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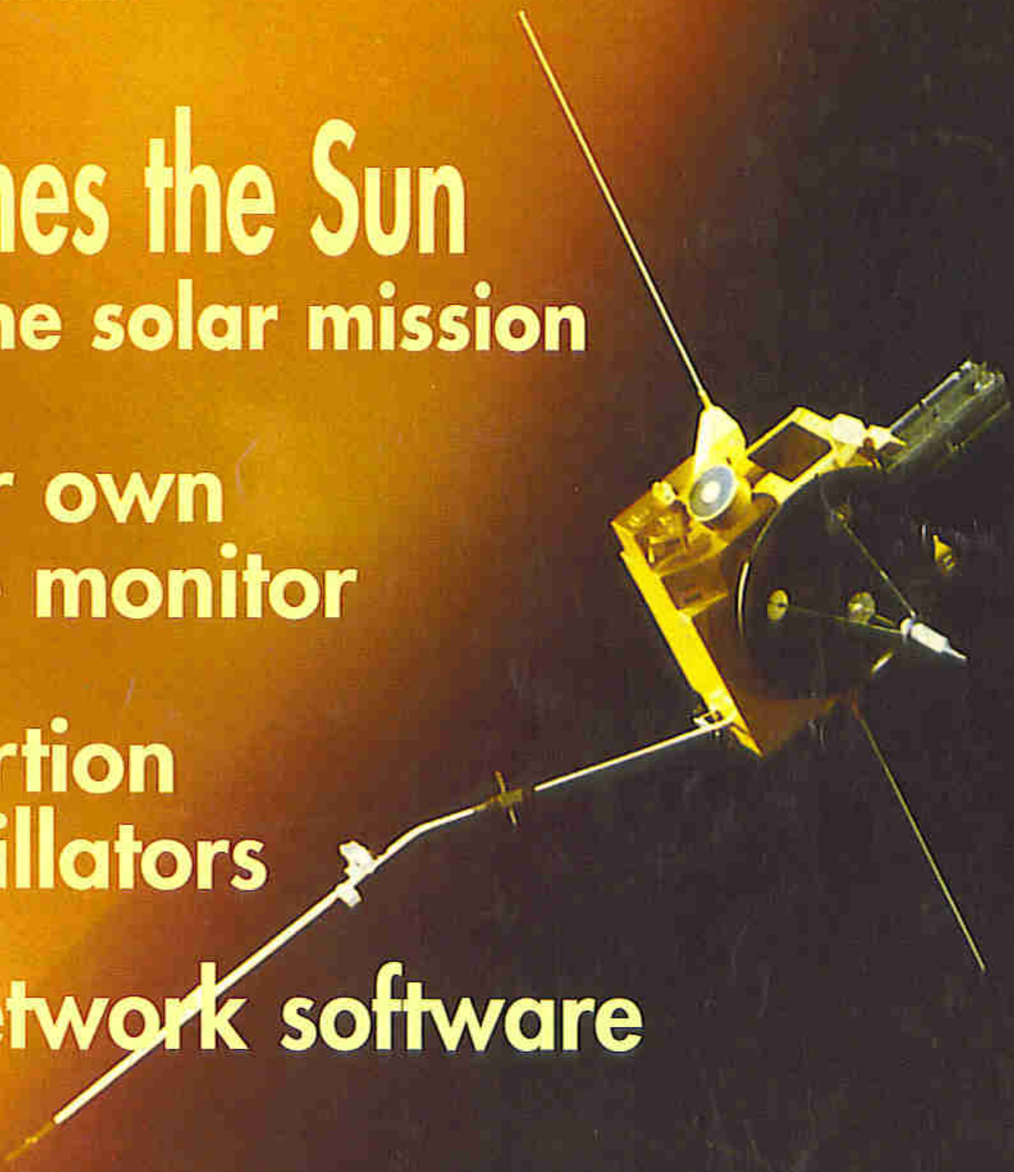

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- Electronic musical box
- Tri-colour frost alert
- Make a torch-finder

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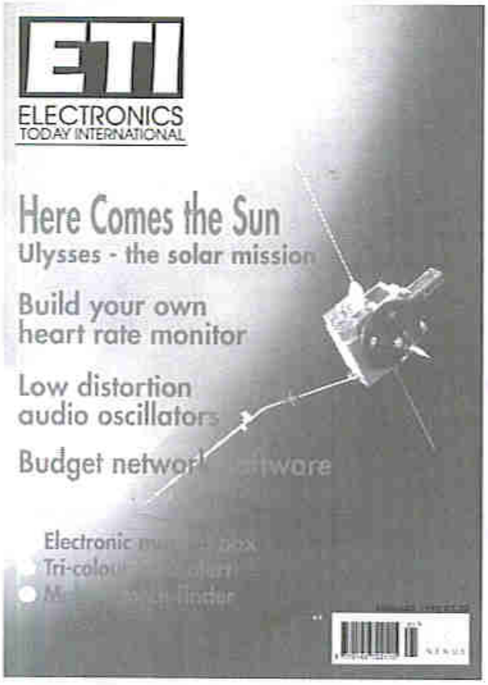
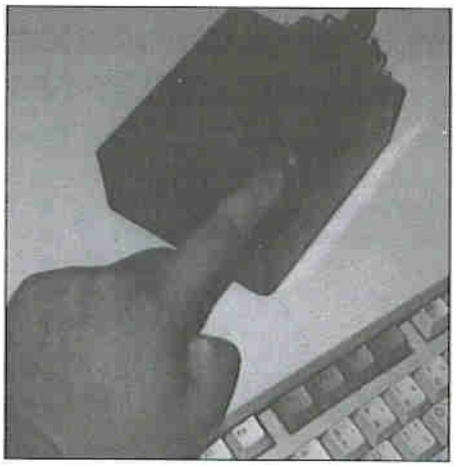
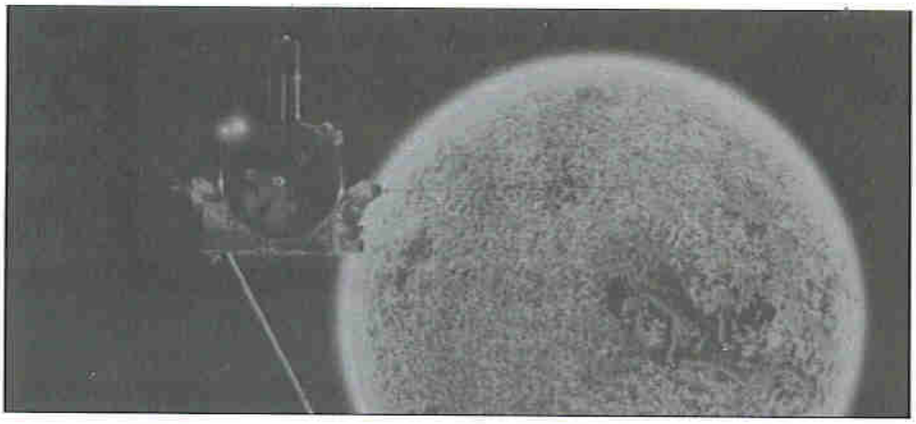


Volume 25 No.1

& Features Projects





Regulars

SURVEILLANCE TELESCOPE Superb Russian zoom telescope adjustable from 15x to 60x! complete with metal tripod (imposible to use without this on the higher settings) 66mm lense, leather carrying case £149 ref BAR69

RADIATION DETECTOR SYSTEM Designed to be wall mounted and connected into a PC, ideal for remote monitoring, whole building coverage etc. Complete with detector, cable and software. £19.95 ref BAR75

WIRELESS VIDEO BUG KIT Transmits video and audio signals from a minature CCTV camera (included) to any standard television! All the components including a PP3 battery will fit into a cigarette packet with the lens requiring a hole about 3mm diameter. Supplied with telescopic aerial but a piece of wire about 4" long will still give a range of up to 100 metres. A single PP3 will probably give less than 1 hours use. **£99** REF EP79. (probably not licensable!)

CCTV CAMERA MODULES 46X70X29mm, 30 grams, 12v 100mA, auto electronic shutter, 3.6mm F2 lens, CCIR, 512x492 pixels, video output is 1v p-p (75 ohm). Works directly into a scart or video input on a tv or video. IR sensitive. £79.95 ref EF137.

IR LAMP KIT Suitable for the above camera enables the camera to be used in total darkness! £5.99 ref EF138.

TANDATA TD1400 VIEWDATA Complete system comprising modem, infra red remote keyboard, psu, UHF and RGB output, phone lead, RS232 output, composite output. £9.95 ref BAR33.

MAGNETIC CARD READERS (Swipes) £9.95 Cased with flyleads, designed to read standard credit cards! they have 3 wires coming out of the head so they may write as well? complete with control elctronics PCB. just £9.95 ref BAR31

PANORAMIC CAMERA OFFER Takes double width photographs using standard 35mm film. Use in horizontal or vertical mode. Complete with strap £7.99 ref BAR1

COIN OPERATED TIMER KIT Complete with coinslot mechanism, adjustable time delay, relay output, put a coinslot on anything you like! TV,s, videos, fridges, drinks cupboards, HIFI, takes 50p's and £1 coins. DC operated, price just £7.99 ref BAR27

ZENITH 900 X MAGNIFICATION MICROSCOPE Zoom, metal construction, built in light, shrimp farm, group viewing screen, lots of accessories. £29 ref ANAYLT.

LUBITEL 166U Twin lens Russian 2 1/4" sq reflex camera supplied with two free rolls of colour film, flip up magnifier, 3 element f 4.5 lens. £19.99 ref BAR36.

AA NICAD PACK Pack of 4 tagged AA nicads £2.99 ref BAR34

PLASMA SCREENS 222x310mm, no data hence £4.99 ref BAR67

NIGHTSIGHTS Model TZS4 with infra red illuminator, views up to 75 metres in full darkness in infrared mode, 150m range, 45mm lens, 13 deg angle of view, focussing range 1.5m to infinity. 2 AA batteries required. 950g weight. £210 ref BAR61. 1 years warranty

FILIN-1 150m range, 15 deg angle of view, focusing 10m-infinity. £179 ref BAR62. A separate infra red light is available at £30 ref BAR63.

WHITE NIGHT SIGHTS Excellent professional night sight, small, hand held with camoflaged carrying case £325. 1 years warranty.

MEGA AIR MOVERS 375 cubic feet per min!, 240v 200 watt, 2,800 rpm, reversable, 7"x7" UK made, new, Aluminium, current list price about £180 ours? £29.95 ref BAR35.

LIQUID CRYSTAL DISPLAYS Bargain prices,

16 character 2 line, 65x14mm £1.99 ref SM1612A

16 character 2 line, 99x24mm £2.99 ref SM1623A

20 character 2 line, 83x19mm £3.99 ref SM2020A

16 character 4 line, 62x25mm £5.99 ref SMC1640A

TAL-1 110MM NEWTONIAN REFLECTOR TELESCOPE Russian. Superb astronomical 'scope, everything you need for some serious star gazing! up to 169x magnification. Send or fax for further details £249 ref TAL-1

GOT AN EXPENSIVE BIKE? You need one of our bottle alarms, they look like a standard water bottle, but open the top, insert a key to activate a motion sensor alarm built inside. Fits all standard bottle carriers, supplied with two keys. **SALE PRICE £7.99** REF SA32.

GOT AN EXPENSIVE ANYTHING? You need one of our cased vibration alarms, keyswitch operated, fully cased just fit it to anything from videos to caravans, provides a years protection from 1 PP3 battery, UK made. **SALE PRICE £4.99** REF SA33.

DAMAGED ANSWER PHONES These are probably beyond repair so just £4.99 each. BT response 200 machines. REF SA30.

COMMODORE GAMES CONSOLES Just a few of these left to clear at £5 ref SA31. Condition unknown.

COMPUTER DISC CLEAROUT We are left with a lot of software packs that need clearing so we are selling at disc value only! 50 discs for £4, thats just 8p each!!(our choice of discs) **£4** ref EP66

IBM PS2 MODEL 160Z CASE AND POWER SUPPLY Complete with fan etc and 200 watt power supply. **£9.95** ref EP67

DELL PC POWER SUPPLIES 145 watt, +5,-5,+12,-12, 150x150x85mm complete with switch, flyleads and IEC socket. **SALE PRICE £9.99** ref EP55

1.44 DISC DRIVES Standard PC 3.5" drives but returns so they will need attention **SALE PRICE £4.99** ref EP68

1.2 DISC DRIVES Standard 5.25" drives but returns so they will need attention **SALE PRICE £4.99** ref EP69

PP3 NICADS Unused but some storage marks. £4.99 ref EP52

DELL PC POWER SUPPLIES (Customer returns) Standard PC psu's complete with fly leads, case and fan, pack of two psus **SALE PRICE £5 FOR TWO!!** ref EP61

GAS HOBS AND OVENS Brand new gas appliances, perfect for small flats etc. Basic 3 burner hob **SALE PRICE £24.99** ref EP72. Basic small built in oven **SALE PRICE £79** ref EP73

BITS AND BOBS We have a quantity of cased modems, multiplexers etc different specs but ideal strippers. **£4** each ref EP63

RED EYE SECURITY PROTECTOR 1,000 watt outdoor PIR switch **SALE PRICE £9.99** ref EP57

ENERGY BANK KIT 100 6"x6" 6v 100mA panels, 100 diodes, connection details etc. £69.95 ref EF112.

PASTEL ACCOUNTS SOFTWARE, does everything for all sizes of businesses, includes wordprocessor, report writer, windowing, networkable up to 10 stations, multiple cash books etc. 200 page comprehensive manual. 90 days free technical support (0345-326009 try before you buy!) **Current retail price is £129, SALE PRICE** £9.95 ref SA12. SAVE £120!!!

WOLVERHAMPTON BRANCH NOW OPEN AT WORCESTER ST W'HAMPTON TEL 01902 22039

MINI MICRO FANS 12V 1.5" sq **SALE PRICE £2**. Ref SA13.

REUSEABLE HEAT PACKS Ideal for fishermen, outdoor enthusiasts elderly or infirm, warming food, drinks etc, defrosting pipes etc reuseable up to 10 times, lasts for up to 8 hours per go, 2,000wh energy, gets up to 90 degC. **SALE PRICE £9.95** REF SA29

12V 2AMP LAPTOP psu's 110x55x40mm (includes standard IEC socket) and 2m lead with plug. 100-240v IP. **£6.99** REF SA15.

PC CONTROLLED 4 CHANNEL TIMER Control (on/off times etc) up to 4 items (8A 240v each) with this kit. Complete with Software, relays, PCB etc. £25.99 Ref 95/26

COMPLETE PC 300 WATT UPS SYSTEM Top of the range UPS system providing protection for your computer system and valuable software against mains power fluctuations and cuts. New and boxed, UK made Provides up to 5 mins running time in the event of complete power failure to allow you to run your system down correctly. **SALE PRICE just £89.00.**

SOLAR PATH LIGHTS Low energy walklights powered by the sun! built in PIR so they work when you walk past. Includes solar panel & rechargeable bat. **SALE PRICE £19.95** REF EP62

BIG BROTHER PSU Cased PSU, 6v 2A output, 2m o/p lead, 1.5m input lead, UK made, 220v. **SALE PRICE £4.99** REF EP7

WANT TO MAKE SOME MONEY? STUCK FOR AN IDEA? We have collated 140 business manuals that give you information on setting up different businesses, you peruse these at your leisure using the text editor on your PC. Also included is a certificate enabling you to reproduce the manuals as much as you like! **SALE PRICE £14** REF EP74

RACAL MODEM BONANZA! 1 Racal MPS1223 1200/75 modem, telephone lead, mains lead, manual and comms software, the cheapest way onto the net! all this for just £13 ref DEC13.

4.5mw LASER POINTER. BRAND NEW MODEL NOW IN STOCK!, supplied in fully built form (looks like a nice pen) complete with handy pocket clip (which also acts as the on/off switch.) About 50 metres range! Runs on 2 AAA batteries. Produces thin red beam ideal for levels, gun sights, experiments etc. just £39.95 ref DEC49 TRADE PRICE £28 MIN 10 PIECES

BULL TENS UNIT Fully built and tested TENS (Transcutaneous Electrical Nerve Stimulation) unit, complete with electrodes and full instructions. TENS is used for the relief of pain etc in up to 70% of sufferers. Drug free pain relief, safe and easy to use, can be used in conjunction with analgesics etc. £49 Ref TEN/1

COMPUTER RS232 TERMINALS. (LIBERTY) Excellent quality modem units.(like wyse 50,s) 2xRS232, 20 function keys, 50 thro to 38,400 baud, menu driven port, screen, cursor, and keyboard setup menus. (18 menu's). £29 REF NOV4.

RUSSIAN MONOCULARS Amazing 20 times magnification, coated lenses, carrying case and shoulder strap £29.95 REF BAR73

PC PAL VGA TO TV CONVERTER Converts a colour TV into a basic VGA screen. Complete with built in psu, lead and s/ware.. Ideal for laptops or a cheap upgrade. Supplied in kit form for home assembly. **SALE PRICE £25** REF SA34

EMERGENCY LIGHTING UNIT Complete unit with 2 double bulb floodlights, built in charger and auto switch. Fully cased. 6v 8AH lead acid req'd. (secondhand) £4 ref MAG4P11.

SWINGFIRE GUIDED MISSILE WIRE. 4,200 metre reel of ultra thin 4 core insulated cable, 28lbs breaking strain, less than 1mm thick! Ideal alarms, intercoms, dolls house's etc. **£13.99** ref EP51

ELECTRIC CAR WINDOW DE-ICERS Complete with cable, plug etc **SALE PRICE JUST £4.99** REF SA28

ASTEC SWITCHED MODE PSU BM41012 Gives +5 @ 3.75A, +12@1.5A, -12@.4A. 230/110, cased, BM41012. £5.99 ref AUG6P3.

AUTO SUNCHARGER 155x300mm solar panel with diode and 3 metre lead fitted with a cigar plug. 12v 2watt. **£8.99** REF SA25.

TOP QUALITY CENTRIFUGAL MAINS MOTORS SALE PRICE2 FOR JUST £2.50 REF SA38

ECLATRON FLASH TUBE As used in police car flashing lights etc, full spec supplied, 60-100 flashes a min. **£6.99** REF SA15.

24v AC 96WATT Cased power supply. New. £9.99 REF SA40

MILITARY SPEC GEIGER COUNTERS Unused and straight from Her majesty's forces. **SALE PRICE £44** REF SA16

MICRODRIVE STRIPPERS Small cased tape drives ideal for stripping, lots of useful goodies including a smart case, and lots of components. **SALE PRICE JUST £4.99 FOR FIVE** REF SA26

SOLAR POWER LAB SPECIAL You get TWO 6"x6" 6v 130mA solar cells, 4 LED's, wire, buzzer, switch plus 1 relay or motor. Superb value kit **SALE PRICE JUST £4.99** REF SA27

RGB/CGA/EGA/TTL COLOUR MONITORS 12" in good condition. Back anodised metal case. **SALE PRICE £49** REF SA16

PLUG IN ACORN PSU 19v AC 14w , £2.99 REF MAG3P10

POWER SUPPLY fully cased with mains and o/p leads 17v DC 900mA output. Bargain price £5.99 ref MAG6P9

ACORN ARCHIMEDES PSU +5v @ 4.4A. on/off sw uncased, selectable mains input. 145x100x45mm **£3.99** REF MAG7P2

*SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

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250 PORTLAND ROAD, HOVE, SUSSEX . BN3 5QT. (ESTABLISHED 50 YEARS).

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TEL: 01273 203500

FAX 01273 323077

13.8V 1.9A PSU cased with leads. Just £9.99 REF MAG10P3

200 WATT INVERTER Converts 10-15v DC into either 110v or 240v AC. Fully cased 115x36x156mm, complete with heavy duty power lead, cigar plug, AC outlet socket. Auto overload shutdown, auto short circuit shut down, auto input over voltage shutdown, auto input under voltage shut down (with audible alarm), auto temp control, unit shuts down if overheated and sounds audible alarm. Fused reversed polarity protected, output frequency within 2%, voltage within 10%. A well built unit at an keen price. Just £64.99 ref AUG65.

UNIVERSAL SPEED CONTROLLER KIT Designed by us for the C5 motor but ok for any 12v motor up to 30A. Complete with PCB etc. A heat sink may be required. £17.00 **REF: MAG17**

COMPUTER COMMUNICATIONS PACK Kit contains 100m of 6 core cable, 100 cable clips, 2 line drivers with RS232 interfaces and all connectors etc. Ideal low cost method of communicating between PC's over a long distance. Complete kit £8.99.

VIEWDATA SYSTEMS made by Phillips, complete with internal 1200/75 modem, keyboard, psu etc RGB and composite outputs, menu driven, autodialler etc. **SALE PRICE £12.99** REF SA18

AIR RIFLES .22 As used by the Chinese army for training puposes, so there is a lot about! £39.95 Ref EF78. 500 pellets £4.50 ref EF80.

PLUG IN POWER SUPPLY SALE FROM £1.50 Plugs in to 13A socket with output lead. three types available, 9vdc 150mA £1.50 ref SA19, 9vdc 200mA £2.00 ref SA20, 6.5vdc 500mA £2 ref SA21.

VIDEO SENDER UNIT. Transmits both audio and video signals from either a video camera, video recorder, TV or Computer etc to any standard TV set in a 100' range! (tune TV to a spare channel) 12v DC op. Price is £15 **REF: MAG15** 12v psu is £5 extra **REF: MAG5P2**

***FM CORDLESS MICROPHONE** Small hand held unit with a 500' range! 2 transmit power levels. Reqs PP3 9v battery. Tuneable to any FM receiver. Price is £15 **REF: MAG15P1**

***MINATURE RADIO TRANSCEIVERS** A pair of walkie talkies with a range up to 2km in open country. Units measure 22x52x155mm. Including cases and earp'ces. 2xPP3 req'd. £30.00 pr **REF: MAG30**

***FM TRANSMITTER KIT** housed in a standard working 13A adapter!! the bug runs directly off the mains so lasts forever! why pay £700? or price is £15 REF: EF62 (kit) Transmits to any FM radio.

***FM BUG BUILT AND TESTED** superior design to kit. Supplied to detective agencies. 9v battery req'd. £14 REF: MAG14

TALKING COINBOX STRIPPER COMPLETE WITH COINSLOT MECHANISMS originally made to retail at £79 each, these units are designed to convert an ordinary phone into a payphone. The units have the locks missing and sometimes broken hinges. However they can be adapted for their original use or used for something else?? **SALE PRICE JUST £2.50** REF SA23

GAT AIR PISTOL PACK Complete with pistol, darts and pellets £12.95 Ref EF82B extra pellets (500) £4.50 ref EF80.

6"X12" AMORPHOUS SOLAR PANEL 12v 155x310mm 130mA. **SALE PRICE £4.99** REF SA24.

FIBRE OPTIC CABLE BUMPER PACK 10 metres for £4.99 ref MAG5P13 ideal for experimenters! 30 m for £12.99 ref MAG13P1

MIXED GOODIES BOX OF MIXED COMPONENTS WEIGHING 2 KILOS YOURS FOR JUST £5.99

4X28 TELESCOPIC SIGHTS Suitable for all air rifles, ground lenses, good light gathering properties. £19.95 ref R/7.

RATTLE BACKS Interesting things these, small piece of solid perspex like material that if you try to spin it on the desk it only spins one way! in fact if you spin it the 'wrong' way it stops of its own accord and go's back the other way! £1.99 ref GI/J01.

GYROSCOPES Remember these? well we have found a company that still manufactures these popular scientific toys, perfect gift or for educational use etc. £6 ref EP70

HYPOTHERMIA SPACE BLANKET 215x150cm aluminised foil blanket, reflects more than 90% of body heat. Also suitable for the construction of two way mirrors! £3.99 each ref O/L041.

LENSTATIC RANGER COMPASS Oil filled capsule, strong metal case, large luminous points. Sight line with magnifying viewer. 50mm dia, 86gm. £10.99 ref O/K604.

RECHARGE ORDINARY BATTERIES UP TO 10 TIMES! With the Battery Wizard! Uses the latest pulse wave charge system to charge all popular brands of ordinary batteries AAA, AA, C, D, four at a time! Led system shows when batteries are charged, automatically rejects unsuitable cells, complete with mains adaptor. BS approved. Price is £21.95 ref EP31.

TALKING WATCH Yes, it actually tells you the time at the press of a button. Also features a voice alarm that wakes you up and tells you what the time is! Lithium cell included. £7.99 ref EP26.

PHOTOGRAPHIC RADAR TRAPS CAN COST YOU YOUR LICENCE! The new multiband 2000 radar detector can prevent even the most responsible of drivers from losing their licence! Adjustable audible alarm with 8 flashing leds gives instant warning of radar zones. Detects X, K, and Ka bands, 3 mile range, 'over the hill' 'around bends' and 'rear trap facilities. micro size just 4.25"x2.5"x.75". Can pay for itself in just one day! £79.95 ref EP3.

SANYO NICAD PACKS 120mmx14mm 4.8v 270 maH suitable for cordless phones etc. Pack of 2 just £5 ref EP78.

3" DISCS As used on older Amstrad machines, Spectrum plus3's etc £3 each ref BAR400

STEREO MICROSOPES BACK IN STOCK Russian, 200x complete with lenses, lights, filters etc etc very comprehensive microscope that would normally be around the £700 mark, our price is just £299 (full money back guarantee) full details in catalogue. Ref 95/300

SOLAR POWERED CAR VENTILATOR Simply fits along the top of the glass in a side window and provides a constant supply of fresh air in hot sunny conditions! keeps your car cool in summer. £19.95 ref s/vent

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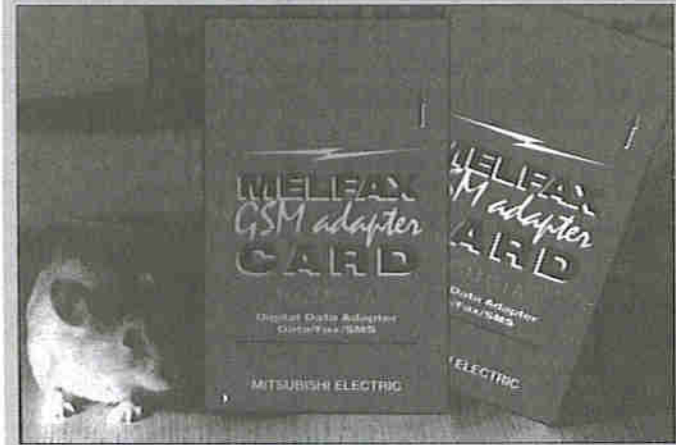
ETI ELECTRONICS TODAY INTERNATIONAL

News...

High Reliability PCMCIA GSM Fax Card



Mitsubishi Electric recently announced the introduction of its extremely low power consumption PCMCIA GSM MelFax card to provide fax and data modem facilities for portable computers and the fast growing GSM digital mobile phone network.

Currently, the GSM mobile phone service provides access to many countries worldwide, with users able to roam freely between these countries. The new Mitsubishi GSM MelFax card further enables GSM subscribers to use GSM networks for fax and data transfer (subject to fax and data service provision by network operators). Furthermore, the faxed data will benefit from the GSM network major advantages of clearer and more secure transmission.

Mitsubishi's GSM MelFax card provides the final link in the system, enabling GSM mobile phone subscribers to make the connection between phone and computer in the mobile office. Currently, the card is available to Motorola 8200, 7500 and Flare GSM phone users, as well as other manufacturers, GSM phones having the necessary connection for the PCMCIA card's lead.

The GSM MelFax card operates at 5V and consumes just 50mA. It is easy to use and can seamlessly provide transparent and non-transparent fax and data transfer at up to 9600bps, subject to the data rate limitations of the phone being used. Support is also provided for sleep and stop modes to conserve the all-important portable's battery power.

For communications with the host computer, the GSM MelFax card operates at DTE speeds up to 115,200bps and supports auto baud at all rates. Connection support is provided for ports Com 1 to Com 4, as well as for a host defined port. The PCMCIA Type II card features a buffered UART interface and is 16550A compatible.

For data transmission, the Mitsubishi GSM MelFax card supports the Enhanced Hayes AT command set as well as CCITT V.25bis, the EIA/TIA 578 Fax Class 1 and the de-facto Fax Class 2 standard. Error correction is provided during transmission via the GSM Radio Link Protocol.

The Mitsubishi GSM MelFax card comes complete with all necessary accessories for easy connection of the portable computer to the GSM network, including full Windows-based, easy to use software and the fax card connection to the data interface of the GSM phone. A specially designed bracket also neatly clips the GSM phone to the edge of the computer.

The new GSM MelFax card from Mitsubishi is compatible with PCMCIA notebook PCs from most leading manufacturers. The cards are manufactured to the highest standard with full quality control during manufacture far ahead of PCMCIA requirements. Notably, the Mitsubishi fax and data modem card for GSM is warranted for three years from date of purchase.

For further information, contact Mitsubishi Electric UK Ltd on 01707 276100.

Versatile Alarm Generation

Radamec NDC has introduced DARAD, an alarm generation and logging system.

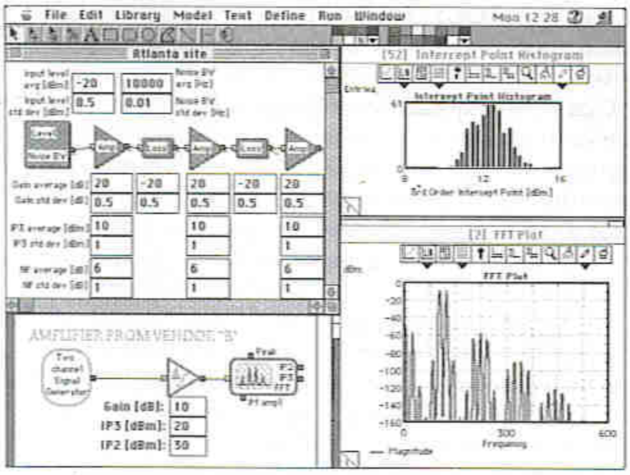
DARAD is module based and allows the easy configuration of over 300 channels, specific to user requirements. Alarms and events can be generated and logged within a two wire data loop of up to 1.5Km.

Modules are available for digital or analogue input, digital output, alarm display, memory storage and repeaters. Windows driven PCs or laptops may be used as masters or slave controllers.

Operator-friendly Windows based software allows modules to be set up and data assessed with ease.

DARAD is designed and manufactured in the UK by Radamec NDC. Tel: 01635 40528.

Rf Intercept Increases Design Confidence



Sample screen from Rf Intercept: Statistical and non-linear simulator of communication systems and devices RHR Laboratories, (905) 884-2392.

The design of reliable and cost-effective wireless or cable communication systems requires careful allocation of gains, noise figures and intercept points among the various system components. RfIntercept increases your design confidence by providing four ways of analysing communication systems and their components:

- Allocate channels for minimum intermodulation distortion interference.
- Reduce a chain of devices to an equivalent single device described by its gain, equivalent noise figure, second and third order intercept points.
- Obtain the statistical distributions of overall system gain, output level, noise figure, intercept point, signal-to-noise ratios, given the statistical distribution of the system components. Predict yield rates and quality indices such as Cpk; determine the statistical distributions of performance parameters. Statistical simulations for thousands of trials execute in seconds.
- Simulate the response of non-linear devices to arbitrary input, such as triple-beat distortion and channel loading simulations. Non-linear devices are characterised by their gain, second and third order intercept points when used in a matched, resistive environment. Analyze intermodulation distortion and harmonic content with up to 120 input signals.

RfIntercept can successfully analyze radio and microwave frequency receivers, exciters, feedforward amplifiers, balanced amplifiers, cable television distribution systems and microwave hops. The user interface is graphical; models are created by placing and connecting icons on the simulation page.

RfInterface includes simulation models for amplifiers, mixers, attenuators, filters, repeaters, power splitters and combiners, delay and phase shift. Simulated results can be viewed by various plotters, including a 160dB dynamic range spectrum analyzer based on the latest FFT algorithms. You can easily create your own custom models by using the versatile C-like development environment. Custom models are compiled and therefore execute with no speed penalty.

Both Macintosh and Windows versions of RfIntercept are available; simulation files are cross-platform compatible between the two versions. Price ranges from £390 to £995.

For further information, contact RHR Laboratories, 207 Harding Blvd. W., Richmond Hill, ONT L4C 8X6, Canada; (905) 884-2392; fax (905) 884-2392.

Mondex pilot figures

Well over half a million pounds of electronic cash has changed hands since the Mondex pilot was launched in Swindon last July. And with today's introduction of over 250 Mondex compatible payphones, the trend towards electronic cash is set to gather pace.

The conversion of Swindon payphones to allow Mondex cardholders access to their bank accounts to withdraw or deposit cash has effectively turned the town's phone boxes into cash machines.

"The payphone is the key to Mondex and we believe that having a cash machine on virtually every street corner and over 80 in shops is going to be a great attraction," said Mondex chairman Tony Surridge.

The electronic cash card has already been taken up by over 8,000 consumers, giving a total household penetration of 4% in just three months. And the Mondex compatible BT payphones which went live in October will add another key piece to the jigsaw.

BT director of payphones Bob Warner said: "One of the main benefits of Mondex over traditional cash is its convenience - and payphones are a big part of that.

"Since October Mondex customers effectively have over 250 more cash machines than they used to - virtually one on every street corner."

Initial figures from the pilot confirm that the convenience factor is a big draw for Mondex. Over 200 additional applications were received on September 23 alone, when car parks around the town started to accept the card and coins were no longer needed for 'pay and display' machines. More than 700 outlets in Swindon now take the card. The local bus service is now taking Mondex.

Other findings from the first three months confirm cash-on-a-card is steadily gaining in popularity - already well over £300,000 Mondex cash has been withdrawn by consumers and retailers have taken in more than £250,000.

Microwave Power Meter

Designed to cater for all RF and microwave power measurement requirements in the communications industry, the new Giga-tronics 8540B series power meters are now available in the UK from specialist distributor Sematron.

The single channel (8541B) and dual channel (8542B) units offer frequency coverage from 10MHz to 40GHz, handle power levels in the range -70dBm to +47dBm and are fully backward compatible with the extensively used 8540 series instruments and sensors. In addition, their measurement capability is considerably enhanced, on modulated waveforms, by the introduction of the two new Modulation Power Sensors (80401A/80402A) and the new installed firmware.

Giga-tronics, renowned innovators in advanced techniques for making power measurements using diode sensors, has incorporated a wide range of measuring functions in the new 8540B which are simply not available in any other single RF power meter. Included in these capabilities are burst average power, pulse modulated power, modulated average power and peak power. In addition to these new measurement modes, algorithms such as adaptive averaging have been developed to increase the measurement speed; with software enhancements such as anti-aliasing (dither sampling) introduced to improve the reliability and accuracy of measurements made on the complex signals typically found in communication and radar systems.

Giga-tronics have advanced further the principle of diode detector measurements in order to provide communication engineers with the measurement capability to meet their needs. The limitations of thermal detectors in terms of speed, dynamic range and their inability to make anything other than average power measurements on complex waveforms severely restricts their use in testing modern communications systems.

The Giga-tronics diode sensor technology, together with the new post-processing algorithms, now allows accurate measurements on burst and pulsed signals to be made without the need for prior knowledge of duty cycles, or being limited to constant duty cycles. The 8540B will make measurements on burst signals by sampling the input signal only when the burst is present. This not only increases the accuracy and reliability of the measurement, but also permits measurements to be made on a specific part of the burst, if required. This measurement capability is essential when testing the newly emerging digital communications systems such as GSM, CDMA and TDMA.

Flexibility in signal measurement is just one of the features which the 8540B incorporates to meet the needs of automated systems designers. High speed, reliability of measurement and wide dynamic range using a single detector combine to make it the leading systems power meter. Capable of delivering up to 200 readings/second over the GPIB, with up to 4,000 readings/second in buffered mode, the 8540B can reduce test times significantly.

Building arbitrary 'waits' into programmes is now a thing of the past with the new speed algorithms which automatically determine when the measurement has settled and only outputs a reading after this period. Faster measurements are also possible with the 90dB dynamic range power sensors which will permit most measurements to be made without a change of sensor, thereby eliminating the delays and errors caused when sensors need to be switched.

For further information, contact Sematron UK Ltd on 01734 819970.

Spectra plus 3.0

Strategic Test announces the release of SPECTRA PLUS 3.0, a new low-cost Windows program that provides the functionality of a dual channel FFT Analyser from any existing Windows compatible soundcard for only £395.

Spectra Plus provides all the measurement features normally found in professional instruments, such as FFT to 16384 block size, 1/3 Octave measurement with Flat/A/B/C weightings, Total Harmonic Distortion and Transfer Functions together with an amplitude calibration and microphone compensation facility. Digital filtering is available as a post-processing feature.

Signals can be acquired and displayed continuously, recorded to disc for later playback and post-analysis, or loaded from existing WAV files. Multiple displays can be configured and sized as required. Display options include: time series, phase, spectrum, spectrogram and 3-D surface plot. Cursors allow point measurements and customisable frequency markers can be assigned.

Reports can be generated on any Windows compatible printer and graphs pasted to the Windows Clipboard for inclusion within word processing software.

Spectra Plus supports the full sampling rates provided by the soundcard, typically to a maximum of 44.1 kHz. Dynamic range to 96dB is obtained from 16 bit soundcards.

Strategic Test are the exclusive suppliers for a range of data acquisition hardware, analysis and presentation software, FFT Analysers and expandable portable PCs manufactured in the USA and Germany.

For further information, contact: Strategic Test & Measurement Systems Ltd, 11 Ashton Road, Wokingham, Berks. RG4l IHL
Tel:01734 795950 Fax: 01734 795951

A Windows Genie for £99!

IMS recently announced the release of Version 2 of the Genie for Windows Data Acquisition and Control software package.

Genie is a flexible data acquisition and control software package designed to provide a simple to use front-end which allows users to quickly set up and configure engineering and scientific measurement and control applications without requiring in-depth programming knowledge.

The latest version of Genie incorporates over 35 extra features which include: Multi-screen display of up to 8 screens of graphical display; new operator interface and display icons; Networked operation; execution of external DLLs from within Genie; additional mathematical computation; enhanced speed of data acquisition; extended user programmable blocks; extended animation with conditional bitmaps as well as wave audio files; support for up to 9 serial ports; historical trending; alarm logging plus many more. In addition to the original Strategy Editor, Genie now also includes a Script Designer allowing Macro style programs to be created for more sophisticated Data Acquisition and Control strategies.

Genie also supports Windows Client & Server DDE (Dynamic Data Exchange) functions which allows data to be exported or imported in real time with other Windows applications such as spreadsheets or databases, as well as IPX based communications for networked data exchange between PCs running Genie.

As an introductory promotion, Genie will be available for a limited period for only £99! For existing users, there is a FREE upgrade for purchases of Genie made in 1995.

Shareware CD

Equinox Technologies recently launched its 'Electronics & Microcontroller Shareware CD', containing a wealth of PC & microcontroller shareware programs, demonstration versions of many popular CAD packages and a comprehensive collection of PC based Internet utilities.

The CD is aimed at both the professional engineer and keen enthusiast alike and features contributions from many major silicon manufacturers including Atmel, Philips, Intel and Siemens.

The CD contains over 25 Mbytes of data, divided into the following sections:

- PC shareware - general DOS utilities, editors, compression programs etc.
- Demonstrations of many commercial CAD packages.
- Microcontroller shareware utilities and applications software for a wide variety of microcontrollers.
- Internet Newsgroups - 2,500 articles from relevant newsgroups.
- PC Internet utilities - Newsreaders, Mail readers, Web-browsers plus many other utilities, all running under Windows.

The 'Electronics & Microcontroller CD' is priced at £30 plus P&P plus VAT. For further information, contact Equinox Technologies on 01204 492010

POWER AMPLIFIER MODULES-TURNTABLES-DIMMERS-LOUDSPEAKERS-19 INCH STEREO RACK AMPLIFIERS

★ PRICES INCLUDE V.A.T. ★ PROMPT DELIVERIES ★ FRIENDLY SERVICE ★ LARGE (A4) S.A.E., 60p STAMPED FOR CATALOGUE ★

OMP MOS-FET POWER AMPLIFIERS HIGH POWER, TWO CHANNEL 19 INCH RACK

THOUSANDS PURCHASED BY PROFESSIONAL USERS

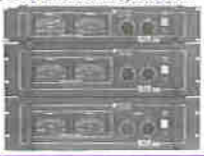
THE RENOWNED MXF SERIES OF POWER AMPLIFIERS

FOUR MODELS:- **MXF200** (100W + 100W) **MXF400** (200W + 200W) **MXF600** (300W + 300W) **MXF900** (450W + 450W)

ALL POWER RATINGS R.M.S. INTO 4 OHMS, BOTH CHANNELS DRIVEN

FEATURES: ★Independent power supplies with two toroidal transformers ★ Twin L.E.D. Vu meters ★ Level controls ★ Illuminated on/off switch ★ XLR connectors ★ Standard 775mV inputs ★ Open and short circuit proof ★ Latest Mos-Fets for stress free power delivery into virtually any load ★ High slew rate ★ Very low distortion ★ Aluminium cases ★ MXF600 & MXF900 fan cooled with D.C. loudspeaker and thermal protection.

