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ROBOTS

Walking, Learning, Thinking... and Creating Carnage

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Editor :
Natasha Nagaoka
nnagaoka@electronicsandbeyond.com

Design and Layout :
Iain Houston
ihouston@modgofish.com

News Editor :
Jonathan Aldred
jaldred@electronicsandbeyond.com

Marketing & Media Sales Executive :
Anna Penar

Customer Service Manager :
Paula Matthews
01970 621039

UK Newstand Sales :
WH Smiths
01793-562163

UK Newstrade Distribution :
Kanda Systems Ltd
01970 621030

Export Distribution :
Comag Magazine Marketing
Tavistock Road,
West Drayton,
Middx, UB7 7QE
01895-433644

USA Distribution :
Logical Devices Inc
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Subscription queries :
Paula Matthews
pmatthews@electronicsandbeyond.com

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The Past, Present and Future of Electronics

The Electronics and Beyond Team

Jonathan Aldred BSc(Hons) – News Editor

I was born in Wirral, Merseyside where I lived up until 7 years ago when I moved to Talybont, near Aberystwyth. I studied Geography at Aberystwyth University, but my interests cover a wide range of subjects and I am currently learning how to program in C.

My other hobbies include reading, short story writing, science fiction programmes, computer games and keeping up to date with technological trends and current events.

You can contact me at jaldred@kanda.com.

Anna Penar – Media Sales Manager

I was born in a mountain area in Lower Silesia in Poland in February 1975. I studied Law in three countries: Poland, Germany and United Kingdom.

I have two law degrees and study at the moment a part-time MBA at the University of Wales (Aberystwyth).

I often worked for international organisations like Red Cross in Poland, Konvoi 96 in Germany, but have work experience in administration (magistrate court and Internal and Foreign Ministry in Poland) and business as well (DEBET consulting and accounting company in Wroclaw, Kanda Systems).

One of my passions are foreign languages (Polish, Russian, German, English, Spanish and Italian), Contact: apenar@kanda.com.

Natasha Nagaoka – Publishing Manager

I was born in Aberystwyth, brought up on a welsh hill farm and then studied Politics at Leicester, then a year in Bilbao, Spain as a TEFL Teacher .

I did an MBA and moved to Tokyo, where I worked for two diverse Japanese companies, studied on a Scholarship scheme at Keio University.

I relocated to the UK after 9 years in Tokyo, and joined Kanda in October 2000 as Marketing Manager, and am now in charge of Electronics and Beyond.

I enjoy horse-riding, oriental arts and learning new skills, I speak fluent Japanese and some Spanish.

I can be contacted on 01970 621030 , via Fax on 01970 621040 , email to nnagaoka@electronicsandbeyond.com and welcome any feedback on the contents of the magazine.

Paula Matthews – Subscriptions Manager

I was born in Sutton Coalfield not so long ago, I have a BTEC in Business and Finance and Business & Finance.

I worked as a special constable for 4 years in Aberystwyth and then joined Kanda Systems in 1997 as a receptionist and later on as an accounts assistant and customer service co-ordinator.

In my spare time, I enjoy films, reading and dining out and try to do some sport in between.

As Your Subscriptions manager, I handle all day to day queries on Electronics and Beyond, update all customer information and you can ring the Electronics and Beyond Hotline on 01970 621039 which is open between 9 and 5.30pm on weekdays for assistance.

I look forward to talking to you and helping you with any questions you have as a subscriber to Electronics and Beyond.

The Sun is shining...

For July, we give you the facts on the power of the Sun, and how we can harness this infinite energy source. Whether you want to get involved with the Solar clubs activities or need advice from the experts at Power Pumps then look no further than the green pages this month. For those of you pottering around in the garden, you may need a device which will allow you to check the state of your soil, then take a look at our green project from Gavin Cheeseman which is the handy soil moisture tester.

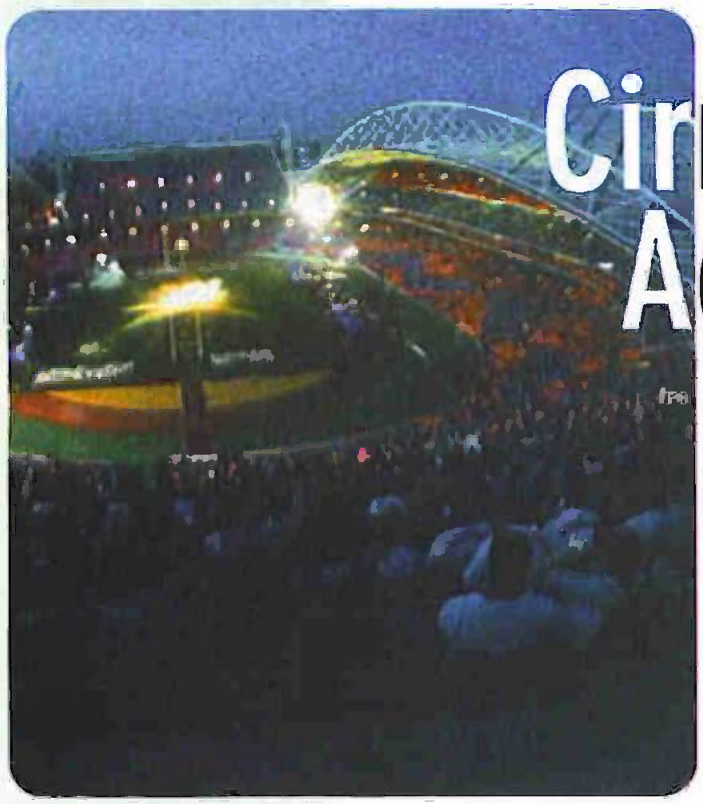
This month, we have set off on a journey across the Atlantic to bring you a Sci-fi story from a famous American short story writer, Frank McCoy plus we have balanced this up with a successful American businesswomen's viewpoint on the status of women in male-orientated disciplines such as Electronics.

You may want to find out whether you are actually compliant or non-compliant with the standards set by CE Marking then look at Part 2 of our feature in the Ideas into Profit section, it could be mean make or break for your business and help reduce time to market. The blue section also shows you how 2 young German engineers actually took their dream project and made it into a real-life business adventure. If you have a similar frame of mind then send us your business from the kitchen table concept and we promise to publish them as soon as space permits.

The new section, Beyond Belief gives you the people at Microsoft actually vandalising their own hardware with a baseball bat and an online massacre which leads to waves of mourning despite it being NOT REAL plus other strange, but true stories from the flip-side of the world of electronics.

This issue, Electronics and Beyond brings you an exciting feature on Robot Wars, this theme runs through What's On into Web Electronics and is extended and detailed in a Robot Wars orientated Product Review and the short story competition, where all you budding writers have the opportunity to win the 1st prize and get a remote-controlled replica house robot or you could be one of the lucky eight runners-up who will receive eight Robot Wars action models. Be on your guard and look out for snake robotics slithering past in one of the pages. Find out about the close connection between robotics and pieces of coloured lego as the power of Lego Mind storms is investigated by one of the masters of electronic projects, Robert Penfold.

We, at Electronics and Beyond hope that you have an enjoyable read through and look forward your comments and suggestions on this summer edition.



Cirrus Logic Acquires Peak Audio

Peak Audio, developer of new technologies and products for professional audio markets worldwide, have been bought by Cirrus Logic – supplier of high-performance analogue and DSP Chip solutions for Internet entertainment electronics. The acquisition brings together two world leaders in audio ICs and networks.

Peak Audio's products provide high-quality audio to such high profile facilities as the United States Senate Chamber, Sydney Opera House, and Stadium Australia (see photo), home of the most recent Olympic games. Cirrus expects to take advantage of Peak Audio's technical expertise and high market share in order to develop a broad range of entertainment-centric audio solutions for networked environments in both the commercial and consumer audio markets.

Financial terms have not been disclosed, but the transaction is expected to be accretive on a cash basis within six months, starting in May. 'We see a strong future in networked entertainment solutions,' said David D. French, Cirrus Logic's President and CEO. 'According to research firm In-Stat, the digital home network market is expected to grow from 5 million to more than 27 million digitally networked homes worldwide by 2004. This acquisition creates a great opportunity to develop cost-effective, networked entertainment solutions based on our combined leadership positions'.

See www.peakaudio.com and www.cirrus.com for further details.

NEWS bytes

C-Cube Announce New Video Codec

C-Cube Microsystems, specialists in new digital video processors and networked consumer products have announced the availability of the industry's first single-chip codec compatible with Sony Corporation's professional MPEG IMX Video Tape Recorder (VTR) products.

'The C-Cube DVxpress-MXT50 codec is targeted for the professional broadcast market and benefits the server and non-linear editing equipment vendors by enabling seamless interoperability between the range of Sony professional equipment in its IMX family,' says John Scarcella, senior vice

London Underground's Billboards Go Digital.

Digital billboards are set to spring up all over London Underground thanks to an agreement between the owners of the transport system and a consortium made up of Swedish media company DHJ Media AB, TDI Advertising Ltd, Citylink Telecommunication Ltd and Thales Telecommunication Services. The consortium have signed a 12-year agreement with London Underground in what is regarded as being the largest ever digital project for information and advertising in real time.

During this year, DHJ and Thales Telecommunication will install around 100 digital billboards in London's underground stations, with testing probably to begin at Oxford Circus and Euston. The consortium plans to install a total of 400 screens,

each measuring 4 by 3 metres, within the next couple of years.

The Outdoor Evolution digital system, developed by DHJ, will use IMAX projection equipment linked to curved screens that face out onto the platforms – current projections in the region of four to six of these per platform. The advertising will not just be fluid and up-to-date, it will also be demographically targeted so as to reach the different types of audience that will be using the Underground at various times, and indeed various stations, during the course of the day.

Outdoor Evolution has been a feature at London City Airport for the past two years, where the ability to change the message in the advertisement and direct it at specific groups of consumers at specific times at selected platforms or gates has proven to be a highly effective advertising tool. It has also been installed at Stockholm's Arlanda airport, the airport's connecting trains, and the city's metro.

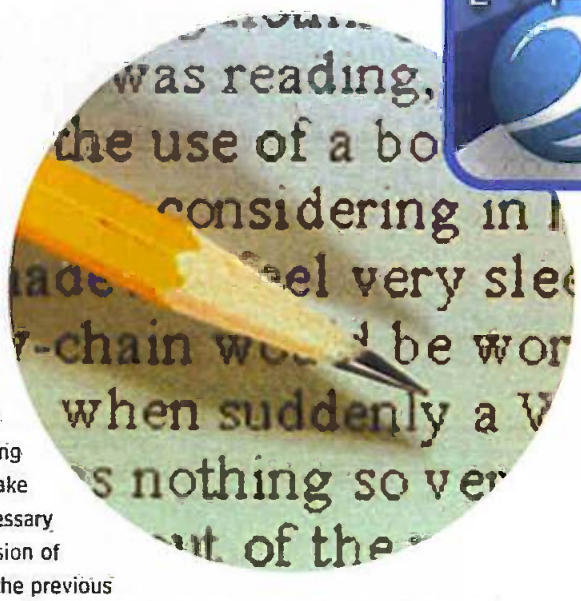
'Because we have patent rights to Outdoor Evolution in a large number of countries and because we are one of the few companies in the world that can provide advertisers with a concept of advertising in real time, the market is enormous,' says Per Johnsson, Managing Director of DHJ. 'The future is undeniably bright for DHJ thanks to the breakthrough provided by the contract with London Underground. Our success paves the way for continued sales of the system to other underground operators, airports, shopping centres and places that attract a lot of people'.

New Epson Colour LCD for Mobile Phones

Epson has released a new series of transflective colour STN LCDs especially designed to comply with the requirements of the mobile phone market. The series allows operation with and without a backlight unit. It has a compact design and features high image quality, contrast and good colour reproduction achieved through applying the newly developed Single Polarizer Display technology with the reflector placed inside the LCD cell and use of the Multi-Line Selection driving method.

The unit is currently available in two types – 1.7" or 2.0" screen diagonals (120 x RGB x 143 & 120 x RGB x 160 respectively).

E Ink Announces Leap Forward In Electronic Ink Displays



E Ink Corporation, developer and marketer of electronic ink technology, have demonstrated the world's first active matrix electronic ink display capable of producing high resolution illustrations and text. The prototype is 12.1 inches in diagonal with the resolution of a typical laptop computer monitor and is capable of creating high quality images, including illustrations. To make the electronic ink easily compatible with the necessary electronics, E Ink scientists developed a new version of electronic ink that changes 10 times faster than the previous version. Contrast was also improved by switching the ink from blue to deep black. Electronic ink allows a fixed image to remain on the screen even after the power source is shut off, leading to dramatically longer battery life. There is also no need for a backlight. The display draws less than 1/1000th the power required by a standard notebook computer screen when used for normal reading. Further details at www.eink.com.

NEWS bytes

president of Sony Electronics' Broadcast and Professional Company.

The DVxpress-MXT50 codec deploys innovative video compression and transcoding technology resulting in multi-generation video quality. The codec implements 50 Mb/s encoding and decoding of video at 4:2:2P@ML, while preserving all the features of the DVxpress-MX product line, including multiple-stream editing and real-time special effects. More information at www.c-cube.com.

Electronics engineering student numbers fall

Despite current growth in the UK electronics sector and an increase in the number of students wanting to go to college or university this year, the number of electronic engineering applications from students aiming to do degrees and HNDs have fallen considerably.

According to UCCAS, the University and Colleges Admissions Service, degree applications are down 0.4% and HND applications have fallen by a quite staggering 20%.

500 businesses to work with undergraduates

On a similar note, a scheme to encourage graduates into the electronic engineering industry has been announced – under the STEP Solutions: Electronic

NEWS bytes

Engineering scheme, 500 small to medium-sized businesses will get the chance to work with undergraduates on projects lasting anything from 1 month up to a year. STEP Enterprise's £1.4 million pound scheme will be supported by EMTA and funded by the Department of Trade and Industry and the Communications Industries Directorate.

