the years I have noticed changes in the numbers of readers' letters received about various types of problems. The percentage of letters in the "I built X project and it does not work" has reduced somewhat in recent years. This is possibly due to the increased use of custom printed circuit boards, which certainly help to increase the chances of a project working first time.

Letters in what I term the *"life, the universe, and everything"* category seems to be larger than in days gone by, which is perhaps a reflection of the increasingly diverse applications of electronics. Recent issues of *Everyday Electronics* have featured amongst other interesting but unusual projects a *Bat Detector* (June '89) and a *Seismograph* (Oct/Nov '89). This is a far cry from the relatively conservative projects of twenty or thirty years ago.

What has probably been the major growth area in readers' letters is enquiries about where to obtain components, and readers trying to ensure that the components they are about to obtain are the right ones. This is not really all that surprising. Twenty or thirty years ago there were few really large component catalogues. In fact the only one from that period which I can remember is the "Home Radio" catalogue (ceased trading). This featured a vast range of bits and pieces, but a substantial percentage were actually mechanical odds and ends (slow-motion drives, case accessories, etc.).

The number of electronic components was small by today's standards. Not because Home Radio did not stock a very good selection of components, but because there were relatively few electronic devices available at that time.

TTLs

Probably the nearest equivalent of the Home Radio catalogue today is the Maplin Catalogue. This is not exactly short on tools, drives, etc., but is very much dominated by truly electronic components. In the semiconductors section alone there are many hundreds of components listed, and there are a lot of specialised devices (communications chips etc.) which are not included.

No apologies are made for repeating the much given advice to obtain as many component catalogues as possible. They contain a lot of data and useful information, and should enable you to track down the more elusive components. No one company stocks absolutely everything you will need.

Trying to pursue this hobby without the aid of components catalogues is about as sensible as trying to build projects without first buying solder and a soldering iron! Many readers enquiries would be unnecessary if the people concerned obtained three or four of the larger component catalogues.

Probably the major cause of component buying problems is not so much the sheer number and variety of components, as the hoards of very similar components. Logic integrated circuits and capacitors are perhaps the worst offenders. It can be difficult to tell your CMOS from your TTLs, and your Mylars from your polyesters.

FAMILY LOGIC

Taking logic integrated circuits first, there are several families of logic devices. This may seem an unnecessary complication, but it is a situation that has arisen due to the inadequacies of the early devices.

The original 4000 series CMOS integrated circuits achieved low power consumption, particularly at low operating frequencies, but were very slow. On the other hand, the original 7400 series TTL devices were respectably fast, but their power consumption was quite high.

Even a circuit based on just a couple of simple gate packages required a high capacity battery or a mains power supply unit. As the technology improved, new versions of TTL and CMOS integrated circuits appeared, offering higher speed and (or) lower power drain.

The original TTL and CMOS devices are still readily available, albeit with the 4000 CMOS devices having been upgraded slightly (the modern devices have a "B" suffix instead of an "A" suffix). The 4000 series CMOS family are still much used, with their very low power consumption at low frequencies being as much an asset as it ever was. The standard 7400 series components are now largely obsolete, and are mainly used as replacements in old circuits, or when building a design from several years ago.

Some of the families of "improved" TTL integrated circuits are now largely obsolete, or simply never caught on to a significant extent. Those that are currently available from most retailers and used to a significant extent are the 74LS00 (low power Shottky), 74HC00 and 74HCT00 (high speed CMOS) types.

This LS type is what could be regarded as the current "standard" range, offering slightly improved speed and much lower current consumption than the ordinary TTL range. The HC and HCT devices are more recent ranges which offer even higher speed and lower current consumption. They differ in that the HC type operate at normal CMOS input and output voltages, while the HCT type operate at normal TTL signal levels.

Note that some 4000 series CMOS devices are available as HC components. These have type numbers such as 74HC4050 and 74HC4017 (the HC equivalents of the 4050BE and 4017BE respectively).

In many cases you can get away with using the wrong version of a component. This is not to be recommended though, and is fraught with potential incompatibility problems.

In an extreme case you could end up with logic devices powered from a totally unsuitable supply voltage, with them all being destroyed as a result. I have occasionally used an LS device where an HC type was called for, but only as a temporary measure until the correct device could be obtained.