USED THE WORLD OVER IN CLUBS, PUBS, CINEMAS, DISCOS ETC.



SIZES:- MXF200 W19"xH3½" (2U)xD11"
MXF400 W19"xH5¼" (3U)xD12"
MXF600 W19"xH5¼" (3U)xD13"
MXF900 W19"xH5¼" (3U)xD14¾"

PRICES:- MXF200 £175.00 MXF400 £233.85
MXF600 £329.00 MXF900 £449.15

SPECIALIST CARRIER DEL. £12.50 EACH

OMP XO3 STEREO 3-WAY ACTIVE CROSS-OVER

Advanced 3-Way Stereo Active Cross-Over, housed in a 19" x 1U case. Each channel has three level controls: bass, mid & top. The removable front fascia allows access to the programmable DIL switches to adjust the cross-over frequency: Bass-Mid 250/500/800Hz, Mid-Top 1.8/3/5KHz, all at 24dB per octave. Bass invert switches on each bass channel. Nominal 775mV input/output. Fully compatible with OMP rack amplifier and modules.

Price £117.44 + £5.00 P&P

STEREO DISCO MIXER SDJ3400SE

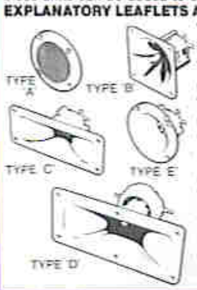
★ ECHO & SOUND EFFECTS★

STEREO DISCO MIXER with 2 x 7 band L & R graphic equalisers with bar graph LED Vu meters. **MANY OUTSTANDING FEATURES:-** including Echo with repeat & speed control, DJ Mic with talk-over switch, 6 Channels with individual faders plus cross fade, Cue Headphone Monitor. 8 Sound Effects. Useful combination of the following inputs:- 3 turntables (mag), 3 mics, 5 Line for CD, Tape, Video etc.

Price £144.99 + £5.00 P&P SIZE: 482 x 240 x 120mm

PIEZO ELECTRIC TWEETERS - MOTOROLA

Join the Piezo revolution! The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is **not** required these units can be added to existing speaker systems of up to 100 watts (more if two are put in series. **FREE EXPLANATORY LEAFLETS ARE SUPPLIED WITH EACH TWEETER.**



TYPE 'A' (KSN1036A) 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi apeakers. **Price £4.90 + 50p P&P.**

TYPE 'B' (KSN1005A) 3½" super horn for general purpose speakers, disco and P.A. systems etc. **Price £5.99 + 50p P&P.**

TYPE 'C' (KSN1016A) 2"x5" wide dispersion horn for quality Hi-Fi systems and quality discos etc. **Price £6.99 + 50p P&P.**

TYPE 'D' (KSN1025A) 2"x6" wide dispersion horn. Upper frequency response retained extending down to mid-range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. **Price £9.99 + 50p P&P.**

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. **Price £5.99 + 50p P&P.**

LEVEL CONTROL Combines, on a recessed mounting plate, level control and cabinet input jack socket. 85x85mm. **Price £4.10 + 50p P&P.**

ibl FLIGHT CASED LOUDSPEAKERS

A new range of quality loudspeakers, designed to take advantage of the latest speaker technology and enclosure designs. Both models utilize studio quality 12" cast aluminium loudspeakers with factory fitted grilles, wide dispersion constant directivity horns, extruded aluminium corner protection and steel ball corners, complimented with heavy duty black covering. The enclosures are fitted as standard with top hats for optional loudspeaker stands.

POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET FREQUENCY RESPONSE FULL RANGE 45Hz - 20KHz

***ibl* FC 12-100WATTS (100dB) PRICE £159.00 PER PAIR**
***ibl* FC 12-200WATTS (100dB) PRICE £175.00 PER PAIR**

SPECIALIST CARRIER DEL. £12.50 PER PAIR

OPTIONAL STANDS PRICE PER PAIR £49.00
Delivery £6.00 per pair

IN-CAR STEREO BOOSTER AMPS

THREE SUPERB HIGH POWER CAR STEREO BOOSTER AMPLIFIERS

150 WATTS (75 + 75) Stereo, 150W Bridged Mono
250 WATTS (125 + 125) Stereo, 250W Bridged Mono
400 WATTS (200 + 200) Stereo, 400W Bridged Mono

ALL POWERS INTO 4 OHMS

Features:
★ Stereo, bridgable mono ★ Choice of high & low level inputs ★ L & R level controls ★ Remote on-off ★ Speaker & thermal protection.

PRICES: 150W £49.99 250W £99.99 400W £109.95 P&P £2.00 EACH

OMP MOS-FET POWER AMPLIFIER MODULES

SUPPLIED READY BUILT AND TESTED.

These modules now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models are available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE that all models include toroidal power supply, integral heat sink, glass fibre P.C.B. and drive circuits to power a compatible Vu meter. All models are open and short circuit proof.

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS

OMP/MF 100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 45V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 123 x 60mm.
PRICE £40.85 + £3.50 P&P

OMP/MF 200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 155 x 100mm.
PRICE £64.35 + £4.00 P&P

OMP/MF 300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 60V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 330 x 175 x 100mm.
PRICE £81.75 + £5.00 P&P

OMP/MF 450 Mos-Fet Output power 450 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 385 x 210 x 105mm.
PRICE £132.85 + £5.00 P&P

OMP/MF 1000 Mos-Fet Output power 1000 watts R.M.S. into 2 ohms, 725 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 422 x 300 x 125mm.
PRICE £259.00 + £12.00 P&P

NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.

LOUDSPEAKERS

LARGE SELECTION OF SPECIALIST LOUDSPEAKERS AVAILABLE, INCLUDING CABINET FITTINGS, SPEAKER GRILLES, CROSS-OVERS AND HIGH POWER, HIGH FREQUENCY BULLETS AND HORNS, LARGE (A4) S.A.E. (60p STAMPED) FOR COMPLETE LIST.

McKenzie and Fane Loudspeakers are also available.

EMINENCE:- INSTRUMENTS, P.A., DISCO, ETC

ALL EMINENCE UNITS 8 OHMS IMPEDANCE

8" 100 WATT R.M.S. ME8-100 GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO.
RES. FREQ. 72Hz, FREQ. RESP. TO 4KHz, SENS 97dB. **PRICE £32.71 + £2.00 P&P**

10" 100 WATT R.M.S. ME10-100 GUITAR, VOCAL, KEYBOARD, DISCO, EXCELLENT MID.
RES. FREQ. 71Hz, FREQ. RESP. TO 7KHz, SENS97dB. **PRICE £33.74 + £2.50 P&P**

10" 200 WATT R.M.S. ME10-200 GUITAR, KEYB'D, DISCO, VOCAL, EXCELLENT HIGH POWER MID.
RES. FREQ. 65Hz, FREQ. RESP. TO 3.5KHz, SENS 99dB. **PRICE £43.47 + £2.50 P&P**

12" 100 WATT R.M.S. ME12-100LE GEN. PURPOSE, LEAD GUITAR, DISCO, STAGE MONITOR.
RES.FREQ. 49Hz, FREQ. RESP. TO 6KHz, SENS 100dB. **PRICE £35.64 + £3.50 P&P**

12" 100 WATT R.M.S. ME12-100LT (TWIN CONE) WIDE RESPONSE, P.A., VOCAL, STAGE MONITOR. RES. FREQ 42Hz, FREQ. RESP. TO 10KHz, SENS 98dB. **PRICE £36.67 + £3.50 P&P**

12" 200 WATT R.M.S. ME12-200 GEN. PURPOSE, GUITAR, DISCO, VOCAL, EXCELLENT MID.
RES. FREQ. 58Hz, FREQ. RESP. TO 6KHz, SENS 98dB. **PRICE £46.71 + £3.50 P&P**

12" 300 WATT R.M.S ME12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARD, DISCO ETC.
RES. FREQ. 47Hz, FREQ. RESP. TO 5KHz, SENS 103dB. **PRICE £70.19 + £3.50 P&P**

15" 200 WATT R.M.S. ME15-200 GEN. PURPOSE BASS, INCLUDING BASS GUITAR.
RES. FREQ. 46Hz, FREQ. RESP. TO 5KHz, SENS 99dB. **PRICE £50.72 + £4.00 P&P**

15" 300 WATT R.M.S. ME15-300 HIGH POWER BASS, INCLUDING BASS GUITAR.
RES. FREQ. 39Hz, FREQ. RESP. TO 3KHz, SENS 103dB. **PRICE £73.34 + £4.00 P&P**

EARBENDERS:- HI-FI, STUDIO, IN-CAR, ETC

ALL EARBENDER UNITS 8 OHMS (Except EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)

BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND

8" 50watt EB8-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 7KHz SENS 97dB. **PRICE £8.90 + £2.00 P&P**

10" 50WATT EB10-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS. 99dB. **PRICE £13.65 + £2.50 P&P**

10" 100WATT EB10-100 BASS, HI-FI, STUDIO.
RES. FREQ. 35Hz, FREQ. RESP. TO 3KHz, SENS 96dB. **PRICE £30.39 + £3.50 P&P**

12" 100WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO.
RES. FREQ. 26Hz, FREQ. RESP. TO 3 KHz, SENS 93dB. **PRICE £42.12 + £3.50 P&P**

FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND

5¼" 60WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC.
RES. FREQ. 63Hz, FREQ. RESP. TO 20KHz, SENS 92dB. **PRICE £9.99 + £1.50 P&P**

6½" 60WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC.
RES. FREQ. 38Hz, FREQ. RESP. TO 20KHz, SENS 94dB. **PRICE £10.99 + 1.50 P&P**

8" 60WATT EB8-60TC (TWIN CONE) HI-FI, MILTI-ARRAY DISCO ETC.
RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 89dB. **PRICE £12.99 + £1.50 P&P**

10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC.
RES. FREQ. 35Hz, FREQ. RESP. TO 12KHz, SENS 98dB. **PRICE £16.49 + £2.00 P&P**

TRANSMITTER HOBBY KITS

PROVEN TRANSMITTER DESIGNS INCLUDING GLASS FIBRE PRINTED CIRCUIT BOARD AND HIGH QUALITY COMPONENTS COMPLETE WITH CIRCUIT AND INSTRUCTIONS

3W TRANSMITTER 80-108MHz, VARICAP CONTROLLED PROFESSIONAL PERFORMANCE, RANGE UP TO 3 MILES, SIZE 38 x 123mm, SUPPLY 12V @ 0.5AMP.
PRICE £14.85 + £1.00 P&P

FM MICRO TRANSMITTER 100-108MHz, VARICAP TUNED, COMPLETE WITH VERY SENS FET MIC, RANGE 100-300m, SIZE 56 x 46mm, SUPPLY 9V BATTERY.
PRICE £8.80 + £1.00 P&P

PHOTO: 3W FM TRANSMITTER

POSTAL CHARGES PER ORDER £1.00 MINIMUM. OFFICIAL ORDERS FROM SCHOOLS, COLLEGES, GOVT. BODIES, PLCs ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER. VISA AND ACCESS ACCEPTED BY POST, PHONE OR FAX.

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B.K. ELECTRONICS

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PORTABLE X RAY MACHINE PLANS Easy to construct plans on a simple and cheap way to build a home X-ray machine! Effective device, X-ray sealed assemblies can be used for experimental purposes. Not a toy or for minors! £6/set. Ref F/XP1.

TELEKINETIC ENHANCER PLANS Mystify and amaze your friends by creating motion with no known apparent means or cause. Uses no electrical or mechanical connections, no special gimmicks yet produces positive motion and effect. Excellent for science projects, magic shows, party demonstrations or serious research & development of this strange and amazing phychic phenomenon. £4/set Ref F/TKE1.

ELECTRONIC HYPNOSIS PLANS & DATA This data shows several ways to put subjects under your control. Included is a full volume reference text and several construction plans that when assembled can produce highly effective stimuli. This material must be used cautiously. It is for use as entertainment at parties etc only, by those experienced in its use. £15/set. Ref F/EH2.

GRAVITY GENERATOR PLANS This unique plan demonstrates a simple electrical phenomena that produces an anti-gravity effect. You can actually build a small mock spaceship out of simple materials and without any visible means- cause it to levitate. £10/set Ref F/GRA1.

WORLDS SMALLEST TESLA COIL/LIGHTENING DISPLAY GLOBE PLANS Produces up to 750,000 volts of discharge, experiment with extraordinary HV effects, 'Plasma in a jar', St Elmo's fire, Corona, excellent science project or conversation piece. £5/set Ref F/BTC1/LG5.

COPPER VAPOUR LASER PLANS Produces 100mw of visible green light. High coherency and spectral quality similar to Argon laser but easier and less costly to build yet far more efficient. This particular design was developed at the Atomic Energy Commision of NEGEV in Israel. £10/set Ref F/CVL1.

VOICE SCRAMBLER PLANS Minature solid state system turns speech sound into indecipherable noise that cannot be understood without a second matching unit. Use on telephone to prevent third party listening and bugging. £6/set Ref F/VS9.

PULSED TV JOKER PLANS Little hand held device utilises pulse techniques that will completely disrupt TV picture and sound! works on FM too! DISCRETION ADVISED. £8/set Ref F/TJ5.

BODYHEAT TELESCOPE PLANS Highly directional long range device uses recent technology to detect the presence of living bodies, warm and hot spots, heat leaks etc. Intended for security, law enforcement, research and development, etc. Excellent security device or very interesting science project. £8/set Ref F/BHT1.

BURNING, CUTTING CO2 LASER PLANS Projects an invisible beam of heat capable of burning and melting materials over a considerable distance. This laser is one of the most efficient, converting 10% input power into useful output. Not only is this device a workhorse in welding, cutting and heat processing materials but it is also a likely candidate as an effective directed energy beam weapon against missiles, aircraft, ground-to-ground, etc. Particle beams may very well utilize a laser of this type to blast a channel in the atmosphere for a high energy stream of neutrons or other particles. The device is easily applicable to burning and etching wood, cutting, plastics, textiles etc £12/set Ref F/LC7.

MYSTERY ANTI GRAVITY DEVICE PLANS Uses simple concept. Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or science project. £6/ set Ref F/ANT1K.

ULTRASONIC BLASTER PLANS Laboratory source of sonic shock waves. Blow holes in metal, produce 'cold' steam, atomize liquides. Many cleaning uses for PC boards, jewlery, coins, small parts etc. £6/set Ref F/ULB1.

ULTRAHIGH GAIN AMP/STETHOSCOPIC MIKE/SOUND AND VIBRATION DETECTOR PLANS Ultrasensitive device enables one to hear a whole new world of sounds. Listen through walls, windows, floors etc. Many applications shown, from law enforcement, nature listening, medical heartbeat, to mechanical devices. £6/set Ref F/HGA7.

ANTI DOG FORCE FIELD PLANS Highly effective circuit produces time variable pulses of accoustical energy that dogs cannot tolerate £6/set Ref F/DOG2

LASER BOUNCE LISTENER SYSTEM PLANS Allows you to hear sounds from a premises without gaining access. £12/set Ref F/LLIST1

CRAWLING INSECT ROASTER PLANS Harmless high frequency energy pulses destroy pests as they crawl into the energy field! £4/set Ref F/RCR1

LASER LIGHT SHOW PLANS Do it yourself plans show three methods. £6 Ref F/LLS1

PHASOR BLAST WAVE PISTOL SERIES PLANS Handheld, has large transducer and battery capacity with external controls. £6/set Ref F/PSP4

INFINITY TRANSMITTER PLANS Telephone line grabber/ room monitor. The ultimate in home/office security and safety! simple to use! Call your home or office phone, push a secret tone on your telephone to access either: A) On premises sound and voices or B) Existing conversation with break-in capability for emergency messages. £7 Ref F/TELEGRAB.

BUG DETECTOR PLANS Is that someone getting the goods on you? Easy to construct device locates any hidden source of radio energy! Sniffs out and finds bugs and other sources of bothersome interference. Detects low, high and UHF frequencies. £5/set Ref F/ BD1.

ELECTROMAGNETIC GUN PLANS Projects a metal object a considerable distance-requires adult supervision £5 ref F/EML2.

ELECTRIC MAN PLANS, SHOCK PEOPLE WITH THE TOUCH OF YOUR HAND! £5/set Ref F/EMA1.

PARABOLIC DISH MICROPHONE PLANS Listen to distant sounds and voices, open windows, sound sources in 'hard to get' or hostile premises. Uses satellite technology to gather distant sounds and focus them to our ultra sensitive electronics. Plans also show an optional wireless link system. £8/set ref F/PM5

2 FOR 1 MULTIFUNCTIONAL HIGH FREQUENCY AND HIGH DC VOLTAGE, SOLID STATE TESLA COIL AND VARIABLE 100,000VDC OUTPUT GENERATOR PLANS Operates on 9-12vdc, many possible experiments. £10 Ref F/HVM7/ TCL4

WOLVERHAMPTON BRANCH NOW OPEN AT WORCESTER ST W'HAMPTON TEL 01902 22039

MINI FM TRANSMITTER KIT Very high gain preamp, supplied complete with FET electret microphone. Designed to cover 88-108 Mhz but easily changed to cover 63-130 Mhz. Works with a common 9v (PP3) battery. 0.2W RF. £7 Ref 1001.

ELECTRONIC SIREN KIT Impressive 5 watt power output. Ideal for car/bike alarm etc. 6-12v dc max current 1A, 1.2khz £6 Ref 1003.

3-30V POWER SUPPLY KIT Variable, stabilized power supply for lab use. Short circuit protected, suitable for profesional or amateur use 24v 3A transformer is needed to complete the kit. £14 Ref 1007.

1 WATT FM TRANSMITTER KIT Supplied with piezo electric microphone 8-30vdc. At 25-30v you will get nearly 2 watts! £12 ref 1009.

FM/AM SCANNER KIT Well not quite, you have to turn the knob your self but you will hear things on this radio that you would not hear on an ordinary radio (even TV). Covers 50-160mhz on both AM and FM. Built in 5 watt amplifier, inc speaker. £15 ref 1013.

MOSQUITO REPELLER KIT Modern way to keep midges at bay! Runs for about a month on one 1.5v battery. £7 Ref 1015.

3 CHANNEL SOUND TO LIGHT KIT Wireless system, mains operated, separate sensitivity adjustment for each channel, 1,200 w power handling, microphone included. £14 Ref 1014.

MOTORBIKE/CYCLE TREMBLER ALARM KIT Adjustable sensitivity, preset alarm time, auto reset. Could be connected to horn etc. £12 Ref 1011.

0-6 MINUTE TIMER KIT adjustable, will switch up to 2A mains. Perfect for alarms, photography, etc. £7 Ref 1020.

4 WATT FM TRANSMITTER KIT Small but powerful FM transmitter, 3 RF stages, microphone and audio preamp included. £20 Ref 1028.

STROBE LIGHT KIT Adjustable from 1-60 hz (a lot faster than conventional strobes). Mains operated. £16 Ref 1037.

ULTRASONIC RADAR KIT Ideal as a movement detector with a range of about 10 metres, automate your cat flap! 12v dc. £15 Ref 1049.

LIQUID LEVEL DETECTOR KIT Useful for tanks, ponds, baths, rain alarm, leak detector etc. Will switch 2A mains. £5 Ref 1081.

COMBINATION LOCK KIT 9 key, programmable, complete with keypad, will switch 2A mains. 9v dc operation. £10 ref 1114.

PHONE BUG DETECTOR KIT This device will warn you if somebody is eavesdropping on your line. £6 ref 1130.

ROBOT VOICE KIT Interesting circuit that distorts your voice! adjustable, answer the phone with a different voice! 12vdc £9 ref 1131

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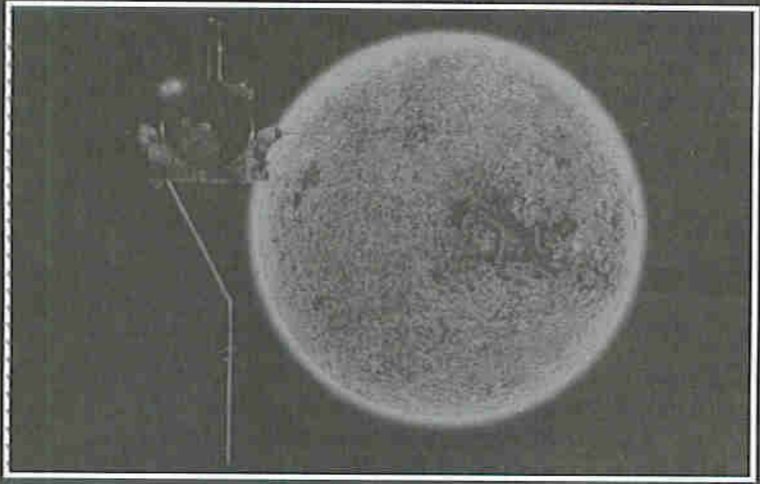


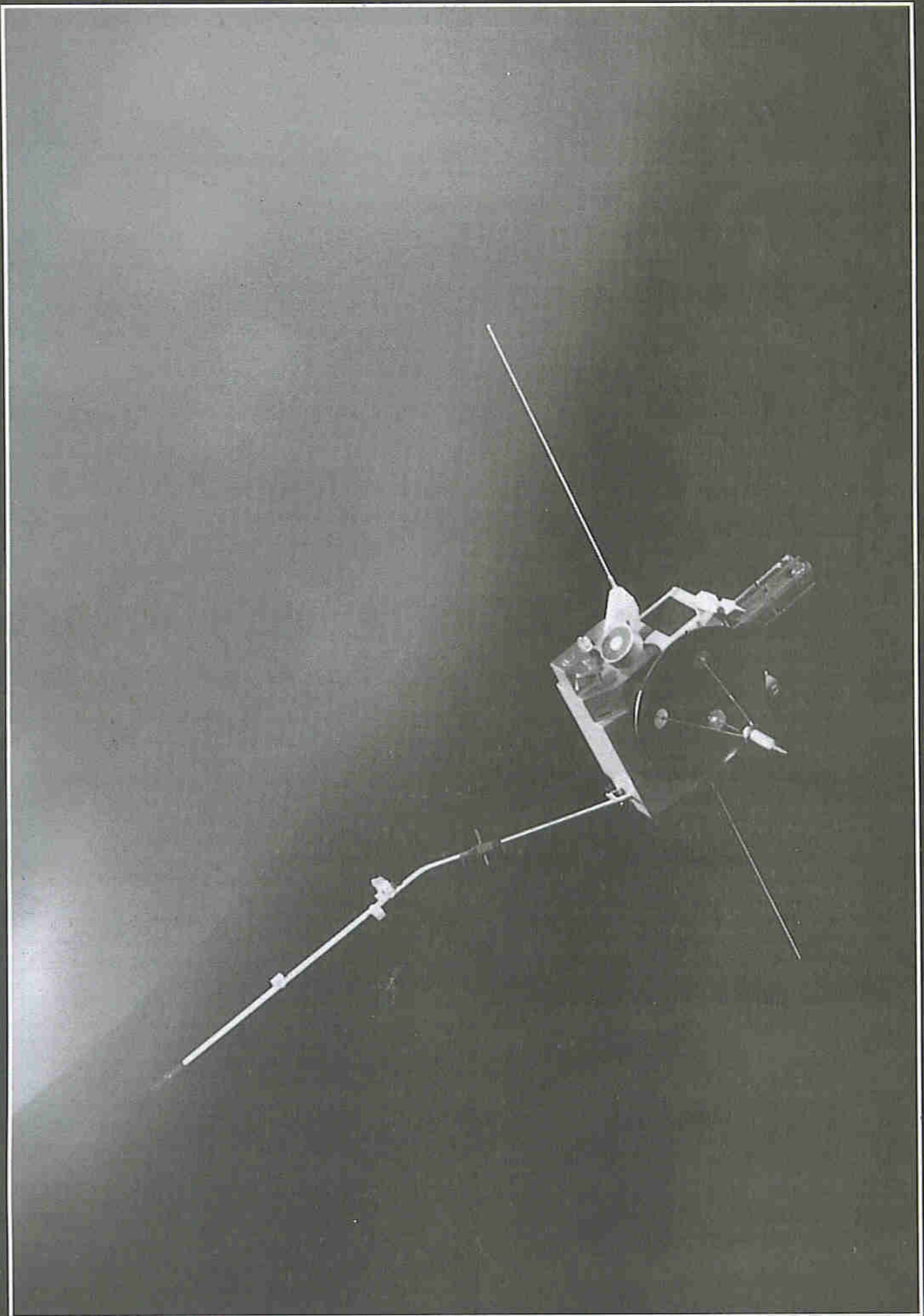
Figure 5. Artist's impressions of Ulysses in its solar mission.
Left (Photo:ESA) Right (Photo:NASA)

Douglas Clarkson takes a look at a joint NASA/European Space Agency project to build and launch a satellite to explore the surface of the sun

Ulysses: *The Solar Mission*

Figure 1. Solar activity as captured by a telescope on board NASA's Skylab orbiting station on August 1973. The picture, taken in the ultraviolet spectrum, shows details of the chromosphere, a layer of gas in the outer part of the sun's atmosphere.

Inset: Picture taken of the sun by the JPL Soft X-Ray camera while on board the Japanese orbiting solar observatory, Yohkoh.
(Photo NASA)



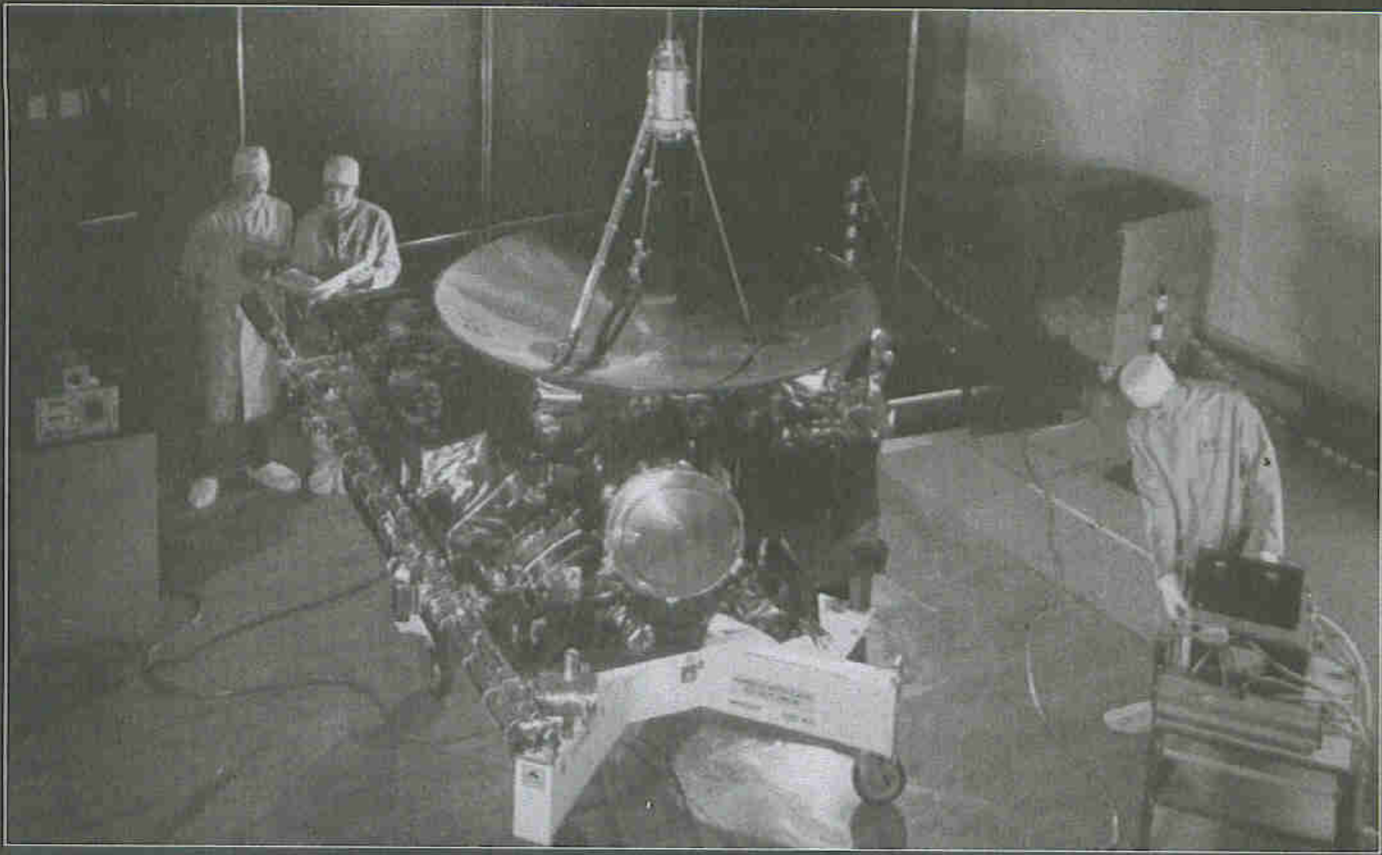


Figure 4. Ulysses satellite under test at ESTEC, Europe. (Photo:ESA)

The sun is very much at the centre of things in the solar system. It provides heat and light and its gravitational field binds all the planets of the solar system together as it were in some complex clockwork mechanism. Figure 1 shows solar activity as captured by a telescope on board NASA's Skylab orbiting station on August 1973. The picture, taken in the ultraviolet spectrum, shows details of the chromosphere, a layer of gas in the outer part of the sun's atmosphere. The apparently porous texture of the solar disk is the result of granules and supergranules which are convection cells formed of hot rising gas and cooler descending gas. In the upper part of the picture, a giant flame-like solar prominence spews out material which streams along the outlines of magnetic fields.

The inset in the image is a picture taken of the sun by the JPL Soft X-Ray camera while on board the Japanese orbiting solar observatory, Yohkoh. However, while earth-based telescopes can observe events from the plane of the ecliptic, little is known of the influence of the sun in space within its 'polar' regions i.e. in excess of 70 degrees of latitude.

To remedy this deficiency in our knowledge of the sun, the Ulysses mission - a joint NASA/ESA project - sought to place a satellite in orbit 'over' the poles of the sun. Figure 2 shows the nature of the gravity assist manoeuvre in relation to the sun and other planets of the solar system required to place Ulysses in polar 'solar' orbit. The timetable of the flightpath of Ulysses is shown in figure 3. Ulysses will, in fact, reach a maximum solar latitude of 80.2 degrees and spend at least 234 days above 70 degrees latitude during the prime mission.

The Ulysses satellite under test at ESTEC, Europe - looking very much like a patient in an operating theatre - is shown in Fig.4. Ulysses was launched by the STS-41 mission on the shuttle Discovery on October 6th, 1990. Leak problems in the hydrogen fuel system initially delayed the mission, though, fortunately, a postponement by a period of 13 months to the next launch window was avoided.

The manoeuvre to change axis of rotation of a satellite from being in the plane of the solar system to one at right angles takes an immense amount of energy. This manoeuvre could be undertaken, however, with less energy using gravity assist to reach Jupiter. The three stage booster rocket supplied by NASA sent Ulysses initially to Jupiter at a speed of 54,959 km/hr - the fastest man-made departure from the earth so far.

The gravity assist encounter at Jupiter turned the satellite into its trans-polar solar orbit with a period of around 6.2 years. The closest approach of the satellite to the sun (perihelion) is 1.3 Astronomical Units (A.U.) and the furthest distance (aphelion) 5.4 A.U. In undergoing the gravity assist, the craft had to pass through the magnetosphere of Jupiter and experience high levels of radiation.

Although the plane of the ecliptic had been investigated before by other craft - such as the Pioneer and the Voyager probes, the more highly developed resolution and accuracy of Ulysses's instruments provided valuable new information of the solar wind conditions on the 16-month journey out to Jupiter.

During February 2nd some of the 14 different instruments aboard Ulysses indicated that Jupiter's magnetosphere was larger than that which had been encountered when the Voyager spacecraft probed the planet in 1979 and was expanding and contracting in response to changes in the solar wind. The craft also detected that ions from the solar wind are penetrating deep into Jupiter's magnetosphere. The instrumentation also determined that Io, Jupiter's active volcanic moon, was a source of ions to a large portion of the main magnetosphere. Streams of dust were also detected at around 5 A.U. which were located in highly inclined orbits.

Ulysses has two key periods of observation during each orbit round the sun - the south polar pass and the north polar pass. The first solar pass was successfully observed during June - November 1994. The second solar pass, the one which is the subject of current observational interest, will take place during June - September 1995. Figure 5 shows an artist's impressions of Ulysses in its solar mission.

The scientific payload

The range of scientific experiments carried by Ulysses is outlined in the following table:

Investigation	Principal Investigator
Magnetic field	Imperial College, London
Solar Wind Plasma	Los Almos National Lab. (USA)
Solar wind ion composition	University Berne (CH) and Univ. Maryland. (USA)
Unified radio and plasma waves	GSFC (USA) + others
Energetic particles and interstellar neutral gas	Imperial College (UK) + others
Low energy ions and electrons	Bell Labs + others
Comic Rays and solar particles	University Chicago (USA)
Solar X-ray & cosmic gamma bursts	UC Berkley (USA) + others
Cosmic dust	MPE I(Germany) + others

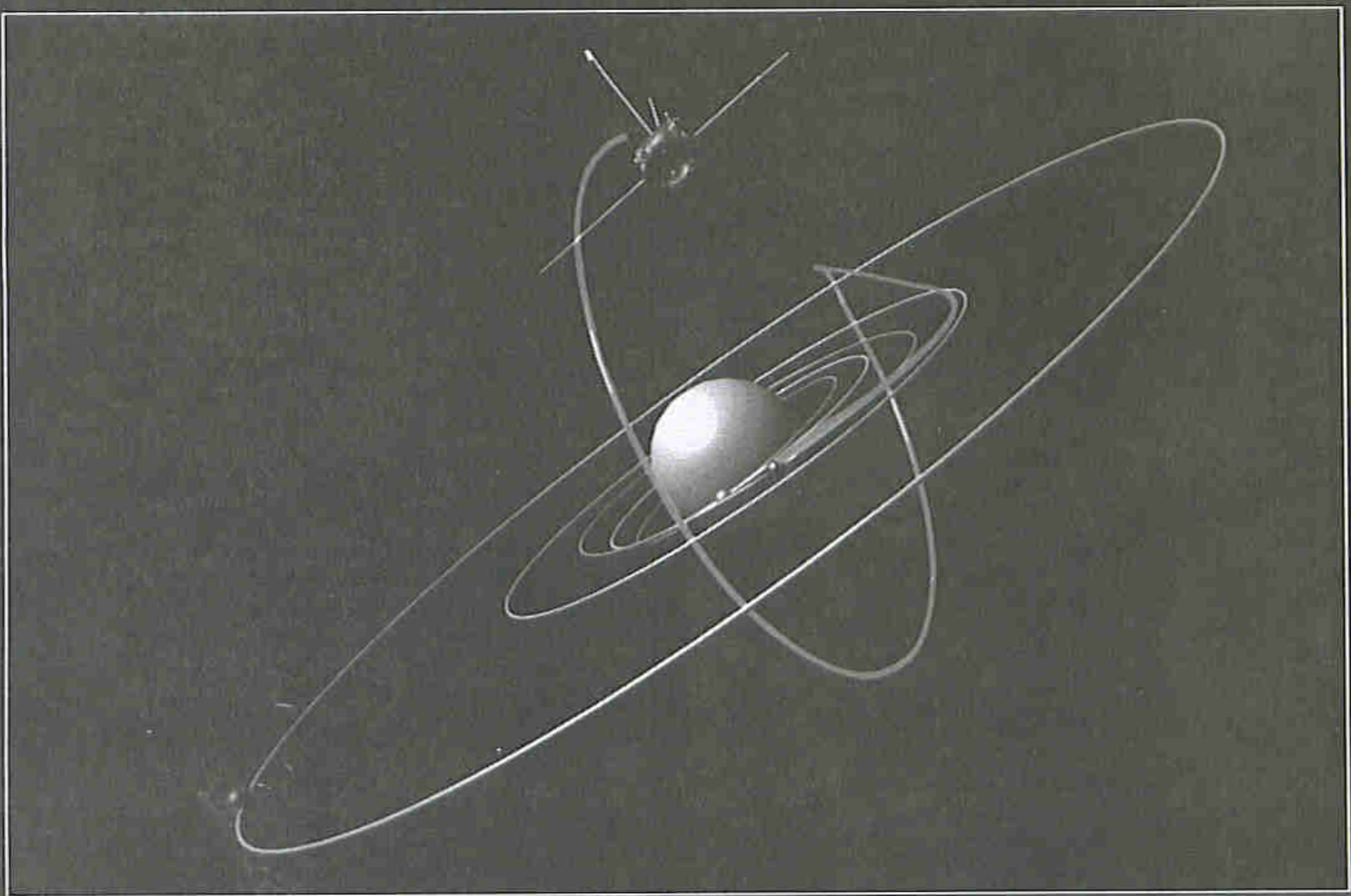
In addition, a separate set of four experiments dedicated to radio-science and interdisciplinary studies investigated coronal sounding, gravitational waves, directional discontinuities and mass loss and ion composition.

The range of instruments have performed well during the present extent of the Ulysses mission. Satellite function has only been interrupted on four occasions when a 'disconnect non-essential loads' status was detected during earth pointing manoeuvres which resulted in a cessation of scientific data collection. On each occasion, less than a day's extent of data was lost.

One problem which was encountered during the mission was a nutation-like motion of the 7.5 metre axial radio wave experiment antenna which was detected shortly after launch from the Space Shuttle. This motion was thought to have arisen due to alternate solar heating of the antenna as the main craft spun on its axis. This problem was solved by 'parking' the antenna in the permanent shadow of the craft. An additional ground station was required to provide sufficient control over Ulysses to stabilise its orientation. Communication facilities at the ESA launch facility at Kourou were enhanced to provide the necessary additional link.

In a mission such as Ulysses, good coverage of the available data is required to provide sufficient scientific information to develop and test models of solar activity. Excellent scientific data has typically been received from Ulysses in excess of 95% of the time since the launch. The data has been extensively reported in the mainstream scientific journals such as Geophysical Research Letters, Astronomy and Astrophysics Supplement, Science and Planetary and Space Science.

Nature of the gravity assist manoeuvre in relation to the sun and other planets of the solar system.(Photo ESA)



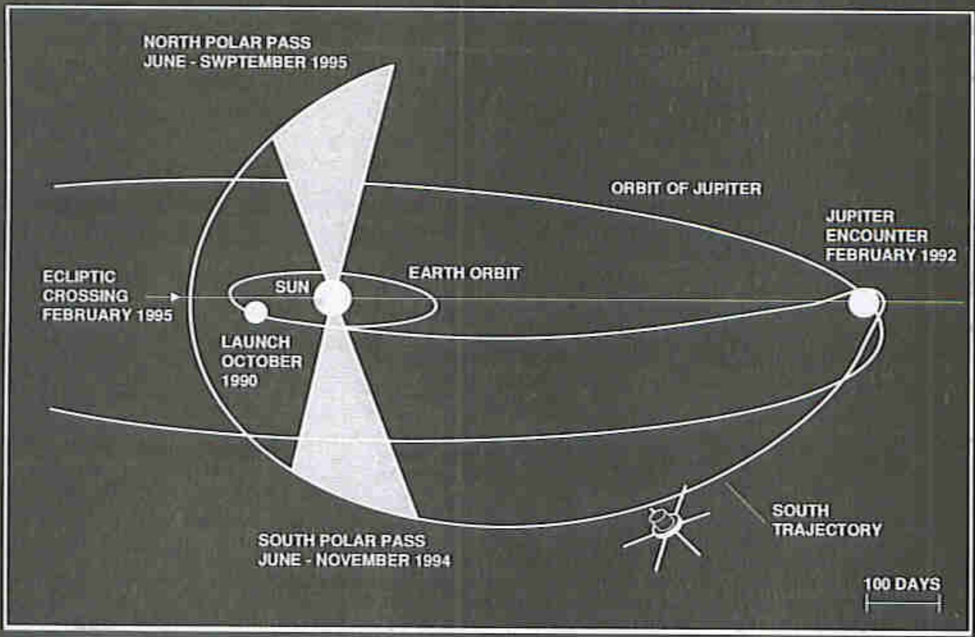


Figure 3. Trajectory of the Ulysses mission showing the periods of polar observation.