Motorola signs contracts worth $146m

Motorola's Global Telecom Solutions Sector (GTSS) have announced the signing of five contracts, worth $146 million, for GSM and GPRS networks expansion with China Mobile Communications Corporation. Motorola will expand China Mobile's GSM networks in five of China's major provinces and municipalities and, in addition, will expand the Beijing Branch of China Mobile's (Beijing Mobile) General Packet Radio Service network to increase network coverage.

Newt in Eden

Cornwall's Eden Biodome project is using metallic inspection technology developed by Portsmouth-based Newt Engineering to monitor the state of its closed-environment buildings. Based on advanced electromagnetic array technology, the Lizard (previously used in theme parks, manned space flights and the rail industry) detects minor defects and cracks in large and/or complex metal structures.

Amkor Stacks Die 3-High In IC Packages

Amkor Technology www.amkor.com is expanding its development and qualification of three-dimensional (stacked) IC packages, including the integration of three or more die and supporting passive devices. The resulting packages cost less to produce, require less handling throughout the manufacturing and mounting process, require less space, and have higher reliability and better electrical performance than the combination of devices they replace.

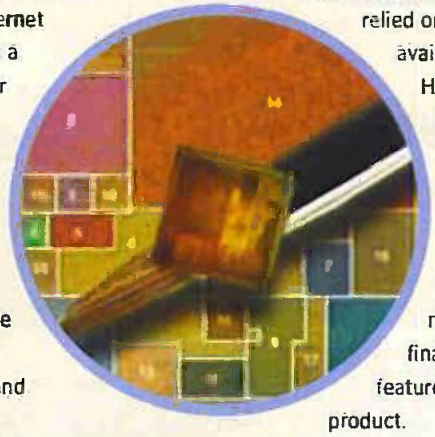
Amkor has developed 3D packaging options that include die stacked three or more high, stacked die of the same or different sizes and side-by-side 3D die stacks. 3D assembly techniques allow mixing of interconnect technologies within the package. These include die-to-die or die-to-substrate using combinations that can include either wirebond or flip chip technologies within the same package.

3D packaging was first introduced so that mobile phones and other hand-held devices could be made smaller by allowing flash and static RAM chips to be vertically stacked within a single package. Stacked die packages decrease the total system cost by reducing the number of components needed as well as simplifying the application's motherboard. Additionally, stacked die reduce the length of interconnections between the devices, enhancing the electrical performance and final system application performance. Weights of stacked packages can be up to 70% less than multiple single-die chips capable of performing the same functions – an important consideration, especially in the design of mobile communications technology.

New IBM Chips Will Drive Innovative, Lower-Power Internet Appliances

IBM has announced a new family of chips that are expected to help launch a wave of lower-power Internet-attached consumer electronics.

The IBM PowerPC IAP (Internet Appliance Platform) combines a microprocessor with a number of optional pervasive computing features, all onto a single 'system-on-a-chip'. Manufacturers of consumer products can use PowerPC IAP to add Internet capability while minimising the number of chips so to make products smaller, less costly and more power efficient.



'We're merging custom chip technology with consumer electronic products,' said Scottie Ginn, vice president for pervasive technology, IBM Microelectronics. 'The one-size-fits-all days of PC microprocessors are over. Unlike PCs, consumer electronics that attach to the Internet will come in all types of sizes and shapes, each demanding unique things of the chips that drive them. With PowerPC IAP, manufacturers can design a chip to fit their product, rather than limiting their product to what a standard chip will allow'.

Makers of Web phones and other innovative appliances are providing consumers with new services by linking to the Internet. This requires added 'computing power' in smaller and smaller packages. Consumer products have largely relied on the low cost and ready availability of standard chips. However, standard chips limit the unique functions that can be added. With PowerPC IAP, IBM assembles most of the chip in advance to keep costs and lead times in line with standard parts. Yet manufacturers can still make final modifications to add unique features for a particular consumer product.

The customisability of the PowerPC IAP can open the door to all types of new Internet-attached consumer electronics. In the PC environment, one proprietary operating system and one standard chip type defined how the products would look and perform. Internet appliances, however, are expected to take many forms, made possible by software like Linux and IBM's own WebSphere, as well as adaptable chip technology like PowerPC IAP.

More information about IBM Microelectronics can be found at www.chips.ibm.com. Photo of PowerPC 450 courtesy of IBM Corporation.

TCS – A Long-term Opportunity for SME's

TCS (Teaching Company Scheme) is a Government funded scheme, which enables businesses of all sizes to take advantage of the wide range of expertise available within universities. It aims to improve competitiveness by enabling companies to improve their products, operations or quality and therefore to expand sales and open up new markets.

The scheme facilitates partnerships between the company and university in the form of a TCS programme. An innovative project that is central to the strategic development of the Business is supervised by senior staff from both the company and the University and carried out by high-calibre graduates who are employed within the company for at least 2 years.

TCS programmes are part-funded by Government grants and the balance is borne by the participating company (typically around £28,000 over the two years). At the end of the programme it is expected that the business will not only be able to quantify the benefits in terms of increased turnover and profit but will have incorporated the knowledge and skills into the company for the future.

There are currently 63 TCS programmes taking place in Wales. A key factor behind the success of TCS is its business-lead approach, with the flexibility to meet changing business needs.

Case Study

CellPath Ltd has been successful in a bid to run two TCS programmes over the next two years. One programme involving the University of Bangor is already making progress on improving and implementing an Information Management System (IMS) and exploring the possibilities for e-commerce in Cell Path Ltd. The second programme will involve a product engineering review including preparation for ISO quality standards. CellPath Ltd aims to supply its products quicker, more efficiently and more competitively and these improvements will play a key part in the company growth strategy.

Previously the group has used TCS to develop a new screening product that is now one of its most successful products. CellPath Ltd. was delighted with the way the TCS enabled them to research and develop an addition to their range, bringing in key chemistry expertise from the University of Bangor to complement its own product development team and a substantial grant towards the costs.

The company was helped along the way by Know-How Wales – a free Business Connect service helping to create links between businesses, universities and colleges.

Know-How Wales is fully funded by the National Assembly for Wales and Managed by the WDA Innovation and Technology Team.

If you would like to find out more about TCS scheme or have a strategic project which might fit a TCS Programme please contact Know-How Wales Regional Executive Linda Denton 01970 613205 email: linda.denton@wda.co.uk or Dr. Julie Finch on 01970 622385, email: ribs@aber.ac.uk

To find out more information about Know-How Wales service logon www.knowhowwales.com

New TerraTec Soundcard Plays Direct From The Hard Drive

German audio specialists TerraTec have launched their new AudioSystem EWX 24/96 soundcard, which enables music to be played direct from the hard drive. The 24/96 of the title refers to its 24Bit / 96kHz converter technology, and the card reaches a signal to noise ratio of more than 100 dB/A. In addition to the analogue stereo input and outputs, there is an optical digital In and Out (TOS link) for all standard formats up to 24Bit and 96kHz. These operate without any sample rate conversion and thereby deliver a 1:1 (bit-true) perfect recording.

For full details of software included in the package, go to www.terratec.net/ttuk.

NEWS bytes

BSkyB analogue shutdown

With BSkyB's digital service now accounting for 95% of its total subscriber base, the satellite broadcasting company is to shut down its analogue transmissions this summer. For quarter 3 of this year, BSkyB's profits were £46.6m – double what they were at the same time last year.

Clam Talks A Load Of Shelbish

Shelby, an interactive clam with the gift of gab, is soon to be released into the toy market by its developers Tiger Electronics. Like its predecessor, Furby, Shelby responds to its surroundings and continues to develop as you spend more time with it. Shelby has a vocabulary of 180 words in a mixture of its own special language, 'Shelbish', as well as 'Furbish' and English. With all the enhancements made, Shelby has 70 more vocabulary and 50 more memory than the Furby did. It also speaks three times the phrases, has more sensory input, and possesses double the number of built-in features that are unlocked through play.

An Introduction to LEGO MINDSTORMS

by Robert Penfold

THIS ISSUE WE WELCOME BACK TO THE MAGAZINE ROBERT PENFOLD – ACCLAIMED AUTHOR OF BOOKS SUCH AS 'INTRODUCING ROBOTICS WITH LEGO MINDSTORMS' AND 'MORE ADVANCED ROBOTICS WITH LEGO MINDSTORMS'. ROBERT USED TO BE A REGULAR CONTRIBUTOR TO ELECTRONICS AND BEYOND AND I AM SURE MANY OF OUR READERSHIP WILL REMEMBER HIS PROJECTS. WE WANT TO PROVIDE YOU WITH THE OPPORTUNITY TO LEARN AGAIN FROM ONE OF THE OLD MASTERS OF ELECTRONICS.

THIS MONTH ROBERT INTRODUCES US TO THE LEGO MINDSTORMS RCX AND DESCRIBES HOW TO BUILD A SIMPLE AND EFFICIENT ULTRASONIC TRANSMITTER AND RECEIVER WHICH CAN BE USED TO SWITCH ON AND OFF ANY ROBOT BUILT AROUND THE RCX UNIT.

When many people think of LEGO, they think of it as a toy that they or their children used to play with – fun and educational in a creative way, but not the kind of thing you'd still be playing with as an adult. In truth, many adults 'play' with LEGO and even build functional robots from it. If you have never heard of LEGO MindStorms, you might wonder how this is possible. If you have heard of LEGO MindStorms, you might wonder what it is. If you have seen LEGO MindStorms in action, turn to the next page – you do not need to read this article.

The MindStorms Robotics Invention System was 1999's surprise best-seller, capturing the imaginations of children and adults alike. The merging of LEGO bricks with electronic components and microprocessors allowed LEGO creations to move and think.

There are currently four main sets in the MindStorms collection: The Robotics Invention System has over 700 bricks and a robot 'brain' known as the RCX.

The Robotics Discovery System is a smaller version of the Robotics Invention System, containing 400 pieces and a microcomputer similar to the RCX – the Scout. Star Wars meets LEGO in the third set – the Droid Developer Kit, with which you can build simple robots, including R2D2, using a smaller version of the Scout – aptly named the Micro Scout. The Micro Scout and Star Wars theme are also central parts of the fourth set – the Dark Side Developer Kit.

The RCX is an autonomous microcomputer that can be programmed using a PC. It is a robot 'brain' that uses sensors to take input from its environment, processes data, and signals output motors to turn on and off. After building the robot from the pieces provided (plus others if needed – the MindStorms kits are compatible with normal LEGO and Technic elements), users can create a program for their invention using RCX Code, a simple but powerful programming language. This program is downloaded to the RCX using a special infrared transmitter. The finished robot can then interact with the environment, fully autonomous from the computer.

To connect a motor to one of the RCX's outputs, you use a special wire with LEGO connectors on each end. Snap one end onto the motor and the other onto one of the RCX's outputs. The light sensors and touch sensors are attached to the RCX's input connectors using the same method. The latest version of the Robotics Invention System – version 1.5 – includes touch and light sensors, motors and gears. With the Robotics Discovery System, the light sensor is built into the Scout.

There are also accessory kits available. The

LEGO Facts

- The word 'LEGO' is formed from the Danish words 'leg godt,' which means 'play well'. It also means 'I put together' in Latin.
- Two eight-stud LEGO bricks can be combined in 24 different ways. Three eight-stud LEGO bricks can be combined in 1,060 different ways. Six eight-stud LEGO bricks can be combined in 102,981,500 different ways.
- More than 203 billion LEGO elements have been moulded from 1949 to the present.
- The LEGO Company named a star in honour of its 65th Anniversary. The LEGO Star is in the constellation of Ursa Minor, which also includes the North Star.
- An estimated 400 million children and adults all over the world have played with LEGO bricks.

LEGO RCX
Remote Control

by Robert Penfold

Vision Command PC video camera allows for the creation of robots that respond to what they see. Using the MindStorms visual programming system, users can program robots to respond to motion, light and colour. For example, a yellow ball could be tracked by the robot as it is rolled around the room. Users can let their robot explore and watch the action as it happens on their PC (an extra long cord with a USB connection is supplied). Vision Command can also be used alone as a PC video camera, with standard video and image capturing capabilities.

Exploration Mars, Robosports and Extreme Creatures are accessory kits primarily aimed at children, with CD-ROMs packed with facts and interactive exercises, as well as components specific to their nature. The Ultimate Accessory Set also includes an infrared Remote Control, extra touch sensor, rotation sensor for precision control and a LEGO lamp with concave mirror, as well as extra LEGO building pieces. Temperature sensors are also available.

Robots featuring MindStorms are very commonly found in robotics galleries – for example the gallery site at www.robotcafe.com, and the kits are very popular amongst amateur robot builders. The official web site of LEGO MindStorms can be found at http://mindstorms.lego.com.

THE LEGO MINDSTORMS KIT WAS AN IMMEDIATE SUCCESS WHEN IT WAS LAUNCHED TWO OR THREE YEARS AGO. THERE HAD BEEN ROBOTICS KITS BEFORE, BUT THE MINDSTORMS KITS HAD THE NOVEL FEATURE OF AN OUTSIZE LEGO BRICK CONTAINING A 9-VOLT BATTERY AND A MICROCONTROLLER.

This is called the RCX unit, and it enables robots constructed using the kit to be programmed using a PC. Several programming languages can be used, including RCX code that enables the robot to be programmed via a sort of flowchart built up on the screen of the monitor. Robots can be controlled manually from the PC, programmed to 'do their own thing', or a combination of the two.

Since its launch there has been a steady stream of additions to the system, including a remote control unit. However, this unit is quite sophisticated and expensive. It is designed to provide manual control of a robot using the RCX unit's infrared link. All that is needed in many cases is a simple controller that enables robots to be switched on and off. A device of this type is particularly useful with the faster vehicle robots where it avoids having to chase after the thing and pounce on it like a cat after a mouse. However, with practically any robot it is easier to deal with if it can be switched on and off remotely.