TYPECAST

This is not the place for a detailed discussion of TTL technicalities, and the best advice is to only use the correct versions of logic integrated circuits unless you are absolutely certain you know exactly what you are doing. It may seem reasonable to assume that a more modern version of a logic integrated circuit can be used instead of an earlier version, but it is not as simple as that.

When you get the components they are unlikely to be marked with just the basic type number, and are almost certain to have some form of prefix and suffix. These just indicate the particular manufacturer (the prefix) plus their particular coding for the type of casing (the suffix).

Taking a device at random from the spares box, it is marked "SN74LS273N". The basic type number is 74LS273, the "SN" prefix indicates that it is manufactured by Texas Instruments, and the "N" suffix shows that it is the plastic cased dual in-line (d.i.l.) version. Virtually all TTL logic devices used in amateur electronics have this "N" suffix, but you might occasionally encounter a different one.

Do not be put off if there are one or two other numbers on the casing. These are such things as batch numbers, the date of manufacture in some cryptic form (number of days since the beginning of the century or since the factory started production), and are meaningless practically to everyone except those who work at the factory where the chip was manufactured!

CAPACITORS

I suppose that capacitors are potentially more confusing than logic devices. With TTL and CMOS integrated circuits the different types do at least have slightly different type numbers, and provided you are careful, there should be no major difficulty in obtaining the right components.

If you look through a large component catalogue you might find that some of the middle values of around 1n to 100n are available in about a dozen different types. Apart from choices between (say) Mylar and polyester capacitors, you might even find that there is a choice of several polyester types.

In many cases there are several types of capacitor that will fit the bill, and it is merely a case of choosing the cheapest type that will do the job.

A capacitor consists basically of two metal plates with a layer of insualtion in between. Practical capacitors are normally in the form of two layers of metal foil plus two layers of insulating foil, with alternate layers of the two types. These are then rolled up so that quite high values can be crammed into usably small sizes and shapes.

The "plastic foil" description was meant to imply that any capacitor having a plastic insulating layer, which means most types of capacitor, would be suitable. It seemed to cause a certain amount of confusion, with readers looking through cataloguers for a range of capacitors specifically referred to as "plastic foil" types.

These days components lists normally refer to a specific type of plastic foil capacitor, such as polystyrene, polyester, or Mylar. From the electrical point of view using a different type of plastic foil component is unlikely to give any problems.

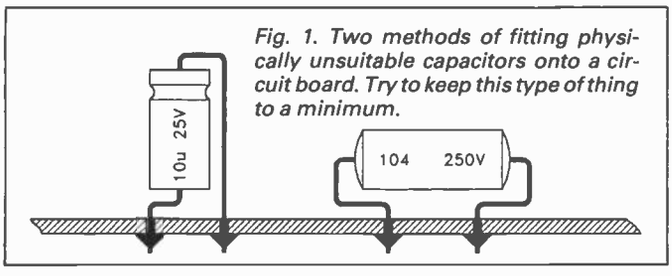


Fig. 1. Two methods of fitting physically unsuitable capacitors onto a circuit board. Try to keep this type of thing to a minimum.

VOLTAGE RATINGS

Voltage ratings of capacitors vary from type to type, but with most circuits operating at supply potentials of about 3V to 15V, and most capacitors having a voltage rating of 100V or more, this is not likely to be a significant factor. Obviously some circuits operate at higher voltages, and where necessary you must ensure that capacitors having a high enough voltage rating are used.

Voltage ratings are an important factor when ordering electrolytic capacitors. These often have quite low maximum operating voltages, and components lists should always indicate the minimum acceptable rating. There is no problem in using a capacitor having a voltage rating *higher* than that specified in the components list. At least, there is no problem from the electrical point of view.

Hight voltage capacitors, particularly if they are not of recent manufacture, can be quite large. This makes it quite likely that a component having a higher than necessary voltage rating will simply not fit into the available space on the board.

The tolerance ratings are not often mentioned in components lists, and are not usually of importance. However, if a component tolerance is given, you must use a component that has this rating or a better one (e.g. a 2 per cent component can be used in place of a 5 per cent one, but *not* the other way round).

Due to their very high tolerance ratings it is generaly not satisfactory to use a ceramic type where some form of plastic foil capacitor has been specified. Something like plus and minus 50 per cent is not unusual for ceramic capacitors. Furthermore, their values can change dramatically with variations in temperature, and simply with the passage of time.