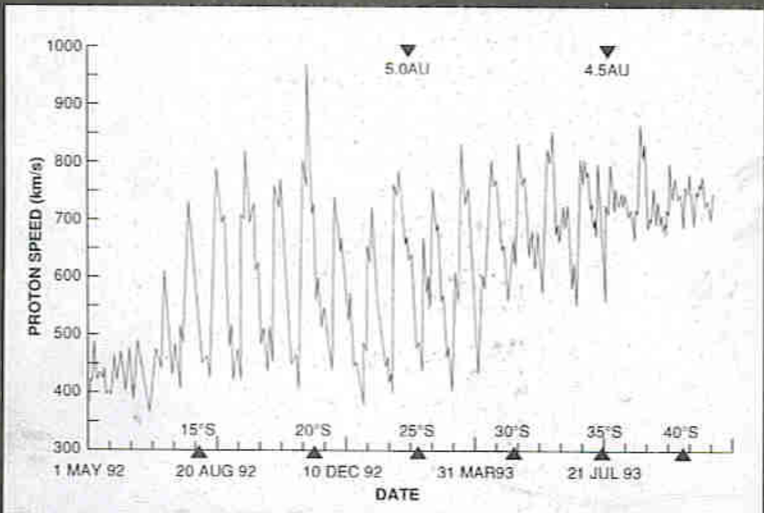


Figure 6. Variation in solar wind speed as a function of heliographic latitude.

Energetic particles and cosmic rays

At best, the detection of cosmic rays at the earth's surface is difficult and tedious. Little is known about the origin of these particles. Some indeed do originate from the sun, though it is clear that the more energetic types originate outside the solar system.

A craft such as Ulysses provides a superb opportunity to directly observe these highly energetic particles.

High energy positive ions - predominantly protons - interact with the earth's atmosphere, inducing secondary radiation of various types. The high energy telescope of the COSPIN experiment on board Ulysses was able to determine the distribution of isotopes present in the cosmic ray flux. Figure 7 shows isotope histograms for Carbon (C), Nitrogen (N), Oxygen (O), Neon (Ne), Magnesium (Mg) and Silicon (Si).

An important early result to emerge is an apparent over-abundance of the isotope 22Ne of Neon compared with its known solar abundance. Such findings are being compared with existing models of specific types of stars (such as Wolf-Rayet) in order to further refine theories of Cosmic Ray sources. The scientific experiment is clearly able to resolve the various mass peaks of the isotopes present. It is experiments such as these which allow theory of stellar evolution to be matched against data.

Interstellar gas and dust

In an analogy to raindrops contacting the windscreen of a moving car, Ulysses was able to measure details of the interstellar gas and dust 'passing through' the solar system. The solar system is considered to be travelling at a speed of 26 km/sec with respect to the interstellar medium. As the solar system thus passes through the 'at rest' co-ordinate system of the local galaxy, the solar system passes through dust and gas particles which are essentially at rest in this reference frame.

The SWICS and HI-SCALE experiment were able, for example, to detect grains of dust with an average speed in excess of 26 km/sec and with a mass of around 10-13 g. This mass is typically larger than that known to exist in interstellar space and which absorbs light of stars in a characteristic fashion. This would suggest that the heliospheric boundary at the edge of the solar system is filtering out the smaller particles of dust.

In a similar way, neutral atoms at rest with reference to the galaxy are also passing through the solar system. These atoms tend to become charged under the influence of solar ultraviolet radiation - termed 'pickup ions' - and then convected out of the solar system by the solar wind. Helium has been confirmed as having the characteristic 26 km/sec velocity. Hydrogen atoms, however, have been observed at only 20 km/sec, suggesting that the heliospheric boundary is slowing the hydrogen atoms. The SWICS experiment has been able to

Magnetic field and solar wind

The sun streams out large numbers of ions and atoms from its surface. These penetrate to the furthest reaches of the solar system and beyond. These high energy particles can have a significant influence on weather systems on earth and also in propagation of radio waves in the earth's atmosphere. The sun has a basic 11-year cycle within which this activity alternates between 'quiet' and 'noisy' periods of activity.

The Ulysses spacecraft is one of the most electromagnetically 'clean' platform ever launched - allowing measurements to be made with unprecedented sensitivity.

Figure 6 shows the solar wind speed measured by the SWOOPS solar wind plasma experiment. It shows recurrent high-speed stream structure that developed after the Jupiter flyby in mid-1992 and its variation with heliographic latitude. Essentially, it is showing that the speed of protons, the principal component of the solar wind, varies considerably. The periodic variation decreases after about 30 degrees south latitude is attained - in the south polar cap environment where solar wind is thought to emanate from the southern polar coronal hole.

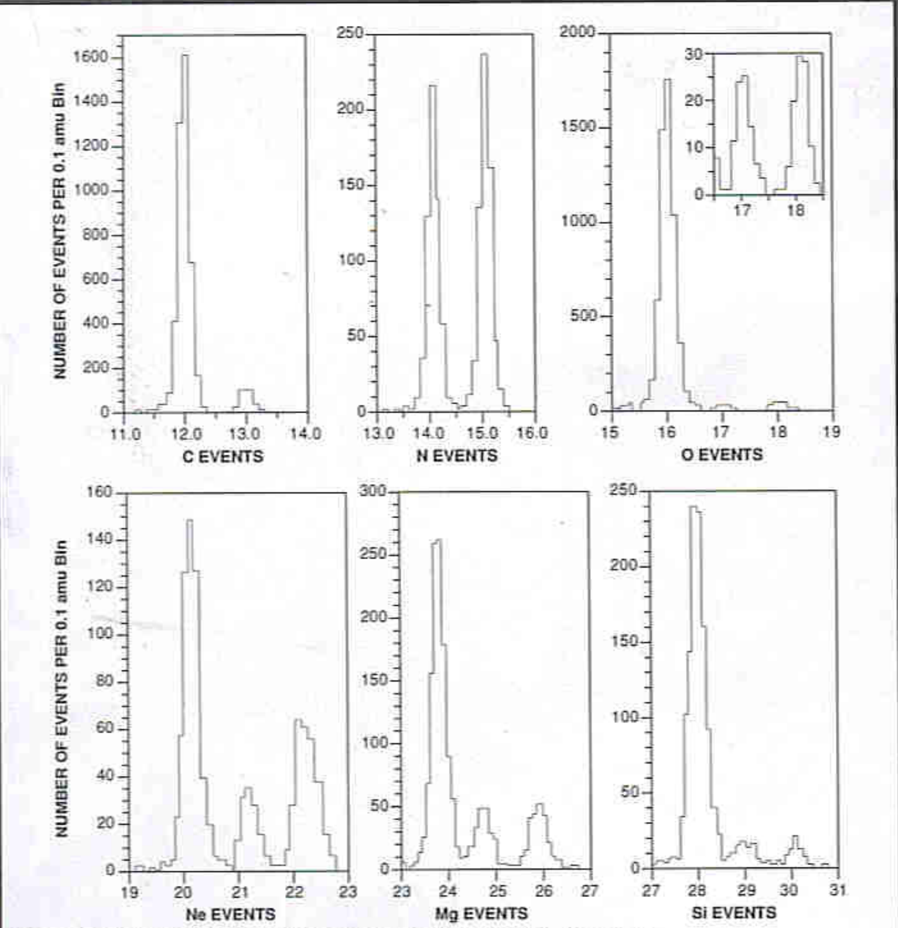


Figure 7. Values of isotopic histograms for Carbon (C), Nitrogen (N), Oxygen (O), Neon (Ne), Magnesium (Mg) and Silicon (Si) as determined for Cosmic Ray particles by the COSPIN experiment.

detect H, N, O and Ne pick-up ions and determine their relative abundance.

Figure 8 shows the variation of protons, solar wind velocity and magnetic field magnitude as the mission progressed and Ulysses assumed higher latitudes. Initially due to large numbers of solar flares, the 1 MeV proton intensity remains high and rarely reaches background levels. At low and mid latitudes the typical cyclic variation of the solar wind activity is observed due to 'Corating Stream Interaction'. This phenomenon is caused by the mixing of streams of particles from the north and south coronal holes of the sun as indicated in figure 9. As the probe latitude increases, the level of variation decreases as this mixing effect reduces.

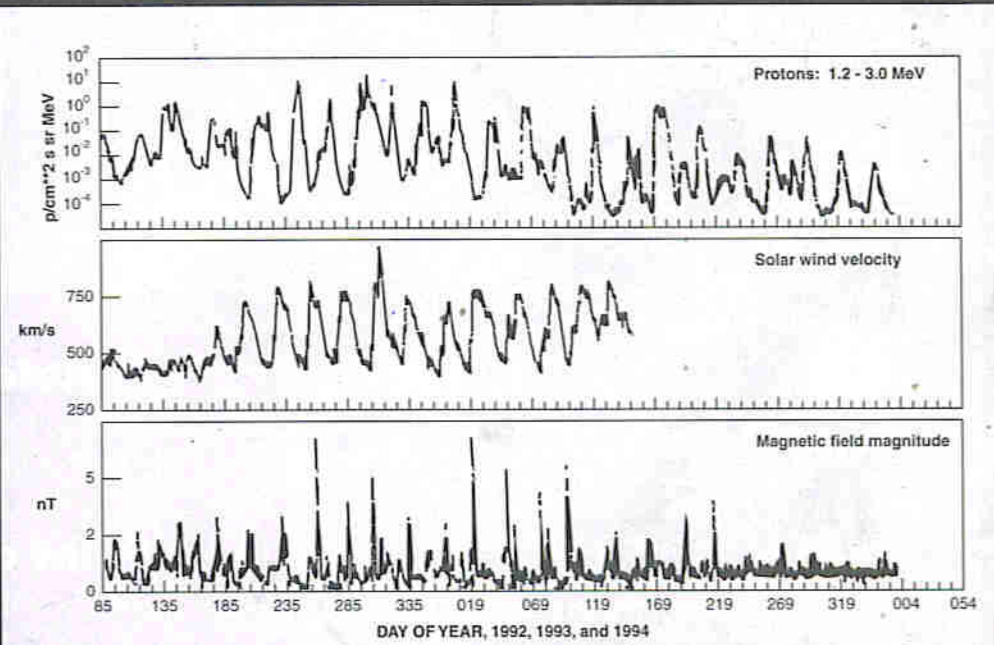


Figure 8. Variation of protons, solar wind velocity and magnetic field magnitude as the mission progressed and Ulysses assumed higher latitudes

Radio emissions

A range of radio emissions of the sun was investigated. A phenomenon termed Type III radio emission was thought to be associated with electrons of energy up to 100 keV (100,000 electron volts) travelling along open magnetic field lines. Data from Ulysses indicated that such radio waves could originate from local conditions along an electron beam and not uniformly along it.

Jupiter is a highly active radio source. One component of this emission - the so called QP-40 burst with a periodicity of 40 minutes - was studied by Ulysses. It was discovered that such QP-40 bursts are typically triggered by high speed solar wind streams impinging on the Jovian magnetosphere.

By observing solar wind activity and measuring the time of occurrence of QP-40 events, the Ulysses craft on its outward journey from Jupiter could use these measurements to time the relative velocity of the solar wind out to Jupiter. This was shown to be accurate for distances up to 5 A.U. from the planet.

Data archive

Based on experience of similar missions, the importance of ease of access to the core of scientific data is seen as a key goal of the Ulysses mission. This will take the form of a two-stage process, initially with the formation of a European based archive 'Ulysses Data System' to facilitate data transfer between Principal Investigator teams. The second phase will be the availability of the data to the general space science community.

Repeat mission

The Ulysses craft has been designed for the capability of a second mission subject to satisfactory coverage being present from the Deep Space Network from NASA. This 'weak link' in ESA's facilities could indicate that ESA may, in time, develop (cost permitting) its own Deep Space facility. Ulysses carries a significant

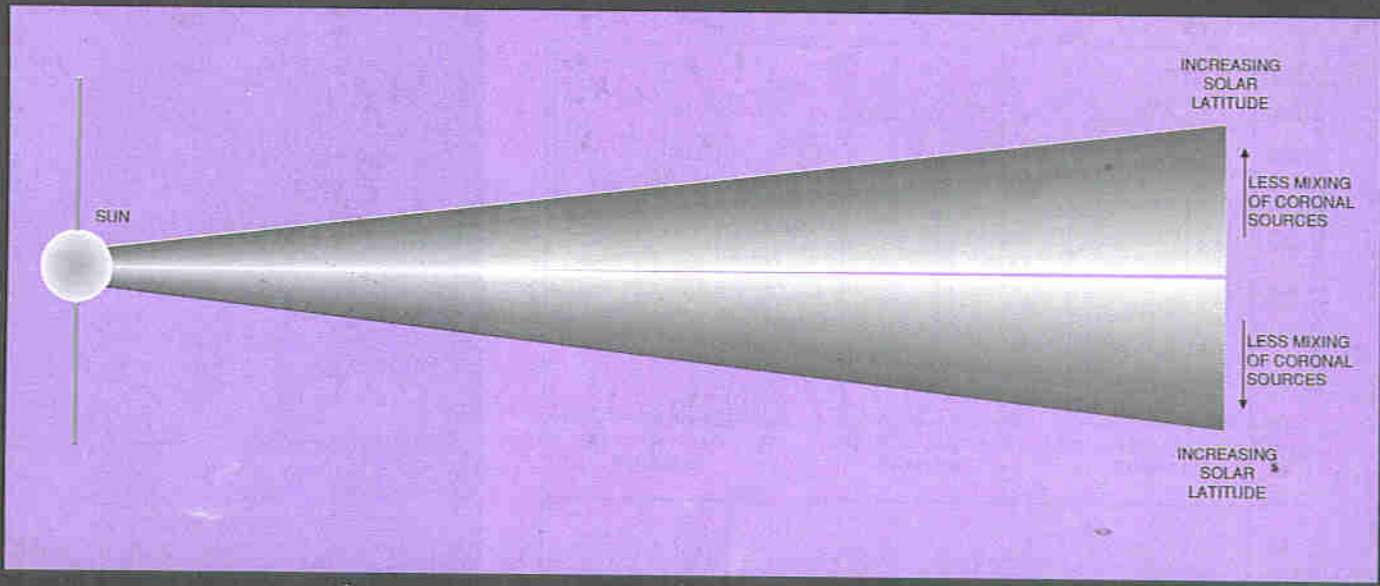


Figure 9. Simplified model of 'Corating Stream Interaction' caused by the mixing of streams of particles from the north and south coronal holes of the sun. With increasing latitude, each stream becomes more stable.

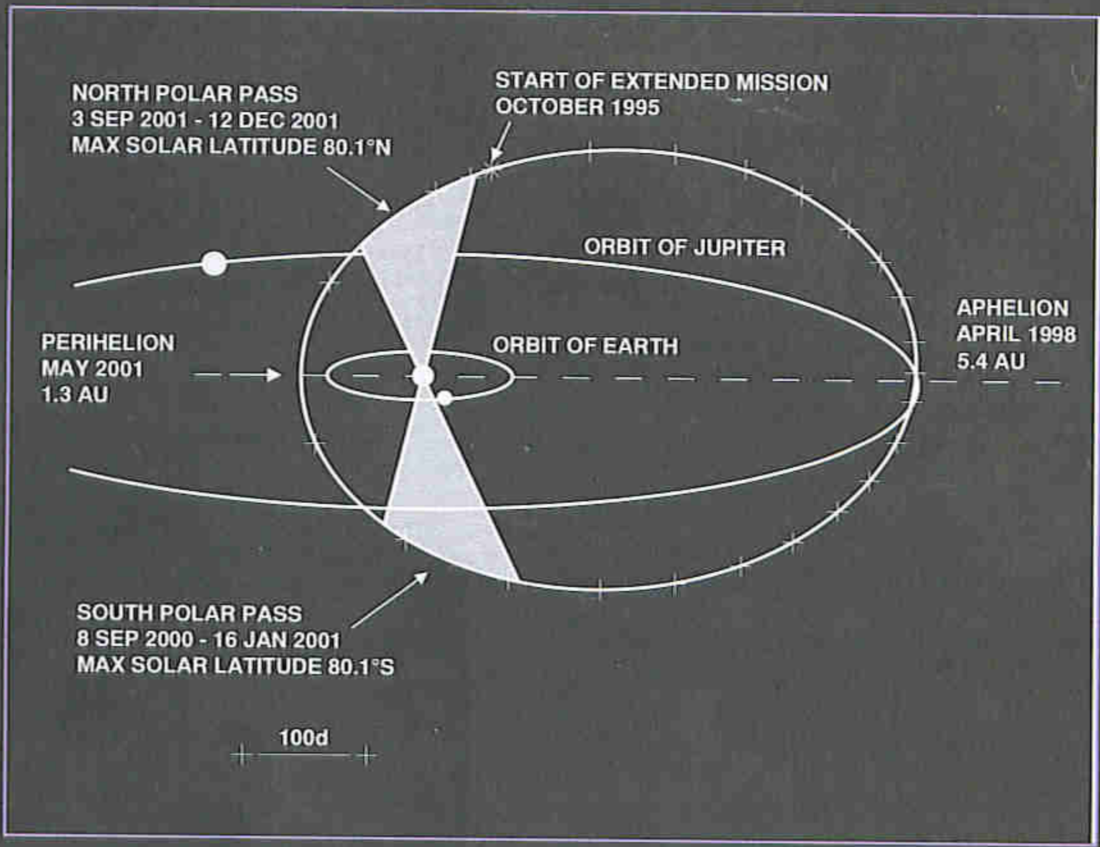


Figure 10. Phase II of the Ulysses misson - the second orbit of the sun. The craft is designed to undergo a second solar orbit. Deep Space Network links, however, are essentail to collecting its data.

amount of plutonium on board and heat from its radioactive decay is used to power its electronic systems.

Figure 10 indicates the periods and phases of the next key periods of south and north latitude exploration. While the data obtained from the polar encounter regions is of key interest and scientific value, the range of on-board experiments provides a steady stream of valuable scientific data which improves understanding of both the sun and of the interstellar medium though which it travels.

At a time when scenarios of global climatic change are likely to have very real effects on the earth in years to come, missions such as Ulysses are likely to provide valuable insight into interaction of patterns of solar activity and terrestrial weather systems and, hence, help provide a more complete picture of our weather patterns.

References:

ESA's Report to the 30th COSPAR Meeting, Hamburg, Germany, July 1994.

Point of Contact:

ESA, 8-10, rue mario-Nikis, 75738, PARIS CEDEX 15, France.

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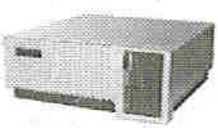

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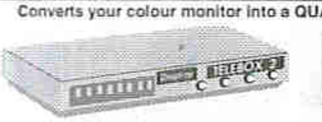

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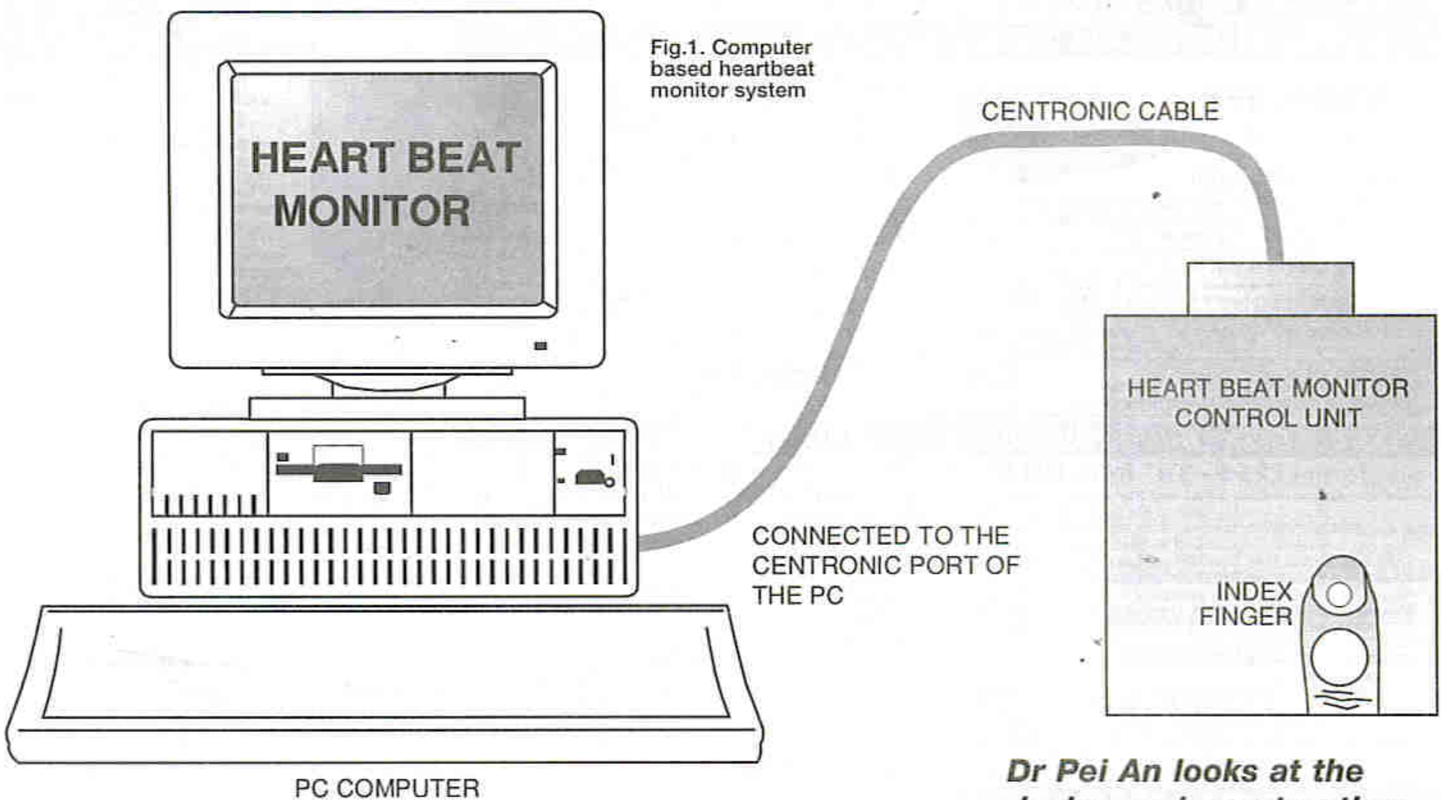


Fig.1. Computer based heartbeat monitor system

Dr Pei An looks at the design and construction of a personal computer-based heart rate monitor - ideal for the health conscious or the hypochondriac

Heartbeat *monitor*

The rate at which the heart beats is the most important parameter of our body. This article will explain various techniques for measuring the heartbeat rate. It will also show readers how to construct a computer-based heartbeat monitor.

This device is controlled by a pc via the printer port. The complete system is illustrated in Figure 1. By putting your index finger over an optical sensor on the monitor, the rate of your heart beat can be measured.

How to measure the heartbeat rate

Our heart is constantly in motion contracting and expanding. When it expands, blood is sucked into the heart and when it contracts the blood is pumped out. By doing so, a close-loop circulation of blood is achieved throughout our body. Apart from the motion of the blood in blood vessels, the motion of the heart is accompanied by other physiological phenomena.

Firstly, when the heart beats, it creates sounds. We can

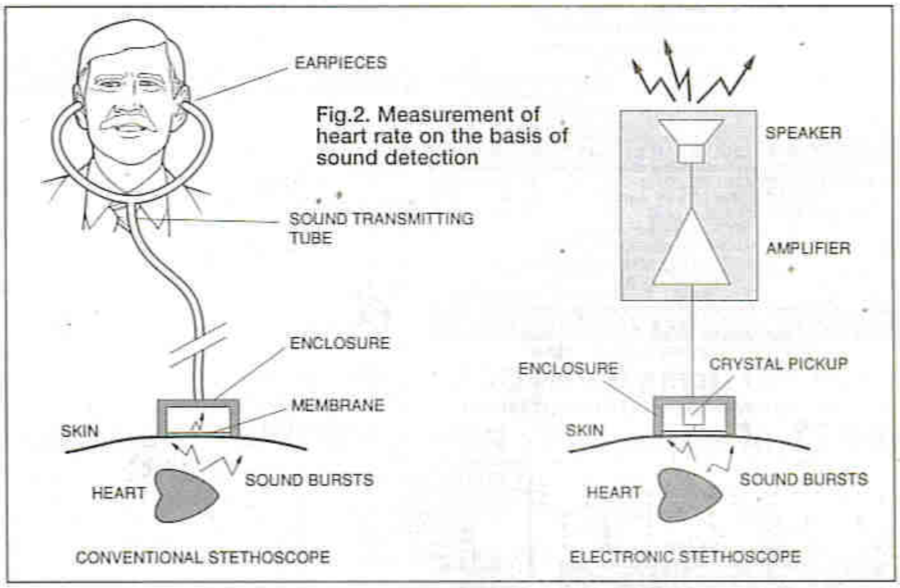


Fig.2. Measurement of heart rate on the basis of sound detection

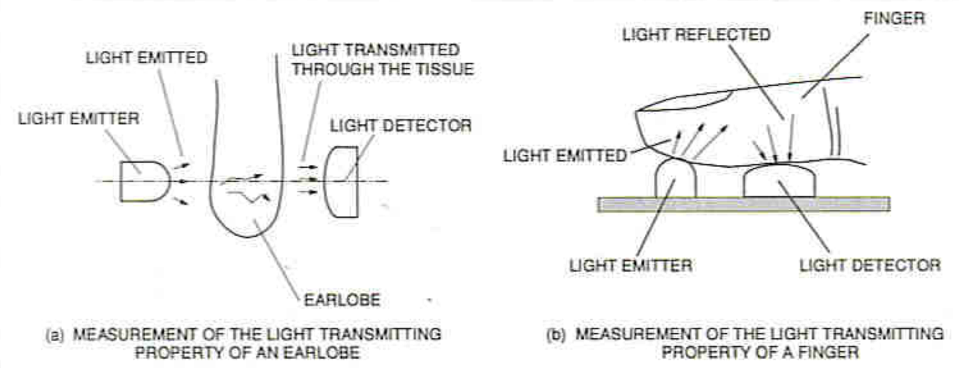


Fig.3. Measurement of heart rate on the basis of light detection

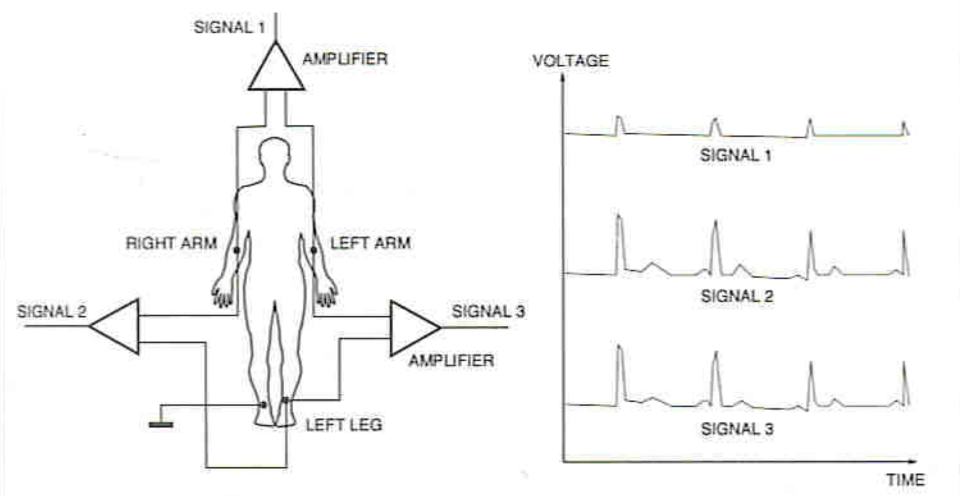


Fig.4. Measurement of heart rate on the basis of ECG

therefore measure the heartbeat rate simply by listening it and counting the number of sound bursts in a known period of time. Secondly, when the heart beats, blood is pumped into blood vessels which makes the vessels expand. We can feel this slight movement and measure the rate of heartbeat. This is actually the most common method we use in our everyday life.

It is also a less well known fact that when the pulsating blood flows through a tissue, the amount of blood in the tissue changes and this causes a change in the light transmitting property of the tissue. This is not noticeable by the naked eye but modern optical electronics can sense this. The rate at which the property changes indicates the rate of the heartbeat. Finally, when the heart beats, a small electric signal is generated. When detected by special instrumentation, this signal can be displayed as an electrocardiogram. By analysing the signal, the heartbeat rate can be obtained.

Sound detection

The conventional stethoscope is still used in clinics (see Figure 2a). It consists a sound pick-up, which is a small soundproof cup with a plastic membrane covering it. A hollow tube is used for transmitting the sound from the pick-up to the ears. In use, the membrane is brought close to the chest and doctors can hear the sound bursts produced by the heart. This isn't ideal, however, as doctors have to count the number of heartbeats for a set period and then calculate the rate afterwards.

The conventional stethoscope can be upgraded using modern electronics (Figure 2b). A crystal microphone is used to pick up the sound and the signal from the microphone is then amplified and output to a speaker. With this technique, we can create a 'personal stereo' type of stethoscope.

Light detection

This technique is commonly used nowadays in clinics, where a finger or an earlobe is used (Figure 3). The measurement is based on detecting the change of the intensity of light transmitted through, or reflected by, a tissue. If a biological tissue, such as the earlobe, is placed between a light source and a light detector, the light transmitting property of the tissue can be measured (Figure 3a). Earlier experiments showed that this property changes with the pulsation of blood. Therefore the signal output from the light detector will change in sympathy with the heartbeat. Earlier research also showed that the light reflecting property of a tissue also changes as a result of blood pulsation. Hence, a finger can be used for heartbeat rate measurement with a light source and light detector placed on the same side of the finger (Figure 3b). This method provides a very convenient way for heart beat rate measurement.

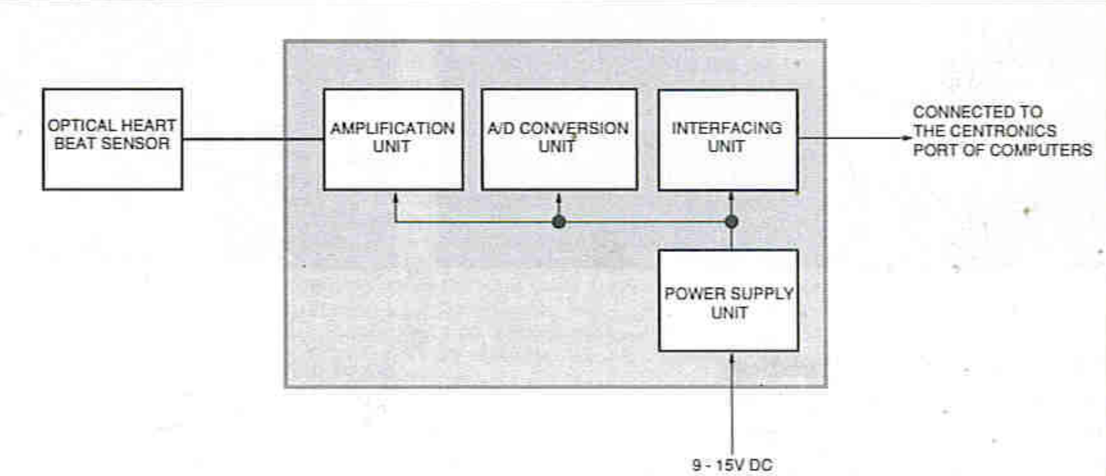


Fig.5. Block diagram of heart rate monitor

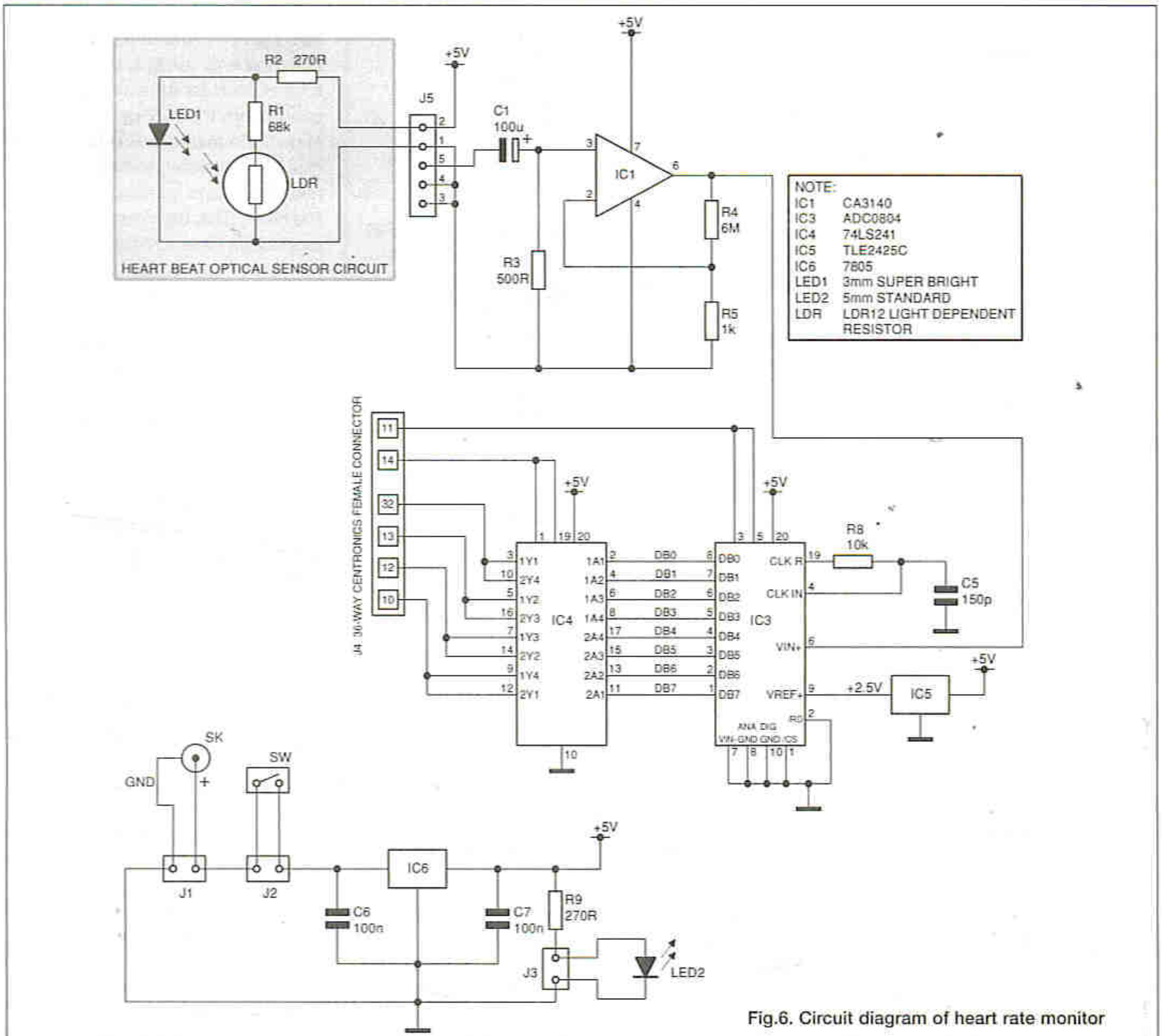
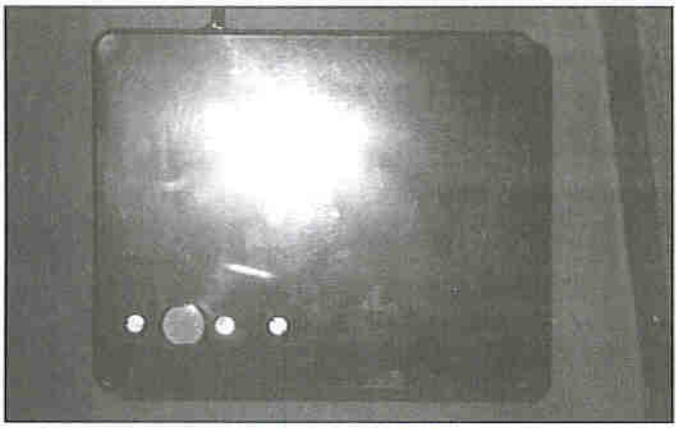
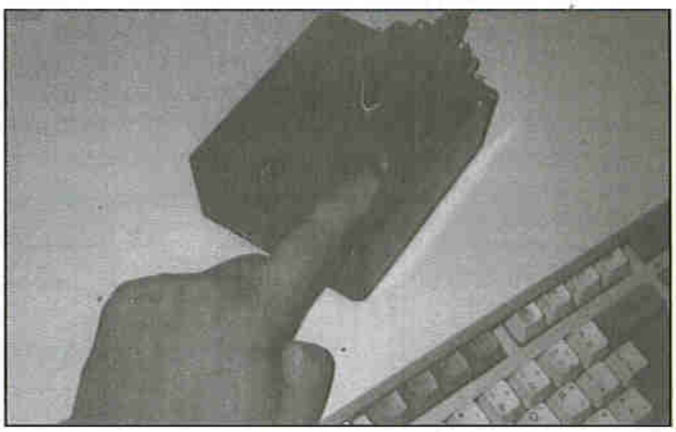


Fig.6. Circuit diagram of heart rate monitor





Electric signal detection

Heart nerves and muscles generate electric signals which can be picked up by electrodes placed on the skin and amplified by electronic circuits (see Figure 4). This technique is known as the electrocardiogram, ECG in short. The voltage generated by the heart muscles has a typical voltage level of about 0.001 V. The ECG has a unique pattern and it repeats itself for every beat of the heart. By measuring the time period between the two adjacent patterns, the heartbeat rate can be found. ECG is not only used for heartbeat rate measurement. In fact, the individual shape of the signal is used for analysing the working conditions of the heart.

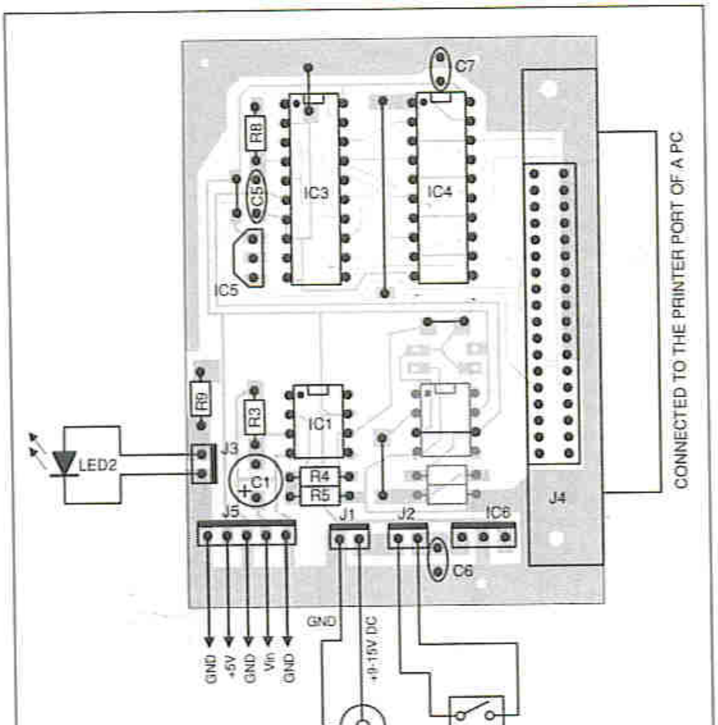
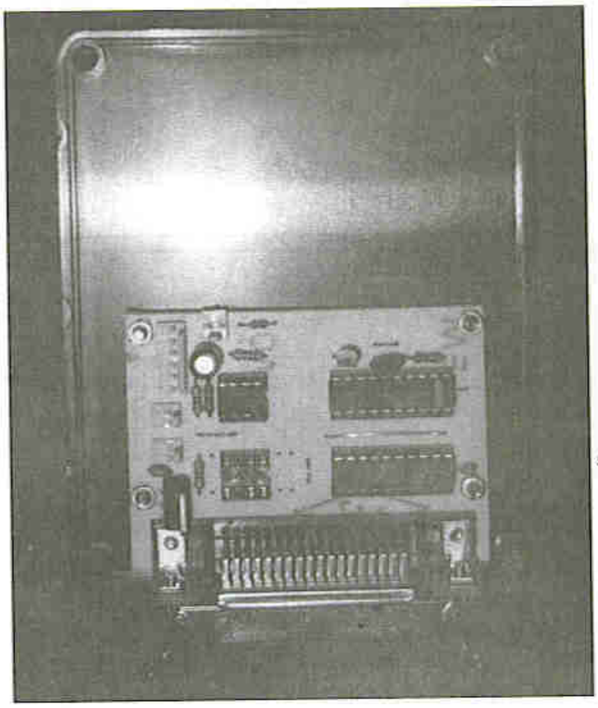


Fig.8. PCB component overlay



Construction

This heart beat monitor utilises the technique based on the measurement of the intensity of light reflected from a finger. The complete system of the heartbeat monitor is shown in Figure 1. The monitor consists of 5 units. They are the optical sensor, the amplification unit, the A/D conversion unit, the interfacing unit and the power supply unit (see Figure 5). The complete circuit diagram of the system is given in Figure 6. The function of each unit is explained as follows.