The receiver of the simple remote control system featured here connects to the RCX unit as a sensor, and it is used with MindStorms programming languages like any other sensor. With some programming languages it is possible to have different numbers of key presses on the transmitter which produce different results from the robot, so the controller can actually provide a little more than simple on/off switching. However, it is not designed to provide the sophisticated methods of control that are possible with the Lego control unit.

System Operation

Simple remote control units generally use infrared or ultrasonics to provide the link.

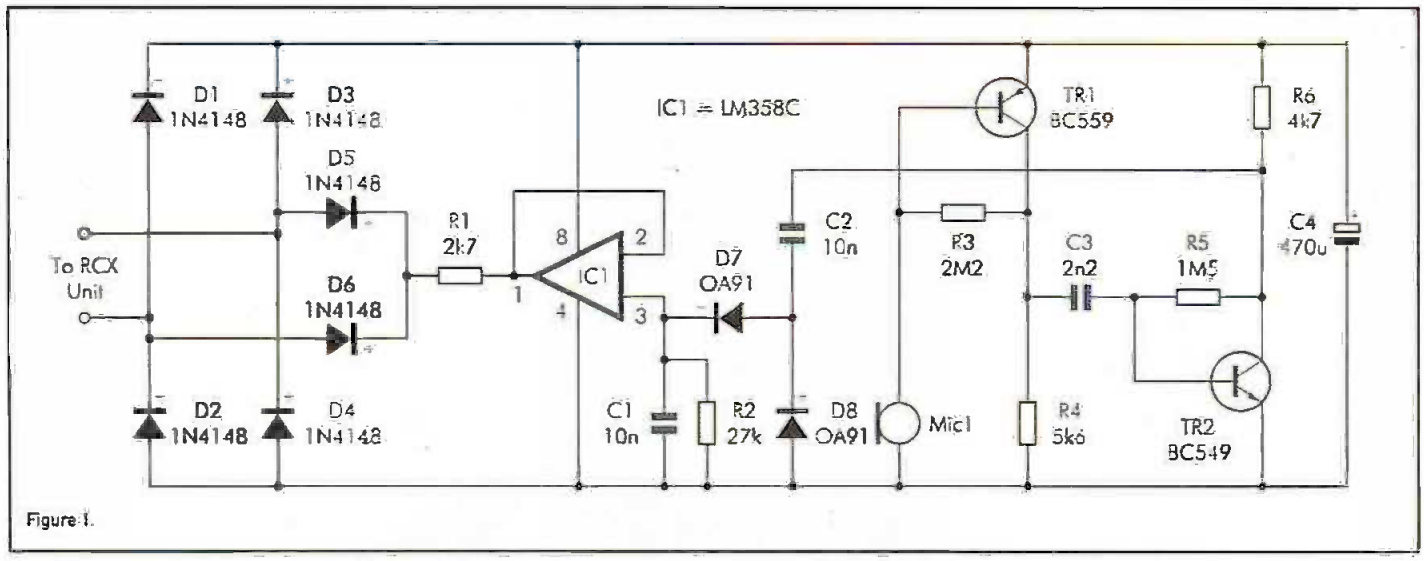


Figure 1.

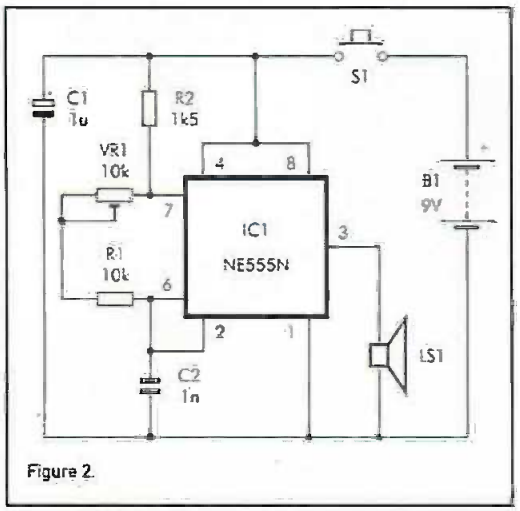


Figure 2.

In this case ultrasonics offer a safer option, with no risk of interfering with the RCX unit's complex infrared link that provides its means of communicating with the PC. The range of an ultrasonic link is not very great because the high frequency sound waves do not travel through air as effectively as lower frequency sounds. With a range of 12 metres or so the system feature here is fairly typical. A range of this order is more than adequate for the current application. The block diagram of Fig.1 shows the general scheme of things used in this remote control system.

The transmitter is just an oscillator that produces a squarewave signal when the pushbutton switch is operated. The transmitting transducer is a special Piezo device that does not require a high drive current or voltage for good results. It can therefore be driven direct from the oscillator. Both the receiving and transmitting transducers are very efficient, but only over a narrow band of frequencies around 40kHz. The output frequency of the oscillator has to be carefully set-up in order to obtain good results. No test equipment is needed, and the RCX unit's display can be used to act as a signal strength indicator. The output frequency is well above the upper limit of human hearing, which is normally about 20kHz, or less, so there is no audible output from the transmitter. Note though, that some animals can hear frequencies as high as 40kHz.

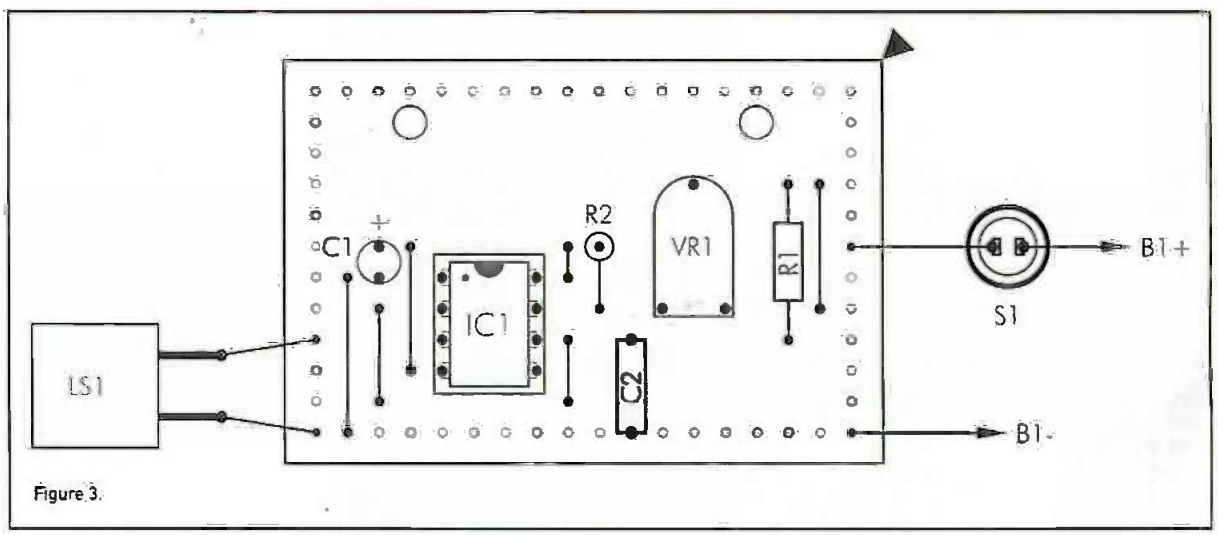


Figure 3.

Another Piezo transducer is used in the receiver, and it is virtually the same as the transducer in the transmitter. It operates much like a conventional crystal microphone, but it is only efficient at frequencies around 40kHz. The lack of efficiency at other frequencies is very important in this application where there is likely to be a substantial amount of noise and vibration from the robot once it has started. The efficiency of the transducer is so low at audio frequencies that this noise will not block the system, and it is still possible to communicate with the RCX unit once the robot is operating. The output from the transducer will normally be quite low even at 40kHz, and a high gain amplifier is therefore used to boost its output signal.

The output from the amplifier is fed to a rectifier and smoothing circuit. With the transmitter inoperative there will only be a small amount of noise on the output from the amplifier. This gives an insignificant output level from the smoothing circuit. With the transmitter switched on and in-range there is a much higher output from the amplifier, giving a strong positive d.c. output signal. This is fed to an input of the RCX unit via a buffer amplifier and a diode array. There are three input ports on an RCX unit, and they are all analogue types that drive a 10-bit analogue to digital converter. On the face of it, the output voltage from the buffer amplifier could be fed direct to an input of

the RCX unit.

In practice matters are complicated by the fact that the RCX unit is normally used to power an active sensor such as this unit, but there are only two terminals per input port. Actually there are four terminals per port, but these are cross-connected in pairs. The idea is to make using sensors as foolproof as possible, and making the connection to an input port with any of the four possible orientations will result in a sensor working properly. The price that has to be paid for this simplicity in use is an increase in the complexity of active sensor circuits.

An array of six diodes provides two functions. Four of the diodes work in conjunction with a smoothing circuit to provide a supply of the correct polarity for the sensor. The smoothing circuit is needed because the supply is briefly cut off a few hundred times per second so that the input voltages can be monitored. The other diodes in the array ensure that the buffer amplifier is not damaged during the periods when the supply is present on the input terminals, while still enabling it to drive the input properly at other times.

Transmitter

The circuit diagram for the transmitter is shown in Fig.2. A standard 555 oscillator circuit directly drives the ultrasonic transducer, LS1. R2 has been made low in value relative to the series resistance of VR1 and R1 so that the output waveform is close to being a squarewave. A short pulse waveform would not drive the transducer efficiently. VR1 is adjusted to produce an output frequency where the two transducers operate efficiently. Power is obtained from a small 9-volt battery, and the current consumption is about 10-milliamps or so. Since the unit is only switched on briefly and very intermittently there is no need to bother with any form of 'high power' battery.

Receiver

Fig.3 shows the circuit diagram for the receiver. Receiving transducer Mic1, in common with other Piezo devices, has an extremely high resistance and can therefore be coupled direct to the input of the amplifier, no coupling capacitor being required. The amplifier has two common emitter stages with TR1 as the preamplifier and TR2 in the second stage. Coupling capacitor C3 has been given a fairly low value so that it provides highpass filtering in conjunction with the input impedance of TR2. This further reduces the sensitivity of the circuit at audio frequencies. Normal sounds do produce some output from TR2, but at too low a level to produce any problems. When testing the prototype, loud sounds or even tapping on Mic1 failed to produce any change in readings from the RCX unit. Blowing on the sensor does produce some change in readings, but this is probably due to a significant amount of ultrasonic sound being generated.

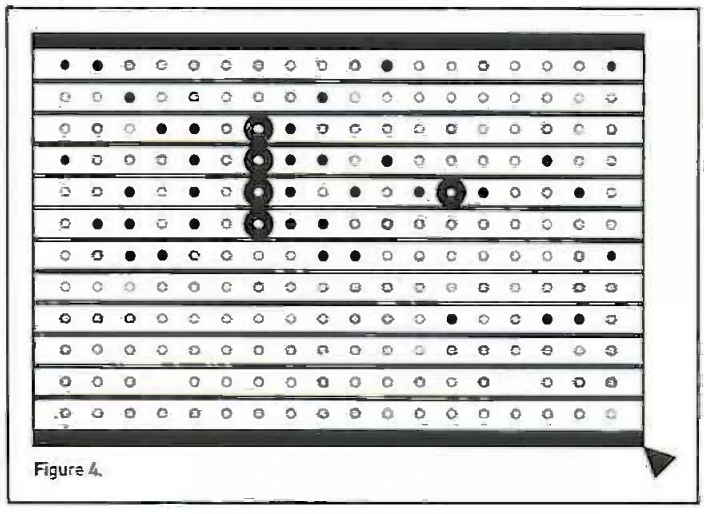


Figure 4.

The output from TR2 is coupled by C2 to a simple rectifier circuit using D7 and D8. The smoothing circuit is comprised of C1 and R2. The buffer amplifier uses IC1 in a straightforward voltage follower circuit. The LM358C used for IC1 is actually a dual operational amplifier, but in this circuit only one section is required. There are no connections to the other section of the device. Note that the LM358C is a type that will operate properly in d.c. amplifier circuits that have a single supply rather than the usual operational amplifier dual balanced supplies. Most other dual operational amplifiers can not operate with their outputs virtually at the 0-volt supply potential and will not work properly in this circuit.

Diodes D1 to D4 form a bridge rectifier and they ensure that the circuit is powered from a supply of the correct polarity whichever way round the circuit is connected to the RCX unit. The RCX unit has a 9-volt battery supply, but the supply voltage for an active sensor such as this circuit is significantly lower than 9 volts. One reason for this is that two diodes in the bridge circuit are connected in series with the supply, and they produce a voltage drop of about 1.2 volts or so. Another problem is that the supply is switched on and off by an electronic switch in the RCX unit, and there is a further voltage drop through this switch. The voltage reduction is dependent on the supply current drawn, and seems to be around 150 millivolts (0.15 volts) per milliamp of supply current. Supply currents of more than about 20 milliamps are not really practical, and a maximum of about 10 milliamps or so is preferable. The 4 milliamps or thereabouts drawn by this circuit is not a problem. The supply potential for the circuit is around 7 volts, which is more than adequate.