Neither is it safe to use a plastic foil capacitor in place of a ceramic type. Ceramic capacitors are mainly used in high frequency coupling and decoupling applications where their high tolerances are of no consequence. What is of importance is their good performance at these high frequencies. Other types of capacitor are generally inferior at these frequencies, and may not provide satisfactory results.

GETTING PHYSICAL

These days it is often the physical size and shape of a capacitor that is more important than its precise electrical characteristics. Many projects are built on custom printed circuit bopards that are designed for printed circuit mounting capacitors of a certain lead spacing.

It is not impossible to fit non-printed circuit mounting capacitors onto a board of this type. Neither is it impossible to fit printed circuit types having the wrong lead spacing. This is doing things the hard way though, and might not be entirely satisfactory.

Two possible ways of manipulating the wrong type of capacitor into the right space is shown in Fig. 1. This type of thing will not always be successful though. Many modern circuit boards have little space between one component and the next. If some of the components are too large, or simply the wrong shape, there may be no way of fitting them all in place satisfactorily.

When mounting axial components vertically there is a real risk that the height of the circuit board will be more than the height of the case can accommodate. This obviously depends on the particular project concerned, but with a component such as a high value electrolytic capacitor the height of the board assembly could easily be brought to about 30 to 40 millimetres if vertical mounting is used. This would take the board beyond acceptable limits in most instances.

The main problem with these methods of mounting is that they are physically weak. With even a few components manipulated into place in this fashion the reliability of the project could be seriously impaired.

Simply getting printed circuit mounting capacitors where appropriate may not solve all your problems. These capacitors are widely available with 2.5mm, 5mm, 7.5mm, and 10mm lead spacing (about 0.1in, 0.2in, 0.3in, and 0.4in respectively). The leads are actually more like pins in most cases, at only about 4mm to 5mm in length.

In order to fit a component of this type onto a board designed for a different lead spacing it will almost certainly be necessary to solder on some extension leads. Trying to bend the leads inwards or outwards to accommodate a different spacing is not to be recommended.

Modern printed circuit mounting capacitors seem to be much tougher than those of a few years ago, but that is not really saying a great deal. Printed circuit mounting polyester capacitors in days gone by quite often lost a leadout wire even when being fitted on a board with the correct hole spacing. Modern components are tougher, but still need to be treated reasonably carefully.

Using extension leads is something that could only be recomended as a temporary measure until the right components can be obtained. It is not likely to give strong and reliable results. If a project needs polyester (or similar) printed circuit mounting capacitors, then check on the lead spacing required, and make sure you order suitable components.

If a supplier does not guarantee to supply capacitors having a specific lead spacing, then I would have to advise against buying them from that supplier. The problems I have experienced with components of the wrong lead spacing has led to me adopting a policy of only buying polyester capacitors of known lead spacing.

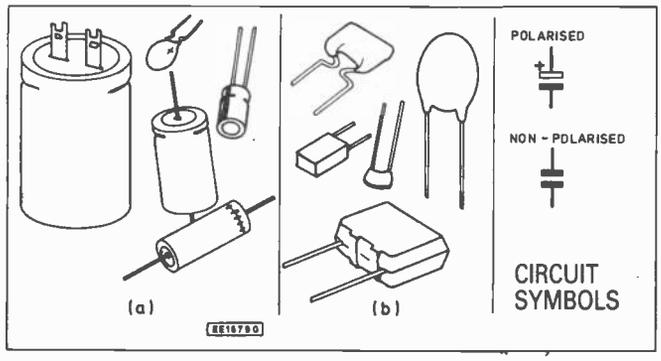
FINALLY

While it may often be acceptable to use one type of plastic foil capacitor where a different type has been specified, always use the correct type where a more specialised type of capacitor is specified. A polystyrene or ceramic plate capacitor might work in place of an expensive silvered mica type, but the performance of the project is likely to suffer in some way.

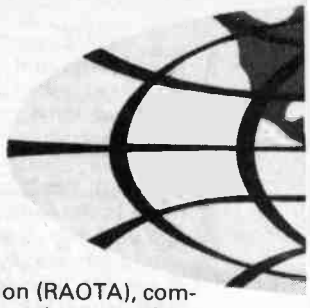
Do not be tempted to use an ordinary electrolytic where a tantalum bead component has been specified. Apart from any problems with the extra size of an electrolytic type, they tend to have relatively high leakage currents.