The optical sensor

The sensor is comprised of a light emitter and a light detector. The light emitter is a super-bright LED and the light detector is a light-dependent resistor (LDR) device. They are mounted on a piece of stripboard with a distance of 11.5 mm from centre to centre. It can be seen from Figure 6 that the LDR and R1 are connected in series. The voltage across the LDR is fed to the amplification unit via a capacitor, C1. When placing the index finger over the LED and the light detector cell as shown in Figure 3b, a voltage variation of about 100 uV will be produced. A better design would be to use a Whitestone bridge with the LDR used on one arm of the bridge. However, the present circuit is simple to construct and gives satisfactory results.

Amplification unit

The varying signalgenerated by the sensor is amplified several thousands times so that the signal level is high enough for the A/D conversion. Two amplification stages are included in the design, each based on a CA3140 operational amplifier configured as a standard, non-inverting amplifier. The amplification of the first amplifier is calculated by 1+R4/R5, (typically about 6000). In practice, only the first amplifier is needed to amplify the signal from the optical sensor to the required level. The second amplifier is therefore not used.

The A/D converter unit

The A/D converter is a ADC0804 CMOS successive-approximation A/D converter. Only a timing resistor (connected between Pins 19 and 4) and a capacitor are used for generating the clock signal and an external band-gap voltage reference is used to set the voltage reference for the converter. The power supply is 5V with a typical current consumption of about 1.3 mA. The maximum data conversion rate is about 8700Hz. In most cases, the analogue ground (Pin 8), the digital

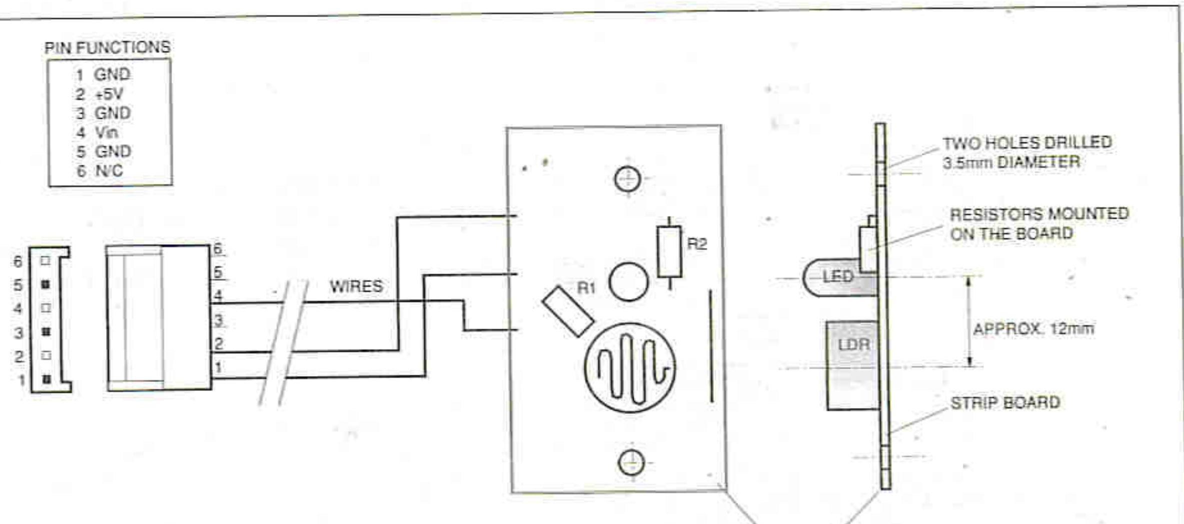


Fig.9. Construction of the optical sensor

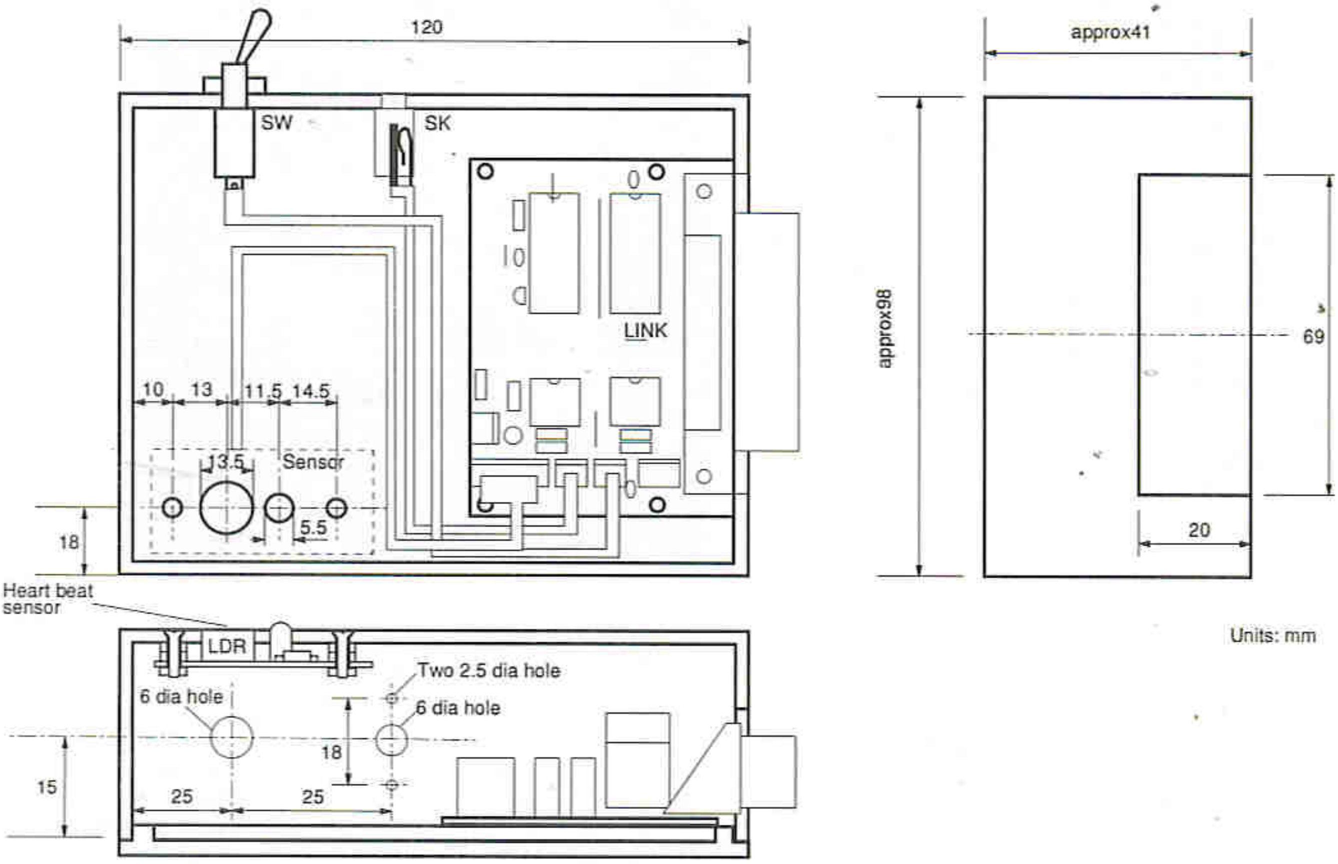


Fig.10. Assembly of the heartbeat monitor

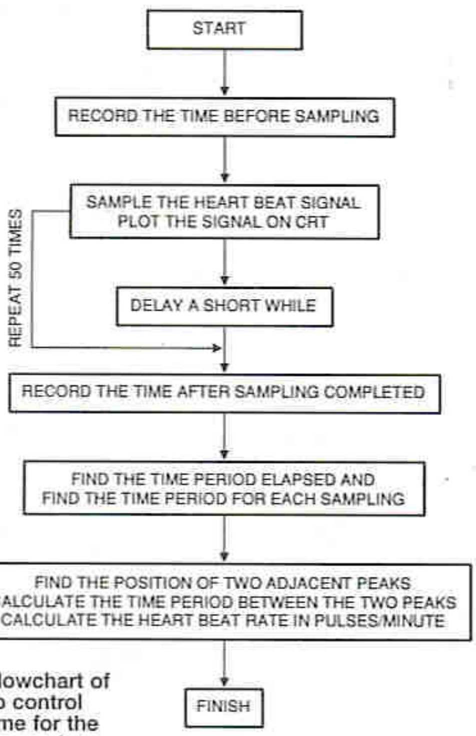


Fig.11. Flowchart of the demo control programme for the heart rate monitor

ground (Pin 10) and Vin(-) (Pin 7) are connected together as a single ground.

The -CS (Pin 1) is the chip select. To enable the converter, this pin must be held low. At the low-going edge of the -WR (Pin 3), the A/D converter starts the A/D conversion. During a conversion, -NITRE (Pin 5) is at logic high. When a conversion is completed, -NITRE goes low. When -RD (Pin 2) is taken low, the converted data will appear on the output lines dB to dB (Pins 18 through to 11); otherwise these lines are in high impedance state. In the present circuit, the converter is configured in a free-running mode by connecting the -NITRE and -WR together and the -RD input is held low all the time.

The PC interfacing unit and the Centric port

The Centric port of PCs consists of three separate I/O ports, namely, the Data port, the Control port and the Status port. The Data port is an 8-bit output port, which sends data to the printer. The Control port is a 4-bit output port, which issues commands to the printer. The Status port is a five-bit input port which reads the information from the printer into the pc. For the LPT1 Centric port, which is allocated on the mother board of the computer (not on the expansion card), these ports correspond to three I/O addresses: 888, 890 and 889, respectively. Because the Centric ports only have five input lines, in order to read an 8-bit data generated by the A/D converter a suitable interface has to be used.

A 74LS241 tri-state octal buffer IC is used in the interfacing unit. It has two sets of tri-state buffers, each containing four buffers. Each set has an enable input, Pin 1 for the first set and Pin 19 for the second. When Pin 1 is taken low, the first set of buffers works (i.e. the outputs will follow the status of the inputs). When pin 19 goes high, the second set of buffers works. Pin 1 and 19 are connected together to form a Data Selection Line (DSL). By putting the line low and then high, the computer can read the 4 bit connected to the 1st set of buffer (DB, DB1, DB2 and DB3) and the other 4 bits connected to the other set of buffers (DB4, DB5, DB6 and DB) in turns. Operating in such a manner, the 8-bit data from the A/D converter can be read into the computer in two halves. By manipulating the bits of the two readings, 8-bit data can be formed.

The power supply unit

The power supply unit incorporates a 7805 5V voltage regulator for supplying the 5V DC to the circuit. A 9-15V DC external power supply is required.

Construction

The heartbeat monitor is constructed on a single-sided PCB board. The PCB artwork is given in Figure 7 and the component layout is given in Figure 8.

The heartbeat sensor is constructed on a piece of stripboard. The construction details of the optical sensor are given in Figure 9. The LED and the light-dependent resistor are mounted on the stripboard, a small distance apart. Some resistors are also mounted on the board.

In this design, the electronic board and the optical sensor are all housed in a plastic box. A suggested arrangement for mounting the boards in the box is given in Figure 10.

Programming

The control program listed below is written for LPT1 using Turbo Pascal 6. The program reads the signal sensed by the optical sensor into the computer first. While the program reads the signal, it also plots the signal on the screen to give a visual indication of the heartbeat signal. After sampling, the program calculates the heartbeat rate and shows this information on the screen. The flowchart of the program is given in Figure 11.

The interval between each sampling is calculated by knowing the total time required for a known number of sampling. In the demo program, readers may notice the procedure gettime (h,m,s,hund). This is the procedure in Turbo pascal 6 to get the time. Parameters h, m, s and hund correspond to hour, minute, second and hundredth of a second, respectively. This procedure is called before and after sampling. The total time needed for sampling can be therefore obtained. Knowing that the total number of sampling which is chosen to be 50 in the demo program, the time delay between each sampling can be calculated.

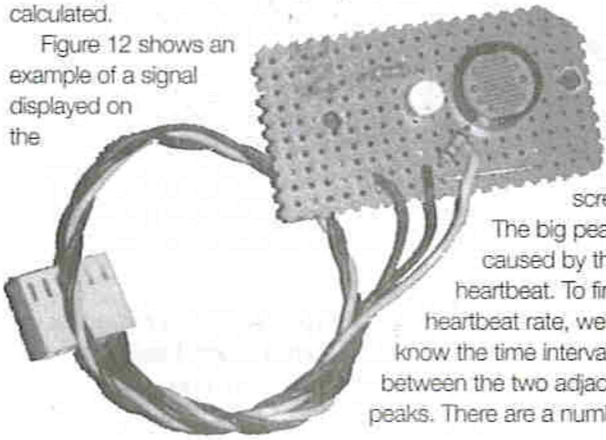


Figure 12 shows an example of a signal displayed on the screen. The big peaks are caused by the heartbeat. To find the heartbeat rate, we must know the time interval between the two adjacent peaks. There are a number of ways to do this. This program adopts the following scheme. Firstly, the program finds the position of the first peak, k1, in which k1 is the index of the sampling point. Then the program finds the position of the second peak, k2. k2-k1 is the number of samples between the two peaks. Knowing the time interval for each sample, the time (in seconds) between the two peaks can be found. This is the time for each heartbeat. The rate of heartbeats (normally in pulses/minute) can then be easily calculated.

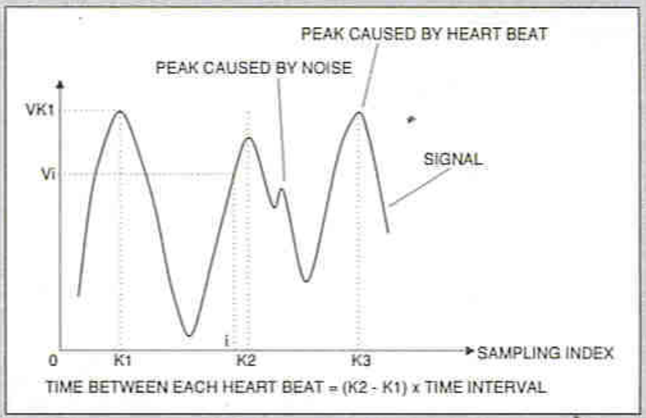


Fig.12. Signal input to the PC from the heart rate monitor circuit

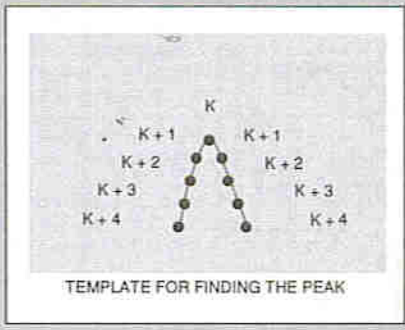


Fig.13. Method for finding the position of signal peaks

A question may be raised as to how to find the position of the peak. This program does this by defining a template for a peak: A point (of an index number k) on the signal curve will be recognised as a peak if the values of the 4 data points before it (index numbers k-1, k-2, k-3 and k-4) and the values of the 4 data points after it (the index number k+1, k+2, k+3 and k+4) are all lower than the central point (see Figure 13). This template is able to find the peak of the signal produced only by the heartbeat. Signals resulted from electronic noise or other sources will not be recognised as peak. This scheme of finding the peak is the simplest one and, in most cases, it gives a good result.

Demo program

```
Program Heart_beat_monitor;
(demonstration program for heart beat monitor)
{written by Fei An, 13/7/95}
uses
 crt,graph,dos;
const
 totalnumber=50; delaytime=70;
 (Total number of sampling is 50.
 Delay time between each sampling is 40 ms}
var
 byte1,byte2,truebyte     :byte;
 bitweight,bit            : array [1..8] of byte;
 P_address,i,j,k,dummy :integer;
 V    :array [1..60] of integer;
 HB_rate,sum, average,inteval: real;
 datafile:text;
 (Variables:  byte1=4 high bits,   byte2=4 low
bits,                    truebyte=8 bit byte from
the A/D converter)
```

```
Procedure initial_bit;
{Initialize binary bitweight and bit}
begin
 for i:=1 to 8 do begin bitweight[i]:=1;
                        bit[i]:=0; end;
 for j:=1 to 8 do begin
 for i:=1 to j1 do bitweight[j]:=bitweight[j]*2
 end;
end;


Procedure Input_printer_address;
{Input the address of the printer}
begin
 writeln('Configure the address of the printer
                                      port');
 writeln('LPT1 on motherboard is 888');
 writeln('LPT1 on I/O card, check the address of
           your computer, 956 for example');
 write ('Input the address of the printer port:
                                        ');
 readln(P_address);
end;


Function voltage:real;
{Logging data}
var
 sum:real;
 ii:integer;

begin
 initial_bit;
 port[P_address+2]:=0;         {CONVERT=0, DSL=1}
repeat
 byte1:=port[P_address+1];  {read 1st byte, check
BUSY line and wait it to become high}
until byte1<128;              {note: BUSY line is
inverted in the PC}
 byte1:=port[P_address+1];   {DSL=1, read the high
4 bits}
 port[P_address+2]:=2;        {DSL=0}
 byte2:=port[P_address+1];   read the 4 low bits}
     {binary format of byte1 and byte2
     byte1:               hhhh0 (high 4 bits)
     byte2:               1110 (low  4 bits)
     note: .=do not care,  h,1=data}
 byte1:=byte1 and 120;   {00011110 and ...hhhh0 =
                                       000hhhh0}
 byte1:=byte1 shl 1;     {shift 1 bit left,
                              byte1 = 0000hhhh}
 byte2:=byte2 and 120;   {00011110 and ...11110 =
                                       00011110}
 byte2:=byte2 shr 3;     {shift 3 bits right,
                              byte2 = 11110000}
 truebyte:=byte1 or byte2;    {byte1 or byte2 =
              11110000 or 0000hhhh = 1111hhhh}
 Voltage:=(truebyte);
end;


Procedure crtinitialization;
{show initial data on the screen}
begin
 writeln;
 writeln('****************************
*************************************
**********');
 writeln('              IBMPC 8 input 8 bit
                      analogue to digital
                      converter program');
 writeln('****************************
*************************************
**********');
 writeln;
 writeln;
end;


Procedure Plot_hb;
{plot the signal on the screen}
var
 Gd, Gm : Integer;
 h1,h2,m1,m2,s1,s2,hund1,hund2:word;
 dtime:real;
begin
 Gd := Detect; InitGraph(Gd, Gm, '');
 if GraphResult <> grOk then Halt(1);
 OutText('Voltage from barcode reader');
 moveto(1,V[1]);
 gettime(h1,m1,s1,hund1);
 for k:=1 to totalnumber do begin
      V[k]:=round(voltage);
      lineto(2*k,3002*V[k]);
      delay(delaytime);
      end;
 gettime(h2,m2,s2,hund2);

inteval:=((60*m2+s2+hund2/100)(60*m1+s1+hund1/100))
                                    /(totalnumber);
 readln;
 CloseGraph;
end;


Procedure calculate_heart_beat;
{calculate the heart beat}
var
 ii:integer;
 pulse:array[1..20] of integer;
 hbr: array [1..20] of real;
begin
ii:=1;
for k:=4 to totalnumber5 do begin
      if (V[k]>V[k1]) and (V[k]>V[k2])
and(V[k]>V[k3]) and V[k]>V[k+1]) and (V[k]>V[k+2])
and (V[k]>V[K+3]) and (V[k]>V[k+4]and(V[k]>V[k+5])
      then begin
                        pulse[ii]:=k;
                        ii:=ii+1;
                        end;
      end;
hb_rate:=2/(pulse[3]pulse[1])/inteval *60;
writeln('Your heartbeat is: ',hb_rate:6:2,' pulses
per minute');
writeln('Put your finger on the optical reader and
press return');
readln;
end;
Procedure Scan;
{scan procedure}
begin
repeat
 writeln('Place your indix finger on the optical
                                          reader');
 writeln('Please wait for several seconds');
 writeln('Please do not move your finger');
 delay(1000);
 plot_hb;
 calculate_heart_beat;
until keypressed;
end;

{=================main program===================}
begin

clrscr;
 input_printer_address;
 crtinitialization;
 scan;
 gotoxy(10,19);write('Thank you for running this
                                        program');
 readln;
end.
```

Applications

Readers have to try several times to put fingers over the optical sensor before good measurements are obtained. Readers can try this whilst watching the signal plotted on the monitor and adjust the position of the finger slightly to get the maximum variation of the

PARTS LIST

Resistors
(0.25W 1% metal film resistors)

R1	66K
R2	270R
R3	500R
R4	6M
R5	1K
R6,R7	not used
R8	10K
R9	270R

Capacitors

C1	100uF Electrolytic
C2	150pF ceramic disc
C3,C4	100nF ceramic disc

Semiconductors

IC1	CA3140 op-amp
IC2	CA3140 op-amp, not used
IC3	ADC0804 8-bit A/D converter
IC4	74LS241 octal buffer IC
IC5	TLE2425C 2.5V precision voltage reference
IC6	7805 +5V voltage regulator
LED1	5mm super bright LED
LED2	5mm standard LED
LDR	LDR12 light-dependent resistor

Miscellaneous

J1,J2,J3	2-way PCB connectors
J4	36-way female Centric connector
J5	6-way PCB connectors
SK	2.5mm power socket
SW	toggle switch

signal. To get good results every time, be sure not to press the finger too hard on the sensor, as this may squeeze the blood vessels too much and stops the blood flowing through the finger. Also, ensure that the finger used should be clean. Any dirt on the finger will affect the accuracy of the measurement.

The present design has some limitations. One limitation is that it cannot be used for continuous monitoring of the heartbeat rate. To solve this problem, the optical sensor can be modified. The sensor can be built inside a specially designed clip. In use, the optical sensor and the finger are clipped together with the sensor connected to the electronic circuit via a screened cable. One interesting application of this system is to monitor your heartbeat rate through the night. Before you go to bed, you put the optical sensor on your finger and start the program. The computer will then automatically measure the rate of heartbeat at the pre-set interval. Next morning when you get up, you press a key and you can see the plot of the history of your heartbeat rate through the night. This could prove to be very useful information about your health. It may also tell you if you had a calm night or a night full of heart-pounding dreams.

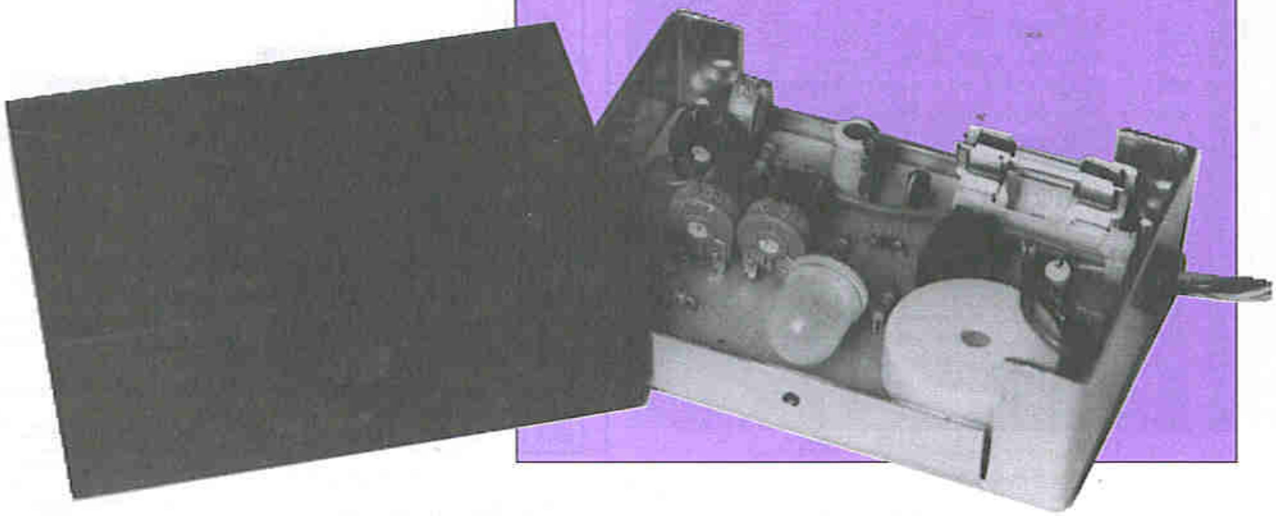
Apart from being used in the heartbeat monitor, the electronic board of the heartbeat monitor can be used for other applications. For example, the signal from a pressure transducer or a strain gauge or a sound pick-up can be read into a pc using the board.

Technical support

Kits are available from the author at a special promotion price of £33 plus £2 P&P. It includes all the components and software for readers to construct (note that the box and the power supply are not supplied with the kit). The fully assembled and tested system is available at a price of £50 plus £2 P&P. Please make your cheque payable to Ms. C. X. Qiu, 58 Lamport Court, Lamport Close, Manchester M1 7EG, UK, Tel/Fax/Answer: 44+(0)161-272-8279

TRI-COLOUR frost alert

With winter weather on its way, this project fromTerry Balbirnie will warn motorists of icy road conditions



This device will provide in-car indication of the outside temperature and gives an audible warning when it approaches freezing point. The display is a large tri-colour LED which shows green with temperatures above 4oC, yellow between 4oC and 2oC and red below 2oC. These temperatures are adjustable within limits to suit the user's preferences. The audible signal is given as a short, high-pitched bleep every 15 seconds or so and operates when the yellow or red warning shows. This provides a discrete alert without it being too distracting. Using this circuit allows the motorist to keep an eye on trends and so gain an early warning of possibly hazardous road conditions ahead.

The main unit is housed in a small aluminium enclosure mounted under the dashboard. The temperature sensor is contained in a plastic box located outside the car and connected to the main unit using twin wire. The circuit is powered by the car supply and, since it is connected via the ignition switch, draws current only while this is on. The maximum current requirement is less than 50mA so it imposes practically no drain on the charging system.

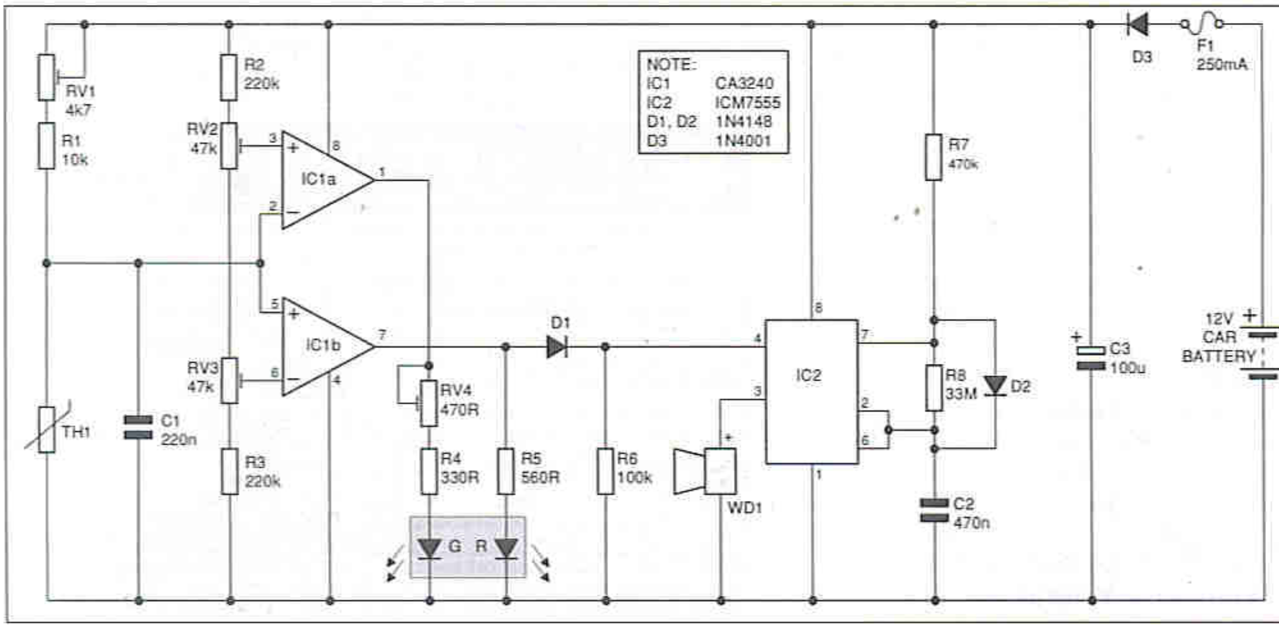
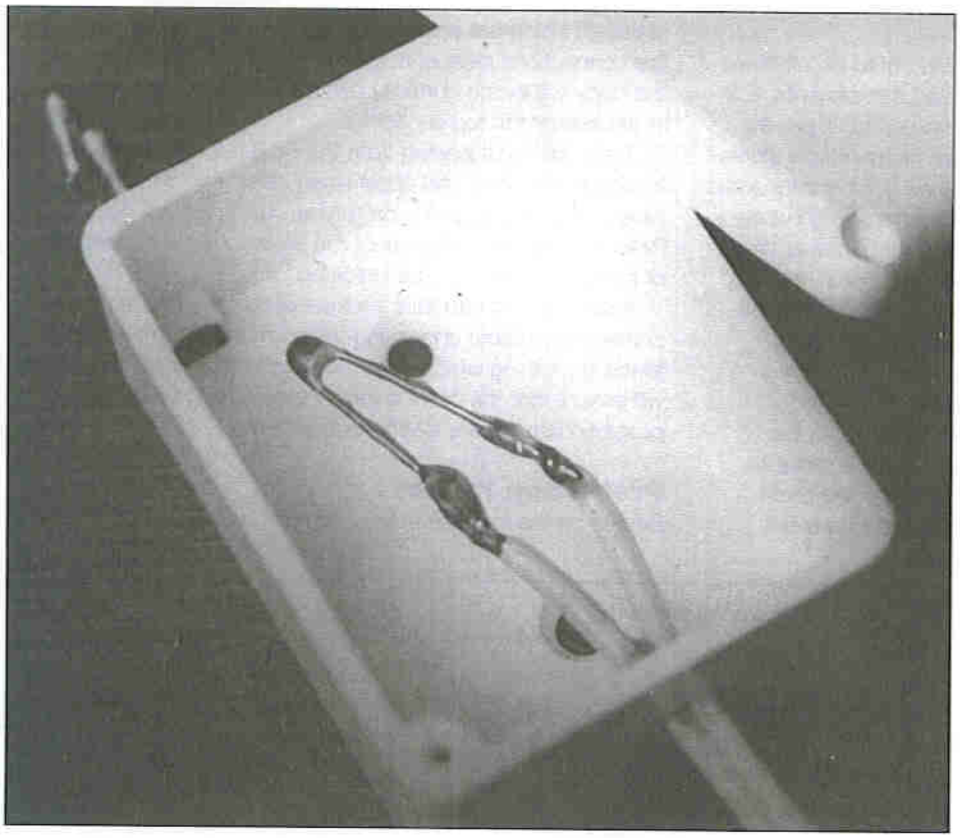


Fig.1. Circuit diagram of tri-colour frost alert



supply. At low temperatures, when the resistance of the thermistor is high, the voltage across it will also be relatively high. As the temperature rises, the resistance falls and so does the voltage. Typical values are 6.2V and 5.8V at 2oC and 4oC respectively and it is these changes which operate the circuit.

IC1 is a dual operational amplifier - that is, it contains two identical op-amps, IC1a and IC1b, in one package. The inverting input of IC1a, pin 2, and the non-inverting input of IC1b, pin 5, are connected together and receive the voltage developed across TH1. The non-inverting input of IC1a, pin 3, and the inverting one of IC1b, pin 6, receive voltages dependent on the adjustments of RV2 and RV3 respectively. Fixed resistors, R2 and R3 narrow the range of adjustment. For the purposes of illustration, suppose RV3 and RV2 are set so that the voltage values mentioned previously - 5.8V and 6.2V - appear at pins 6 and 3 respectively.

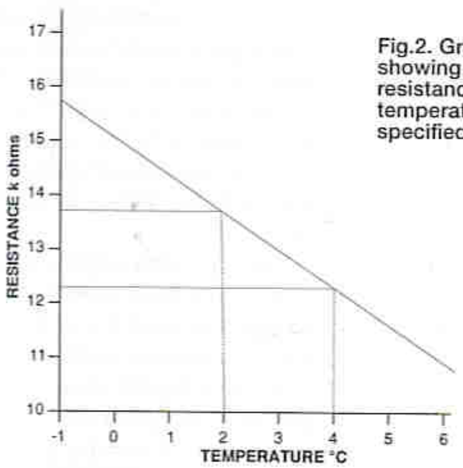


Fig.2. Graph showing variation of resistance with temperature for specified thermistor

For setting-up purposes you will need an accurate mercury or alcohol thermometer (or an electronic one) which covers the range 0oC to 5oC and having a resolution of 0.5oC or better. You will also need access to a freezer or the freezing compartment of a domestic fridge.

Circuit description

The circuit diagram of the Tri-Colour Frost Alert is shown in Fig. 1. The actual temperature sensor is negative temperature coefficient thermistor, TH1. The specified component is a miniature bead type and has a nominal resistance of 4.7kW at 25oC. In common with all devices of this type, its resistance rises as the temperature falls. The graph of resistance against temperature is shown in Fig. 2 and over the small range considered, it is reasonably linear. It will be seen that between 2oC and 4oC, the resistance changes by over 1kW.

The thermistor is connected in series with potentiometer RV1 (wired as a variable resistor) and fixed resistor, R1. This arrangement forms a potential divider connected across the car

Over the threshold

An op-amp is on (output high) if its non-inverting input voltage exceeds its inverting one. It will be seen that, above 4oC, the voltage across the thermistor will be less than 5.8V so IC1a will be on and IC1b off. Below 2oC the voltage across TH1 will exceed 6.2V so IC1b will be on and IC1a off. Between 2oC and 4oC, the voltage across TH1 will lie somewhere between 5.8V and 6.2V. Under these conditions, both op-amps will be on.

IC1a output, pin 1, is responsible for operating the green LED and IC1b output, pin 7, the red one. These direct current through the LEDs via current limiting resistors, R4 in conjunction with VR4 (for green) and R5 (for red). When both LEDs are on, the colour will be yellow. This is explained by the fact that red and green are primary colours. When these two coloured lights are mixed they give a secondary colour - in this case, yellow. Thus, at temperatures above 4oC green will show, between 4oC and 2oC, yellow and below 2oC, red.

At the end of construction, RV1, RV2 and RV3 will be set for the exact operating temperature required. The purpose of RV4 is to adjust the current flowing in - and hence the brightness of - the green LED. This will be used to provide a good balance between the two colours and therefore produce the best yellow colour.

Since all inputs to the op-amps are derived from potential dividers, changes in supply voltage will have virtually no effect on the output conditions. This is because any changes are reflected in all inputs simultaneously so all voltages will rise or fall together. This means that the operating temperatures will be unchanged. Tests on the prototype showed that there is virtually no change in the operating points between supply voltages of 10V and 15V. This is important because the car charging system output voltage will vary somewhat during the course of driving.

The supply for the circuit is obtained via diode D3 and capacitor C3. This improves the quality of the rather unsmooth supply from the car alternator. Diode D3 also prevents damage to the circuit if it is connected with incorrect polarity. Fuse F1 provides protection in the event of a short circuit.

Bleep...Bleep

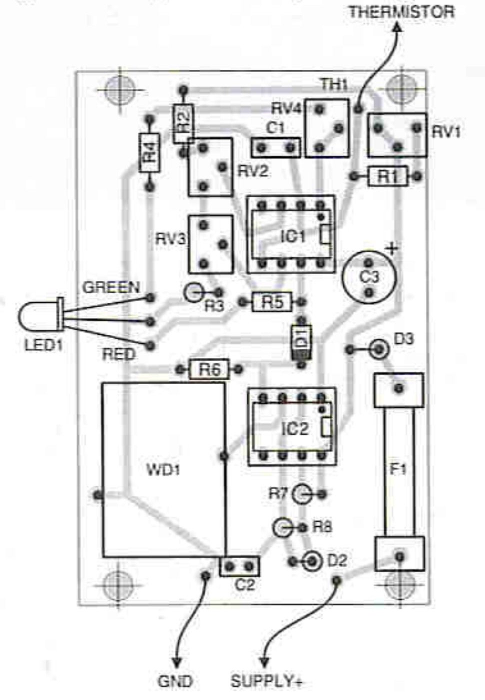
The audible warning section consists of integrated circuit timer, IC2, solid-state buzzer, WD1 and associated components. IC2 is configured as an astable with a long time period. Thus, the output (pin 3) constantly switches between high and low states providing the reset input (pin 4) is high. Since pin 4 is connected to IC1b output (pin 7) via diode D1, it will be made high while this is high - that is, while the red LED operates. At other times, IC2 pin 4 will be maintained in a low state via resistor R6. This will disable the i.c. so pin 3 will remain low and the buzzer off. Diode D2 has the effect of reducing the mark/space ratio. Without it, there would be long on states and long off ones. Here, long off states and very short on ones are needed.

The components which determine the frequency of the astable are resistors R7 and R8 in conjunction with capacitor C2. With the values specified, there will be one pulse given every 15 seconds or so. Since the exact time period is not thought to be important, no adjustment is provided. Note that the value of resistor R8 is very large - greater than the highest standard resistor which is usually 10MW. In the prototype unit, a resistor listed as a "high voltage" type was used (see Buy Lines) although three or four ordinary 10MW resistors connected in series would also serve. Using a large value for R8 allows the physical size of C2 to be kept small.

Construction

Construction of the Frost Alert project uses a single-sided printed circuit board (PCB) and the topside component layout is shown in Fig. 3. Begin by drilling the four holes for mounting it in the enclosure later. Solder all components into position as indicated, starting with the fuseholder and i.c. sockets (but do not insert the i.c's themselves yet). Follow with the resistors, capacitors and preset potentiometers then add the polarity-sensitive components - the diodes (including the LED) and buzzer. Note that the centre LED lead is the common negative while the slightly shorter outside lead is the green positive one. The polarity of WD1 is marked on the underside of the plastic body.

Fig.3. PCB component overlay



Using a trimming tool or small screwdriver, adjust the sliding contacts of the presets in the following way: RV1/RV4 to approximately centre position and RV2/RV3 almost fully clockwise. Solder 15cm pieces of light-duty stranded connecting wire to the points labelled "TH1", "supply +" and "ground". Bend the LED leads very carefully at right angles so that the body projects horizontally (see photograph). If using the specified aluminium box, the flanges on the lower section should be cut off. This will allow sufficient clearance for the circuit panel to be inserted without difficulty. Drill holes in the base section to correspond with those in the circuit panel and for the external leads to pass through (see photograph). Fit this latter one with a rubber grommet. Drill the hole for the LED in the top section.

Mount the circuit panel using a thick piece of plastic underneath to insulate the soldered connections from the metalwork. Alternatively, some small nylon washers or short stand-off insulators could be used on the bolt shanks to keep the connections clear of it. Gently adjust the LED leads so that the body will locate correctly directly behind the hole drilled for it in the side of the top section.

Pass the wires leading from the PCB through the grommet leaving some slack and apply strain relief. This may be done by tying a knot or - as in the prototype - using a small cable tie. Refer to Figure 4 and connect the wires to the 3-section piece of terminal block, TB1, as indicated.