C4 is the smoothing capacitor in the supply circuit. There are gaps in the supply while readings are taken, but they last only about 0.1 milliseconds. Taking into account the low current consumption of this circuit, a low value for C4 would seem to be perfectly adequate. However, noise on the supply lines tends to find its way into the signal path with a very basic amplifier such as the one used here. Once in the signal path it is then amplified by one or even both stages. C4 has therefore been given a relatively high value in order to avoid problems with a high noise

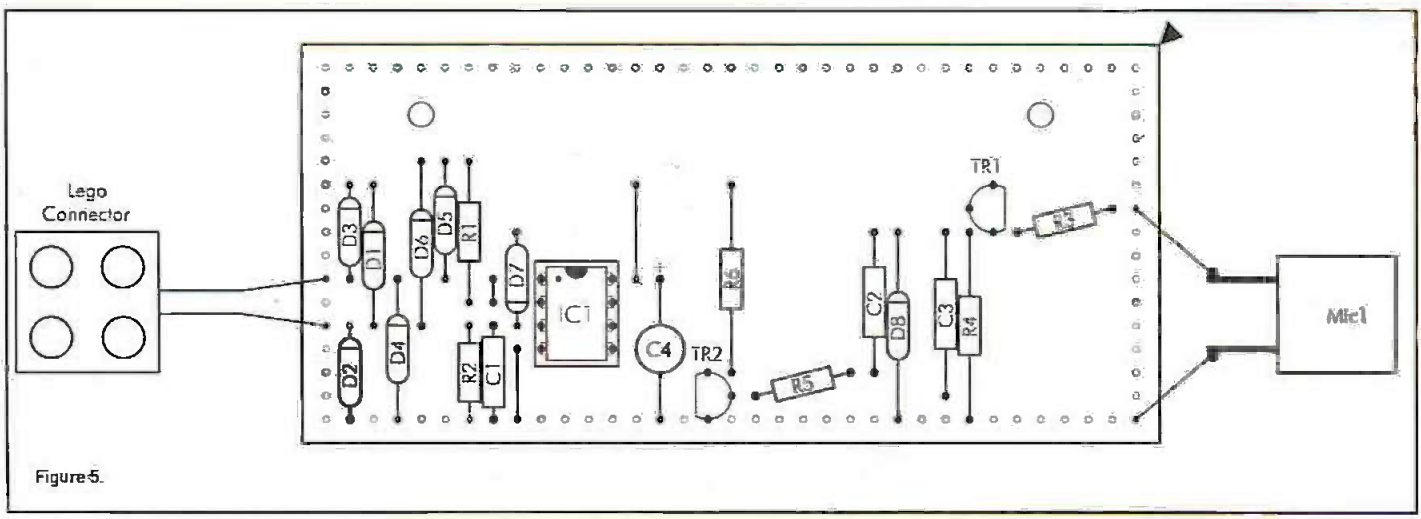


Figure 5.

level at the output of the amplifier.

D5, D6 and R1 enable IC1 to drive the input of the RCX unit when the supply is cut off, and also protect IC1's output stage when the supply is turned on. One input terminal of the RCX unit is the actual input, and the other connects to the RCX unit's earth rail. It does not matter which one is the input terminal, since one or other of these diodes will connect it to the output of IC1. Due to the presence of the diode, IC1 can only act as a current sink and not as a current source. This is not important because the RCX unit has pull-up resistors at the inputs. IC1 pulls the input down to the required voltage via R1 and one of the diodes. R1 is needed to limit the current flow into the output stage of IC1 during the periods when the RCX unit supplies power to its input terminals.

Transmitter Construction

The stripboard layout for the transmitter appears in Fig.4, and the breaks in the underside of the board are shown in Fig.5. A board of the appropriate size (18 holes by 12 strips) is cut from one of the standard size pieces using a hacksaw or a junior hacksaw. Cut along rows of holes and then file any rough edges to a neat finish. There is a special tool for making the breaks in the copper strips but a hand-held twist drill bit of about 5 to 5.5 millimetres in diameter does the job well. Make sure that the strips are cut across their full widths, but avoid cutting so deeply that the board is seriously weakened. The two mounting holes for the board are 3 millimetres in diameter and will accept M2.5 mounting bolts. Most plastic stand-offs do not work well with stripboard, so it is advisable to bolt the board in place.

Next the components and link-wires are fitted to the board. The NE555N is not a static sensitive component, but it is still a good idea to fit it on the board via a holder. The six link-wires can be made from 24 s.w.g. (0.56-millimetre) tinned copper wire, or the trimmings from resistor leadout wires will probably suffice. Mylar capacitors are the best choice for the non-electrolytic capacitors in this circuit and the receiver, because they have long leadout wires that can easily accommodate various lead spacings in the board layouts. However, any plastic foil types that can be manoeuvred into place are suitable.

Cases designed specifically for hand-held control units are available, but practically any small plastic box is suitable for the transmitter. The ultrasonic transducer is mounted at one end of the box, but components of this type do not usually have any form of built-in mounting. Drill a couple of 2-millimetre diameter holes to accommodate the terminals at the rear of the transducer and then glue it to the case. A good gap-filling adhesive is needed, such as an epoxy type. Hot glue guns are ideal for this type of thing, and enable the transducer to be almost instantly glued in place.

The ultrasonic transducers are normally sold in pairs, and the transmitting and receiving devices are not the same. Make sure that you do not get the two transducers swapped over. This will not stop the system from working, but could signficantly reduce the maximum operating range. The transmitting and receiving transducers are normally marked with type numbers that start with 'T' and 'R' respectively.

The circuit board is mounted on the base panel of the case, and it is advisable to use some washers or an extra nut between the board and the case. This avoids having the board buckle and possibly crack when the mounting nuts are tightened. Fit the board well towards the front of the box so that there is sufficient space for the battery to fit behind it. S1 is mounted on the top panel of the case, well towards the front where it is easy to operate. This also ensures that the battery will not obstruct it. To complete the unit a small amount of hard wiring is added, and details of this wiring are included in Fig.4.

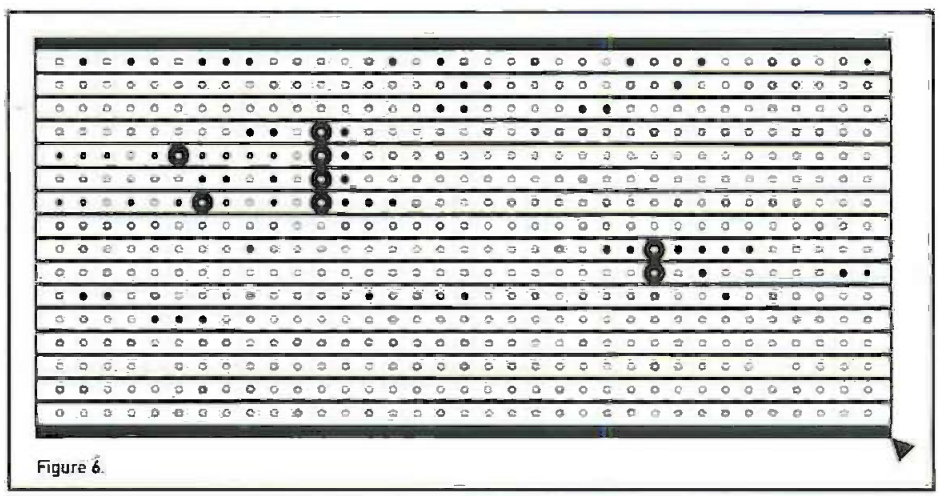
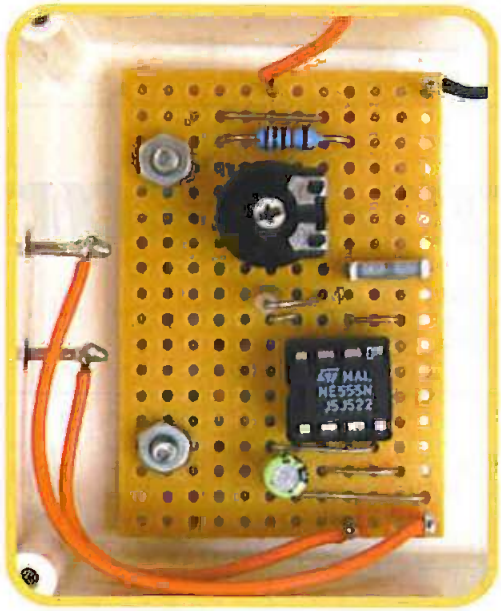


Figure 6.

Receiver Construction

Fig.6 shows the component layout for the receiver board, and the breaks in the copper strips on the underside of the board are shown in Fig.7. A board having 35 holes by 16 copper strips is required. Most of the notes about constructing the transmitter apply equally to the receiver and will not be repeated here. There are a few additional

points to bear in mind when building the receiver. The first of these is that it is not a good idea for complete beginners to undertake a project of this type. The RCX unit is designed to take a certain amount of mistreatment, and there is probably little real risk of damaging the unit if a mistake is made in the construction of the receiver. However, bear in mind that the manufacturer's guarantee will not cover any damage caused in this way, and spare RCX units are expensive.



Some means of connecting the receiver to the RCX unit is required, and a popular method of tackling this type of thing is to sacrifice one of the long leads supplied with the standard MindStorms kit. These leads are little used because they are far too long for most requirements. If both connectors are cut from one of these cables, together with about 150 to 200 millimetres of wire, this produces two leads that are ideal for connecting your own sensors to the RCX unit. The free end of the lead passes through a small hole drilled in the case of receiver, and it is then connected to the circuit board. The other end of the cable connects to an input of the RCX unit.

If you do not wish to use one of the leads supplied with the kit it is possible to buy Lego connecting cables from a few specialist suppliers. The same sources can also supply Lego plates that have built-in contacts. Leads can be soldered to the contacts on the plates, which can be used as male or female connectors. One way of using a plate is to connect it to the input of the receiver and then glue it in place on top of the lid. The receiver can then be connected to the RCX unit via the connector plate and a short Lego lead.

It is necessary to devise a means of securely fixing the receiver onto the Lego robots. Some Bostik Blu-Tack or Plasticine will do the job, but a much neater method is fix a large Lego brick on the underside of the receiver's case. It can then be mounted on the robot much like any other sensor. If you do not wish to use one of the bricks supplied with the kit it is possible to obtain small Lego sets at quite low prices. One of the Lego 'Basic' kits will provide a lot of useful bricks and other parts at a cost of a few pounds. The receiver is quite large by Lego standards, so it is advisable to use one of the larger bricks. A 6 by 2 brick is used on the prototype, and this seems to do the job quite well. Due to the knobbly nature of Lego bricks it can be difficult to glue them in place. An epoxy adhesive or a glue gun will produce strong joins with this type of thing provided plenty of adhesive is used. Alternatively, file down the top surface of the brick to remove the lumps and any good general-purpose adhesive should then fix it to the case reliably.

Adjustment and Use

Obviously RCX code does not have a program block specifically for a unit of this type, but the receiver can be used in conjunction with the block used for light sensors. Note that the appropriate input of the RCX unit must be set up for use with an active sensor so that power is supplied to the receiver circuit. For initial testing it is a good idea to run a program that has one input set up for use with a light sensor. Connect the receiver to that input and then use the RCX unit's View facility to show readings from the receiver on the liquid crystal display. When used with a light sensor the readings run from 100 at minimum input voltage to 0 at maximum input voltage, so under standby conditions the reading should be high. It will probably not reach the maximum of 100, but should be somewhere between about 80 and 100.

Start with VR1 in the transmitter at roughly midway setting. The system should then work, but the range might be very limited. Ultrasonic sound waves are very directional, so the reading on the display can be increased by aiming the transmitter away from the receiver. VR1 is then adjusted for the lowest possible reading. If the reading goes right down to zero, move the transmitter further away or change its aim to increase the reading. Then adjust VR1 again for the lowest reading that can be obtained. The system should then produce a significant reduction in readings when used at ranges of up to about 12 metres.

Because ultrasonic sound waves are very directional the system works best when the transmitter is aimed at the receiver and the transducer on the receiver is aimed back towards the transmitter. In most rooms the sound reflected from walls, the ceiling, etc., is sufficient to maintain the link even if the receiver is 'looking' away from the transmitter. If the system is used outdoors or in a very large room the lack of reflected sounds could give a more limited range unless the receiving transducer is aimed in the general direction of the transmitter. When used outside a breeze blowing over the receiving transducer might produce high frequency sounds that could give problems.

As far as the programming side of things is concerned, the receiver is used much like any other sensor. Bear in mind though that a reduction in readings is produced when the transmitter is operated, and not an increase.