If a tantalum bead capacitor has been specified, then it is highly unlikely that an ordinary electrolytic will be up to the task. A high quality low leakage type might be an acceptable substitute in some cases, but due to their higher tolerances this is by no means certain. With the rarer forms of capacitor it is always best to use the exact type specified.

Fig. 2. Various shapes and sizes for (a) polarised and (b) non-polarised capacitors.



...REPORTING AMATEUR RADIO...



TONY SMITH G4FAI

PROJECT DOVE

The launch of six amateur satellites from the European Space Agency's launch site at Kourou in French Guiana, anticipated last month, should take place on 19th January reports AMSAT-UK.

Among the six satellites is a BRAMSAT (ANSAT-BRAZIL) "Dove" (Digital Orbiting Voice Encoder) microsat which will re-transmit digitized messages of peace from children around the world, plus bulletins, special projects and telemetry for scientific/educational purposes.

The Dove Fact Sheet, describes the satellite and sets out its three major purposes as follows:

"1. A test bed for advanced space communications operations in the amateur radio bands.

2. An orbital tool to aid in the development of cross-curricular, cross-cultural activities/understanding in schools globally for students of all ages. Science, geography, electronics and computer and language arts classes can all make use of Dove.

3. A stimulus for young people worldwide to become involved in amateur radio and technical careers.

"Dove is a nine inch cube packed with computer and radio gear . . . it is a digital satellite, that is, its transmissions are created and controlled by its on-board computer. Nearly all of the cube is covered with high efficiency solar cells which keep Dove's battery charged.

"Dove will be injected into a sun-synchronous polar orbit with an altitude of 808km and an orbital period of 101 minutes. Sun-synchronous means that the satellite will pass overhead at about the same time every day . . ."

"Dove is a receive only satellite. Schools need only to monitor its beacon on 145.825MHz as it passes overhead. Ground reception will be commonly available with scanner receivers or amateur radio gear . . ."

According to BRAMSAT, the idea is to get children interested in amateur radio at as early an age as possible by discussing in school classes all aspects of (amateur) satellites and by personal participation.

Teachers interested in participating in this project can write for further information about its many applications in the educational environment to ***DOVE Education Director, Richard C. Ensign N81WJ, 421 N. Military, Dearborn, MI 48124, USA.***

DxPEDITION TO BOUVET

After nearly two years of planning and negotiations with the Norwegian Department of the Environment a 19-man American scientific/radio operating team hopes to land on remote Bouvet Island in the Antarctic, 1,387 nautical miles from Capetown , on 1st February.

Thirteen team members are amateur radio operators who plan to run seven individual transmitting stations, including satellite operation, during the expedition's 12 day stay on Bouvet. They will use SSB, CW, and RTTY to provide two-way radio contacts or SWL reception with one of the rarest, and most wanted, radio "countries" for amateurs worldwide. *The call sign for all stations will be 3Y0B.*

Apart from the radio operations, the expedition has a serious scientific purpose and includes geochemical, marine biologic, and paleontological research scientists. A photographic team representing the National Geographic Society's Magazine and the TV programme *"Explorer"* will record the expedition for prospective publication and international TV broadcast.

The project is sponsored by the Saturday Evening Post and other organisations, and by the landing team members themselves, at a total cost of around $120,000. Yaesu-Musen is supplying all the transmitting equipment.

Bouvet is a nature reserve and the Norwegian government's permission to land has been granted on the condition that significant impact on the environment is avoided. They have therefore chosen February to avoid the December wildlife birthing season.

SECOND EXPEDITION PLANNED

By coincidence, a smaller Norwegian group, known as *Club Bouvet*, has been planning a similar expedition. To avoid unnecessary competition the Americans invited the three Norwegian radio operators to join them, at no cost, but the Norwegians were unable to accept due to the timing of the trip and other obligations. At the time of writing it is not known if their planned expedition will still take place.

Stations 3Y0B will be the first ever large scale radio operation from Bouvet Island, and probably the last this century, taking account of the frequency of the sunspot cycle. It is planned to establish a permanent repository of data on Bouvet to be made available for all future expedition planners.