Insert the i.c's into their sockets observing the orientation. Immediately before unpacking them and handling the pins, touch something which is earthed (such as a water tap). This will ensure that the body is free of static charge which could possibly damage the CMOS components.

Protection racket

Decide on the location of the main unit under the dashboard and a suitable place for the small box which will house the thermistor under the car. The thermistor unit must be sited with care. It should be mounted close to the road but must obviously be located well away from moving mechanical parts such as driveshafts. Take care to keep it far away from anything which will become hot, such as the exhaust system. Also, it should be reasonably protected from water. Decide how it will be attached and the route to be used for the wiring back to the main unit. Having done this, measure the length of wire needed allowing a little extra. Any light-duty twin wire will do.

The thermistor cannot be fixed in position without protection against both mechanical damage and the ingress of moisture. At the same time, the unit must respond quickly to changes in air temperature or it will be ineffective. Water conducts electricity to some extent so moisture reaching unprotected thermistor leads would lower its apparent resistance. This would be "seen" by the circuit as a higher temperature and so cause false operation. A further effect which must be avoided is moisture evaporating from the thermistor surface, since this would cause cooling and a subsequent change in the operating points.

Down the sink

The method used in the prototype was first to solder the thermistor leads to one end of the connecting wire. Use the whole length of the thermistor leads to minimize the amount of heat reaching the body. As an additional precaution, a heat sink (a pair of pliers gripping the leads close to the body) should be used to remove heat flowing along the wires before it reaches the thermistor. Excessive heat could damage it.

The thermistor and exposed wires are now dipped into polyurethane varnish (which may be obtained from any DIY store) which is then allowed to harden thoroughly - for at least 24 hours. This should be repeated at least four times to build up a hard, insulating layer. Good operation of the circuit depends on this being done efficiently so it is worth spending some time over it. As well as being effective in preventing water from reaching the exposed wires, the coating will be thin enough to allow a rapid transfer of heat so that the thermistor will respond quickly to the air temperature.

Calibration

For this, you will need a 9V battery and a suitable connector. Note that during calibration, the temperature of the thermistor must be allowed to increase only very slowly. It is suggested that 1oC per minute should be the maximum rise time. More than that and its temperature may lag behind that of the surroundings and the operating points will be incorrect when the device is put into service.

Half fill a small glass with water and place it in a freezer. Attach the ends of the thermistor wires to the terminals TB1/1 and TB1/2 on the main unit. Connect the battery - positive to TB1/3 and negative to TB1/2. At room temperature, the LED should show green. When the water begins to freeze (0°C), remove it from the freezer and dip the thermistor in it so that its body is completely covered. It is essential to keep the water thoroughly stirred and the help of an assistant is advised. Don't be surprised when the colour of the display changes. When red or yellow, the buzzer will begin bleeping.

Allow the temperature to rise. When the lower operating temperature (2oC or as required) is reached, RV1 contact should be carefully adjusted until the display just changes from red to yellow. When 4oC is reached (or as required), rotate RV3 sliding contact anti-clockwise so that the red LED goes off (giving a green display). The buzzer should then stop sounding. If satisfactory operation cannot be obtained, adjust RV2 slightly and try again. If the yellow colour appears excessively orange or greenish, adjust RV4 to provide a more satisfactory balance.

Once set, the operating points should be checked and the presets trimmed accordingly. Since calibration is virtually independent of voltage, the operating temperatures should still be valid for the nominal 12V car supply. Check for short-circuits between any part of the circuit and the box then fit the top section. The front face of the box could be sprayed with matt black (car type) paint or finished to match the car interior.

Prepare the plastic box for the thermistor. Drill some small holes in it to allow a flow of air. Drill a tight hole for the thermistor wires to enter and pass the whole length of wire through this from the inside. The thermistor should not need any additional support. Attach the unit in position and route the connecting wire to terminals TB1/1 and TB1/2 on the main unit. With a little ingenuity, the wire can usually be passed through existing grommets. If you do have to drill a hole, fit it with a grommet to protect the wire against being cut by the sharp edge of the metal.

Using proper auto-type wire and appropriate hardware, connect the terminal block positive (TB1/3) to a fuse which is live only while the ignition is switched on. Take the negative connection (TB1/2) to a nearby earth point (this terminal already carries one of the thermistor leads). The main unit may be attached under the dashboard or as required using a small bracket or adhesive fixing pads. The Tri-Colour Frost Alert may then be put into service.

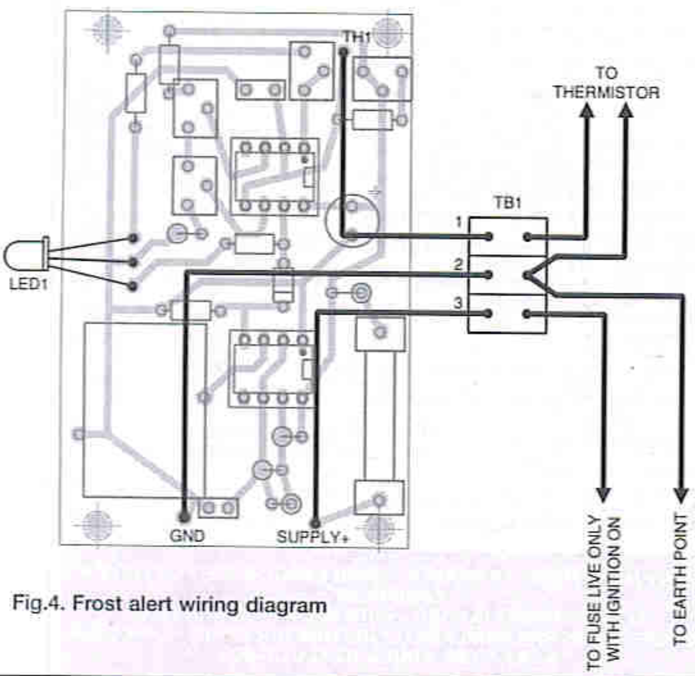


Fig.4. Frost alert wiring diagram

PARTS LIST

Resistors: 0.6W metal film (except R8)

R1 10k
R2,3 220k
R4 330W
R5 560W
R6 100k
R7 470k
R8 33M high voltage resistor
RV1 4k7 min vert preset
RV2,3 47k min vert preset
RV4 470W min vert preset

TH1 bead thermistor 4k7 at 25oC

Capacitors

C1 220nF disc ceramic
C2 470nF polyester.
C3 100mF 25V radial electrolytic

Semiconductors

D1,2 1N4148
D3 1N4001
LED1 10 mm tri-colour LED
IC1 CA3240
IC2 ICM7555IPA

Miscellaneous

8-pin DIL IC socket - 2 off
AB12 aluminium box size 76 x 51 x 25 mm
Plastic box 1521 size 30 x 37 x 24mm
PCB-mounting solid state buzzer. Pin spacing 18mm approx.
20mm PCB fuse block; 250mA glass fuse; 2A screw terminal block (3 sections needed)
Twin wire - as required
4 mm grommet
Polyurethane varnish

Buy Lines

The high-value resistor, R8 (33MW), used in the prototype was a Maplin "high voltage" resistor order code V33M. The thermistor, tri-colour LED and buzzer were also obtained from Maplin.

T E L N E T

8 CAVANS WAY,
BINLEY INDUSTRIAL ESTATE,
COVENTRY CV3 2SF
Tel: 01203 650702
Fax: 01203 650773
Mobile: 0860 400683

(Premises situated close to Eastern-by-pass in Coventry with easy access to M1, M6, M40, M42, M45 and M69)

OSCILLOSCOPES

Gould OS3000/ADVANCE 3000 – 30MHz Dual ch. £200
Gould 5110 – 100MHz Intelligent oscilloscope £850
Hewlett Packard 1740A, 1741A, 17744A, 100MHz dual ch from £350
Hewlett Packard 1707A, 1707B – 75MHz 2ch from £275
Hewlett Packard 1980B - 100MHz, 2 Channel, HPIB Prog'ble £750
Hewlett Packard 54201A - 300MHz Digitizing £1750
Hewlett Packard 54501A - 100MHz - Digitizing 4 channel £1950
Hewlett Packard 54100D - 1GHz Digitizing £4500
Iwatsu TS 8123 - 100 Mhz - D. Storage £850
Kikusui COS 6100 – 100MHz, 5 Channel, 12 Trace £475
Lecroy 140 - 100MHz - D.S.O. £3250
Nicolet 3091 – LF D.S.O. £1100
Philips PM 3315 - 60MHz - D.S.O. £750
Phillips 3211, 3217, 3240, 3243, 3244, 3261, 3262 (2ch + 4ch) from £125 to £350
Philips PM 3295A - 400MHz Dual Channel £1950
Philips PM 3295 - 350MHz Dual Channel £1500
Tektronix 468 - 100MHz - D.S.O. £800
Tektronix 2213 – 60MHz Dual Channel £425
Tektronix 2215 60MHz dual trace £450
Tektronix 2235 Dual trace 100MHz (portable) £800
Tektronix 2335 Dual trace 100MHz (portable) £750
Tektronix 2225 – 50MHz dual ch £450
Tektronix 2465A - 350 Mhz 4 channel £2950
Tektronix 464/466 – 100MHz An storage from £350
Tektronix 465/465B – 100MHz dual ch from £350
Tektronix 475 - 200Mhz Dual Channel £475
Tektronix 7313, 7603, 7613, 7623, 7633, 100MHz 4 ch from £300
Tektronix 7704 – 250MHz 4 ch from £650
Tektronix 7904 – 500MHz from £850
Telequipment D68 - 50MHz Dual Channel £200

Other scopes available too

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LOW DISTORTION Audio Oscillators

A practically oriented look by audio expert John Linsley Hood at ways in which to design low distortion amplifiers

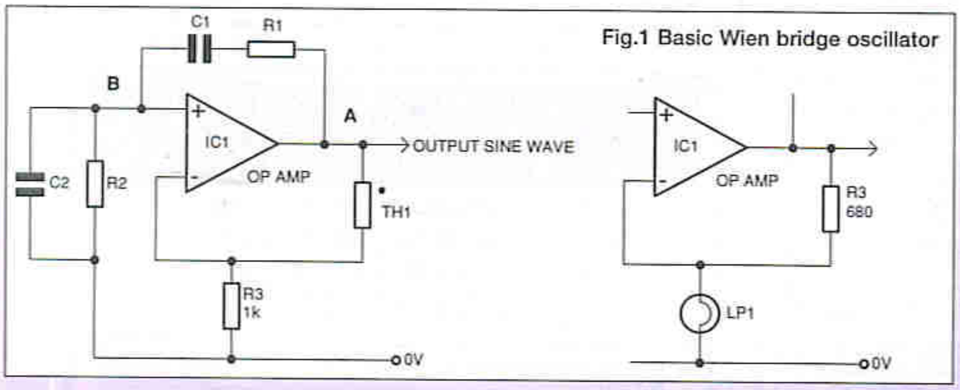


Fig.1 Basic Wien bridge oscillator

One of the most popular ways of assessing the quality of an audio system (particularly things such as an amplifier or preamp.) is to feed it with a low-distortion sinewave input signal and then measure the amount of harmonic distortion the system has introduced - which should, or course, be zero. For use with a typical audio set-up, the frequency range of interest is generally considered to be 20Hz to 20Khz, though it may be prudent to check its performance somewhat beyond this range as well.

Unfortunately, sinewave testing does not, on its own, give a complete picture of audio performance, in that sudden 'transient' shifts in signal voltage level can cause unwanted changes in the way components - or circuits - work and unwanted effects of this kind would not necessarily be revealed by simple steady state harmonic distortion measurements. Also, intermodulation products resulting from 'out of band' non-linearities can result in unwanted 'in band' effects, particularly in the case of wide band 'noise'. However, the results given by sinewave testing and specifications based on steady state measurements, have become so firmly established in the minds of the general public as a measure of audio system excellence that the low-distortion sinewave oscillator is likely to remain one of the major instruments on the audio lab test bench.

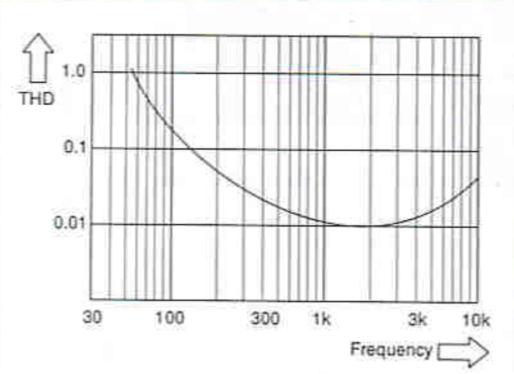


Fig 2 Typical distortion Residues

Generator systems

Any amplifier arrangement can be made to oscillate if the loop gain of some feedback network, from output back to input, is equal to or greater than unity at some frequency at which the loop phase shift is either zero or some multiple of 360. The circuit will then oscillate at this frequency. In practice, the feedback system is usually arranged to provide a gain level which is a little greater that unity at this frequency, to ensure that the system starts oscillating, coupled with some kind of control system which will cause the feedback loop gain to fall to unity when the signal amplitude reaches some convenient AC output level.

The simplest arrangement of this kind uses a 'Wien bridge' layout, of the kind shown in Fig. 1a. The Wien network consists of R1C1 and R2C2 and has the convenient characteristic that, if R1=R2=R and C1=C2=C, the network will have zero phase shift at a frequency (f0) which is given by

$$f0 = 1/2\pi CR.$$

At this frequency, the transmission of the network from point 'A' to point 'B' will be one third. So, if the gain of the op amp (A1) is arranged to be 3x. or greater, the circuit will oscillate. This requirement is met, very easily, by using a thermistor (TH1) and a fixed resistor (R3) in the gain adjustment feedback path to the inverting input of the op amp. For example, if R3 is 1K0 and if 'TH1' is an RS Components 'RA53' thermistor, the output voltage from the circuit shown will settle down at about 1V RMS. With modern, very low distortion op amps, such as the LM833 or

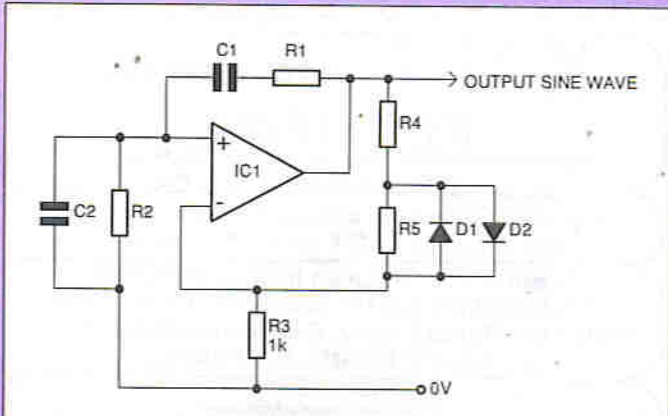


Fig 3. Diode stabilised oscillator

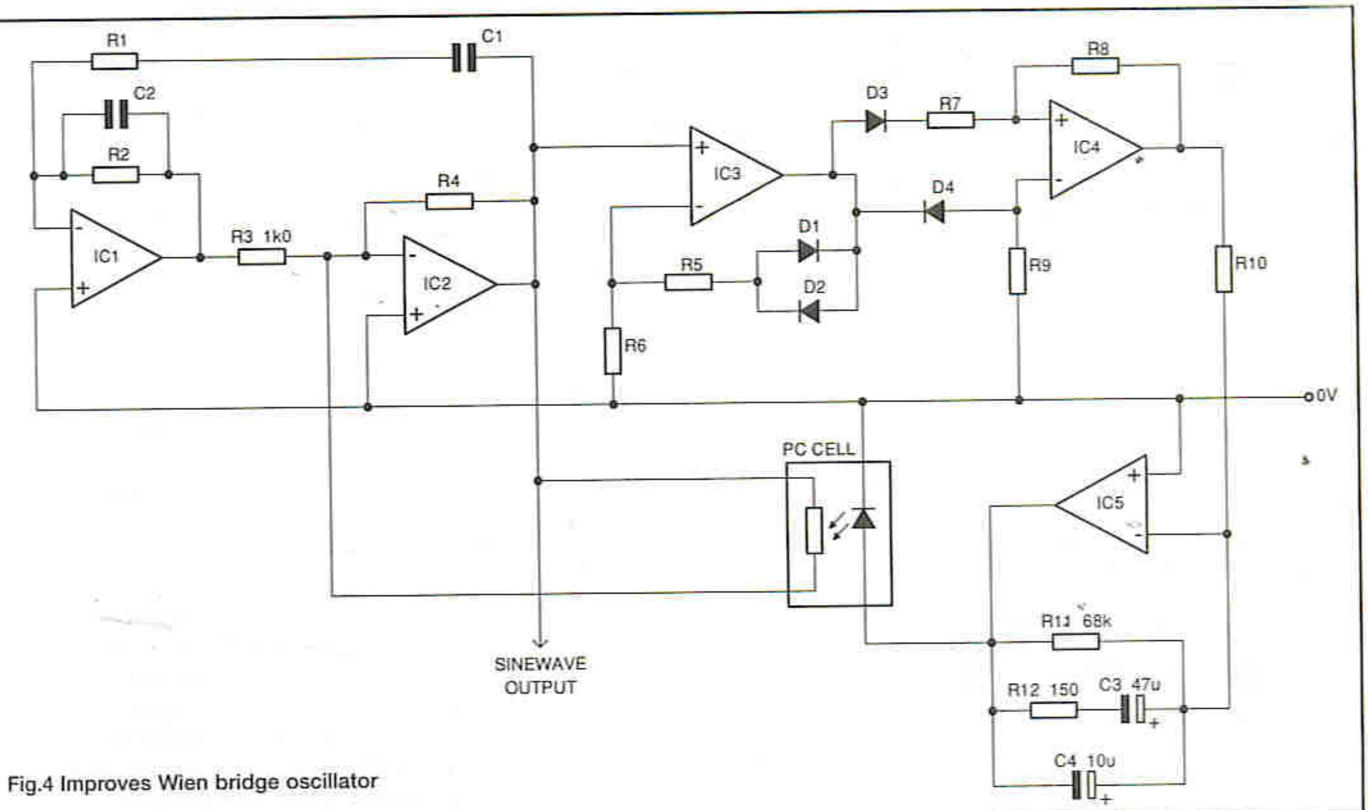


Fig.4 Improves Wien bridge oscillator

the OP27, or, better still, the AD827, the THD of such a circuit would be of the order of 0.008% at 1KHz, with almost all of the residual distortion arising from the operation of the amplitude stabilisation system.

Problems

There are two main difficulties with this type of control circuit, of which the first is that the thermistor (which is used because its resistance falls as it gets warmer - which it does if the AC voltage applied across it increases - which then increases in the amount of NFB it provides and reduces the oscillatory output voltage again) has a thermal time constant of a few seconds, so when the circuit is switched on, or if the operating frequency is changed, the oscillator will take a few seconds for the output AC voltage to settle down to its steady state value. This causes what is called 'amplitude bounce' and, since the circuit will take a finite number of sinewave cycles to settle down, the 'bounce' will be longer lasting and more annoying at low frequencies than at high.

The second problem is that the amplitude stabilisation circuit responds to the value of the output voltage, either AC or DC. At high frequencies, say 1000Hz or greater, this will average out satisfactorily to a virtually constant mean value, but at low frequencies, say 10-50Hz, the thermistor (or most other amplitude stabilisation systems, for that matter) will have enough time to sense the instantaneous value of the output voltage waveform as it swings up and down - if this voltage change is not too small a part of its inherent time-constant - and it will consequently attempt to reduce the size of the peaks of the output waveform. This peak flattening causes third harmonic distortion, and gives a graph of THD vs frequency of the kind shown in Fig. 2. There will also be some rise in THD at frequencies above, say, 10Khz which is due to the deterioration in performance at higher frequencies. This is typical of most op amps and is due mainly to their internal HF loop stabilisation method.

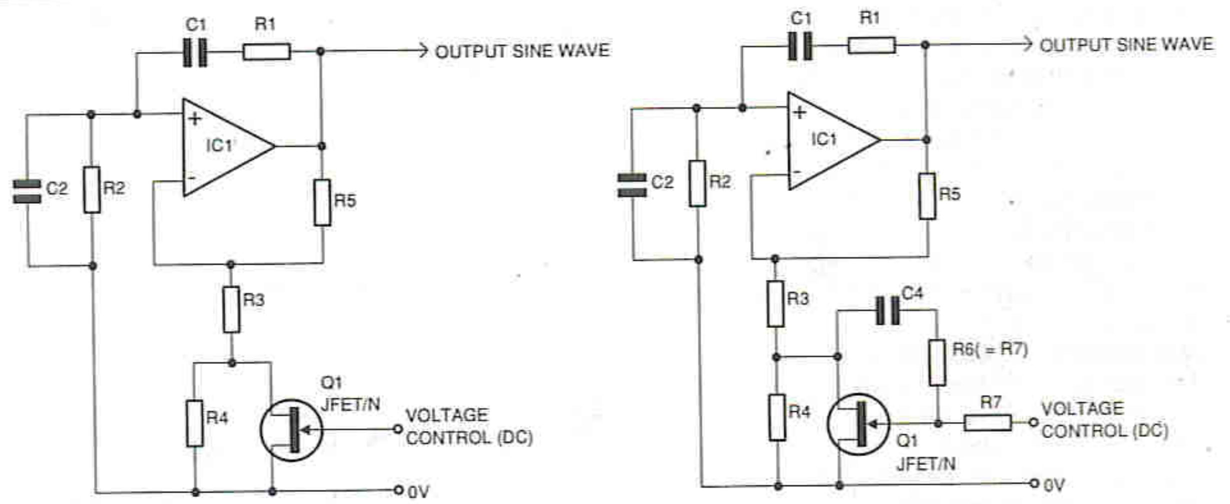


Fig.5 Amplitude controlled by FET

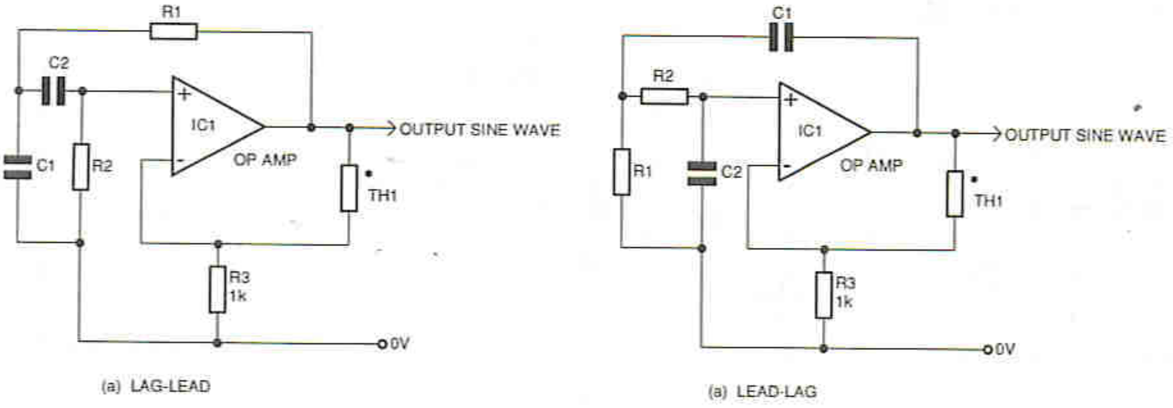


Fig 6. Lag-lead and Lead-lag layouts

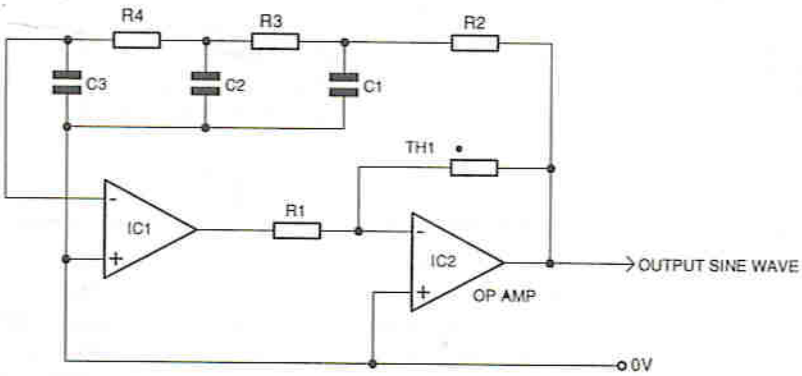


Fig. 7 Three-lag phase shift oscillator

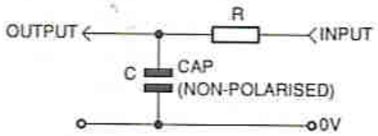


Fig.8 Simple lag network

Practical options

For a simple instruction, the designer has two choices - either to choose the component values in the thermistor limb of Fig 1a so that the circuit has a low distortion (and a long settling time, since the two things go hand in hand) and accept the consequent output amplitude bounce, or to use a different method of amplitude stabilisation, such as a pair of back-to-back diodes (an arrangement which has a rapid settling time, but less good distortion characteristics), using the circuit shown in Fig. 3. A certain amount of fiddling will be necessary to find the best values of R4 and R5 to obtain the best compromise between output voltage and waveform distortion. At its best, diode stabilisation, which operates by clipping the output waveform if it gets too big, will give somewhere between 0.5 and 1% THD, mainly depending on the diode characteristics.

Wien bridge oscillator circuits originating in the USA mainly tend to use low power filament lamp bulbs (e.g. 24V. 0.02A, such as the RS 587-686) in place of thermistors since such lamp bulbs are cheaper and more easy to obtain there than thermistors. However, because lamp filaments change in resistance with applied voltage in the opposite way to thermistors, the circuit must then be rearranged as shown in Fig. 1b). In practice, for similar settling times, there really isn't much to choose, in terms of performance, between these two versions of Fig. 1.

Two further techniques which are quite often used to stabilise the output voltage from a simple oscillator arrangement are the DC coupled 'opto-isolator' (light controlled resistor) and the 'FET' (voltage controlled resistor) systems. The first of these techniques is the better, because the characteristics of the photo-resistor can be largely independent of the signal voltage across it, but both of these arrangements require an additional control circuit to generate a DC voltage proportional to the oscillator AC output level. This is then used to control the value of the resistance of the photo-conductive output limb of an opto-isolator, or the channel resistance of an FET. Because this technique allows greater control of the response characteristics of the output voltage regulation system, it allows lower distortion figures to be achieved at the bottom end of the audio frequency band.

A published circuit arrangement of my own using a photo-resistor, dating from the early 1980s, is shown in Fig. 4. This had a THD of 0.009% at 100Hz, improving to better that 0.0008% at 1KHz or above. An additional feature of this circuit layout was that the op amps in the oscillator section are used in the inverting mode, with the non-inverting inputs grounded. This eliminates 'common mode' distortion problems so that, even with a simple thermistor control system, a THD of 0.002% at 1KHz was still obtainable. The DC control voltage circuit which I used is also shown in Fig. 4.

The use of a junction FET as a gate voltage controlled resistor is frequently proposed as a low distortion technique

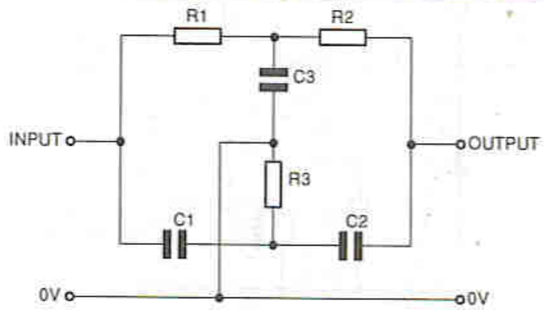


Fig.9 Basic layout for parallel 4

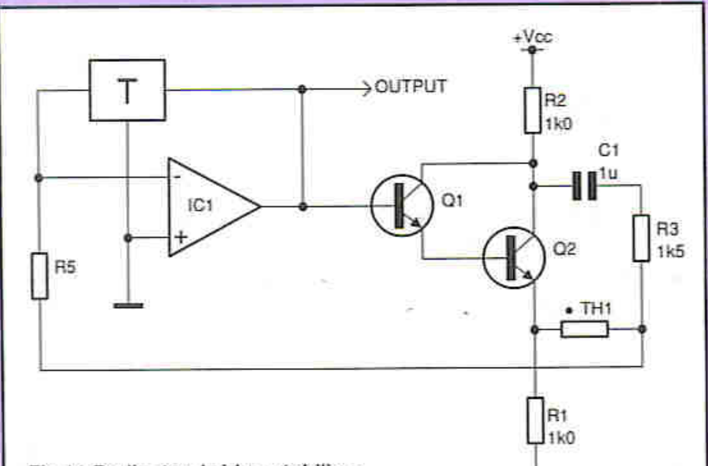


Fig.11 Darlington bridge stabiliser

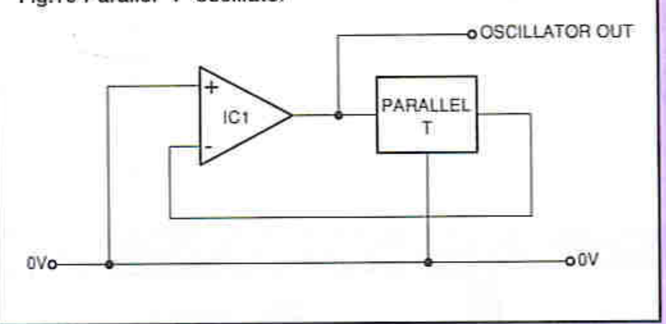


Fig.10 Parallel 'T' oscillator

for use in an oscillator output voltage control system.

Unfortunately, the simple FET control system shown in Fig. 5a introduces quite a lot of distortion. This can be partially corrected by the use of some DC negative feedback across the FET, from drain back to gate, as shown in Fig. 5b, to linearise its performance. The component values shown are typical and this type of layout is used in commercial low distortion test oscillators.

Other oscillator arrangements.

Although the Wien bridge system is by far the most popular circuit layout in this field, the 'lag-lead' and 'lead-lag' layouts shown in Fig. 6a and 6b are virtually identical in performance to the Wien bridge and may be more convenient in some cases. Alternatively, the phase-shift oscillator of Fig. 7 is capable of excellent results, mainly because the signal path through the feedback network, with its three 'low pass' RC filters, attenuates any HF distortion components which might arise in the circuit. An additional buffer stage, A2, is used to stabilise the output voltage.

The way this works is that an RC network, of the kind shown in Fig. 8, will cause a phase lag of 60 when the impedance of the capacitor 'C', which is frequency dependent, ($Zc = 1/(2\pi fC)$), is equal to the resistance 'R'. If three such networks are connected in series, the phase shift of the whole network will be 180 at that frequency. A disadvantage of this layout, by comparison with the Wien bridge, is that three components - either three 'C's or three 'R's - must be adjusted simultaneously to change the operating frequency. This particular snag is side-stepped in a commercially available very low distortion oscillator by simply removing one of the RC lag elements and relying on the op amps to provide the additional 60 phase shift which is necessary to sustain oscillation.

The parallel 'T' oscillator

This is based on the type of network shown in Fig. 9, of which the main characteristics are that it gives a zero-transmission notch at a frequency, f0, at which, if C1 = C2 = C3/2 = 'C', and R1 = R2 = 'R'.

$$f0 = 1/2\pi CR$$

as is the case of the Wien bridge. The difference is that to adjust this notch frequency, three components (either three 'R's or three 'C's) need to be adjusted simultaneously.

The operation of the circuit shown in Fig. 10, as an oscillator, can be explained in several ways, of which the simplest proposition is that, since the network is in the negative feedback path to the amplifier, A1, and since it has zero transmission at f0, there will be no NFB at all at this frequency and the amplifier will therefore operate at full open-loop gain (say 100,00x for a typical IC op amp). This causes that part of the wide-band noise at the input of A1 which happens to be at f0 to be amplified at maximum gain, while those parts of the noise spectrum which are not at f0 will be greatly reduced in size by the loop negative feedback of the system.

The result of this action is that if some non-distorting means is available to limit the size of the output waveform, to prevent the amplifier from clipping, the circuit will generate a very low distortion sinewave, at f0, with very good frequency stability. As noted above, it is necessary to provide some non-distorting and rapid settling means of controlling the output amplitude, so that the amplifier doesn't clip. The circuit I have shown in Fig. 11 is one I

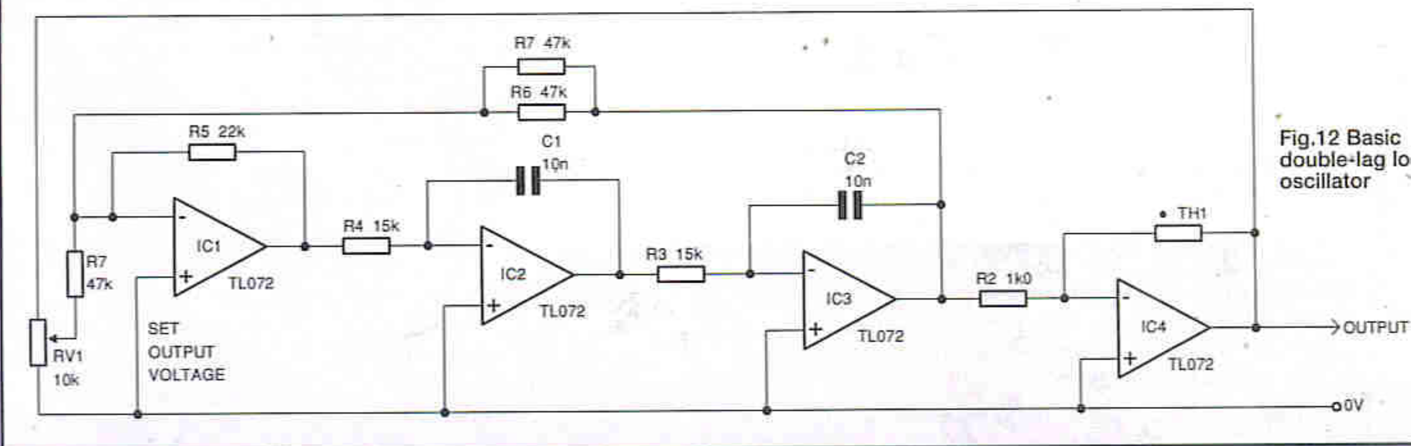


Fig.12 Basic double-lag loop oscillator

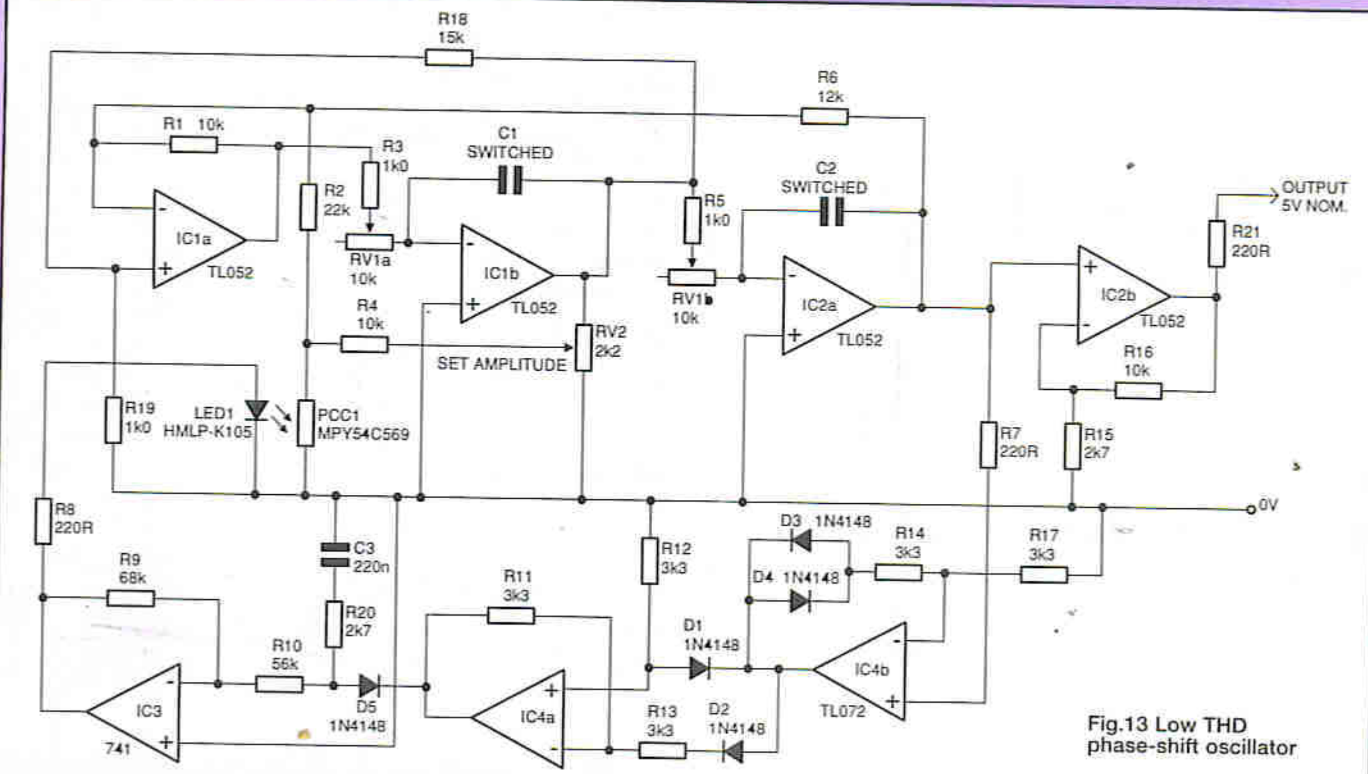


Fig.13 Low THD phase-shift oscillator

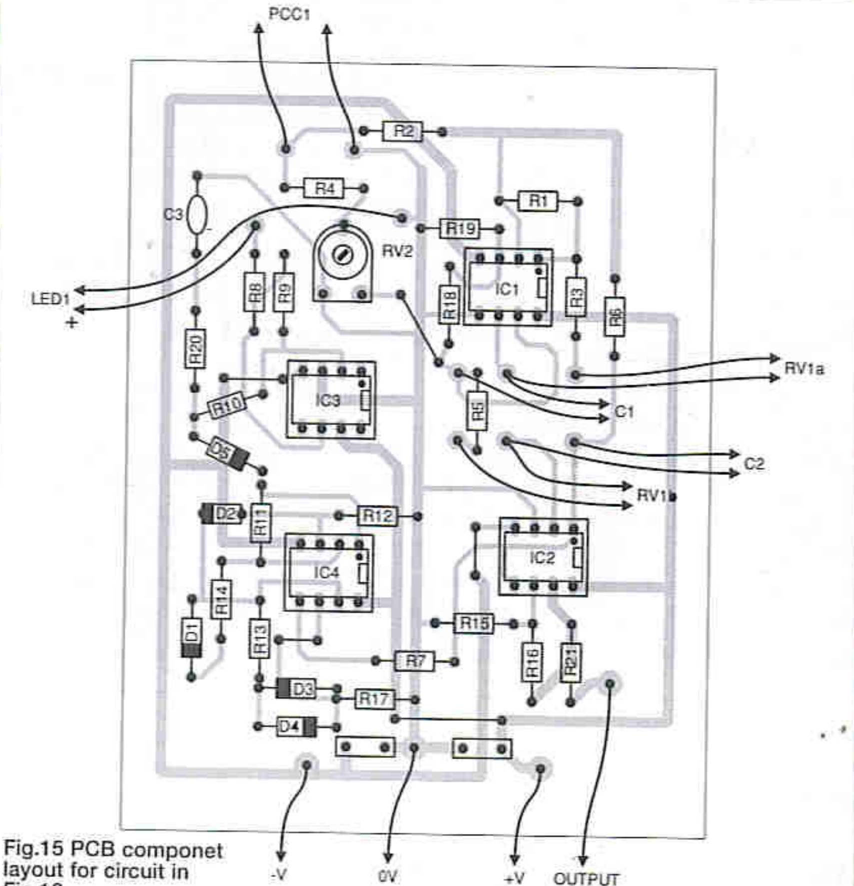


Fig.15 PCB componet layout for circuit in Fig.13

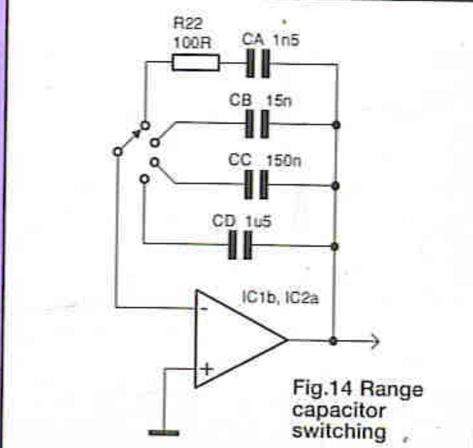


Fig.14 Range capacitor switching

used in a very low distortion 'parallel T' design I described in 'Wireless World' in July 1979 and works by balancing the negative and positive feedback so that the circuit oscillates with just the right amplitude.