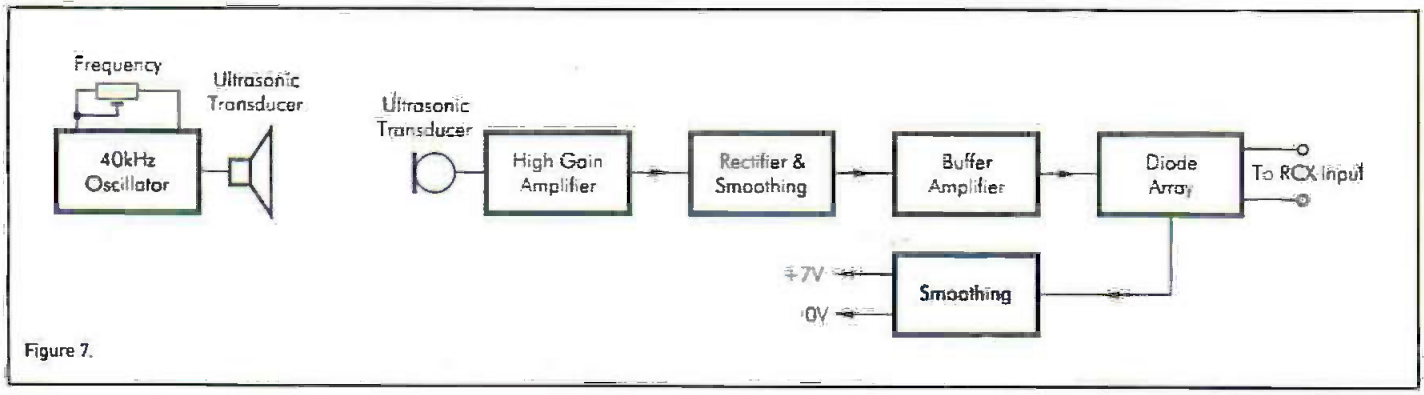


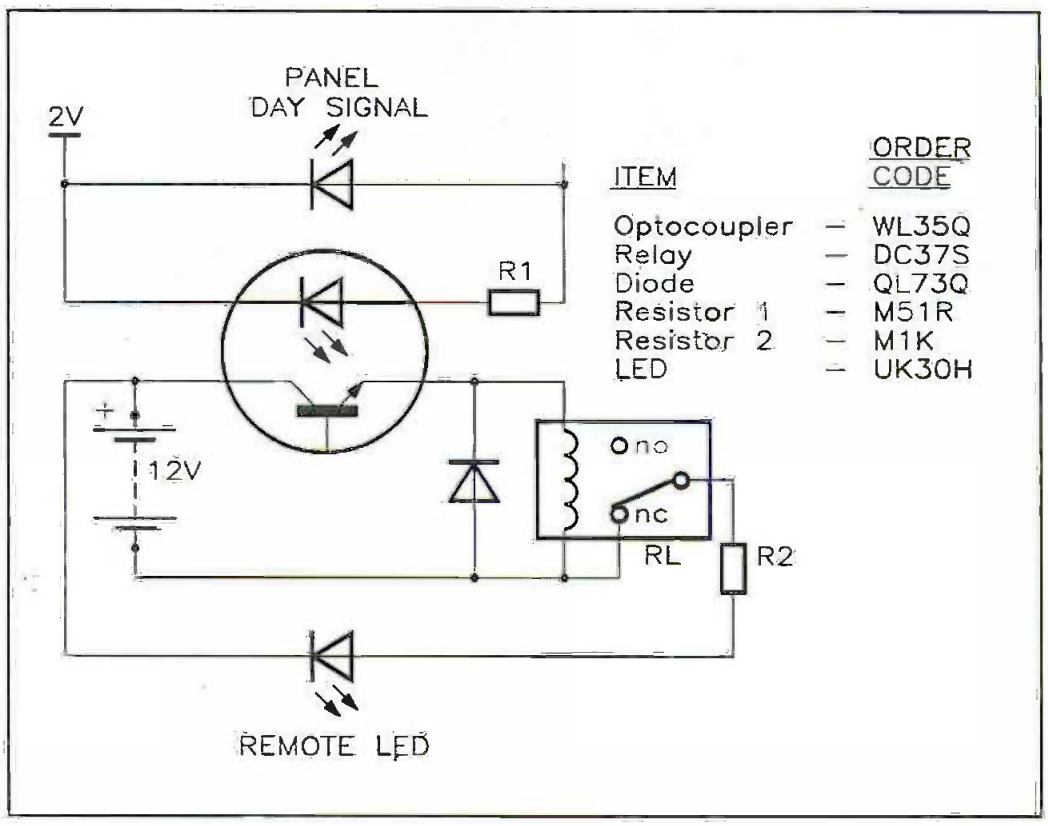
Figure 7.

Fox Wireless SECURITY ALARM

by E.T. Moss

FSS7500 Arm/Disarm Repeater

THIS CIRCUIT FIRST APPEARED IN THE JANUARY 1997 ISSUE OF ELECTRONICS AND BEYOND



The installation of a number of these alarm systems by the writer has demonstrated total success as regards their operating characteristics and reliability. Nevertheless, in one instance it has exposed that the size of the subject premises involving two widely separated entry/exits which are being used at approximately the same frequency produced some communication difficulties.

The owner understandably preferred the convenience of the keyfob method of system control and although the range of the transmitter was quite adequate for use at the exit remote from the control centre, the distant arm/disarm signals could not be heard with certainty. This resulted in some lack of confidence that the system had responded to the input.

It was, therefore, desirable to provide an 'add-on' circuit which eliminated this problem. The amber DAY signal at the control panel being the visual signal which changes state according to the mode of the system (extinguishing when the system is armed) is the obvious output for driving the remote control indicator. The former LED is driven by a 2V supply which is also adequate for driving the IR emitting diode of a DIL optocoupler, the phototransistor providing the output for remote signalling using the 12V supply from the system standby lead acid battery.

Refining of the circuit includes, in particular, the inversion of the remote signal to indicate by LED illumination when the system is ARMED, which is the opposite mode from the panel DAY signal. This function is easily achieved by driving a miniature relay from the phototransistor and utilising its normally closed (nc) contact for the remote signal.

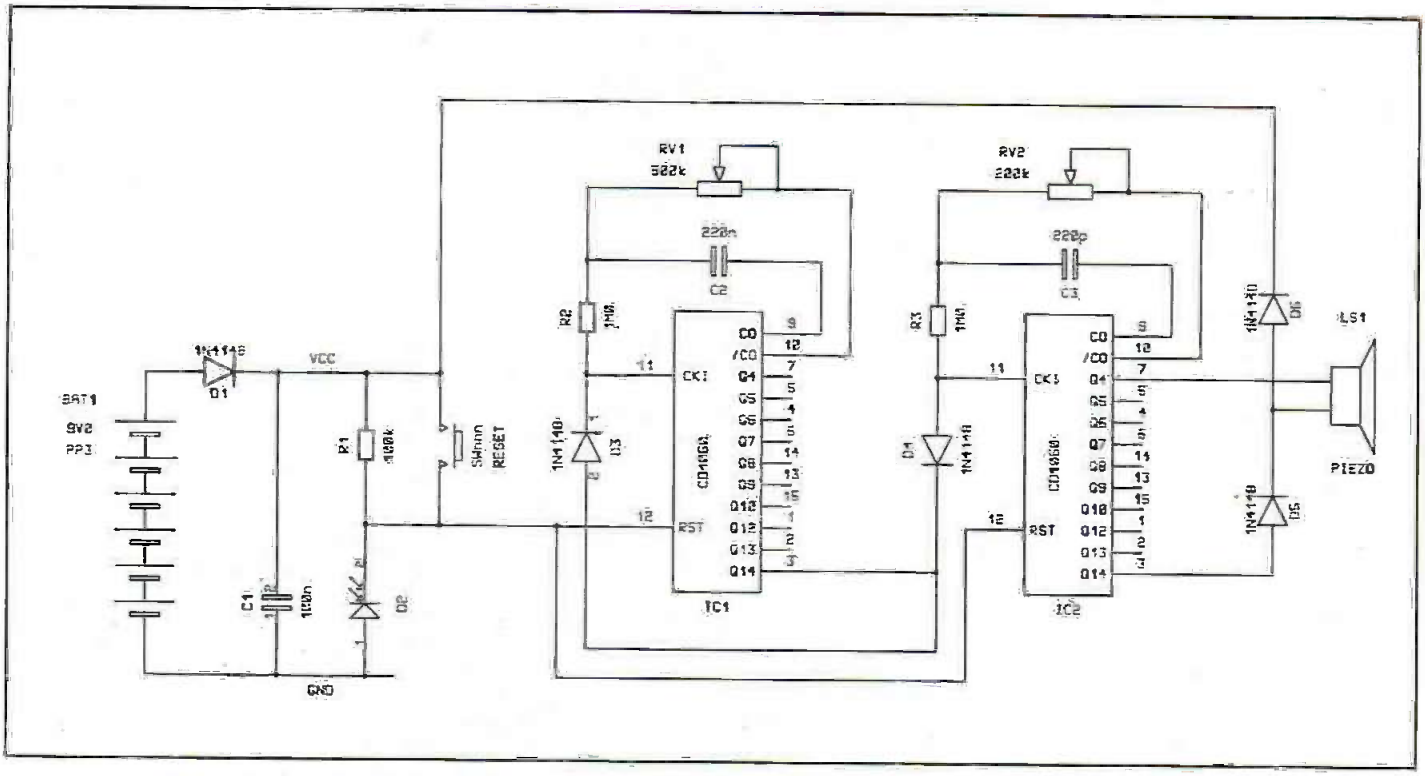
Secondly, a resistor is needed in the optocoupler diode circuit to 'balance' this with the parallel panel LED, to ensure that there is adequate power to drive both these devices. Finally, if a flashing LED is preferred for the remote signal, a series resistor may be needed in this circuit to reduce the voltage, as this type has a tendency to glow continuously at the higher end of its voltage range.

In order to reduce complexity, the system described above utilises hard wiring between the control panel and the remote signal in twin 0.5mm single-core telephone cable.

The schematic circuit shown above, together with a list of components which can be assembled on a 38 3 20mm stripboard, having flying lead connections terminating with 2A blocks.

Delayed ALARM

by John Edwards



THIS IS A DELAYED ACTION ALARM WITH A LEVEL-SENSITIVE TRIGGER CONDITION. IT WILL NOT SOUND UNTIL THE TRIGGER CONDITION HAS BEEN PRESENT FOR SOME TIME, AND WILL THEN ONLY CONTINUE TO SOUND WHILST THIS CONDITION IS HELD.

As soon as the condition is removed the alarm is immediately reset, and the delay will again operate if the condition returns. Originally, it was intended to warn me about leaving the 'fridge door ajar, which is a bit of a habit. To do this it uses light as the trigger condition, and allows me a few minutes before it complains that the door is still open. Temperature could be used instead, of course.

It consists of two sections, both timers based on the CD4060 device, from the standard 3..15V '4000' series CMOS. The first section is the delay, the second is the alarm. The CD4060 is a 14 stage binary counter with a built-in two-inverter oscillator section, so by adding two resistors and a capacitor it can generate its own clock. Not all the counter stages are available as outputs, due to pin count limitations: we cannot use the first 3 stages (Q1..Q3) and the 11th (Q11). There is a RESET input, which is active high and stops the oscillator as well as clears the count to zero.

Power is provided by BAT1, a 9v PP3. Since the chip can operate over a wide voltage range, this could be replaced by whatever else is convenient. No stabilisation is needed as the power drain is very low, and diode D1 is there only to protect against reverse battery connection. C1 provides decoupling for the chips, and should be mounted close to them. Only one chip is clocked at a time, which will reduce VCC noise.

R1 and D2 form the trigger circuit, with switch SW1 providing a manual reset. The switch can be left off if a manual reset is not needed. The diode D2 is a photodiode, and RI should be set to a value which will allow IC1.12 to go high when the diode is in the dark, and low when there is a little light available. This will depend on the diode, but 100k will be a good starting point. The diode could be replaced by a selenium photoresistor, and 100k will be fine for that too. In the dark, then, IC1.12 and IC2.12 will be high, and both oscillators will be halted. All IC1 and IC2 outputs will be low. Nothing is happening, except a slight drain on the battery through D4+R3+RV2.

As soon as there is sufficient light, the D2/R1 takes both RST pins low, and IC1 oscillator starts up. IC2 oscillator continues to be held off via D4 by IC1.3 (Q14), which remains low, so there is nothing happening in the IC2 stage at the start. After 8192 IC1 clock periods, Q14 goes high, and this does two things: D4 ceases to lock up the IC2 clock, which now starts to run, and D3 locks up the IC1 oscillator instead, so the count in IC1 is frozen with Q14 high.

...Continued on page 39

Your guide to CE MARKING

by Gareth Bradley

IN PART 2 OF CE MARKING, GARETH BRADLEY LOOKS AT THE DIFFERENCES AND EFFECTS CREATED BY PRE-COMPLIANCE OR COMPLIANCE.

The question that needs to be asked is: If compliance testing can prove your product and place the CE marking on your product, why precompliance testing?

The answer is simple.

Precompliance testing can be done during the development stage of the project. It is a quick look at your products EMC performance during the prototype stage. This is to get an idea of how well the product will perform in a full compliance test. Although the pre compliance test does not adhere so strictly to the standards it should be done in a meaningful way. The idea behind it is to bring down the level of uncertainty. It is no good testing in such a way that the level of uncertainty is so high that any measurements obtained are so out that they give no real indication that the product will pass a full compliance test. In extreme cases the measurements taken might lead you into believing that the product will pass when in reality it will fail.

If precompliance testing is not done and the product is sent for compliance testing, when the product goes into production, there is no guarantee that the product will pass or fail. If it passes then you are lucky, if on the other hand the product fails it can cause huge problems depending on the product and the nature of the failure. What can be done to solve the problem? There are a few things that can be done, but these will unavoidably add cost to your product and delay the time involved in getting your product to market.

Things like adding shielding, conductive paint and filters, all these can all contribute towards reduction of your EMC problem but used as a cure rather than a preventative measure , they can add to your product cost, time to market and it can become a nightmare for production. In drastic situations it may be necessary to take the product back to the drawing board and start the design over again. This will most certainly add extra unwanted time and expense. It is far better to incorporate these into the design stage and have them accounted for in the initial costing should your product need them.

Pre-compliance can help solve this problem, it can find EMC propels early on in the prototype stage where the problems are easier, cheaper and quicker to fix. Pre-compliance testing is quicker and cheaper to have done. Some companies even set up there own pre-compliance facility because pre-compliance test equipment does not have to be as accurate as full compliance and therefore a lot cheaper which brings it into the said companies budget. Also pre-compliance can provide useful test data which can help you pinpoint potential problems of where the product would fail in full compliance testing. This data can be used for reference for any future projects and help predict the EMC characteristics of your design. As the tests involved in pre-compliance are not as strict as full compliance the time taken to test is a lot shorter. For instance for emissions for full compliance, testing would require all four sides testing for maximum emissions (6 sides if the product can be hand held and has no orientation for use) whereas in pre-compliance an educated decision can be made as to which side will give maximum emissions and test the product just on that one side, once again saving time and money and a big disappointment when the company realises that the product in question which is now all ready for production and shipping out to the market place fails the test. This product can not go out until the EMC propels are addressed and sent back for further full compliance testing, therefore it makes sense to use pre-compliance.

More and more companies are going over to in-house pre-compliance, the cost is more affordable for some companies. Some of the issues to be considered when thinking about an in-house pre-compliance test facility are does the amount of testing that you will be doing warrant it compared to shipping out to a outside test house for your testing to be done. How long would the equipment take to pay for itself compared to the amount you will save from doing the testing in-house, Also each pre-compliance will be different, your new in-house pre-compliance test facility might vary in test results when compared to a known test house. It is a good idea to try and get your results as close to a known good test house as possible thus bringing your degree of uncertainty down. One way of doing this is to send a product for testing at a recognised test house and then doing tests in your own pre-compliance facility and seeing just how close the results are.