Operation from the island is so rare that thousands of amateurs around the world will want to work the expedition and obtain their unique QSL card. I saw an estimate recently that four out of five DXers (long distance enthusiasts) need a contact with Bouvet for the various awards they are working for.

I'm sure the bands will go mad when 3Y0B takes to the air but I have to admit I shall be in there among everyone else trying to make contact with this unique Antarctic station. *Yes Tony, we do expect to publish your "card" in "Reporting Amateur Radio" — Ed.*

AMATEUR RADIO AT WAR

The October 1989 issue of *"O.T. News"*, journal of the Radio Amateur Old Timers Association (RAOTA), commemorates the 50th anniversary of the start of WW2 with several interesting articles about the part played during the war by radio amateurs. Many served in the regular forces as virtually "ready-trained" wireless operators and others were recruited to the Radio Security Service, acting as Voluntary Intercepters (VI's) in their spare time, monitoring the radio bands for enemy stations within the UK and across Europe.

VI's spent many hours with their receivers logging everything they heard, and posted their logs to P.O. Box 25, Barnet. Replies commented on stations heard as "Unwanted", "Identified", "Suspect", or "More Please". By 1941 there were over 200 VI's in London and many more across the country.

A vast amount of information was thus gathered and eventually there can have been few enemy transmissions which were not monitored for the intellegence services. Furthermore, Allied agents could then transmit messages at any time secure in the knowledge that they would be "picked up" by the monitoring stations.

UNWELCOME ENQUIRIES

There was one practical problem. Everyone was "doing their bit" one way or another, as air raid wardens, firewatchers or Home Guards, while neighbours noted that the VI's apparently did nothing, and in some cases seemed to be escaping "call-up". To avoid unwelcome enquiries about their undercover work they were eventually put into the uniform of the Royal Observer Corps.

Some became full-time at specially constructed intercept stations such as Hanslope Park near the Government's Code and Cypher School at Bletchley Park. High quality receivers and special aerial installations were linked to a nationwide direction finding network which permitted the location of enemy transmitters across Europe as well as interception of the coded messages.

It is often argued that amateur radio is a national resource, providing a ready-made reserve of skilled radio operators. Nowadays this applies more, perhaps, to the ability to provide emergency communications at times of natural or man-made disasters, but these memories gleaned from "O.T News" demonstrate clearly how the skills of radio amateurs in the past were recognised and put to good use by the nation.

RAOTA exists "to keep alive the pioneer spirit of Amateur Radio . . . and to preserve the legends of the past." Membership is open to anyone who has had an interest in Amateur Radio for 25 years or more. A copy of *O.T. News* and a membership application form can be obtained from: ***Sheila Gabriel G3HCQ, Millbrook House, 3 Mill Drove, Bourne, Lincs PE10 9BX.***

HIGH GRADE COMPONENT PARCELS

EVERYTHING MUST GO!

Unless otherwise stated, all the clearance parcels we offer contain brand new, top grade components. If some of the offers look too good to be true, all I can say is that the optimists will get some stunning bargains, the cynics will never know what they've missed, so everybody will be happy! All offers apply only while current stocks last – watch out for next month's parcels or, better still, be the first to hear about any new offers by putting your name on our mailing list. (Please write in, or 'phone Pete Leah on 0272 522703 after 6.30 pm).

UNIVERSAL EVERYTHING PARCEL

This one contains some of just about any component you care to name! There are passives (resistors, capacitors, tants, presets), opto devices (couplers, LEDs of all shapes and sizes, infra-red components, 7-segment displays), semiconductors (transistors, diodes, ICs, rectifiers), and all kinds of other odds and ends (relays, VDRs, neons, battery connectors, mixed components packs). A stunning range of components – enough to get a workshop or lab. started – at a ridiculously low price.

The components are of excellent quality, in packs originally intended to sell at £1 each. To make sure you get a good variety, the 20-pack parcel will have no more than two of any one pack, the 100 pack parcel will have at most five of any one pack. Packs supplied as they come – our choice.