As noted above, a snag with the parallel T design is that, like the 3-lag phase shift circuit, it is necessary, in order to change the operating frequency, to alter either R1, R2 and R3, or to alter C1, C2 and C3 at the same time. If one is a regular customer, one could get a potentiometer manufacturer to make up a 3-gang pot consisting of two 10k linear law posts on the same shaft as a 5k one but, for the amateur constructor, the only really sensible approach for this type of circuit is to make the capacitors or resistors fixed values, switched by a three-gang bank of switches. Since it is easier to get intermediate values of resistors than capacitors, it is sensible to opt for switching the capacitors and then make up the non-standard resistance values by paralleling these.

For a 1kHz operating frequency, with a standard value of 'C', such as 10nF, the necessary value of 'R' would be 15915 ohms. This is not a 'stock' value, but a close approximation can be obtained by connecting, in parallel, an 18k and a

150k resistor - both of which are stock values, giving a resultant value of 16071 ohms, which is within 1% of the required value. 'R/2' can be made by doubling up the parallel pairs. Other operating frequencies can be obtained by extrapolation. For example, if one makes 'C' 100nf, then f0 = 100Hz, and if 'C' is 3.3nF, then f0 = 3.03kHz. If switched frequency operation is possible, then circuit layouts like the parallel T or the phase shift system in Fig. 7 become practicable and this latter circuit has the advantage that, with the triple RC integrator layout, the successive attenuation of unwanted high frequency harmonic components helps reduce the THD of the circuit.

The double-lag loop oscillator

An interesting recent development in low distortion sinewave oscillators is a circuit based on the 'double-lag loop' or 'double integrator loop' system, shown in outline form in Fig. 12. In this, a pair of op amps (A2/A3) are connected as active integrators, with separate NFB loops connected accross both A1 and the three amplifiers A1, A2 and A3. This has the effect of providing a gain/frequency response which peaks at the frequency where $f0 = 1/2\pi CR$ and falls off rapidly above this frequency. If some positive feedback is taken, for example from the output of A4, the circuit can be made to oscillate at f0 and, since the gain falls rapidly beyond f0, any harmonics are heavily attenuated, which gives a low distortion output.

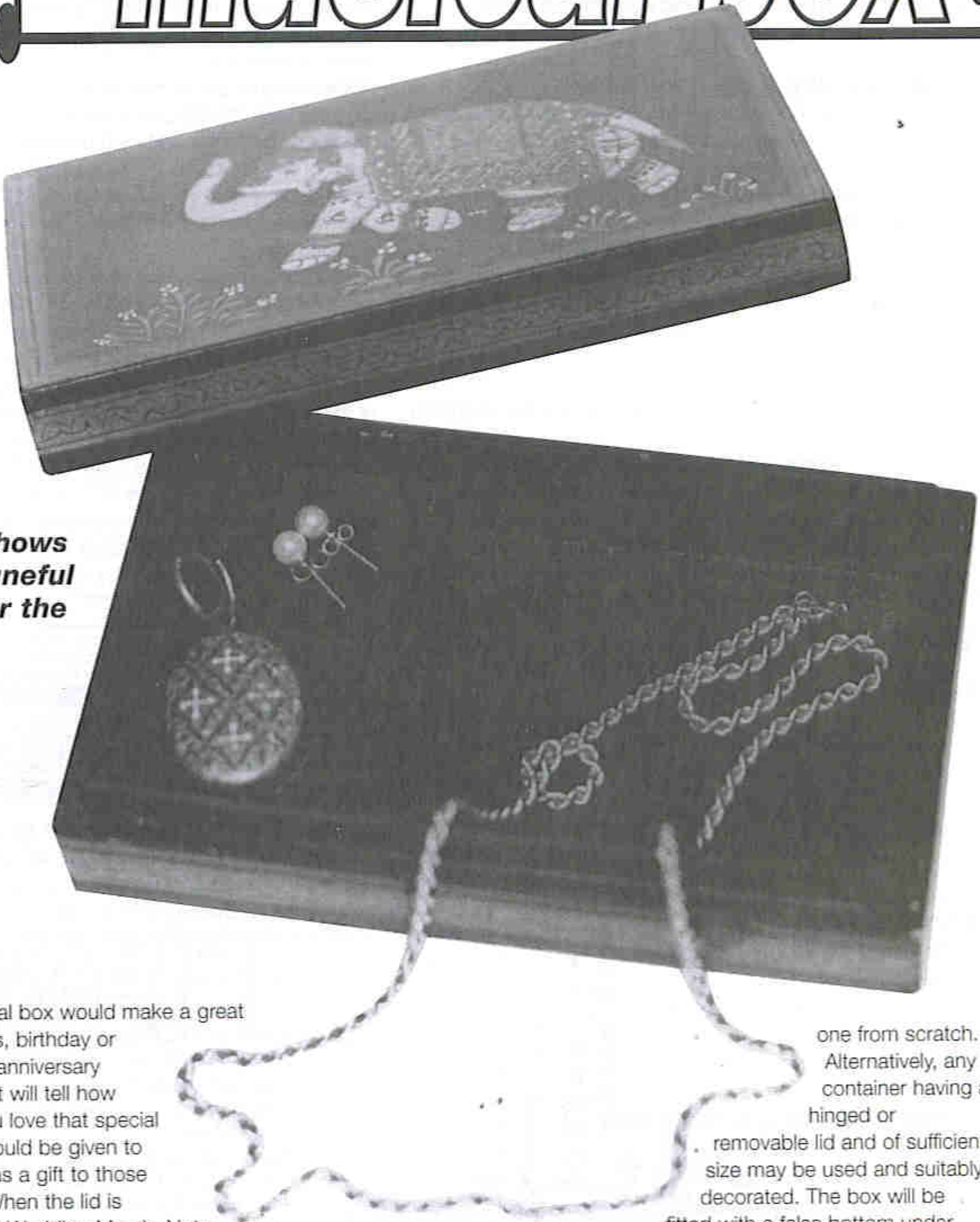
Obviously, a simple thermistor stabilisation system, as shown if Fig. 12, would not give the best possible results, so I have shown, in Fig. 13, a worked example of a wide frequency range (10Hz to 100Khz) design with an LED/photocell amplitude control system. In the design shown, A1/1, A1/2, and A2/1 form the double-lag loop, whose oscillatory frequency is controlled by the switched values of C1 and C2 and by the two-gang pot RV1a and RV1b. Since some op amps resent shunt capacitance feedback, it is prudent to connect a small resistor in series with both the top range capacitors, shown as 'Ca' in Fig. 14, to prevent op amp instability.

In the circuit of Fig. 13, A2/2 is just an output buffer and gain stage, to give a low impedance 5V RMS output and the ICs A3 and A4/1-2 are connected to generate a DC output current through the LED (LED1) which increases as the output voltage increases. This lowers the resistance of the photo-conductive cell (PCC1) from its dark resistance (about 100k) to some 2k, at maximum illumination. (Both the LED and the CdS PC cell are stock items from the Farnell catalogue and the combined unit was made by sticking the nose of the LED onto the face of the PC cell with 'Bostik' rapid-setting epoxy resin adhesive, which is optically clear. The whole was then wrapped in black tape to exclude ambient light.)

The THD given by this design is exceedingly small, typically of the order of 0.001% at 1Khz, or above, though as with all amplitude control systems there is a tendency for the system, in carrying out what it thinks to be its task, to reduce the amplitude of the peaks of a sinusoidal output waveform at low frequencies and this introduces some small amount of third harmonic distortion at the bottom end of the frequency spectrum, perhaps of the order of 0.008% at 100Hz.

I have shown a suitable PCB layout (used in the prototype) in Fig. 15. None of the components used is particularly critical in type, but it is sensible to use good quality capacitors for the frequency range switching.

ELECTRONIC musical box



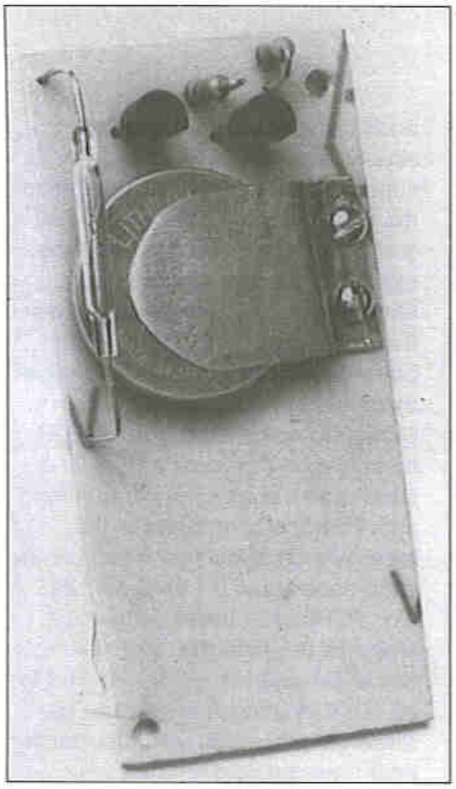
Terry Balbirnie shows how to build a tuneful Christmas gift for the one you love

This musical box would make a great Christmas, birthday or wedding anniversary present. It will tell how much you love that special person in your life. It could be given to someone as a hint or as a gift to those about to be married. When the lid is opened, it will play The Wedding March. Note that the music has an "electronic" sound and, although pleasant, does not sound like a traditional clockwork musical box.

Fruit of Love

In the prototype unit, the case used to house the circuit was a commercially-produced lacquered jewel box. Of course, some readers will have the necessary woodworking skills to make one from scratch. Alternatively, any container having a hinged or removable lid and of sufficient size may be used and suitably decorated. The box will be fitted with a false bottom under which the electronic part is hidden. The circuit only occupies a depth of 15mm so there will be plenty of space left inside to store small objects. The on-off function is provided by a reed switch on the circuit board in conjunction with a small magnet attached to the lid. This provides a very unobtrusive, reliable and unusual method of switching.

The circuit is based on an inexpensive sound generator i.c. of the type used in musical greetings cards. Very few additional



components are needed and all these, apart from the magnet, are mounted on a printed circuit board. The magnet will be attached so that it approaches the reed switch when the lid is closed. This action holds the circuit off and under these standby conditions it will draw a current of around 3 microamps. The specified 3V lithium cell could maintain this for several years.

Play it again

When the lid is opened, the magnet moves away from the reed switch. This results in the contacts parting and the circuit being actuated. The tune then plays from the beginning once, through a miniature sounder. To play it again, it is necessary to reset the circuit by closing the lid and re-opening it. While playing, the current requirement is about 150 microamps and this could be supplied by the battery for about two months continuously. The battery should, therefore, have a very long life and will need to be replaced only very infrequently. While the lid is open and the tune has played out, the current requirement is slightly more - 7 microamps approximately.

To produce the sound, either a loudspeaker or a Piezo transducer could be used. In this circuit, a Piezo transducer was chosen on account of its small size, low cost and extremely modest current requirement. Also, the output from the sound generator can operate it direct - a loudspeaker would require a transistor driver to amplify the signal. This would lead to a much greater power consumption. A Piezo sounder does not reproduce music with any serious degree of fidelity. However, it is satisfactory for the purpose.

Circuit description

The circuit diagram for the Electronic Musical Box is shown in Fig. 1. Thanks to most of the circuitry being fabricated on the sound generator chip, IC1, this is very straightforward.

Begin by considering the action of reed switch, SW1. All common inexpensive switches of this type have normally-open contacts - that is, when the magnet is held near such as when the lid is closed, the contacts touch. This is the reverse of the action required. The contacts must provide a "make" effect when the lid is open so that current is directed to the circuit. It is therefore necessary to invert its operation. This is the purpose of transistor Q1 and resistors, R1 and R2. When the lid is closed, the reed switch contacts "make" and connect Q1 base direct to supply negative (ground). This turns the transistor off since no current will flow in the base/emitter circuit. This being so, no current flows in the collector circuit and IC1 receives no supply.

When the lid is opened, resistor R1 allows current to flow from battery B1 into the base of Q1 and the transistor turns on. Sufficient collector current now flows to operate the i.c. Under standby conditions, current flows continuously through R1 and SW1 contacts. However, by keeping the value of R1 high, this current is kept extremely low. A high-gain Darlington transistor is used to amplify this small base current sufficiently to operate the i.c. Under such low current conditions, Q1 will develop about 0.5V between collector and emitter while on. This voltage will be unavailable to IC1 so the effective power supply to the chip is approximately 2.5V, which is perfectly adequate for the job.

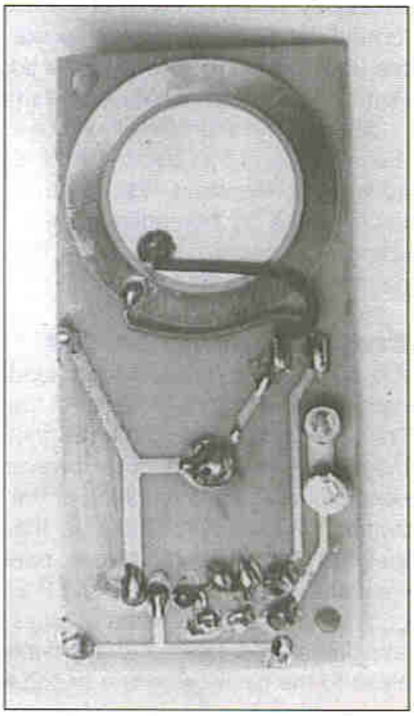
The sound generator, IC1, has the tune - in this case, The Wedding March - written into read-only memory (ROM) having a capacity of 64 notes. This i.c. is dedicated to the tune it is programmed to produce and cannot be changed by the user. At the time of writing, certain alternative tunes in this series of i.c's were unavailable - apparently for copyright reasons. Anyone wishing to play a different melody should therefore make a definite check on its availability before building the circuit.

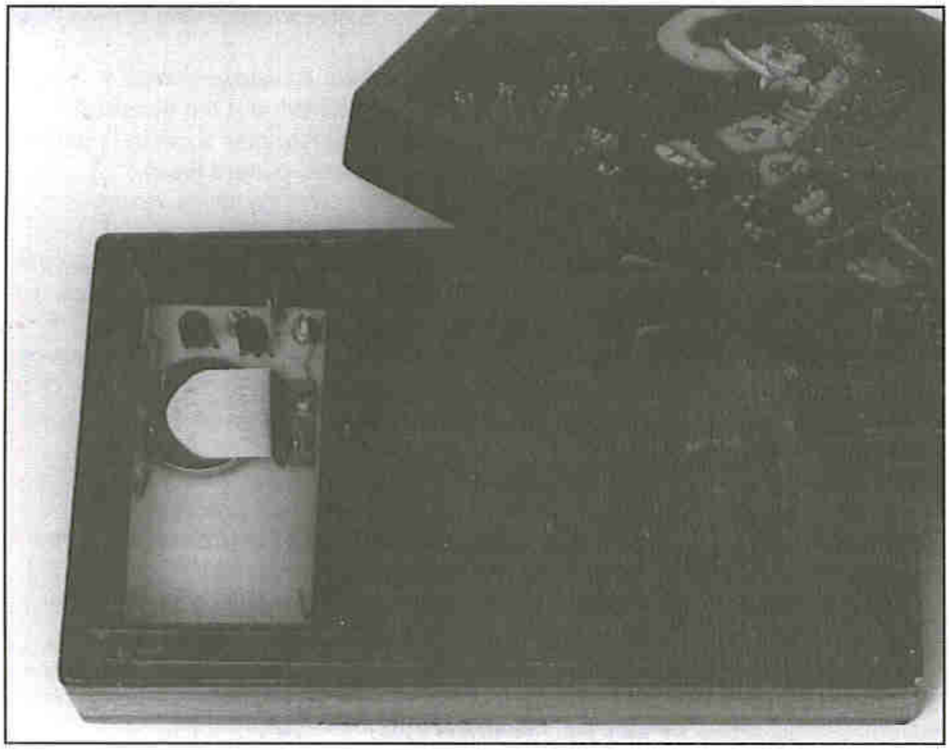
The i.c. appears like a transistor having three leads - two for the power supply and one for the output. When a supply is established between pin 2 (positive) and pin 3 (negative) via Q1 collector/emitter, the memory is read from the beginning and the output, pin 1, produces an electrical signal corresponding to the tune programmed in it. This drives the Piezo sounder, BUZ1, directly.

Construction

Construction is based on a single-sided printed circuit board (PCB) and the topside component layout is shown in Fig. 2. If space is at a premium, it would be possible to reduce the size of the PCB by removing the right-hand half on which the sounder, BUZ1, would be mounted. The sounder could then be attached to some other free surface. Note that Piezo devices need to be glued securely to a surface which will act as a sounding board and increase the volume.

Drill the two mounting holes in the PCB; two small ones for the battery securing bracket and another in the centre of the battery position. Make a bare wire loop a little smaller than the diameter of the battery - see Fig. 3. Single-strand connecting wire with its insulation stripped off would be ideal. Solder the inner end of this to the appropriate pad using the hole just made for it. The battery will rest on





the loop and form the negative connection. Use a trace of quick-setting epoxy resin adhesive around the bottom of the wire to secure it to the PCB. Make certain that no adhesive covers the part where the battery will make contact - this would insulate it and the circuit would fail to work.

Make the small stepped bracket used to secure the battery and to form the topside (positive) connection (see Fig. 4). A piece of thin sheet copper was used in the prototype. However, tinplate from an old can could be used because it is springy enough to hold the battery securely. If using this material, it must be carefully cleaned and all traces of paint removed. Place the battery in position with the positive side up (the polarity is marked on it) temporarily and tighten the bracket down on it. Check that the cell is secure and make any small adjustments as necessary. Make certain that there is no short-circuit formed between the bracket securing nuts and the track on the underside which leads to the sounder positive output. Remove the battery again before proceeding.

Shorten the sounder wires to a length of approximately 25mm. Apply a thin layer of quick-setting epoxy-resin adhesive to the brass side of the sounder and glue it into the free area on the underside of the PCB. Wait for the adhesive to harden, then solder the wires to the rectangular pads also on the underside.

Cracking under stress

It is necessary to bend the end leads of the reed switch at right angles and at a distance of about 5mm from the body. The spacing between the wires should be 30mm so that they will fit the PCB layout. However, before making the bends, check the orientation of the reeds inside the switch. For maximum sensitivity they should end up with their flat face upwards - that is, parallel to the PCB. It is essential to manipulate the end leads with great care - the body of the switch is made of glass and it will crack with a small amount of stress. To avoid this, grip each lead in turn close to the body using fine-nose pliers and bend the free ends using the fingers. Do not simply bend the leads without support. Make small adjustments to the lead spacing as necessary and solder them in position so that the reed switch body stands about 8mm above the circuit panel. It will then be slightly higher than the battery and other components when these are in position.

Complete construction of the PCB by soldering the resistors, i.c. and Darlington transistor in place, taking care over the orientation of the latter two components - the "flat" in each case faces B1 position (see Fig. 5). None of these items must stand higher than the reed switch. Since IC1 and Q1 leads will need to be cut very short, they should be soldered in position using minimum heat from the soldering iron to prevent damage.

Testing

The circuit should be tested before it is built into the box. To do this, slacken the bracket and insert the battery observing the polarity. Tighten it carefully. Make certain the wire loop on the underside does not dislodge and cause a short-circuit with the positive section of the cell. When proper contact is made, the tune should play through once, although it may be erratic until then. The sound will be very quiet under these conditions but it will become louder when the circuit panel is mounted inside the box. Bring the magnet's long face towards the reed switch. The tune should stop if it is already playing. When the magnet is removed again, it should re-play from the beginning. Repeat the operation a few times to check that the reed switch and everything else is working reliably.

Choosing the box

When selecting a box for the project, choose one having a length of 65mm and a breadth of 35mm minimum to accommodate the PCB. There must also be sufficient depth for it - i.e. 15mm minimum. In practice, the depth of the box needs to be greater than this so that objects may be placed inside above the false bottom. The box used in the prototype was large enough (115 mm x 65 mm internal) to be partitioned with a false bottom only in the left-hand section (see photograph). The shallow part will then be convenient for housing small items such as ear-

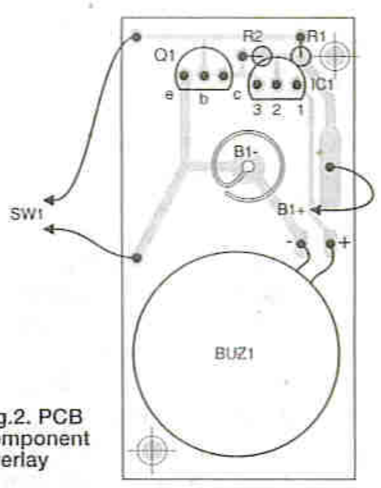


Fig.2. PCB component overlay

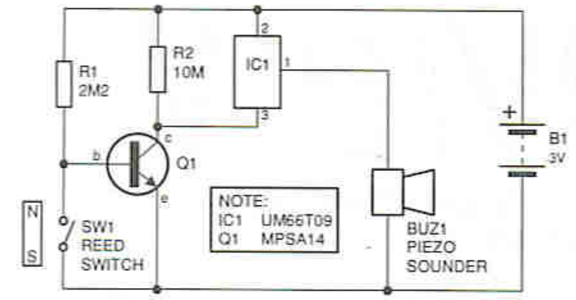


Fig.1. Music box circuit

rings. Note that the magnet on the lid, when in position, must end up no further than 25 mm from the reed switch or operation may not be reliable.

It is very important for the circuit panel to make good mechanical contact with at least one side of the box. This provides acoustic coupling and makes the sound louder. If necessary, apply a little quick-setting adhesive around the mating surfaces. Attach the circuit panel to the base of the box using small fixings and spacers to keep the sounder clear of it. Note that the reed switch must take up a position at the edge so that it will lie directly below the magnet position on the lid. Check that the magnet will operate the reed switch reliably when it is held at the correct distance and make adjustments as necessary. The loudness depends on many factors - even the tightness of the fixing bolts - so it is worth doing some experiments to achieve the best effect.

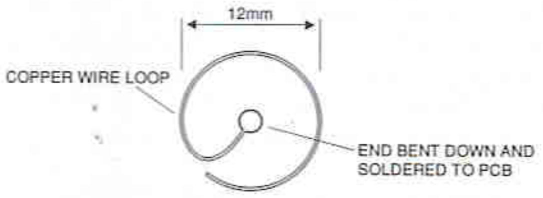


Fig.3. Music box negative battery connections

Cut a piece of very thin plywood or thick cardboard and make the false bottom and any side partition as necessary. This should be a tight push fit so that it is reasonably easy to remove for eventual battery replacement. Later tests will reveal whether it needs a small slot to allow the sound to emerge. Make sure it cannot collapse and damage the reed switch - glue thin pieces of wood to the sides of the box to act as supports if necessary. Attach self-adhesive plastic feet so that the protruding bolt heads will not damage polished furniture.

Any old iron

Taking note of the position of the reed switch on the PCB, attach the magnet on the inside edge of the lid using quick-setting epoxy resin adhesive. Note that, for maximum sensitivity, the whole length of the magnet should approach the reed switch not its end. Check that it takes up a position directly above the reed switch when the lid is in place. Paint or decorate it if necessary so that it does not look obtrusive. The inside of the prototype box was finished in black gloss, so this was easy.

Although the field produced by the magnet will pass through most objects adequately, it will be greatly reduced by magnetic materials. There should be no problems with small items of jewellery. However, objects made of iron and steel should not be placed inside the box or the reed switch may not operate. Traditional (clockwork) watches should also be avoided due to possible damage from the magnetic field.

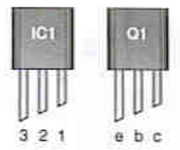


Fig.5. View of IC1 and Q1 looking at flat side

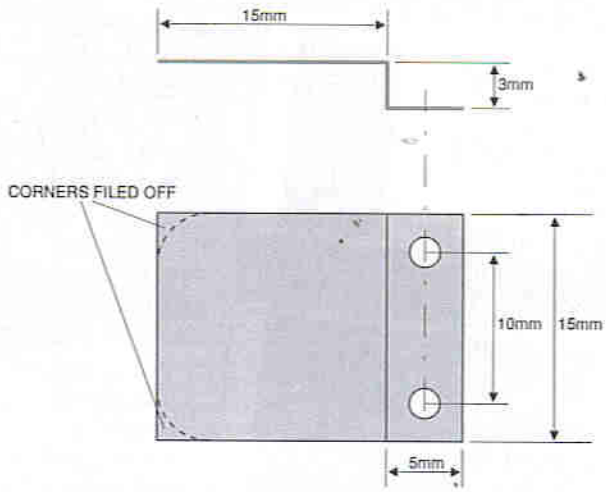


Fig.4. Construction of battery bracket

PARTS LIST

Resistors

0.25 watt 5% carbon film.

R1 2M2
R2 10M

Semiconductors

IC1 UM66T09 Melody Generator (Wedding March)
Q1 MPSA14 NPN silicon Darlington transistor

Hardware & Miscellaneous

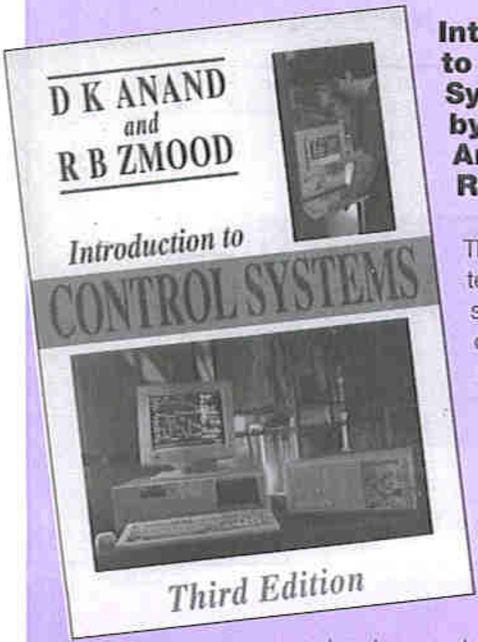
B1 3V lithium cell. 20 mm diameter capacity 220mAh
BUZ1 Piezo transducer 27 mm diameter 4.2 kHz resonant frequency
SW1 Reed switch. Glass length 20.3mm diameter 3.2mm
Miniature magnet 25 x 5 x 5 mm
Box for project - see text.
PCB, small nuts and bolts, tinplate, thin plywood.

Buylines

All the components for the Musical Box may be obtained from Maplin. Note that the i.c. specified plays The Wedding March. It may be obtained from Maplin order code UJ42V. Others are listed but may not be available. Note that the magnet is the larger of the two listed by Maplin.

Book Review

We take a look at a selection of half a dozen recently published books which will be of interest to anyone involved in electronics



Introduction to Control Systems by Dr D K Anand and Dr R B Zmood

This is a classic textbook on control system design and operation which will appeal to both students and professional engineers in both mechanical and electrical engineering. It is the third edition of what has already proved a very popular book and has been entirely rewritten to cover the now widespread use of computer aided design software.

As well as modern computational techniques, the book employs all the classical graphical and analytical methods, the authors quite correctly deeming that such methods have a very important conceptual role in understanding control system design. The book is very heavy on theory but also contains many interesting examples of control systems drawn from real world applications.

This is a very serious textbook and not for the casually curious or the reader for whom the calculus is a complete mystery. But, if you want a good solid grounding in control system design, then this is the book for you.

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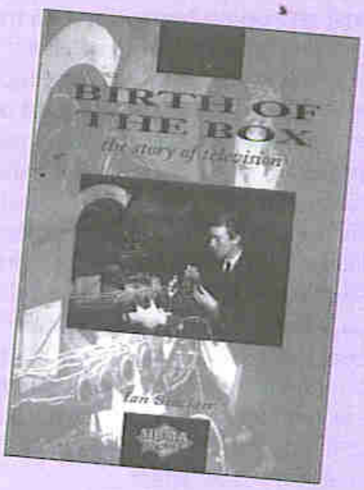
Birth of the Box - The Story of Television by Ian Sinclair



We all watch TV, some of us occasionally, some of us obsessively. We take it for granted and yet, just 50 years ago, few people would have heard of television let alone be the possessor of a TV set.

This book tells the story of the development of television, of all the various components which had to be in place before the first set could be built, of the triumphs and disasters that faced the early inventors and pioneers.

There can be few readers who will not find this book fascinating. It will appeal to everyone who has ever watched TV and wondered how it worked and who invented it. The author leads one through all the various developments with clarity and enthusiasm.

This book is a must for the bookshelf of everyone who is interested in the development of 20th century technology. My only criticisms are that current developments in television technology are looked at very sketchily. I could find, for example, no mention of digital TV; also, it would have been nice if the book had more photographs and was printed on better paper. But these are minor quibbles, I enjoyed this book greatly and would happily recommend it to anyone.

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Practical Fibre-Optic Projects By R.A.Penfold

The author of this book needs no introduction, since he is a regular contributor to ETI. In this little book he offers readers a collection of tried and tested circuits for projects that utilise fibre-optic cables. Such cables provide the experimenter with an innovative and interesting alternative to conventional wire cables.

The circuits included in this book are all simple and cheap to build. In addition, there is a short section on the theory of how fibre-optic cables work, details of where to get cables and associated components, plus how to prepare and connect cables.

If you are thinking of using fibre-optic cables in a project, then you could well find that an investment of £4.95 in this book may well save you a lot of time and effort.

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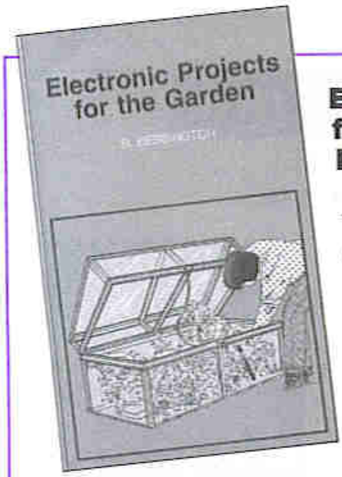

Electronic Projects for the Garden By R. Bebbington

This is an interesting little book since it combines two popular hobbies, electronics and gardening. The author gives us a wide selection of gardening related electronics projects, such as rain and frost detectors, automatic watering, pH measurement, and installation of garden pump systems.

All the projects in this book are both easy and cheap to build, and the author has deliberately used simple breadboard construction techniques to encourage gardeners with no electronics experience to have a go at building some of the circuits.

This little book is packed with a lot of interesting ideas and will make a good addition to the bookshelves of electronics enthusiasts and gardeners alike.

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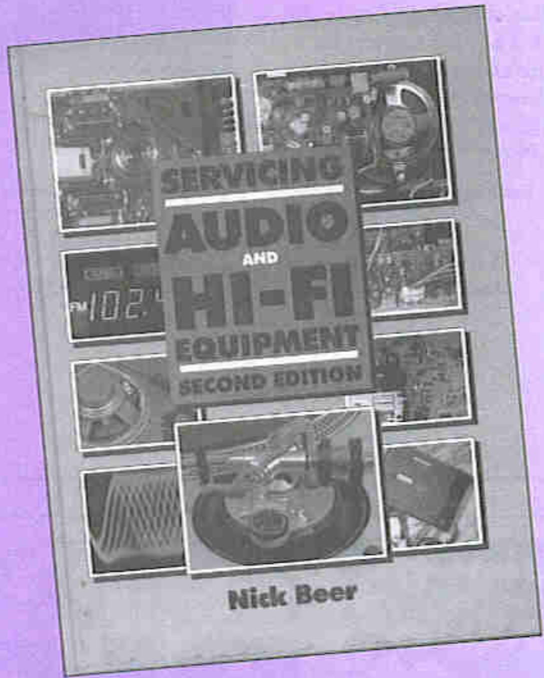

Servicing Audio and Hi-Fi Equipment By Nick Beer

This book is a goldmine of useful information for anyone who has to service audio and hi-fi equipment. The author, who is a professional service engineer with a large independent dealer, shows how to diagnose faults, repair them and then test virtually all types of modern equipment, from the common radio and amplifier, to CDs, digital audio tape drives, or Dolby Surround Sound and Pro-Logic systems.

Besides clear, explanatory text, the book is full of example circuit diagrams, as well as waveform diagrams and construction drawings. This wealth of diagrams as well as text makes this book a very valuable benchside companion and makes it easier to locate common electrical and mechanical faults.

This book is interesting even if the reader is not a professional service engineer since it also shows how such systems work, the variations between different designs etc. Indeed, anyone involved in electronics will find this a very informative book and well worth the purchase price.

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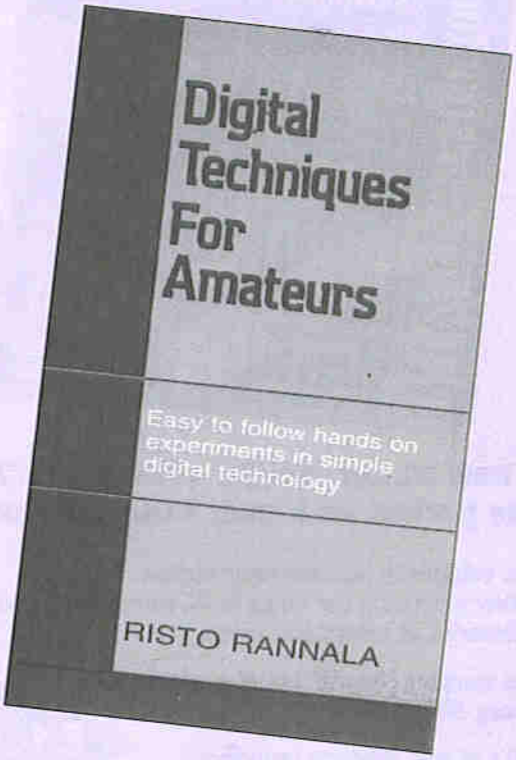

Digital Techniques for Amateurs By Risto Rannala

This is an introduction to digital electronics which the author has aimed at the educated amateur with some knowledge of the fundamentals of digital electronics, Boolean logic and basic circuit theory.

The book is well illustrated with over 200 diagrams and explores topics such as the use of logic gates and microprocessors. Besides the amateur, it should also be of interest to students of physics and mathematics for whom electronics would not be a core subject.

By and large, this is an interesting and useful book, but at times the text and diagrams are rather confusing - the result, I suspect, of being translated from the original Finnish. However, besides a lot of useful information, it is packed with practical applications which makes this book doubly useful.

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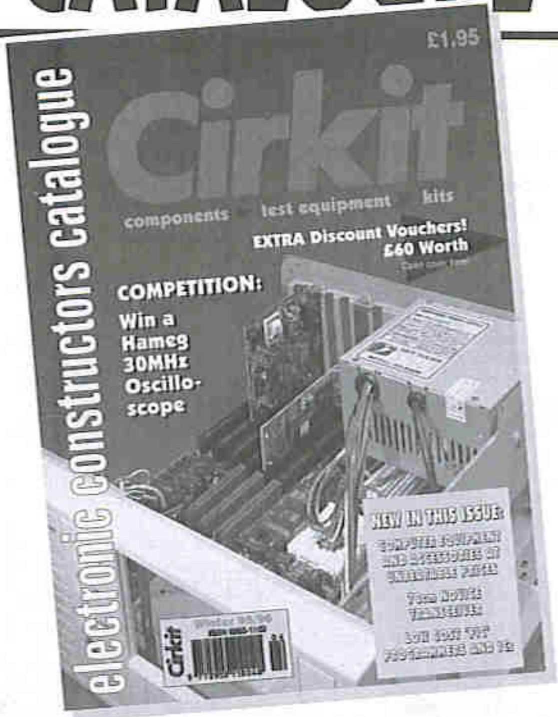

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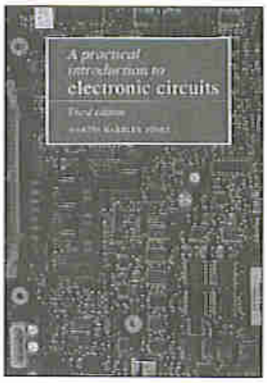

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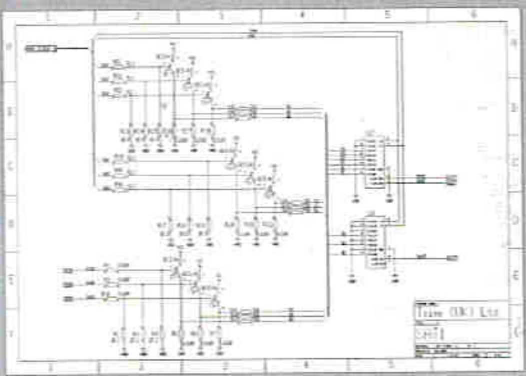

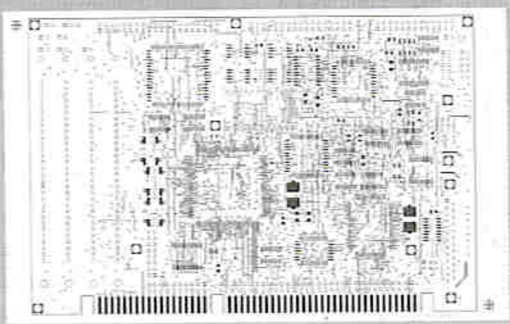

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BASIC for the PIC controller

PART 3

The developer of this unique project, Robin Abbott, continues his look at some other versions of the ETI PIC based controller module, which offer the user a range of additional options making them ideal for specific applications

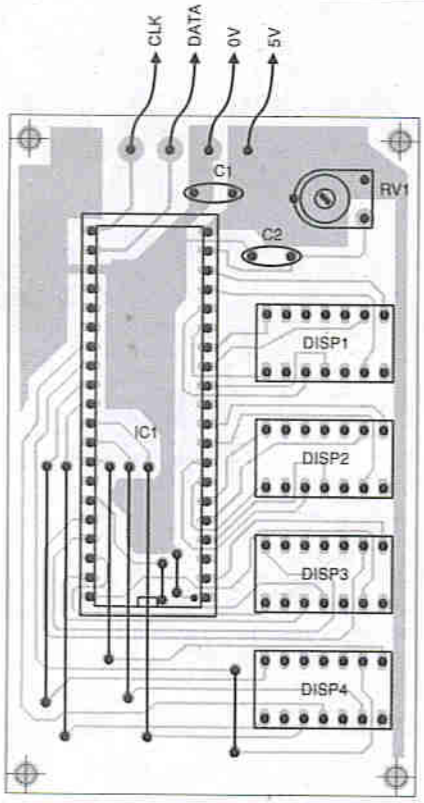

Fig.8. Overlay for LED display

Last month we looked at the design and construction of versions of PIC Controller BASIC which operate on the 16C5x series of processors. The processors in question are the 16C57 and 16C58, which have the advantage of 70 bytes of RAM each and 2K of EPROM. This means that versions of PIC Controller BASIC for these processors allow extensions to the BASIC language which are described in this article.

The 16C57 is provided in a 28-pin package which supports three I/O ports and so, for the BASIC application (which uses 4 bits of port A), there are 16 I/O pins and one input for the real time counter. The 16C58 is provided in an 18-pin package and uses the same circuit and board layout as that shown in last month's article for the 16C84 device.

The 16C57 and 16C58 processors are a better processor than the 16C84 for the BASIC project in every respect with the exception of interrupt support and upgrading. Although it is possible to upgrade the 16C84 device to the latest version of PIC Controller BASIC, it is only possible to do this with the '57 and '58 versions by using the more expensive erasable devices. However, One Time Programmable (OTP) versions of the '57 and '58 are available at very reasonable cost.

(For readers who may have missed last month's issue, Figure 1 shows the circuit diagram for the 16C57 version of PIC Controller BASIC; the PCB component overlay is shown in Figure 2. The 16C58 version uses the circuit shown in the October issue of ETI, but the component references are identical to those shown in Figure 1. The PCB overlay is shown in Figure 3 and we are also repeating the parts list at the end of this article)

We now continue our look at the additional commands which are made possible in these version of the system.