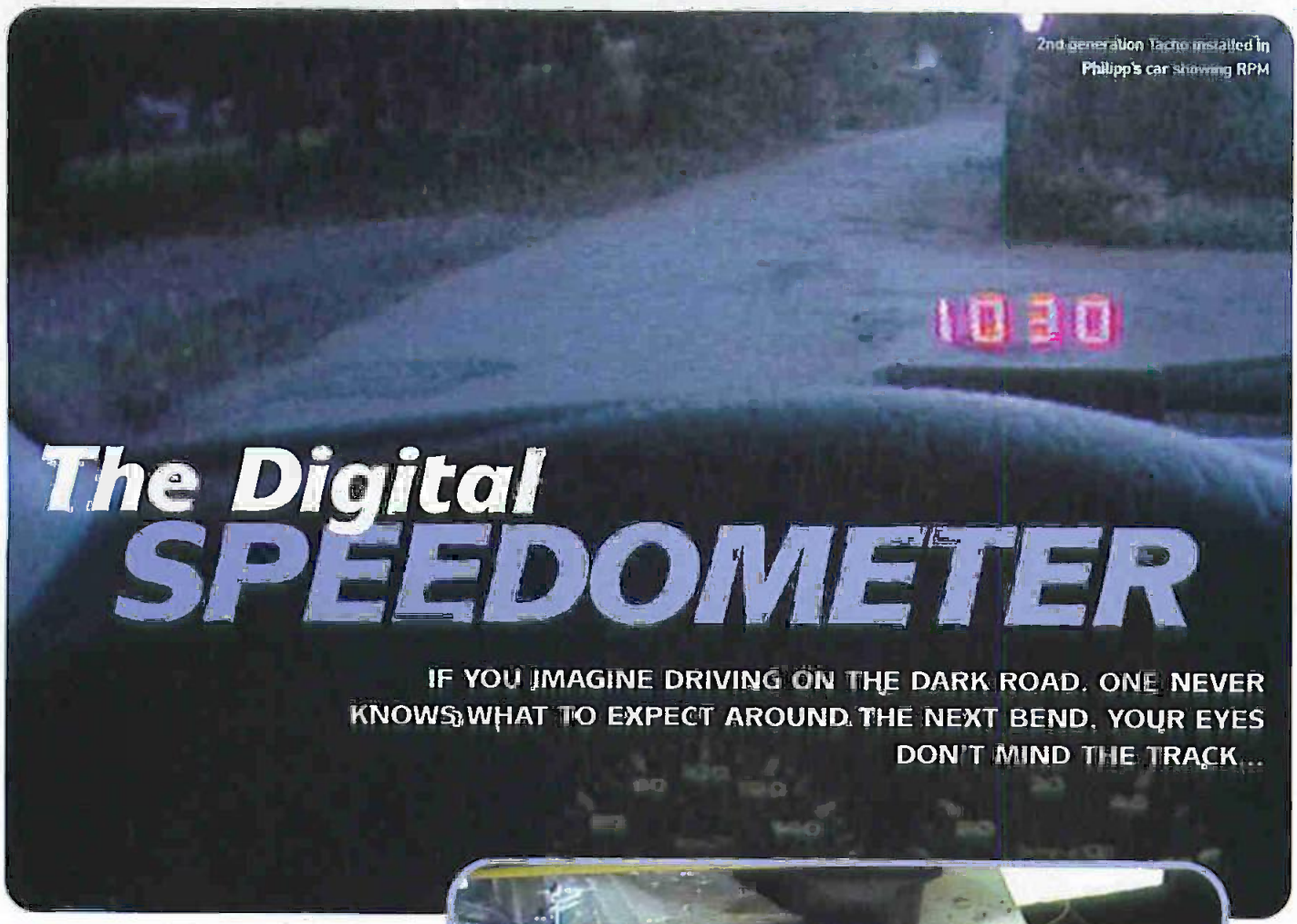
The equipment needed for pre-compliance will vary depending on what it is you want to test. The physical size of your product will define what set up to use. If your product is fairly small then there are set-ups available where to do RF immunity testing normally requires a large screened room, others would only require a small screened cell. There are companies that deal with pre-compliance equipment. They have different solutions depending on your products . It is a good idea to shop around to find the most suitable place for your particular product.

Useful links

www.laplaceinstruments.com
Advice on:
Self test and certifying.
Pre-compliance
Product Design
Product testing

www.ml-electronics.co.uk/emctest.htm
Pre-compliance testing

www.compliance-club.com
EMC compliance journal
Useful information.
Guide to EMC directive and standards.



2nd generation Tacho installed in Philipp's car showing RPM

The Digital SPEEDOMETER

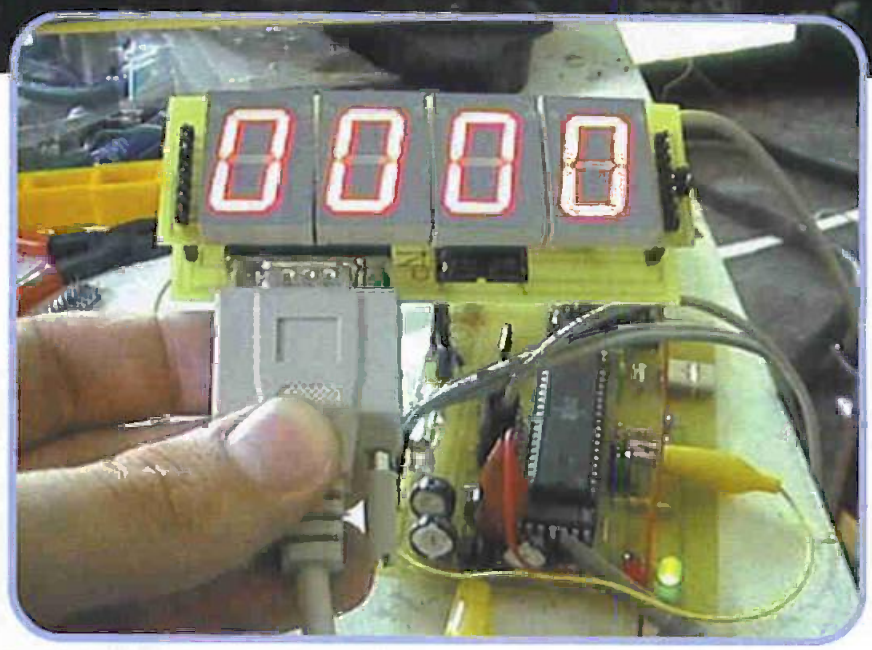
IF YOU IMAGINE DRIVING ON THE DARK ROAD, ONE NEVER KNOWS WHAT TO EXPECT AROUND THE NEXT BEND, YOUR EYES DON'T MIND THE TRACK...

The signpost shows 70 km/h and concentrating as much as one possibly can, one follows the flow of traffic. With time you lose a sense of speed. A glance at the speedometer costs quite a lot of time. The eyes adjust slowly from the change between the high lighted speedometer and the dark street.

However I have driven such a street and felt insecure in the darkness, where it was difficult to evaluate in terms of judging the speed on the basis of the dark landscape moving outside the car window. On one particular bend in the road, I have noticed, that I was driving too fast to safely get round the bend and my car became uncontrollable. I was quite lucky to manage to get round the bend. In effect I had followed the road paying as much attention as I could.

A couple of months later I had an idea of using a shaver, to build a digital speedometer, which shows the reflex of the speed on the windscreen. However my lack of knowledge of digital technology and processors was an obstacle to implement the idea.

I had met by chance Philip, who had exactly the same idea. So we created a team and started to develop the basic concept. It was the beginning of the period, in which our e-mail accounts became full of building schemes.



1st generation Display Unit: two-layer (LEDs on top-, SAA1064 on bottom layer); Background: 1st-generation Main Unit in test mode

The basic idea was: simple and light to build and easy to use.

I started to become interested in embedded controllers. I saw in a German magazine a processor from Atmel, which had a well-developed library (assembler, emulator, debugger and all information for free downloading.

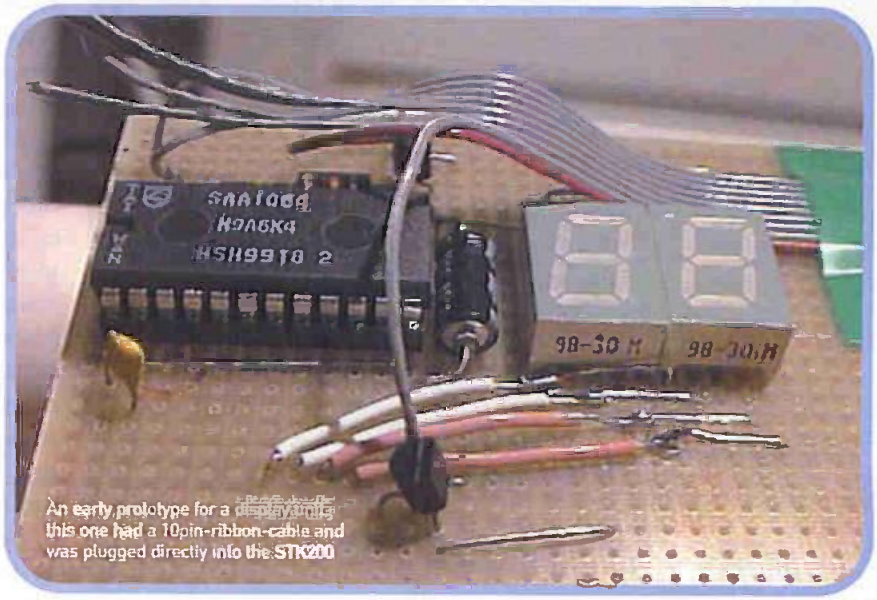
I was looking for an evaluation board. I bought a very good one from Kanda Systems in Great Britain, STK200.

The STK200, supports several Atmel AVR devices including the AT 90s8515. It has, around the processor, all the devices, which are needed for development purposes such as:

- A 4MHz external clock circuit
- All port pins are connected to header pins around the edge of the board, which makes it easy to add circuits for different applications.

- Small rubber feet protect the circuit board in the creative atmosphere of development. All features of the board are well-labelled
- Connection for a Hitachi compatible LCD
- Contrast Potentiometer, which lets you adjust the contrast on the LCD (or windscreen!)
- A brown-out circuit with two voltage settings
- For PC's running windows, there is easy-to-use Beta software available
- RS232-Port using standard 9 pin D connector, for use in applications, for example to connect the board to a PC serial port, the AT90S8515 as EEPROM, RAM and Flash memory for code.

While searching for an application that gives more usage than a running-led-light (knight rider effect), I decided to build the digital-speedometer of the Porsche Boxer on my own.



An early prototype for a display unit, this one had a 10pin-ribbon-cable and was plugged directly into the STK200

After some beta-versions, experiments to build a circuit board, we decided to build our own version of the circuit board, which would be tailored exactly to the needs of our digital-speedometer. We have excluded the parts of the circuit board, which were useless in running our code and could lower the board to one quarter of the size (50x80mm).

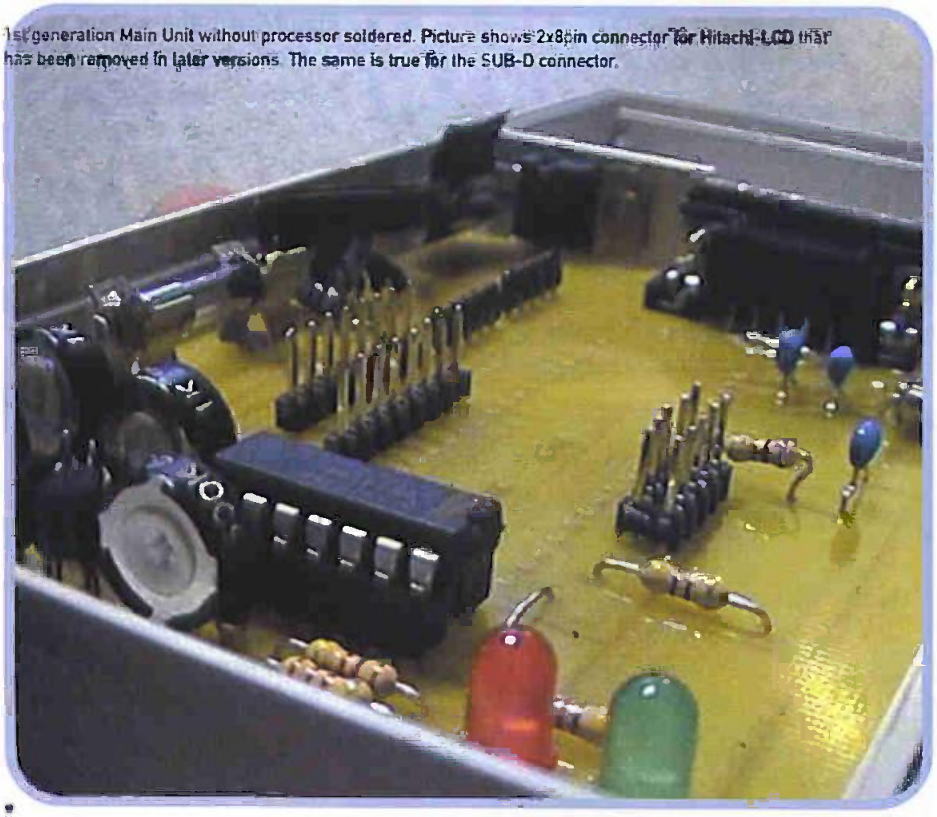
The step from a safe functioning hardware like STK200 to a self-developed board is normally enormous. As a beginner you confront all the problems, which are likely to appear in processor-controlled electronics, like the code running in the processor at 4 MHz, may produce 4 millions mistakes in a signal second! The creation of clock circuit (crystals) and providing the power may pose a problem. The problems do not seem so difficult, if you can use the STK200 to find the solution.

In March 2000, Philip visited me and we created the first character on the display.