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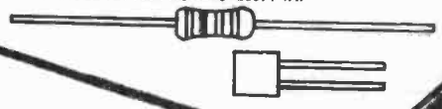

MASSIVE CLEARANCE SALE

Once again, a general purpose parcel containing a huge variety of components: resistors, capacitors, ICs, transistors, electrolytics, tants, triacs, LEDs, diodes, thermistors, trimmers, VDRs, all sorts. All new, top quality components. This is mostly remainders from our own stock – stuff we forgot to advertise, or have in too small a quantity to sell individually. Guaranteed to be worth at least eight times the price if valued from any standard component catalogue! What more can I say?

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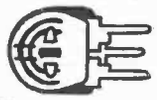

INTEGRATED CIRCUITS

This parcel contains nothing but ICs. The mixture offers TTL and CMOS logic, interface ICs, linear, data converters, op-amps, special functions, and so on. Some of the ICs are pre-packed with data sheets, some (TTL, CMOS, op-amps) we expect you to identify for yourself, others will be covered by the free *data pack* provided, and the rest you'll have to identify under your own steam. If you know your ICs you'll be in for a few nice surprises.

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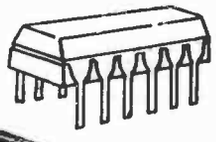

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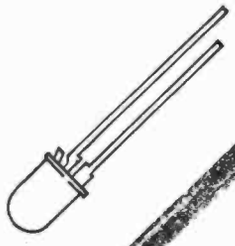

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Boards for some older projects – not listed here – can often be obtained from Magenta Electronics, 135 Hunter St., Burton-on-Trent, Staffs DE14 2ST. Tel: 0283 65435 or Lake Electronics, 7 Middleton Close, Nuthall, Nottingham NG16 1BX. Tel: 0602 382509.

NOTE: While 90% of our boards are now held in stock and are dispatched within seven days of receipt of order, please allow a maximum of 28 days for delivery – overseas readers allow extra if ordered by surface mail. Please check price and availability in the latest issue before ordering. We can only supply boards listed in the latest issue. Boards can only be supplied on a payment with order basis.

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Fridge Alarm	MAY '87	565	£3.00
EE Equaliser-Ioniser		566	£4.10
Mini Disco Light	JUNE '87	567	£3.00
Fermostat	JULY '87	569	£3.34
EE Buccaneer Metal Detector		570	£4.10
Monomix		571	£4.75
Super Sound Adaptor Main Board	AUG '87	572	£4.21
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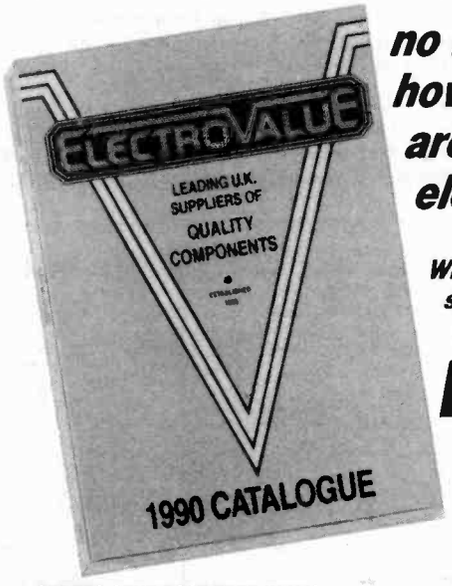

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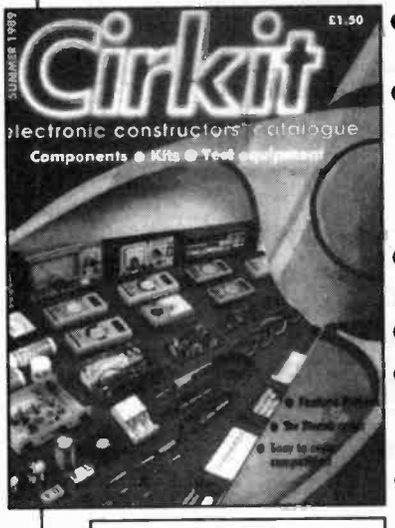

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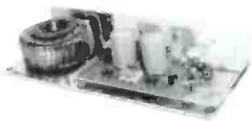

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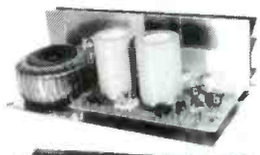

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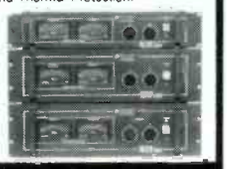

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