Device driving commands

Most of the commands in the following sections allow the user to define any pin on the I/O ports of the PIC to be used for peripheral device connections. These pins are defined using the port definition form. This is the form used for the serout, seroutstring and serin commands which were shown in the November issue of ETI. Consider the width command. The width command looks at the current state of an input pin, looks for a pulse of the opposite state and measures its width. Thus, if the pin is high, then the width command waits until the pin becomes low, then measures the time before it goes high again. The width command needs one parameter which is the pin on which a pulse is to be measured. The pin is defined as the address of the port+16*bit number. Thus, bit number 4 on port A is defined as ADDPORTA+16*4. The following example program shows how to measure the width of a pulse on port B, bit 5, the result can be read in the debugging window.

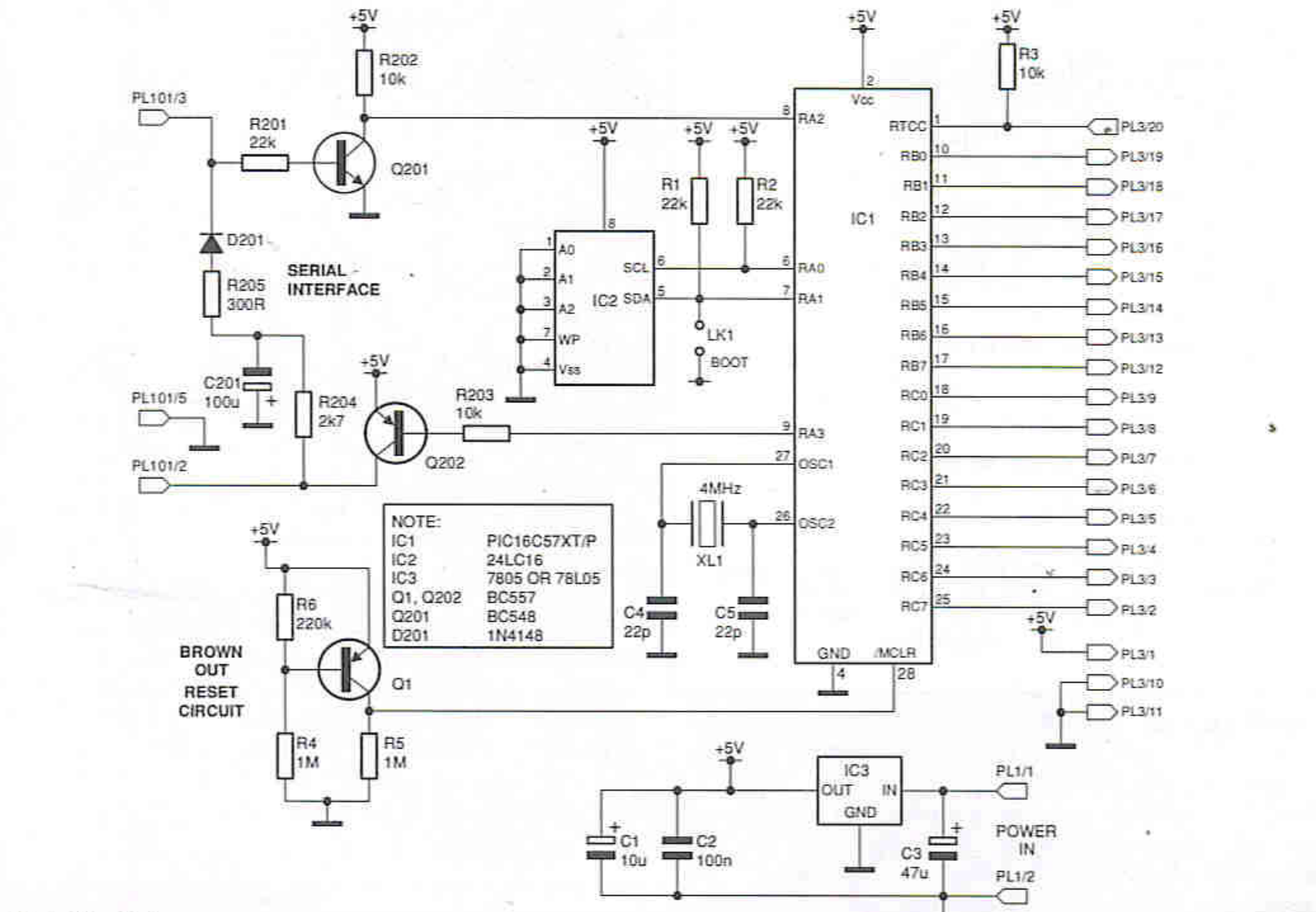

Fig.1. Circuit diagram

```
const portpin=ADDPORTB+16*5

dim x.16
x=width(portpin)
monitor()
```

The result returned depends on the processor frequency. For example with a 4MHz clock then the result is in units of 10uS; with a 20MHz clock the result will be in units of 2uS. Thus, the above program will measure a 1KHz square wave as x=100 with a 4MHz clock, and x=500 with a 20MHz clock.

Infra-red transmission and reception

Extended BASIC for the '57 and '58 offers the capability for transfer of data between two modules separated by up to 10m. The protocol is not particularly fast (offering about 1kbit transfer rate, which converts to about 80 bytes per second at most), but is quite reliable. The transfer protocol makes use of any of the 3-pin integrated infra-red receivers which are widely used in consumer equipment. The prototype used the IS1U60 device from Sharp, although any of the 3-pin integrated receiver/demodulator devices designed to work at around 37KHz should also work with no problems. Please see the end of the article for suggested sources for these devices.

The integrated receivers are based around the use of an amplitude modulated 36KHz carrier. To send a '1' bit then the carrier is turned on for approximately 900uS; to send a 0 bit the carrier is turned off for the same period. The receiver device contains an IR diode, amplifier, EM shield and demodulator. It converts the carrier signal into 1 and 0 bits which may be decoded into a byte.

The start of a byte is signalled with a 1 bit followed by a 0 bit, and the last data bit is followed by a 0 bit. This protocol is illustrated in figure ? which shows the transmitted sequence and the output of the receiver device. The start bit, being a 1 followed by a 0, allows timing to be gained from the falling edge of the signal, which proved to give more reliable results than the rising edge.

The commands to support the infra-red protocol are irrx() and irtx(). These have the following definitions:

```
irtx(value,portdefout)
x=irrx(portdefin,wait)
```

irtx() transmits a value on a port pin; value is the value which will be transmitted - if it is more than 8 bits long, then only the bottom 8 bits will be sent. Portdefout is the output port definition in port definition form.

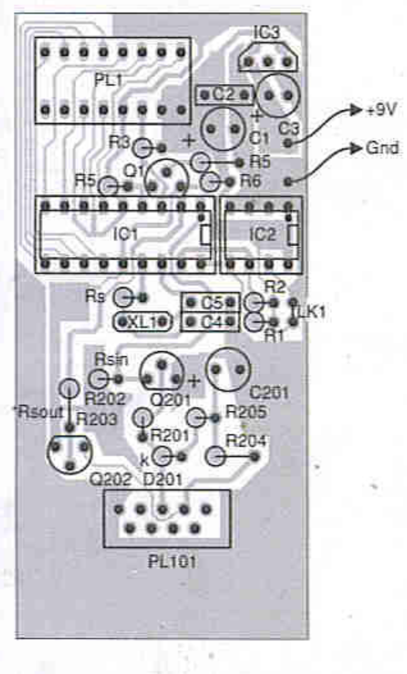

Fig.3. Overlay for 16C58 version

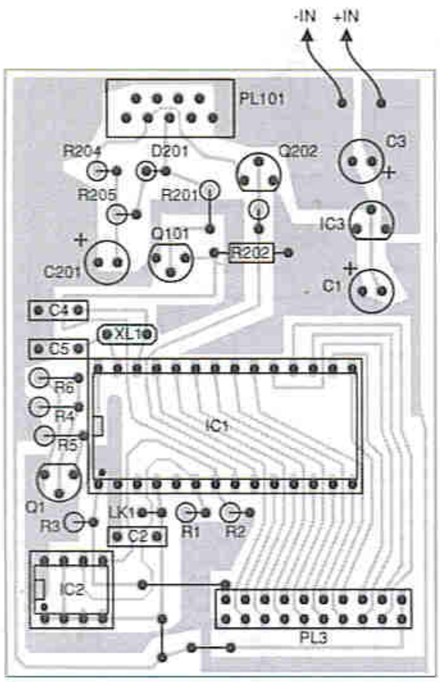

Fig.2. Overlay for 16C57 version

irrx() receives a bit from a receiver connected to a port pin. In this case, portdefin is the port definition form for the pin to which the receiver is connected. wait is 0 if the program is to wait for an input and then when one is detected to read the value and return it as an 8 bit integer. If wait is not 0, then the program will wait for the defined value in units which are approximately 10uS and then if no input is received will return -1. However, if an input is received during this time then the received value will be returned. This prevents the program locking up waiting for an input.

Figure 5 shows the external circuitry required to support infra-red transmission and reception for a simple application. The transmitter is straightforward and is the circuit used in the light gun project. If only one emitter is required, then R1 can be replaced with a 30R value. The 1000uF capacitor sharpens up the edges of the waveform. The push button in the transmitter is used in the sample application to send a message.

The irtx()/irrx() protocol is quite reliable but, like all infra-red protocols, is liable to errors with a poor signal if the source is not pointed directly at the receiver. To overcome this, all transmissions should be sent with an error check. For a simple 8 bit transmission, such as might be used for a remote control, then a byte can be sent followed by the inverse of the byte. The following program section shows a subroutine to send a data byte using this protocol to port B bit 0.

```
typesub sendir(x)

; program here

sub sendir(x)
    irtx(x,ADDPORTB+16*0)
    wait(5)
    irtx(~x,ADDPORTB+16*0)
end
```

The wait(5) function waits for 5mS and allows the receiver to run its program between the first and second bytes. The next function is an infra-red receiver which only returns a value when a byte is received followed by the inverse byte. The receiver is connected to Port B, bit 1.

```
typefunc receiveir()

; program here

func receiveir()
    dim x.8,flag.8
    flag=0
    while(flag=0)
        x=irrx(ADDPORTB+16*1,0)
        flag=(x=~irrx(ADDPORTB+16*1,3500))
    wend
    return 1
end
```

Having received a byte, the variable flag is set to 0 if the second byte is the inverse of the first and the while/wend loop will terminate. In case the second flag is never received, the second irrx function will wait for about 35mS and, if it is not received, then it returns -1 and the loop continues to look for another initial byte.

Figure 6 shows the code for an infra-red receiver and transmitter routine which will send an 8 byte array (called txdata) with a checksum. The receiver routine waits for the correct reception of an 8 byte array before it returns. The array is sent with a simple checksum, which is the 8 bit sum of all the numbers transmitted. The receiver sends the array which is received to the serial port, and illuminates the LED for 1 second before looking for a another message.

Driving serial LED displays or large numbers of outputs

Last month we looked at driving 2 digit LED integrated displays. Unfortunately these do not seem to be generally available, and so in this article we'll consider another form of LED driving, which is also very useful for driving any type of output device, such as relays. The M5450 is a 40-pin IC which accepts data in the same serial format as the integrated LED displays (in fact, it is almost certainly the device used in the displays). It has 34 outputs, each of which can be set or reset on a 2-pin serial interface. The device operates with a start bit, the data bits and then a stop bit and it is only on the stop bit that the serially shifted data is transferred to the outputs. Thus, for LED displays, there is no interference as new data is sent. The outputs are non-multiplexed and the LED current can be set for all outputs with a single external variable resistor.

Several of the M5450 devices can be driven with the same data line, each device needing its own clock. Thus, two 4-digit displays can be driven from three output pins on the BASIC module.

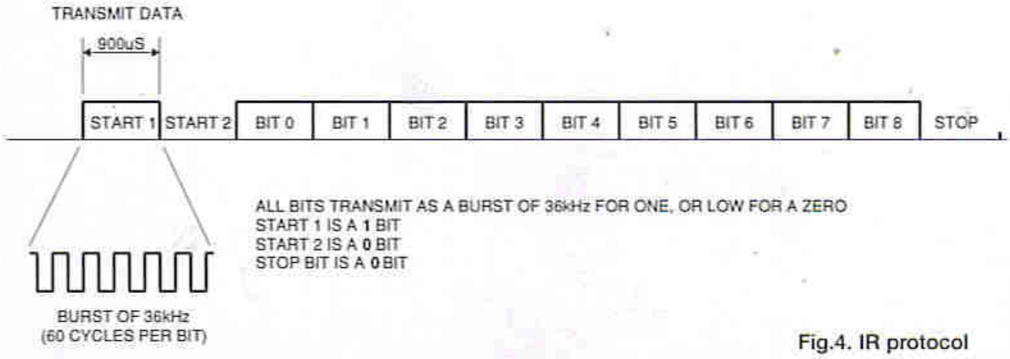

Fig.4. IR protocol

The device is so useful that extended BASIC supports it directly with a command called LEDS. This command is provided to send 32 bits to an M5450 connected to any of the port pins. The command shifts data to the 5450 in less than 400uS (with a 4MHz clock) and is thus considerably faster than using BASIC to interface to it.

The circuit diagram of a 4 digit LED display is shown in figure 7. The circuit is extremely simple, the brightness of the LEDs is set using the variable resistor. To drive any other type of output device then the LED displays can be replaced by PNP transistors with 1K base resistors driven from the output pins. An example is also shown on the figure. A circuit board has been designed for a 4 digit 0.3" LED display. The overlay is shown in figure 8 Construction is very straightforward; there is a number of wire links, some of which must be fitted under the IC socket. A similar circuit board could be designed for bigger displays. Digit 1 is driven by the first 8 bits sent to the display, digit 2 by the second 8 bits etc.

The LEDS command takes four parameters :

```
LEDS(lower,upper,clock,data)
```

lower is the 16 bit number which is sent to output bits 1 to 16 and upper is the 16 bit number which is sent to output bits 17 to 32. Digit 1 is the leftmost digit driven by lower and digit 4 is the rightmost digit driven by upper. Clock and data are the clock and data bits in port definition format. A simple example program which sends the patterns in 8 bit variables 11 to 14, to digits 1 to 4 respectively is shown here. The clock is connected to port C, bit 0, and the data line to port C, bit 1 :

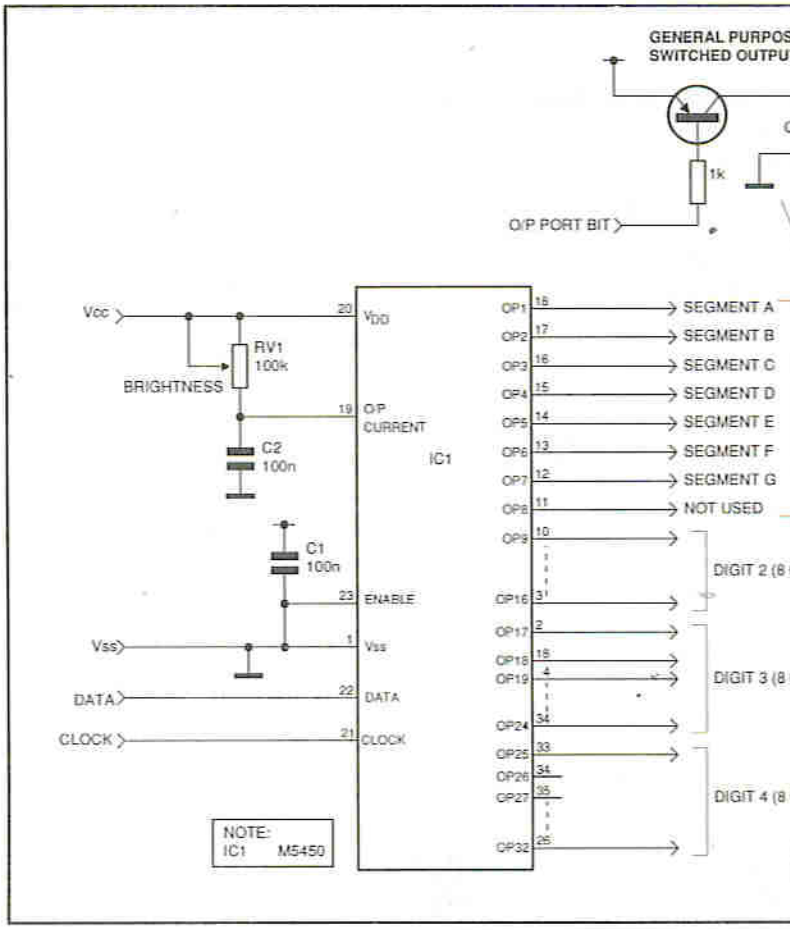

Fig.7. 4-digit serial LED display

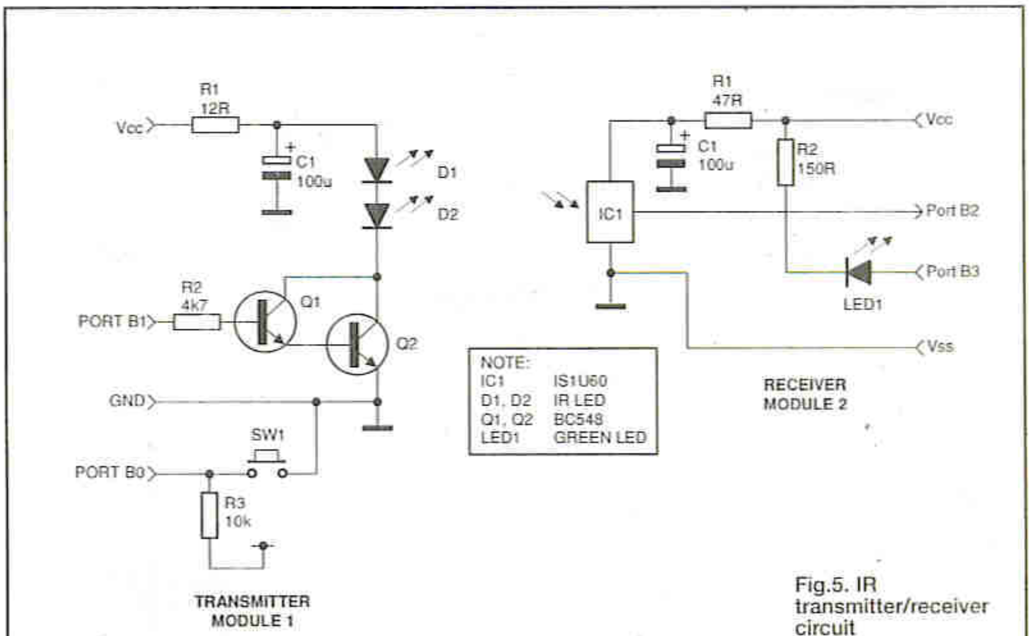

Fig.5. IR transmitter/receiver circuit

```
alias clock=c0,data=c1

trisc(0)
portc=0
clocks(37,clock)
dim 11.8,12.8,13.8,14.8

; code here

leds(12<>8+11,14<>8+13,clock,data)
```

<> is a new operator which shifts the argument before the <> symbol left by the number of places shown after the <> symbol. The clocks() command is an extended BASIC command which sends the a number of clocks to the specified port pin. In this case we send 37 clocks with the data line set to 0; this initialises the M5450 and is essential at the beginning of a program to avoid the device being out of sync with the BASIC module.

The development environment for extended BASIC includes a library of routines to handle 4 digit LED displays, including number printing, and simple text messages.

LCD modules

Extended BASIC includes routines to handle LCD modules based on the Hitachi LCD driver chip set. A number of library routines are also provided to avoid users having to learn the complex commands needed to initialise and drive these devices. The LCD module must be connected to port B. We'll have a look at the LCD module routines in next month's article.

Other commands in extended BASIC

Other commands in extended BASIC are shown in the development environment, both in the documentation and in the help files.

Device sourcing

The component lists for all the circuits shown in this month's article are shown in the accompanying box.

The author is prepared to program 16C57 and 16C58 devices for £15.00, or can provide a programmed 16C57 (4MHz) for £21.00, or a programmed 16C58 (4MHz) for £24.00. Please state 24LC16 or 24LC65 EEPROM and processor speed required (4, 10 or 20MHz). Please note that the 10MHz version requires the /10P version of the devices, and the 20MHz version requires the /JW version. The latest version of PICBASDE will also be required for these devices which handles extended BASIC and the paged memory format needed for the 5X series. Please send payment, an SAE, a blank FORMATTED disk (if the latest version of PICBASDE is required) and a blank device (if required) to Robin Abbott, 37 Plantation Drive Christchurch, Dorset. BH23 5SG.

The author can be contacted by e-mail on CIS at 100023,535, or via the internet at 100023.535@compuserve.com.

There is a support interest group for ETI PIC Controller BASIC on a bulletin board called the astronomers den which is on 01942-831925.

The IR receiver device (IS1U60) is available from Electromail on 01536-204555. Electromail supply RS components, but are happy to sell to individuals and also stock the 16C57. Farnell on 0113-263-6311 supply the 16C58 and 5450 and an IR receiver, the PIC12043S. Maplin stock the 5450, the 16C57, the EEPROM devices and also the 0.3" LED displays used on the display board.

Next month

Next month we'll take a look at the 16C64 version of PIC BASIC, which offers futher extensions to the language.

Receiver Code

```
;
; Infra-red receiver test
;
const ds=defserout

typesub rxarray(number)

const rxbit=ADDPORTB+2*16
const rxbitv=4,ledv=8
alias led=b3
dim rxa[8].8
trisb(~ledv)

while 1
 led=1
 rxarray(8)
 serout('\s',ds)          ; Clear terminal
     ; Now send the array to terminal
 led=0 for i=0 to 7
 serout(rxa[i],ds)
 next
 wait(1000)
wend
monitor()

sub rxarray(nitem)
 dim i.8,cs.8                 ; cs is the checksum
 cs=1
 while(cs)
 rxa[0]=irrx(rxbit,0)     ; Receive 1st item - wait
for it
 cs=rxa[0]
 for i=1 to nitem-1          ; transmit each item
     rxa[i]=irrx(rxbit,3000)  ; Wait about 35mS
for each item
     cs=cs+rxa[i]
 next
 cs=(cs&0ffh)-irrx(rxbit,3000)        ; and receive
checksum
 wend
end
```

Transmitter Code

```
include "util.inc"
typesub txarray(items)
const txbit=ADDPORTB+1*16,txbitv=2
alias tx=b1,button=b0
dim txa[16].8

tx=0
x=1
trisb(~txbitv)

txa[0]='A'                    ; Set up an array to
transmit
txa[1]=' '
txa[2]='T'
txa[3]='e'
txa[4]='s'
txa[5]='t'
txa[6]='!'
txa[7]='\n'
wait(1000)                    ; allow receiver to go
while 1
 while button : wend
 txarray(8)                    ; Transmit the array
 while button=0 : wend
wend
 monitor()
;
;
;
sub txarray(nitem)
 dim i.8,cs.8                  ; cs is the checksu
 cs=0
 for i=0 to nitem-1           ; transmit each item
     irtx(txa[i],txbit)
     cs=cs+txa[i]
     wait(5)                   ; Wait 5mS for
receiver
  next
 irtx(cs,txbit)                ; and transmit
checksum
end
```

PARTS LIST

PIC 16C57 version of PIC Controller BASIC

Resistors

R1, R2	22K
R3	10K
R4, R5	1M
R6	220K
R201	22K
R202	10K
R203	10K
R204	2K7
R205	300R

Capacitors

C1	10uF 16V Electrolytic
C2	100n, Ceramic
C3	47uF 10V Electrolytic
C4, 5	15pF, Ceramic
C201	100uF 10V Electrolytic

PARTS LIST

Semiconductors

IC1 PIC16C57/58/XT/p
IC2 24LC16 etc (see text)
IC3 7805 or 78L05
TR201 BC548
TR1, TR2 BC557
D201 1N4148

Miscellaneous

XL1 4.000MHz crystal or ceramic resonator
PCB
PL101 9-pin D socket
PL3 20-pin IDC connector
LK1 0.1" link with jumper
IC sockets 8-pin, 28-pin
Veropins2
Heatsink IC3, optional

IR transmitter

Resistors

R1 12R
R2 4K7
R3 10K

Capacitors

R1 12R
R2 4K7
R3 10K

Capacitors

C1 100uF, 10V, Electrolytic

Semiconductors

D1, D2 IR LED
TR1, TR2 BC548

Miscellaneous

SW1 Push to make

IR Receiver

Resistors

R1 47R
R2 150R

Capacitors

C1 100uF, 10V, Eectrolytic

Semiconductors

LED1 Green LED
IC1 IS1U60

Serial LED display

Resistors

VR1 10oK, Horizontal preset

Capacitors

C1, C2 100nF, Ceramic

Semiconductors

IC1 M5450
DISPLAY 1-4 0.3" 7-segment display

The First Electronics Today International amateur Robot competition

As of the end of September 1995 there are about 50 teams across the world who are working on robots for this competition. Quite a few of them are from universities and other academic establishments and because the initial competition date did not allow sufficient time to complete the project within an academic year we have been inundated with requests to move the competition to a little later in the year. We are therefore changing the competition venue and date to the All Model Show at Sandown on May 10th-12th.

Just to remind readers: the competition is to find a walking robot which can, in the shortest time, traverse a course that will include slopes, stairs and numerous different obstacles. The robot will start from one corner of the course area and will be expected to retrieve an empty standard aluminium soft drinks can located at the opposite diagonal corner of the course area and bring it back to the starting position.

The robot must be completely autonomous with no connection or communication of any sort with any external computer or individual. It must therefore contain its own processor and its own power source. However, the size limits mean that it will probably be impossible to incorporate complex environment sensing and analysis on board the robot. In view of this, we are giving the following details about the environment and how the competition rules should be interpreted. These details will also help competitors to construct their own test environments.

The first thing to note is that the course will be square and measure 6m on each side. The sides of the course will consist of a vertical wall of plain unpainted chipboard 30cms high, the base of the course will be unpainted chipboard or plywood. The chipboard walls and base will be fastened together with steel screws to battens on the outside. All spectators will be required to stand at least 2m further back from the course edge.

The robot will be expected to walk over obstacles less than 5cms high and locate and go around any that are higher. Steps will have a rise height of 5cms and a tread depth of 10cms and no ramp will be greater than 20 degrees. All objects are immovable and traversable objects are either steps or ramps, or perhaps a combination of both. Non-traversable objects will consist of vertical surfaces higher than 5cm or drop-offs deeper than 5cms. All surfaces, with the exception of ramps are parallel to either the walls or the floor; there are no curved surfaces. All objects will be built from basic objects 50cms square and constructed from chipboard/plywood panels glued together.

In the course layout, robots will not be required to turn whilst traversing any particular step or ramp. Traversable objects may, however, be combined in sequence and thus necessitate turning. In such cases, an area no smaller than 1m square will be provided for turning. No object, either traversable or non-traversable, will have a cumulative height that exceeds 50cms. Also, at no point on the course will the robot necessarily have a line of sight to either the target or the home base areas

It should be noted that we are expecting that TV cameras with intense lights will be in operation for some of the time. There could also be a very high level of ambient sound, magnetic fields and RF interference.

There will be a setup and test space provided for competitors. This will be isolated from spectators and have sufficient tables and chairs plus mains power points. Prior to competition times competitors will also have limited access to the course for practice; however, the course will be changed for the competition. Practice time will depend upon number of competitors and event schedules.

When moving, each leg of the robot must be lifted clear of the floor at some stage whilst walking on level ground (no using wheels on the end of each leg!) and at no time can all the legs be lifted off the floor for more than two seconds (hopping is allowed but no flying). Each robot must be provided with a lifting handle and an on/off switch that can be easily operated by an official located outside the course perimeter but armed with a long stick. The purpose of this is to be able to retrieve a robot which has become stuck or is suffering from a bout of madness!

The dimensions of the robot must be such that, at maximum leg extension, it will fit within a 50cm cube; it will be tested by being placed in a 50cm cubic box (the only exception to this rule are thin whiskers/feelers that can be bent to fit in the box). It can have between one and ten legs and at no time while traversing the course must the main body of the robot touch the ground although it can do so before starting the course and after completing the course.

The target will be placed in the outside corner of a 50cmx50cm plinth in a corner of the course diagonally opposite the home base corner. The plinth will be 5cms high. The target is a standard 500ml aluminium drinks can; to make picking it up easier it will have a steel insert that will allow it to be picked up using a magnetic grab.

The starting/ending point will be a marked 50cms x 50cms area on the course base in one corner of the course and bounded on two sides by the course walls. When returning with the can, the robot will be deemed to have completed the course when any portion of the robot is within the base area.

To aid navigation, robots will be allowed to drop beacons/markers once it has started the course, it will not be necessary for the robot to retrieve them on its return journey. Beacons/ markers can be of any design, but must be passive, i.e. not relay information from an external computer.

Note that awards will not be made exclusively upon the fastest traversal time but also upon success in reaching the target, capturing it and returning.

Although it is now probably rather late, anyone interested in entering a robot for this competition should write to us as soon as possible at ETI giving your name, address and contact phone number, plus a few details about yourself or your group. This information will help us to plan the event. Preliminary entry notification should be sent to: ETI, Robot Competition, Nexus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST.

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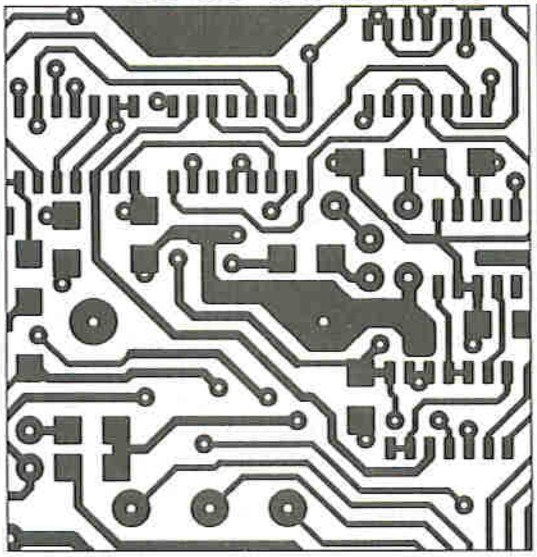

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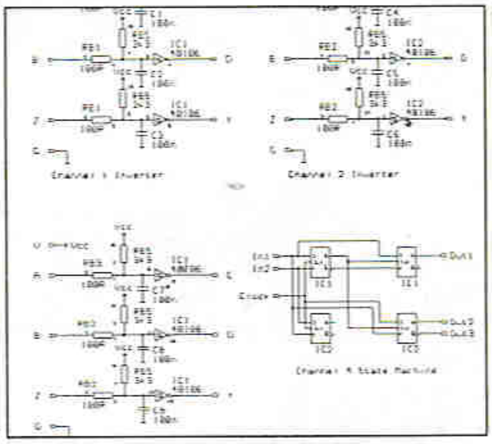

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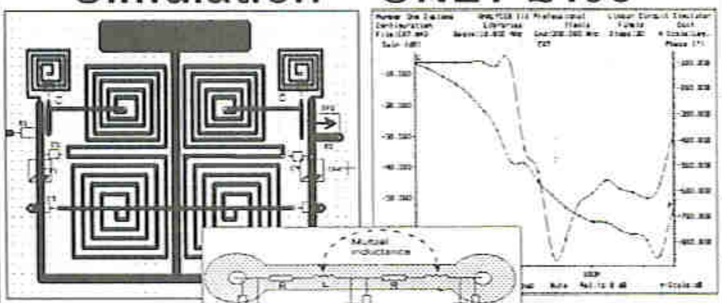

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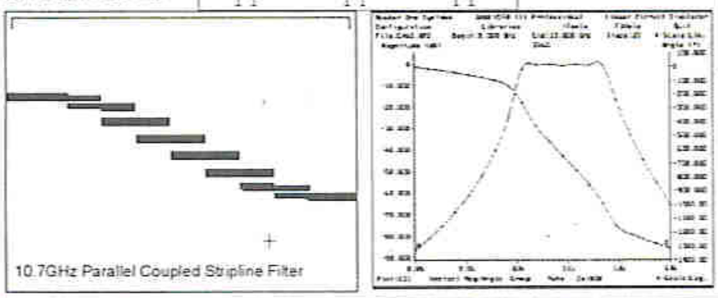

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Budget netw

Paul Stenning takes a look at $25 Network and Little Big Lan

With PC's becoming more popular in the home - many people have more than one machine - the need for a network soon becomes evident. A network will save the endless copying of files via floppy disks and printer sharing by transferring leads.

$25 Network and Little Big Lan from EQ Consultants are designed for home and small office users who neither need, or will use, the complicated features found in the "big name" products.

$25 Network

The $25 Network allows up to three PCs to be networked via the serial ports. The cost is just £35 (not quite $25, but still fairly cheap!). Since it uses the serial ports, no expensive network boards are needed.

When using two PCs, each must have a spare serial (COM) port. This is not usually a problem since most machines have two and only one is usually used, for the mouse. With three PCs, the middle machine must have two spare serial ports.

Serial leads are available from EQ Consultants, custom made to your requirements, for a reasonable cost. However, the wiring diagram is included in the manual and it should be well within the capabilities of most ETI readers to make their own leads.

The manual

The manual is a small, 48-page publication that contains a great deal of information. It is clearly laid out and well written, but does assume a reasonable knowledge of DOS. You should read the installation section before attempting to set up the network.

Software installation

The software is supplied on dual media (one 3.5" 720K disk and one 5.25" 360K disk). With a two PC setup, installation is very straightforward. You simply run the install routine on the disk and answer a few simple questions about which port is being used and which drives and printers are being shared. The install routine copies a few small files into the root directory of the hard drive and adds the appropriate lines to the CONFIG.SYS and AUTOEXEC.BAT files.

The program files can be moved from the root directory into another directory if the appropriate commands in AUTOEXEC.BAT and CONFIG.SYS are modified.

With a three PC system, the installation is a little more involved. The two end machines can be set up automatically using the install routine on the disk as previously. The centre machine will have to be set up manually, by copying the files onto the hard drive and modifying the AUTOEXEC.BAT and CONFIG.SYS files. This is not too difficult and is explained clearly in the manual, but a working knowledge of DOS is needed.

When the computers are rebooted the network will be loaded. I had no problems getting it to work between my two computers, a 486SX unbranded desktop and a Compaq 286 transportable, both of which were running MS-DOS 5.00.

Drive Letters

The network drives are mapped in after the last drive letter on the PC. For example, if a computer had a floppy drive called A: and a hard drive called C:, the first network drive would be D:. The same arrangement applies to printer ports.

The only problem is that a CD-ROM in the local machine would get a drive letter after the network drives. With our example above, the CD-ROM would be E:, even though it used to be D: before the network was installed. There is no way of changing this. Also, CD-ROM drives are not accessible through the network.

Performance

I found the $25 Network was most useful for printer sharing and copying files between machines. It is possible to run programs on the remote drive through the network, but the data transfer rate

work software

can make this a rather slow process. This is not a criticism of $25 Network, but it is due to the limitations of serial data transfer.

$25 Network sets the serial ports to 115,200 baud. In reality, you would be lucky to get 9K bytes per second, so a typical 250K executable would take about 30 seconds to load.

Because the $25 Network operates at a low level, the usual DOS commands can be used and the network drives and printers appear as though they are part of your computer. DOS is convinced that the drives are local, to the extent that you can run utilities like CHKDSK.EXE on the network drives (not recommended).

In use, the product was completely reliable and stable, and gave no problems. The various drivers use between 15K and 35K of memory depending on the installation. Most of this can be loaded high using DOS memory managers or QEMM.

Compatibility

According to the information supplied, $25 Network will operate with any version of MS-DOS or PC-DOS from 2.11 to 6.22. All machines must be running the same version. It is not compatible with DR-DOS or Novell-DOS.

The package will work with Microsoft Windows 3.1 and Windows for Workgroups 3.11.

Because the program works at a low level, file locking utilities such as DOS SHARE.EXE will be ineffective. You will have to use care and common sense to make sure two users do not try to write to the same file.

It would appear that development of $25 Network has virtually ceased, so the product will gradually get left behind. If you want to keep up to date, Little Big Lan may be a better bet.

Little Big Lan

Little Big Lan allows up to 250 PCs to be networked via serial ports, parallel ports, ARCnet cards, Ethernet cards and modems - or any combination of these. The cost is £79.99 per network.

Connection Options

For a basic system, you could start with serial cables. Although the data rate is the same as $25 Network, the transfer is more efficient and should be faster.

Better performance would be obtained using parallel ports (printer ports).The actual speed depends on the speed of the computer, but (according to the manual) 50K bytes per second is possible between a pair of 486 machines. The disadvantage is that the maximum distance is about 4.5 metres (15 feet). Also, many machines do not have a spare parallel port.

For better performance, network boards can be used. EQ Consultants sell ArcNet boards for £15 each, which will give a data rate of up to 80K per second. Cabling is extra, and costs typically £15 per link.

For top performance, EtherNet boards will give a transfer rate of up to 200K bytes per second, which is impressive. EQ Consultants sell EtherNet boards for £49, although they can be obtained for under £30 if you shop around. However, some of these cheap boards are poor quality and may give problems with Little Big Lan. EQ Consultants will be able to confirm whether specific boards have been proved to be reliable. Boards using the National Semiconductor or Winbond chipsets are the best. Ethernet cabling costs are the same as ArcNet.

Remote users can connect to the Little Big Lan network using modems. Obviously the data rate will be slow, but there is sometimes no choice.

These various connection arrangements can be freely mixed on a single network. This allows great flexibility, and also allows parts of the system to be upgraded as required or when funds permit.

The manual

Little Big Lan is one of those products where you must read the manual first. If you tried to install it without the manual, you would be guaranteed to get hopelessly lost!

Fortunately, the small (100-page) manual is well written. The style is friendly and the descriptions are clear and concise. Some information which should be in the installation part (such as how to use CD-ROM drives) is buried in the section detailing the files - but it is not too difficult to find.

The manual also contains details of setting up the various connection options and gives wiring diagrams for serial and parallel cables. It explains networking in a clear manner and avoids the jargon. You will need a basic working knowledge of DOS.

Installation

If you had to install the software separately on each computer in a large network and work out how that machine linked to every other machine, the job would be a nightmare.

The software developers have thought about this and come up with a neat solution. A bootable floppy is created and the Little Big Lan files are transferred to this as detailed in the manual. The install program is then run on this working floppy and requests details of all machines on the network. Each machine must be given an individual number and a name (such as the user's name) for clarity.

Thus, all the information about the network computers and connections is entered just once. The working floppy is then taken to each computer and the software is installed automatically to suit that machine's position.

Once the software is installed on all the machines and they have been rebooted, the LBL.COM utility is run on each machine to set up the drive letters and printer port names. This is very simple and can be changed as required.

Additional Utilities

The installation routine sets up a basic network system. If any of the machines are fitted with a CD-ROM drive, an additional driver will need to be added in the AUTOEXEC.BAT file before MSCDEX.EXE to prevent the network from taking the CD-ROM's drive letter.

This file (CDROM.COM) must not be loaded high or the system will crash during boot-up. The file takes less than 1K of memory so this not a serious problem, but it is not mentioned in the manual. If you are using a memory optimisation utility (such as DOS 6 MemMaker or QEMM Optimize) you will need to tell it to exclude this file. CD-ROM drives can be shared over the network like any other drive.

Another useful utility file is NETBIOS.COM. This is a compatibility file which the manual says is not normally needed. However, I found that it made the system more stable. Various diagnostic utilities are included on the disk for testing the links if the network does not run as expected.

Performance

I tested Little Big Lan with a pair of cheap NE2000 Ethernet boards made by Genius LAN. The transfer speed was superb. It was slower than a local drive - but not by very much! If you intend to run programs through the network, it is definitely worth obtaining proper network boards.

I also tried Little Big Lan with serial connections. It was faster than $25 Network but still fairly slow.

The network drive will appear as additional drive letters on the local machine and can be accessed using normal DOS commands. The drive letter allocation can be changed as required using the LBL.COM utility.

Memory

The software uses between 30K and 50K of memory. However, all the drivers (except CDROM.COM) can be loaded high. Because the individual drivers are fairly small, your memory manager optimisation program should be able to fit them all in somewhere.

If you have the drivers for a CD-ROM and a mouse loaded, together with a disk cache and the usual bits and pieces as well as Little Big Lan, you may find that not all your drivers will load high with the DOS memory managers. A proper memory manager such as QEMM will solve this problem. On my 486 computer, I had about 550K of free memory with the DOS 5 memory managers and 625K with QEMM (version 7.0).