After this first great success the development speeded up, and in April 2000 the first version of the speedometer appeared with a couple of small and easy to solve mistakes the speedometer was running in Philip's car.

The prototype of our speedometer was ready!

The next step was to make the device more sophisticated. The big problem was, how to connect the speedometer into a car. We were studying Alpine-Navigation systems, where we found connections for different cars by means of a speed-pulse. In the meantime we were able to build it into cars like AUDI A3, VW Polo 6N and Ford KA, due to the manufacturer's using the same system for the speed pulses.


1st generation Main Unit without processor soldered. Picture shows 2x8pin connector for Hitachi-LCD that has been removed in later versions. The same is true for the SUB-D connector.

The technique

The signal for the speedometer can be provided in modern cars from the ignition control box, which has a hall-effect sensor which produces a square wave signal , or from the engine-control-unit.

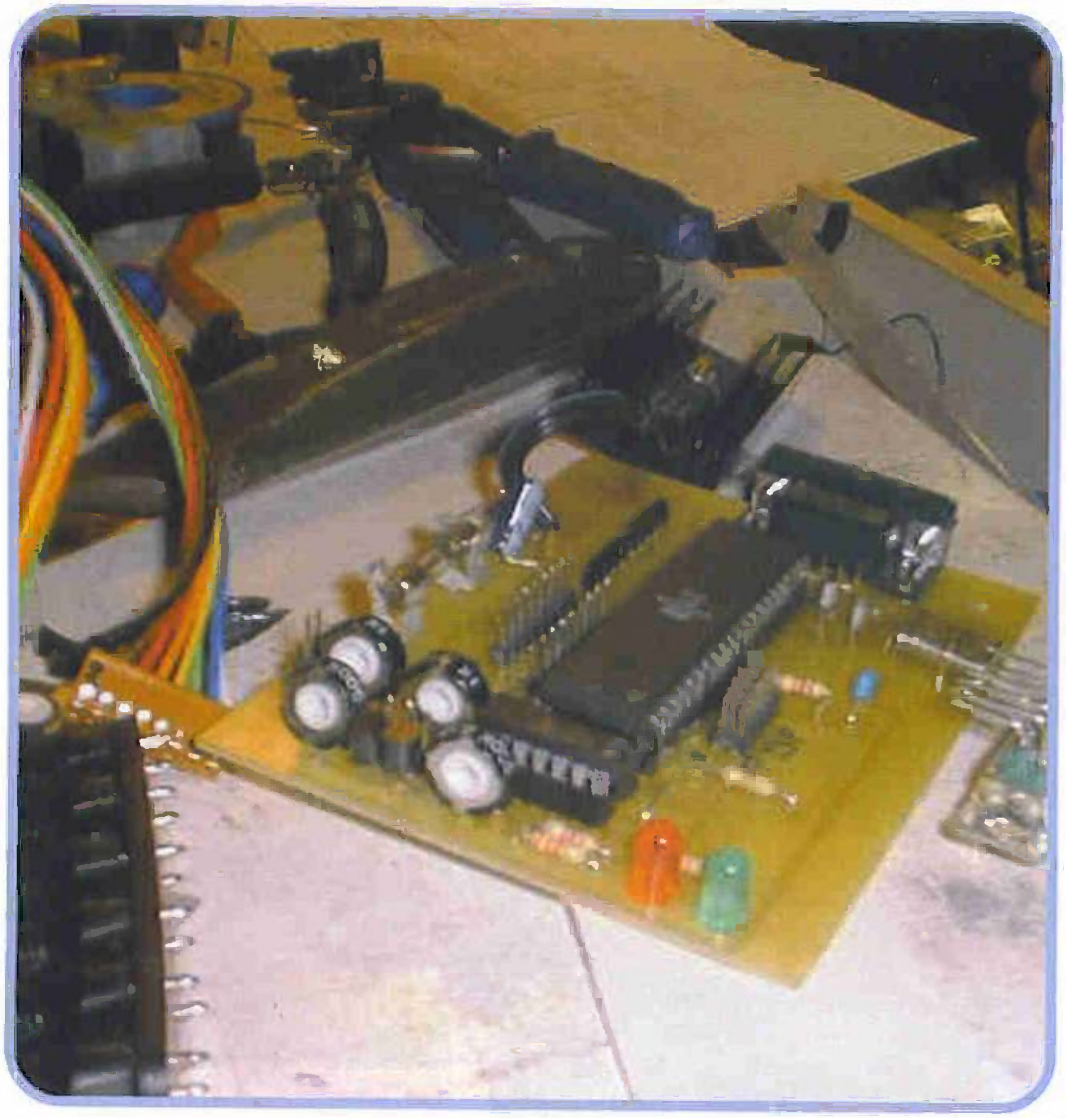
The signal is cleaned up by a Schmitt-Trigger (which is placed in front of the processor) to be readable by the processor. The processor counts the pulses, because of several wheel-sizes we decided to integrate a kind of fine-tuning (calibration-system).

After installing the speedometer you have to drive a distance of 100 meters, during that distance the speedometer counts all pulses that were generated and this value is used for further calculations of the speed. By pressing a key this value will be written into the EEPROM of the AVR

For decoding I used two tables, which are placed in the program memory. The data is transferred from the Flash-ROM. The numbers are shown on the windscreen by using a mirror. In order to limit the use of I/O-connections, which are used by the display I have chosen a I2C-bus between the main unit and the display unit, which requires

Philip filled the gap in terms of my lack of knowledge of microprocessor and programmers being a specialist in Electronics.

After we checked, with the help of the STK200, that our code was working, we had to concentrate on the development of the device to build it in into the car.



Left: 1st generation Main Unit under heavy development

apart from the power connection just two additional connections. The display circuit uses the Philips SAA1064, which drives the LED's. The I2C bus supplies both data and power to the LED segments.

The present

At the moment, I have the second generation digital speedometer in my car, which in addition to speed, also shows revolutions per minute. The built-in tester lets me switch from the speedometer to the revolutions per minute display. The display is shown above the steering wheel on the windscreen, which allows you to keep your eyes on the road.

The software

The software is written in Assembler and is 2500 letters long. The software was tested both on the STK200 and on our own circuit board, by using the same debugger.

The future

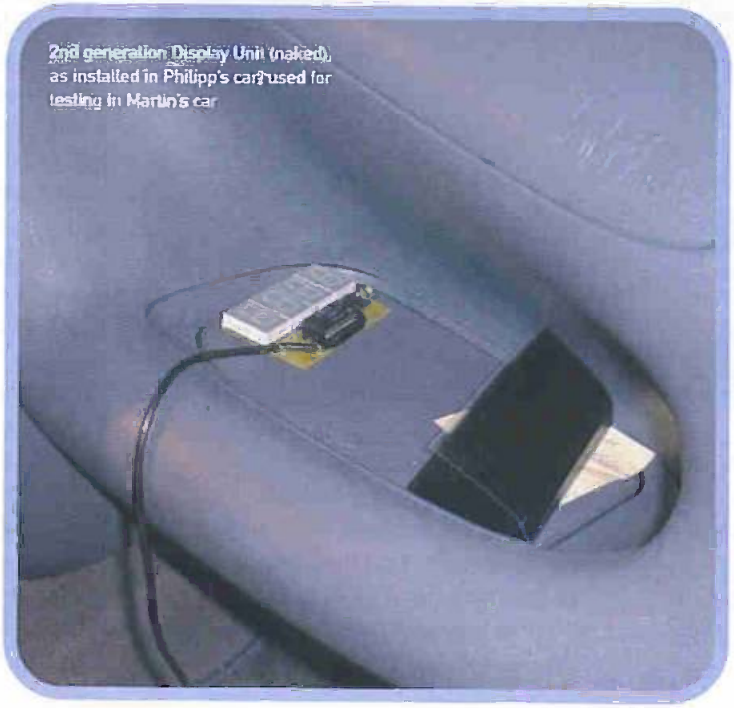
We are planning the next generation of digital speedometer, which would use the PLCC-socket for the processor and become half the size of the current speedometer.

We are trying to write the program now in C language, as the tools for it are available in many variations, of course with the exception of professional IDEs.

Testing and programming for cars would be facilitated and speeded up.

We are working on the new display element, which can be connected like the previous one by I2C. Additionally we would like to use dot-matrix-displays, which would allow it to display further information like temperature, number of revolutions or the status of a connected mobile phone. It is possible to use the current main unit for new features.

If anybody still needs to ask what is the point in having a digital speedometer and don't see the obvious advantages, we have one more point to make: It looks very good!



2nd generation Display Unit (naked), as installed in Philipp's car used for testing in Martin's car

About the Authors:

Martin Stenzel, 25, works as an aviation electronics engineer for the Lufthansa CityLine in Cologne, Germany

Philip Adelt, 22, is a computer science student at the university of Paderborn in Germany and works for different companies as an adviser in netz-werk and pc- areas

This article was translated directly from the German original by Anna Penar

Technical Translation of material courtesy of Andy Walters, Hardware Engineer, Kanda Systems Ltd.

The Inventors:

Martin Stenzel
Amselsheße. 1
51149 Köln. Germany.
martin@schnurlosdusche.de

Philipp Adelt
Fraunhofersheße. 11
33613 Bielefeld. Germany.
padelt@padelt.de

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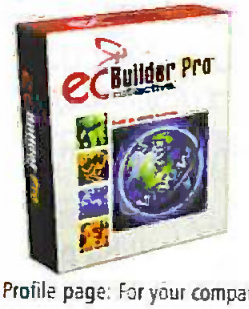

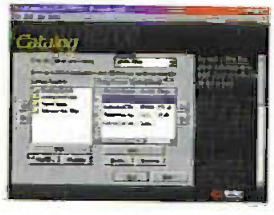

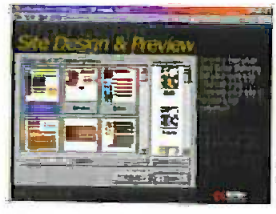

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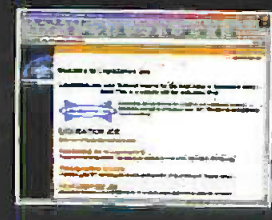

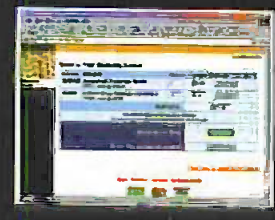

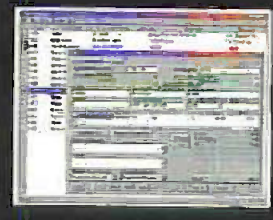

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Tapping the SUN

an introduction to solar water heating

TAPPING THE SUN IS THE SECOND IN A SERIES OF FEATURES ON ALTERNATIVE TECHNOLOGY THEORY AND PRACTICE FROM THE CENTRE FOR ALTERNATIVE TECHNOLOGY (CAT).

Hot water from the sun

Heating water with the sun is one of the simplest means of using a renewable source of energy, and the most accessible for most householders. Over 44,000 solar water heating panels are fitted in the UK and hundreds of thousands worldwide. In this short feature we hope to answer the most common questions about integrating solar water heating panels into your domestic hot water system.

Can I do-it-myself?

Installing a solar water heating system is no more complicated than any other domestic central heating system, so if you feel confident about doing one, you ought to be able to do the other. Similarly, building simple solar panels is quite within the scope of the skilled DIYer.

A 'Solar Club' network is now operating across England, Scotland and Wales, which allows members to join and get training and reduced material and equipment costs. The club aims therefore to reduce the installation costs of a solar system thus making it a better investment. See Fig. 1 for a list of regional club organisers.

What kind of panel should I use?

When choosing a solar water heating system, most people think they need to find the most efficient panel available. It is easy to get hung up on panel efficiency, and to forget the two factors which you really need to know – how much fuel your system will save you, and how long it will take for those savings to recover the cost of the system.

If cost effectiveness is your main objective, then basic DIY panels or cheaper commercial flat plates are probably the best option. If you want to save the maximum amount of fuel, then high efficiency flat plates or evacuated tubes may be a better idea. Whether such an investment is worth it, in strict financial terms, depends on the factors outlined earlier. In particular, you need to consider how much you currently spend on heating water.

If you want to raise the temperature of a swimming pool a few degrees during the summer only, then simpler collectors will do.

Area	Organisation	Contact	Telephone
Ayr	South Ayrshire Energy Agency	Alan McGonigle	01292 280109
Bristol	Centre for Sustainable Energy	Mark Letcher	0117 929 9950
Dorset	Purbeck District Council	Tim Stokes	01929 556561
	Swanage Ahead	Jon Cull	01929 422893
Essex	Uttlesford District Council	John Farnell	01799 510538
Leicester	Environ	Huw Thomas	0116 222 0222
London	Southwark Energy Agency	Chris Dunham	020 7582 9191
Mendip	Mendip District Council	Kate Hall	01749 343399
North Cornwall	North Cornwall District Council	Paul Johnson	01208 893474
Shropshire	Marches Energy Agency	Andrea Hanne	01743 252571
South Cornwall	Community Energy Plus	Ian Smith	01326 316496
Stroud	Stroud Valleys Project	Karen Saunders	01453 753358
Surrey	Centre for Environmental Initiatives	Melanie Weatherall	020 8770 6611
Wales	Dyfi Solar Club	Andy Rowland	01654 705018
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Figure 1.

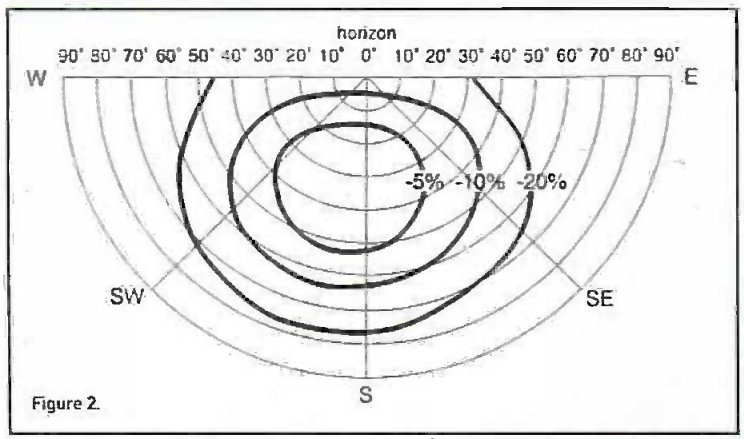


Figure 2.