Compatibility

Little Big Lan is compatible with all versions of MS-DOS and PC-DOS from 2.11 to 6.22. It is also compatible with DR-DOS and Novell-DOS. DOS versions may be mixed across the network. Disk compression programs such as Stacker, SuperStor and DoubleSpace should not cause any problems.

Because Little Big Lan works at a higher level than $25 Network, the network drives are recognised as such. File locking programs such as DOS SHARE.EXE therefore work correctly. Little Big Lan is designed to work with Windows 3.1, and Windows 3.11 for Workgroups.

The software currently ships with a patch for a Beta version of Windows 95, but I could not get this to work with the final release. A more elegant solution is being developed, which will probably be available by the time this review is published.

Reliability

In general, the network was very reliable, although I had a small problem using it with Windows 3.11 for Workgroups. If the user of one machine quit from Windows while someone else was accessing his hard drive, the network would occasionally crash.

I understand that this is not a problem with Little Big Lan, as it also occurs with other network products. A solution is available from EQ Consultants, but I have not had the chance to try it.

Doom and other network games

Some game players may be wondering if Little Big Lan can be used to play the network versions of popular games like Doom. Unfortunately, the answer is no, because Little Big Lan is not IPX compatible (this is a Novell standard).

However, to play Doom over an EtherNet, you do not actually need a network, it is only the IPX you require. You simply load LSL, then the driver for your network card (NE2000.COM for NE2000 boards), then IPXODI. These files (LSL, NE2000 and IPXODI) are in the public domain, and some may be supplied with the network boards.

(Thanks to Jim Bisset at EQ Consultants for this information.)

The competition

In the process of researching this article, I also tested a few peer-to-peer network products from some of the major vendors. Without exception, these were more difficult to set up, used more memory and were much less reliable than Little Big Lan. They were also more expensive and could not be used with serial or parallel connections. Most of them would not work with a CD-ROM.

Conclusion

Although cheap and reliable, the $25 Network is rather limited and, because it has been around for a long time, is on the verge of becoming obsolete. Because of this, I would suggest that readers should consider Little Big Lan instead.

Little Big Lan is a superb product and is excellent value for money. It is extremely flexible and allows you to expand and modify your network at a later date. Because the price is per network rather than per computer, you are not faced with a bill for extra product licences every time you add to the network.

Supplier Details

$25 Network and Little Big Lan are available from:
EQ Consultants
Allt An Fhionn, St Fillans, Crieff, Perthshire. PH6 2NG, Scotland, UK.
Tel (Sales) - 01764 685220, (Support) - 01764 685225
Fax - 01764 685241
Internet - biz@cix.compulink.co.uk   Compuserve - 70611,2032

The $25 Network costs £35 + £3 delivery, plus VAT. Total £44.65
Little Big Lan costs £79.99 + £3 delivery, plus VAT. Total £97.51

Network cards, cables and accessories are available - details on request. Starter kits are also available.

Torch pad

Bob Noye offers an ingenious way out of the dark

How many times has a blown bulb or a mains failure led to you groping around in the dark for the ever so elusive torch - "Last time I saw it I'm sure in was on the mantelpiece". Well, hopefully, TorchPad should show where the torch is, even in total darkness. This project uses a circuit that draws remarkably low current to flash two yellow LEDs when, and only when, subjected to darkness. The torch must be in position or they won't flash. This is to avoid a disappointment when you get to the TorchPad only to find the torch missing. Assuming the torch is in position on the micro switch on the TorchPad it can be pinpointed as being between the two yellow LEDs. It won't light up the room but it will show exactly where the torch is, thereby avoiding groping around in the darkness on the off-chance of finding it.

To show that the circuit is working when the torch is placed in position on the TorchPad, a green LED gives a short flash, which indicates that the batteries are OK and the torch is holding down the micro switch that enables the TorchPad to function. The green LED will flash even in daylight - but only the once, to conserve battery life. The two yellow LEDs won't flash until it's dark enough. After all, if you can see the torch, there's no point flashing little LEDs. The current consumption, even with the two yellow LEDs flashing, is only a fraction of a milliamp and far less when they are not, so a set of batteries should last well over a year. But we can't guarantee six years if you use one particular brand of battery.

How the circuit works

At the centre of the circuit is a 4093, a CMOS quad two input NAND schmitt IC. The schmitt action is critical in the circuit's operation and a conventional quad two input NAND IC like a 4011 will not work.

Well, what is the schmitt action, I hear you ask? A normal CMOS compatible input is within 0.3 volts of either rail i.e. on a 5 volt circuit a logic "1", a high, will be at least 4.7 volts and a logic "0", a low, will be below 0.3 volts. Although CMOS chips differ widely in their characteristics, the general rule is that dodgy inputs lead to dodgy outputs. So normal CMOS chips cannot be used reliably with electrolytic capacitors slowly charging on their inputs. The schmitt gate, however, overcomes this problem by exhibiting a characteristic called hysteresis - no, it's not a medical complaint but a very clever piece of circuitry. As the voltage applied to the input of a schmitt gate rises from zero it is interpreted by the

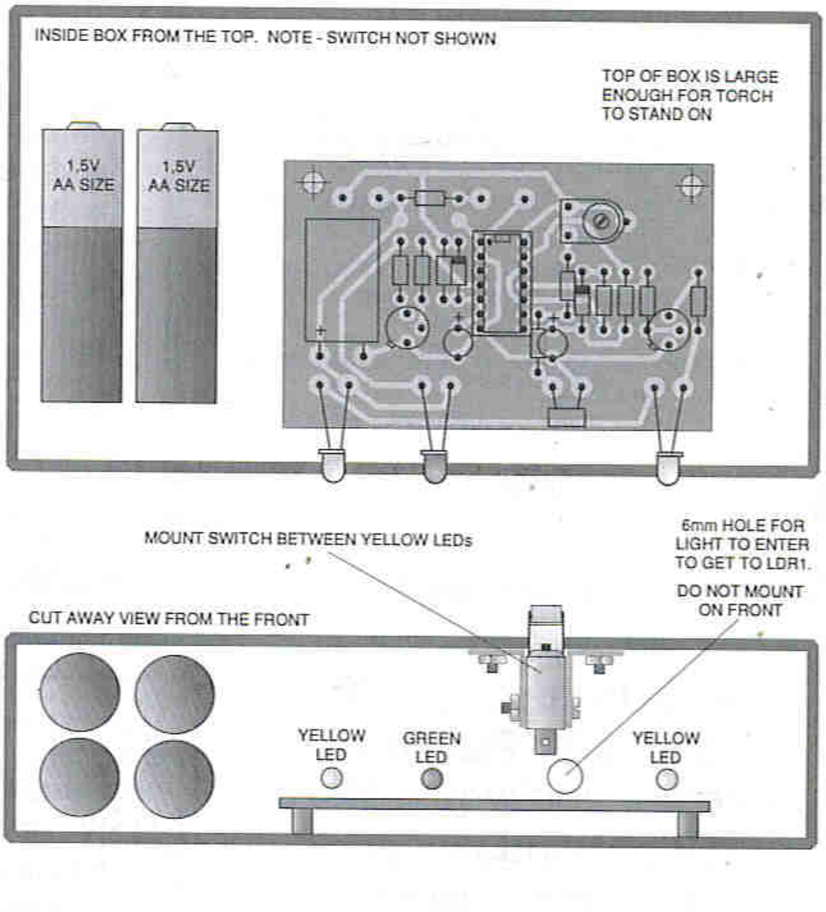


Fig.7 Rough guide for laying out inside the box

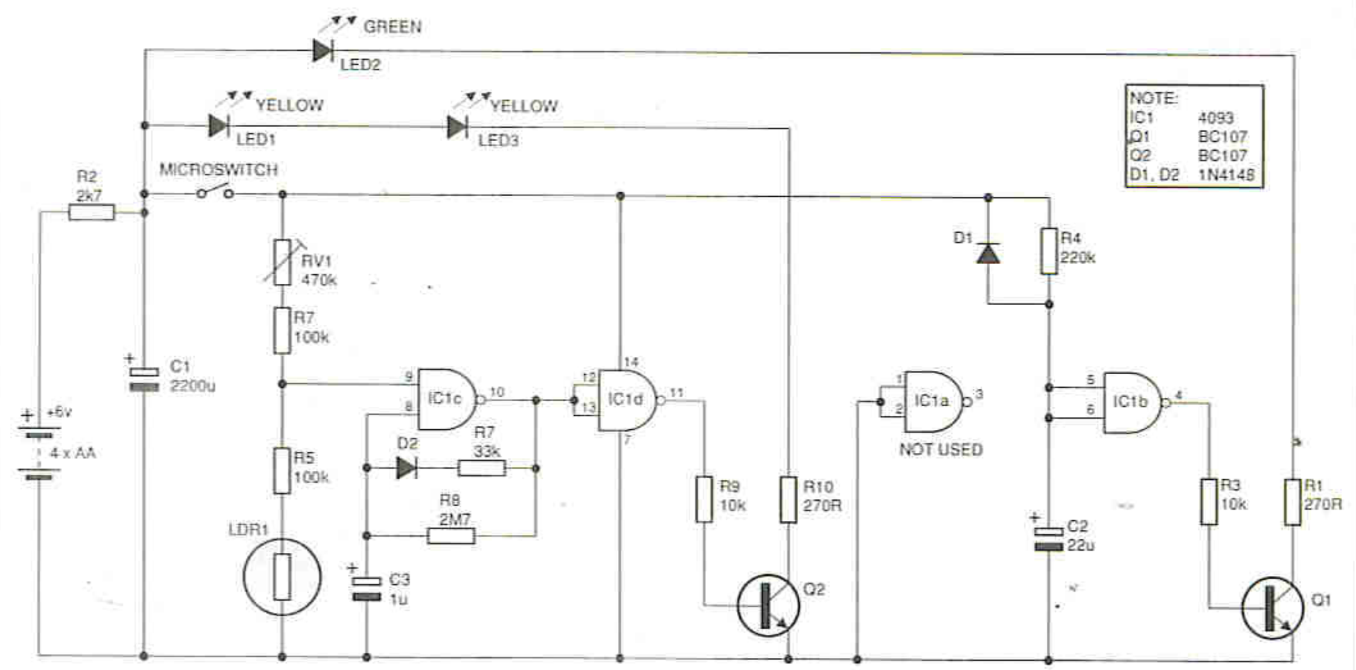


Fig.1 Torchpad circuit

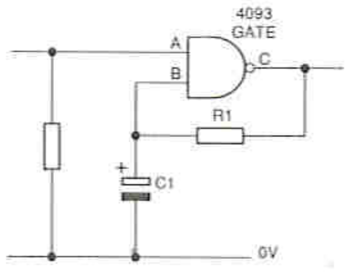


Fig.4 Basic oscillator circuit

A INPUT	B INPUT	C INPUT
0	0	1
0	1	1
1	0	1
1	1	0

0 = LOW 1 = HIGH

Fig.3 Truth table 2 input NAND

gate as a low until it reaches approximately 60% of rail voltage so, on a 5 volt circuit, the voltage can rise to 3 volts; after this, it is interpreted as a high. Once it has been seen as a high it will continue to be seen as a high until the voltage falls below 40% of rail i.e. 2 volts in a 5 volt circuit.

This schmitt action on the inputs makes it free from transient oscillation because once one of the set threshold points has been reached the threshold changes by some 20% of rail volts. It doesn't take a lot of ingenuity to work out that this schmitt action can be used to great effect in the building of an oscillator. In circuit "4" assume that the power has been on but the oscillator pin "A" has been disabled by a low. From the NAND truth table a low on "A" will cause a high on "C" no matter what is on "B". This high on "C" will be within 0.3 volts of rail volts i.e. at least 4.7 volts so CI will charge up via RI until at almost 5 volts, after reaching 3 volts pin "B" will interpret this as a high, but as yet that does not affect the output (see the truth table as a low on "A" will ensure pin "C" stays high). When the gate is enabled by a high on pin "A", "A" and "B" will both be high so pin "C" will go low (see truth table), now CI will be discharged through RI from around 5 volts to about 40% of rail, so it must discharge from 100% to 40%, a change of 60%. When pin "B" reaches 40% or 2 volts it is seen as a low; now pin "C" goes high. At this point pin "B" is at 2 volts so CI charges up from 40% of rail, some 2 volts, until it reaches 60% or 3 volts when pin "B" sees this as a high and pin "C" goes low. Now RI starts to discharge CI until pin "B" drops to 40% of rail and the sequence is repeated with CI being charged up to 3 volts and discharged down to 2 volts. This is the timing element of the oscillator; changing either value of CI or RI will alter the frequency of oscillation. One important characteristic has been observed - when a schmitt oscillator is enabled it takes approximately 3 times longer to change state the first time, in this case from 100% down to 40% on pin "B". After that, it oscillates from 40% - 60%; apart from this anomaly this type of oscillator is particularly suitable for low speeds or frequencies as the prolonged periods when the input pin is at an indeterminate level will not upset the output level.

This allowing of indeterminate levels on the inputs of the IC is used three times in ICI:

I. The light dependent cell LDRI changes resistance proportionately to the amount of light falling on its active surface, from a couple of thousand ohms in strong sunlight (export models only!) to several meg ohms in total darkness so, by arranging a potential divider of R6, R5, VRI and the LDR, it is possible to set the conditions that when it is almost totally dark, pin 9 of ICIC is at above 60% of rail and when light falls on the cell, daylight or artificial light, the resistance drops so pin 9 falls below 40%. The use of the inbuilt hysteresis here prevents any small changes of light (e.g. someone moving near to the cell) from affecting the circuit's operation. The inclusion of R5 at first glance looks a mistake, but at high light levels the resistance of the LDR is quite low; by adding R5 one side from the input of the gate pin 9 to the LDR a similar resistance is added to the other side from the input to the variable resistor VRI making effectively an increase of some 200 of extra resistance in the path from rail to 0V. This in turn reduces the current down this path, hence increasing battery life.

2. The second use of this schmitt action is in the oscillator ICIC. Although the basic oscillator is similar to the one described in detail above, it has the addition of two extra components, D2 and R7. Without these the oscillator would oscillate extremely slowly and give a square wave out, i.e. pin IO would be high for as long as it was low which would mean the yellow LEDs being on for as long as they are off; very pretty but devastating for the

battery so C3 charges up slowly via R8, a 2.7 meg; this takes a couple of seconds. During this time the LEDs are off but when pin 8 reaches 60% of rail, pin 10 goes low assuming pin 9 is high i.e. in darkness. Now D7, which has been reverse biased during the charging of C3 so taking no part, now becomes forward biased allowing C3 to discharge through R7, a 33 Kn. Now it is obvious that instead of discharging through a 2m7, it now discharges through a 33Kn in parallel with it; the discharge time is going to be a tiny fraction of that of the charging time. This short discharge time is the time the two yellow LEDs are on. The principle of long-lasting batteries is not to draw too much from them so the longer the charge time and the shorter the discharge time, the greater the life expectancy of the batteries. The values of R7 and R8 can be changed to suit personal preferences.

The output of IC3c pin 10 is normally high pulsing low. ICld is used as an inverter (both inputs tied together) so its output pin II is normally low pulsing high. TR2 is used to switch the LEDs because their drive current is well above the output current of a 4093. If high efficiency 3mm LEDs are used, the value of RIO can be increased; its value should be as high as possible while still allowing the LEDs to be bright enough to be seen. Remember that they only flash in near total darkness so they do not have to be too bright.

The second part of the circuit is the torch in position pulse generator. This is the third case where a non digital level is applied to the input of a gate.

It's pretty pointless having this TorchPad flashing away when the torch isn't in position so a micro-switch is mounted in such a way that the weight of the torch is used to enable the circuit i.e. the power on to the IC. Note that the reservoir capacitor is always being trickle charged. This is so there is enough power available when the torch is placed in position to flash the green LED.

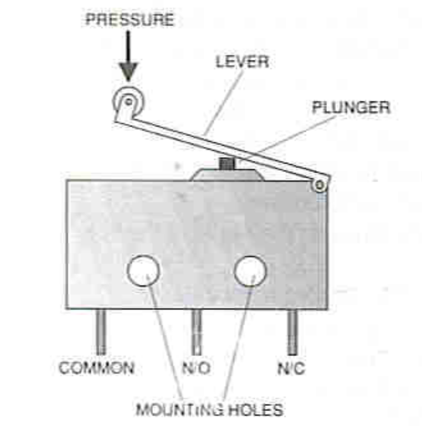


Fig.5 Typical microswitch

To make sure the torch is in position, a green LED pulses once to show that it has enabled the circuit i.e. it is on the switch correctly and it also confirms that the batteries are OK. This pulse is generated by ICIb; here the inputs are tied together, effectively making an inverter. C2 is charged up by R4 when a voltage is applied to the circuit i.e. the torch is in position during the time C2 is charging up from zero to 60% of rail, pin 4. The output will be high turning on TRI via R3; this in turn illuminates the green LED once C2 has charged to above 60%, pin 4 goes low turning off the green LED and will remain off until the torch has been removed - this breaks the power to the IC and C2 can discharge into the power rail of the IC via Dl. C2 will then be discharged ready for the return of the torch which will again set off the pulse generator at pin 4. It must be remembered that C2 will take some time to discharge so if the supply is interrupted quickly C2 will not have discharged down to 40% and will not cause a pulse to be generated. In use, this is not a problem because changing a bulb or the restoration of power will take longer than the discharge time of C2.

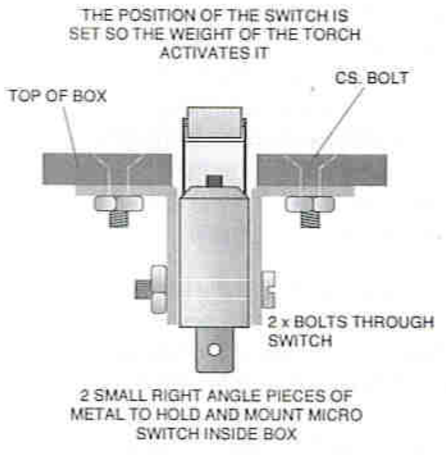


Fig.6 Mounting the microswitch

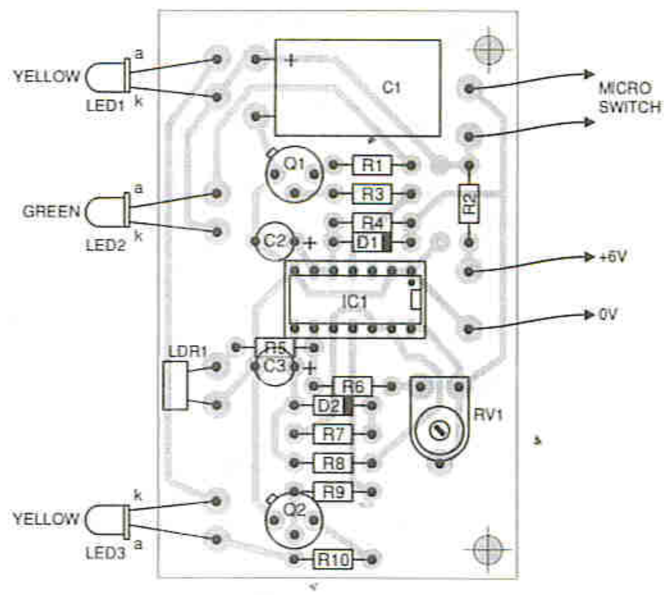


Fig.2 PCB overlay

The green LED is run brighter than the two yellow LEDs because the torch will normally be returned to its position in lit conditions so it must be bright enough to be seen in normal lighting conditions, unlike the two yellow LEDs that are only lit in darkness.

In order to maintain a steady current flow from the batteries a reservoir capacitor and trickle charge system has been employed. The voltage across the reservoir capacitor Cl must not fall below 4.5 volts when the yellow LEDs are flashing. To this end, the value of R2 can be increased slightly. This steady flow of current from the batteries, rather than the pulsating demand, seems to make the batteries last longer. Rechargeable batteries are not suitable for this project because they decay faster so a good quality alkaline type is recommended. They should last well over a year. It is a good idea to change the batteries every year regardless and, at the same time, change the batteries in the torch. Flat batteries in the torch, when found, somewhat defeats the object.

The box the TorchPad project is mounted in must be large enough to mount the PCB and batteries and tall enough to allow enough room to mount the micro-switch and its mounting brackets. The flat top of the box must be large enough to stand the torch on. The battery pack containing the four AA size 1.5 volt batteries can be one of either 3 types; the quad, 2 side by side and 2 on top, 2 side by side with 2 more side by side at one end or 4 side by side. The choice depends upon the box chosen. The micro-switch should be mounted in such a position that the weight of the torch holds the lever down. When the switch is compressed, the pair of contacts that make are the ones to use as most micro-switches have three contacts;

common, normally closed and normally open. Care must be taken because the glass front of the torch is recessed and this distance must be allowed for when mounting the switch. The lever may require bending a little to activate the switch in the right place.

Four holes are drilled in the front of the box, three for the LEDs and one for the LDR. The LEDs can be measured; if holders are used the hole is around 4mm and if not used, around 3mm. The hole for the LDR is 6mm which is mounted 5mm back from the hole (see diagram for details).

Setting Up

There is only one control to set up, VR1. The TorchPad should be placed in its permanent position; a bit of thought is required here because wherever it is to be placed should be easy to get to in total darkness so don't put it behind or in the path of low obstacles that you'll trip over in the dark.

Once in position, VRI should be rotated until the LEDs start flashing at the light level required. It's a good idea to get someone to turn the light on and off (after dark) while adjusting VRI. If the setting is correct, the LEDs flash at near total darkness - if you can see the torch, they shouldn't be flashing.

The micro-switch should be held down or bypassed during this setting up or the LEDs won't flash due to lack of power.

This project should be ideal for the novice constructor; although practical values are given, several of these can be experimented with. Within reason, the exact value of any of the components is not critical so long as they are in the right order. Increasing resistor values generally decreases the current drawn, except for R7, and reducing the resistor values increases the current drawn, again except for R7.

PARTS LIST

Resistors

RI 270n
R 2 2K7
R3 IOKR4 22OK
R5 IOOK
R6 IOOK
R7 33K
R8 2M7
R9 IOK
RIO 270n
VR1 479Kn mini preset

Capacitors

C1 2,200uF 10V Radial
C2 22uF 16V TANT Bead
C3 1uF 16V TANT Bead

Semiconductors

IC1 CMOS4093
LDR1 NSL 19
(RS, Electromail 596-141)
D1, D2 IN4148
LED1 Yellow 3mm
LED3 Yellow 3mm
LED2 Green 3mm
TR1, TR2 BC107

Miscellaneous

I box to suit, I40mm x 80mm x 35mm (this size used in prototype)
I battery holder to suit
I micro switch with roller - Maplin GW70M

Practically SPEAKING

CASSETTE RECORDERS

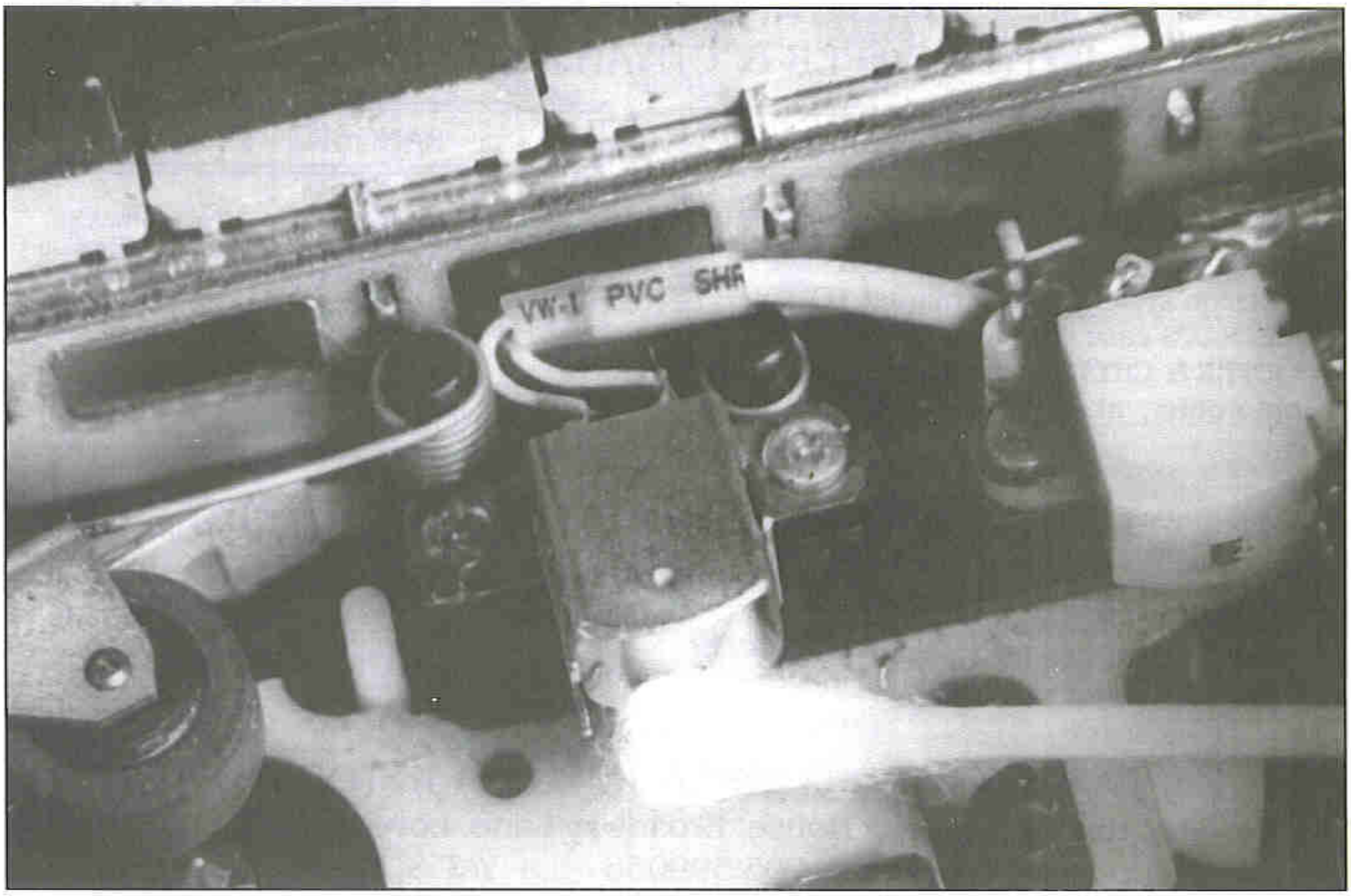
PART 1

One of the more popular requests made of any electronics hobbyist is to "have a quick look" at a cassette player. This work is so common that three months of Practically Speaking will be devoted to it.

The equipment may range from in-car radio/cassette systems and household units to the Walkman type of personal stereo. The most usual report is one of deteriorating sound quality - often described as being muffled. Another common problem with personal stereos is that the headphones work intermittently or only one of the pair operate. Almost all problems with these machines are mechanical ones - the electronic side rarely gives trouble.

Stitching it up

People never learn. If ever there was a good illustration of the proverb a stitch in time . . . . it is with cassette players. The problem is that many users do not bother to carry out the simple maintenance which is essential to keep it working properly. The most pressing one is to keep the heads and tape



transport mechanism free of oxide build-up.

Recording tape consists of a plastic base with a layer of magnetic material on its surface. In its travels, this layer consisting of iron and other oxides rubs off on the various parts referred to as the tape transport mechanism. A specially impregnated cleaning cassette which follows the same path will remove it providing the deposit is not too heavy. With good quality tape, oxide is shed very slowly and like the brakes on a car, the deterioration is scarcely noticed at first.

Wet and dry

There are two types of cleaning cassette - wet and dry. The dry type is convenient and sufficient if used regularly. It is simply run through according to the instructions. It will last for about ten operations and there is often a tick-off label to prevent it being used after that. The wet type is more effective in stubborn cases. In this, a few drops of solvent supplied with the cassette are applied before running it through. Again, this type does not last indefinitely and the instructions in this respect must be closely followed.

As the tape travels from one spool to the other, it moves through guides to maintain the correct alignment. It then passes over the erase and record/playback heads where a springy arm and felt pad maintain a light pressure. It is then squeezed between the capstan and pinch roller. The capstan turns at a precise rate and draws the tape through at the correct speed. After passing through more guides, the tape reaches the take-up spool.

A build-up of material on any of these parts will cause problems. When it forms on the record/playback head, it will prevent the necessary close contact between the head and the tape. This results in the poor high frequency response and the muffled sound referred to earlier. A similar deposit on the erase head can cause poor "wiping off" so that previously recorded material is heard in the background. Oxide on the pinch roller can cause slipping and hence speed fluctuations and when deposited on the tape guides, squealing noises and sticking can result.

Careful work

If a wet cleaning cassette does not cure the problem, the machine will need to be dismantled sufficiently to expose the various parts of the transport mechanism. Cleaning fluid is then applied using cotton buds. Cleaning fluid is supplied either in an aerosol can or a small bottle. Although methylated spirit is an acceptable substitute, do not use nail varnish remover, paint thinners or other strong solvent. The work must be carried out gently and methodically. A brown deposit on the end of the bud will be seen as work progresses and a new one should then be used. All parts of the transport mechanism should be treated until all oxide has been removed. Pay particular attention to the record/.playback head and polish all remaining deposit from it using a new cotton bud.

Unfortunately, this may not effect a complete cure. In many cases there is some improvement which draws attention to other shortcomings. Over a period of time, the record/playback head may have become misaligned and this will cause similar problems of muffled sound quality. Re-alignment is a fairly simple matter and when combined with the thorough cleaning described above, will often make an ageing machine spring back to near as-new performance. Head re-alignment and some other cassette problems, will be discussed next month.

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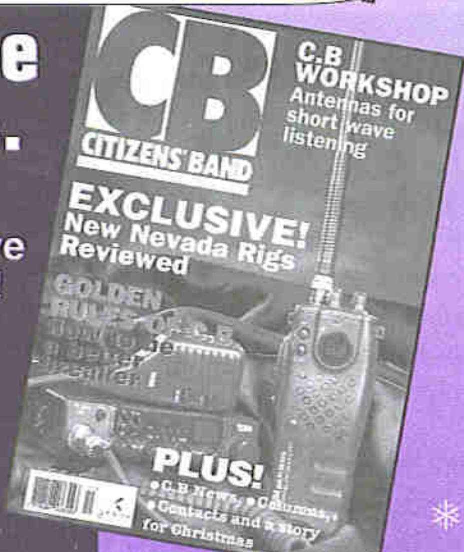

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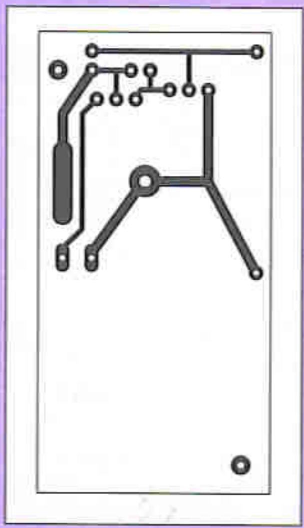

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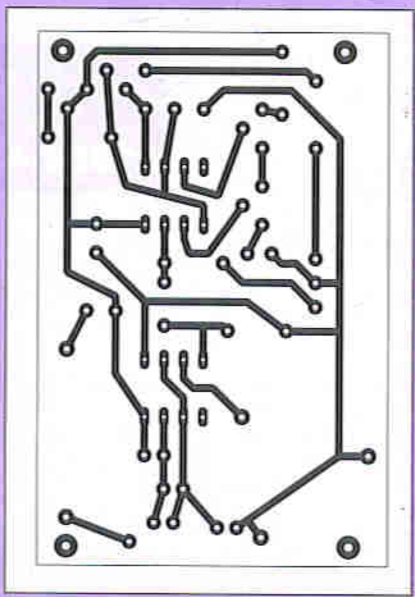

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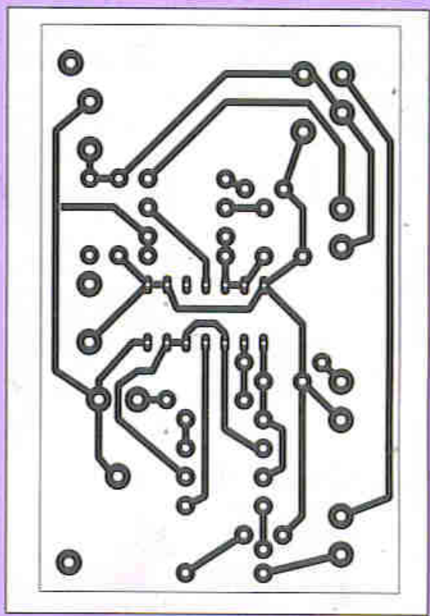

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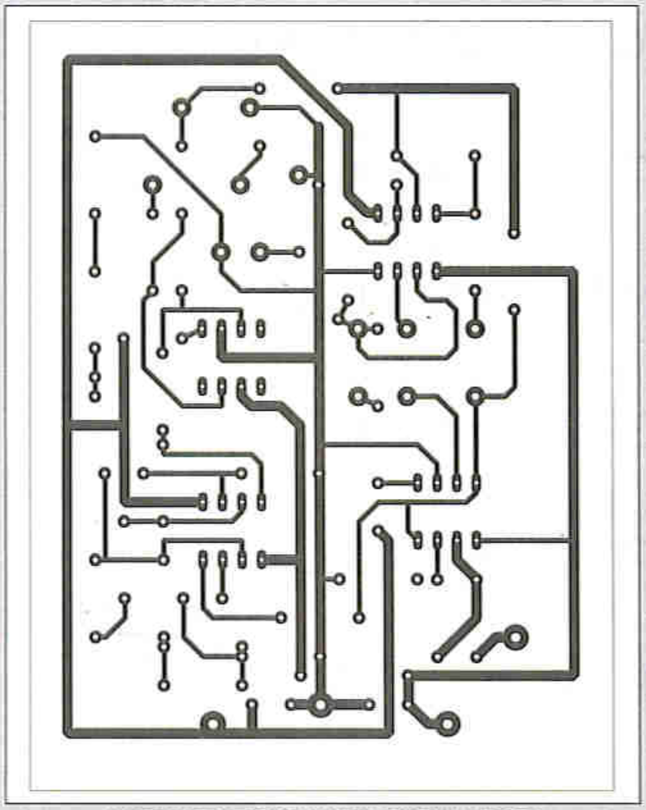

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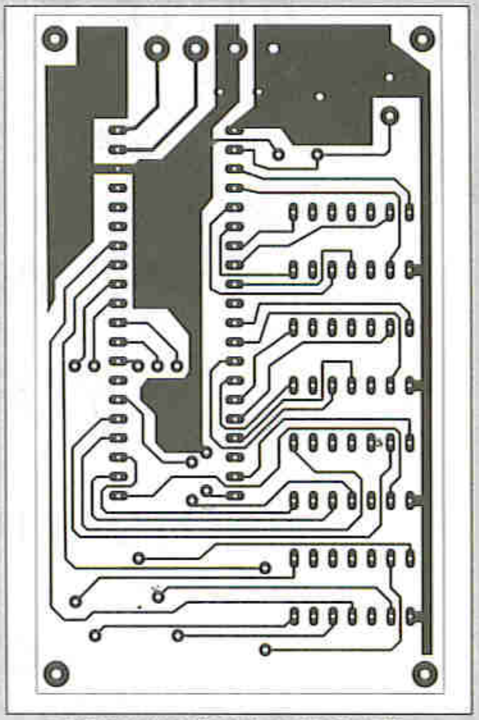

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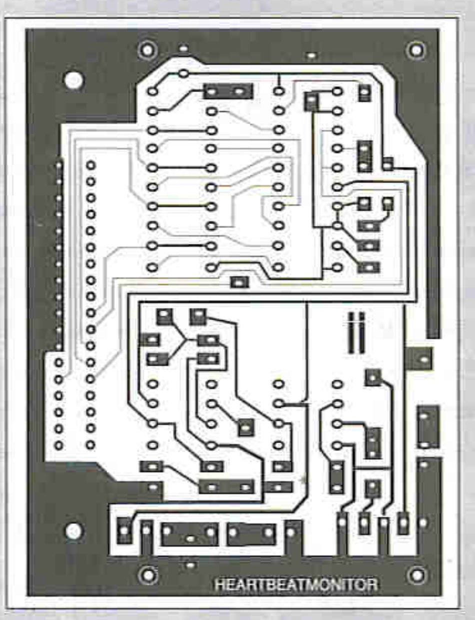

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Around the Corner

Nick Hampshire takes a look at the technology of tomorrow

There can be little doubt that digital technology is steadily but surely conquering the world. First there was the digital computer, then digitised audio in the form of CDs and DAT tapes - and now there is digital television waiting in the wings.

The great thing about digital TV is that by using what are now well established data transmission technologies it is possible to transmit a lot more data over a single channel than is possible with current analog techniques. This means more TV channels, higher definition images and, of course, in cable systems, interactive TV and video on demand.

Overall the logic, both technological and commercial, for moving to digital television is fairly overwhelming, a factor which last August prompted the British Government to publish a White Paper on digital TV.

The first responses to this document have now come from broadcasters and the electronics industry. Both have underlined the fact that the introduction of this technology needs some form of deadline, both to encourage international standardisation and to focus the attention of consumers, manufacturers and broadcasters alike on the impending change.

The BBC is drawing an analogy between the switch from 405-line black and white TV to 625-line colour and is thus proposing a cut-off date for analog TV broadcasting of 15 years from now. However, industry representatives are urging caution, noting the fact that the TV industry is a global one and any unilateral action by the UK could be catastrophic for the UK industry.

This debate is likely to go on for a long time. In the meanwhile, digital technology is already making significant inroads into the TV and film industry. Video on demand systems are being pioneered in several locations in the UK, as are interactive TV systems. We have already seen what the film industry can do with computer generated imagery and special effects, in films like Jurassic Park, but we are now about to see the first fully 3-D electronic clones of well known actors.

The first use of such virtual film stars is in a film called Virtuosity, due for release in April, staring Denzil Washington. This film uses an exact computer generated double of Denzil to perform some really spectacular stunts. Stunts which it would be too risky for any human stuntman to perform.

The computerised double has been created by scanning the actor with a low power laser so as to build up a profile of him slice by slice. These profiles are picked up by a CCD camera at right angles to the laser, another CCD camera being used to input data about skin colour, texture etc.

In most cases, only the actors head needs to be digitised, but digitising even this relatively small part of his body generates an enormous 230,400 reference points (512 slices with 450 points per slice). A special piece of computer software known as a decimation program is then used to reduce this to about one tenth the number of reference points without losing any of the information concerning more complex areas of the head (areas such as eyes, ears, and mouth). This software was developed by the California based company Cyberware which is pioneering the technology that allows the use of virtual actors.

These data points are converted into a 3-D skeletal net onto which the data about skin texture and colour is then mapped. The result - a perfect three-dimensional clone of the actor's head. This is then animated using widely used PC based software such as Autodek's 3-D Studio and Adobe's Photoshop. The result - a virtual actor who can do anything the real one can do and a lot, lot more.

In the future we may no longer have any need for stuntmen, or actors; they will all just be data stored in some computer. But, then again, will we all want to continue watching the same actors doing the same thing?

Next Month...

In the February 1996 issue of Electronics Today International, Richard Grodzik shows how to build a PC controlled logic analyser and, from Terry Balbirnie, there is a special Valentines day project, an electronic love finder.

Testing alarm systems is the subject of a project from Bob Noyes, and, on the subject of alarms, Robert Penfold has a PC alarm project which could just stop someone stealing your system. Bart Trepak is introducing a new PIC based project, a video checker to stop the kids watching TV all day and, of course, we will be continuing our premier autumn project, the ETI Basic programmable micro controller.

The main feature article will be looking at home automation, and in our secondary feature we will be taking a look at some early electronics with George Pickworth. We shall also be reviewing some more PC software and books of interest to readers.

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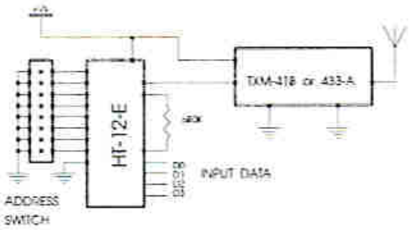

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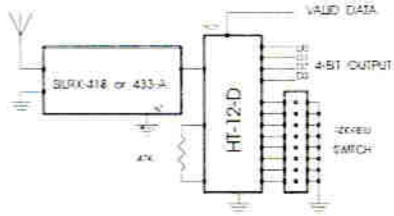

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