Collectors made specially for swimming pool systems usually don't have glazing or insulation, but occupy a large area.

How many do I need?

Not surprisingly, the more hot water you use, the more panels it is worth installing, but the savings benefits become less dramatic with each successive panel. As a rough guide, for a typical four person household the cost effective surface area of panels is:

- 5m² of DIY panels;
- 4m² of typical commercial flat plates;
- 3m² of evacuated tubes.

Where should they go?

In the UK panels should be inclined at an angle to the horizontal or between 15o and 45o. The optimum angle is approximately the same as most pitched roofs, another good reason for roof mounting. Solar water heating is as dependent on diffuse radiation as it is on direct sunlight and so solar panels do not need to be perfectly south facing, at the optimum angle, to work just as effectively. In fact panels can face due west or east, and lose just 20% of their output. See Fig. 2.

How the water in your tank heats up

Once the water has been heated by the panel, that heat has to be taken into your plumbing system somehow. Simply running cold mains water into your panel and then directly to a hot water tap will not work reliably!

Fig. 3 shows one of the more common system layouts. Here, water is pumped through the panels to a coil in a hot water cylinder. Cold mains water first passes through the solar cylinder, in this case a pre-heat cylinder, where it is heated by the solar coil. As hot water is poured from the hot taps, preheated water is drawn from the solar cylinder to the second cylinder, where it can be heated up to temperature with the conventional heating system if necessary.

There are a number of possible variations to this system, though, and the following sections run through some of the choices to be made.

Direct or indirect?

The system shown in Fig. 3 is an indirect system. The hot water in your tap is not heated directly by passing through a solar panel, but indirectly via a separate 'solar loop' and heat exchanger coil that help it absorb the heat brought to it from the panel. One advantage of this approach is that the water in the solar loop can be filled with anti-freeze and corrosion inhibitor. Special additives are produced specifically for solar water heating systems to carry out both of these functions. They are non-toxic, in case of leakage, and will not eat away at normal plumbing fittings and

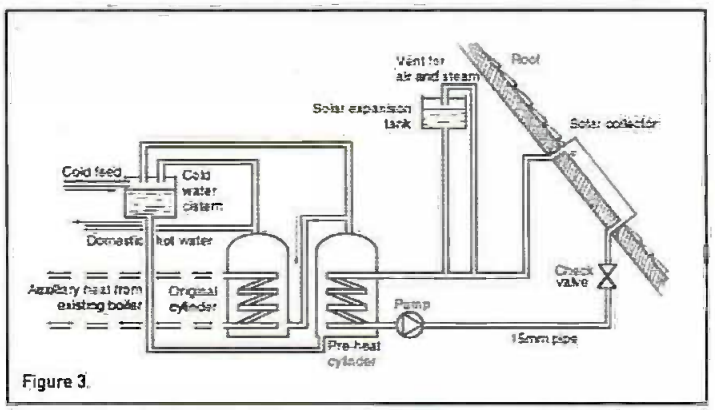


Figure 3.

panels – do not use car anti-freeze!

In a direct system, hot water comes out of the panel and flows directly into the top of the hot water tank. Cold water from the bottom of the tank returns to the panel to be heated. A direct system like this can be slightly more efficient than an indirect one, but clearly neither anti-freeze nor inhibitor can be used, and so some other means of frost protection must be included if there is any risk of freezing.

It is possible to isolate and drain down the panels, and any other exposed pipework manually when there is a risk of frost. However, it is easier to opt for an automatic self draining system, as in Fig. 4. Here, the header tank is situated below the collector panel. The pump is thermostatically controlled (see 'Pump or Thermosiphon?') so when there is a danger of freezing, the pump should already be off. The water level in the whole system falls to the level of water in the header tank. The panels and all exposed pipework contain air only, so there is no risk of freezing.

This system requires an open vent as shown, but does not require an expansion tank, as the water to refill the panel comes directly from the cold supply. The pipes to the panels must be carefully arranged to drain easily without pools of water collecting in the bends, and to fill without air pockets forming. The cold water header tank must be large enough to contain the contents of the panels and drained pipes above the normal level.

Pump or thermosiphon?

Pump: In the system in Fig. 3 the water flowing through the solar panel is driven by a pump. This pump must be switched on when the panel can provide useful heat and switched off when it cannot.

If the pump was left on all the time, then your panel would be as likely to cool your water down as heat it up! Switching the pump on and off is done by a simple box of electronics known as a differential temperature controller or solar controller. The control box measures the temperature of the water in the solar panel and compares it with the temperature of the water in the bottom of the tank. If the water in the panel is significantly hotter than that in the tank, the pump switches on. When this temperature differential falls to a preset level, then the pump switches off again.

Solar control units are commercially available from around £50 upwards, but it is also possible to build one yourself (see next

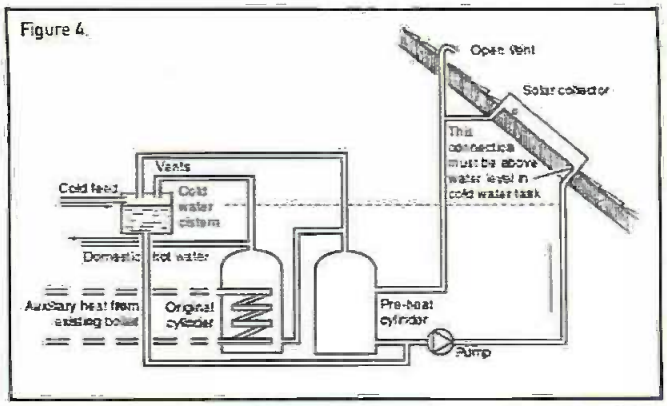


Figure 4.

month's feature).

With a pumped system, you should include a check valve, as shown in Fig. 3. This is a one-way valve which prevents hot water from the coil flowing up into the panel when the pump is off, and radiating your solar heat out into the cold night air.

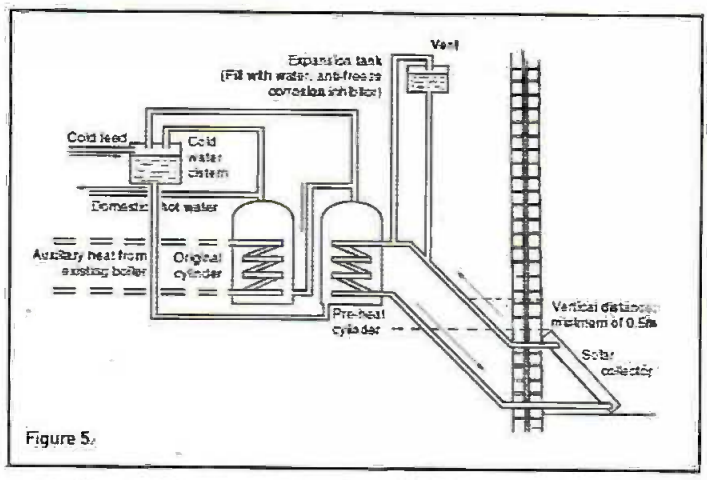


Figure 5.

Thermosiphon:

There is an alternative approach to circulating the water which does away with the pump and the controller altogether. This is known as a thermosiphon or gravity system.

As shown in Fig. 5, the panel is sited below the hot water cylinder. When water in the panel is heated by the sun it becomes less dense than the water in the coil half of the circuit, and so it rises. As the water passes through the coil it gives up its heat and becomes heavier. As long as the water coming out of the top of the panel is hotter than the water coming out of the bottom of the coil, the water will continue to circulate, powered only by the heat of the sun and by gravity. This effect is called thermosiphoning.

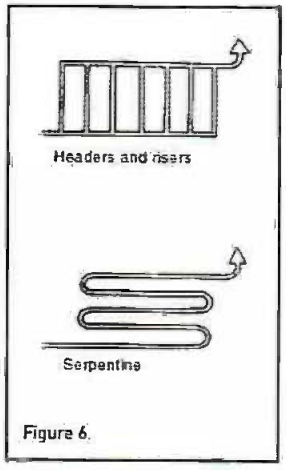


Figure 6.

On the face of it, this is an ideal system. There is no need to buy a pump, or the electricity to power one. Nor do you need to buy or build a controller – the system is entirely self-regulating. In fact, a thermosiphon solar water heating system contains no moving parts, unless you count the water. However, there are a number of restrictions:

- all the pipework in the solar circuit must be at least 22mm diameter and preferably 28mm
- the pipe from the top of the panel to the tank must run uphill all the way; the pipe running back must run downhill
- the tank should be at least a metre higher than the top of the panel, or more if the horizontal distance is more than a few metres
- pumped systems tend to be more efficient as they respond more rapidly in changing conditions
- some commercial flat plate collectors have a serpentine pipe layout, rather than a number of parallel risers, which is not suitable for thermosiphon systems (see Fig. 6)
- it is not possible to have a self-draining thermosiphon system.

Clearly, in many situations it will be difficult to fit the tank and pipework in suitable positions for thermosiphoning to work. It is usually impossible if the panels are to be sited on the roof. However, where a thermosiphon system can be made to work well, it can be cheaper to install and it will require less maintenance.

One cylinder or two?

The system in Fig. 3 includes two hot water cylinders. The original cylinder, supplied from the conventional heating source, has been left alone and an additional 'solar pre-heat' cylinder has been included on the supply side. Generally speaking, a single cylinder system is more efficient (Fig. 7). The choice of system depends on what sort of existing plumbing and space constraints they are working with.

Another arrangement is to site the main cylinder above the pre-heat cylinder, and to connect the two via a thermosiphon loop, as in Fig. 8 . This effectively acts like one big cylinder, but only costs the price of one small one.

Pressurised or unpressurised?

Generally pressurised systems are regarded as the best option as they have several advantages:

- unpressurised systems are always vented, and so are vulnerable to drawing air into the system
- pressurised systems have a higher boiling point, reducing the possibility of boiling and therefore the risk of damage to the system
- pressurised systems do not require a separate header tank (feed and expansion tank) that has to go above the rest of the system, thus allowing the panels to be positioned at the top of the roof. The expansion vessel required for expansion of hot water can be placed almost anywhere in the solar loop, which makes installation easier and faster, plus it does not usually require a separate support platform to be built (see Fig. 9).

The rest of the plumbing

This should be made from conventional copper pipework and whichever jointing system you prefer.

A note about plastic semi-rigid plumbing pipes; these are not recommended for solar systems as the stagnation temperature close to the panel may exceed that recommended by the manufacturer. This is not a general complaint against these types of piping systems as they have proven their value under certain conditions, but we strongly recommend against them for solar systems. Jointing systems chosen should reflect the experience and level of skill of the installer. A professional plumber will probably prefer to use end feed soldered joints, whilst an inexperienced DIY installer may prefer something easier like push-fit joints, Yorkshire fittings with soldering tongs or even compression fittings.

Solar water heating and combination boilers

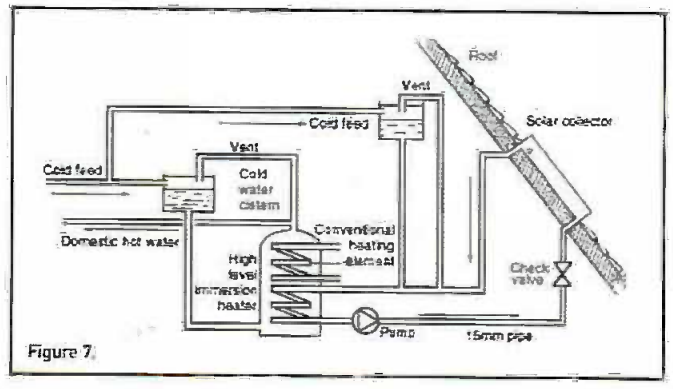


Figure 7.

We had hoped to provide some exciting new ideas on this area, but as yet we don't have the guarantees that we require when giving specific recommendations of this kind.

With the increased popularity in recent years of combination or 'combi' boilers, this has become a controversial issue in the solar trade. This is because most combination boilers are designed to take cold mains pressure water, and solar systems tend to supply hot or warm, low-pressure water. Some

makes of combi boiler are 'fully modulating', ie they check the temperature of water leaving the boiler, and adjust the flame accordingly to give out a sensible temperature. These modulating types are unfortunately rare in the UK at present. For new installers, it will soon be possible to buy a new combination boiler that is guaranteed to take hot water. This should work quite simply with a mains-pressure hot water cylinder preheated by an ordinary solar water heating system.

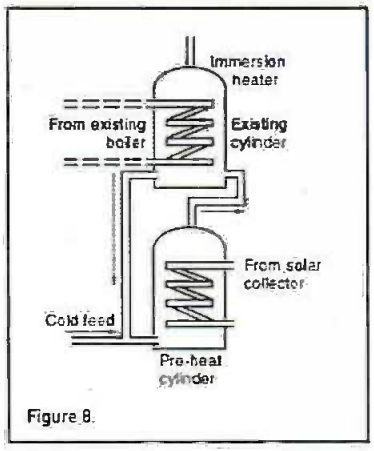


Figure 8.

For 'retrofitters' (as opposed to new-build) with non-modulating combi boilers, things are more difficult.

There are several techniques for integrating a non-modulating combination boiler with a solar system. It would not be prudent for us to detail any of these at present for safety reasons, but please call CAT's information desk for more up to date information (tel. 01654 705989).

The legal position

(All the following applies to the UK only.)

The local planning authority should be approached to check whether planning permission is necessary. Unless the installation is on a listed building or in a conservation area, it is unlikely that planning permission will be necessary. If there are problems, you could try asking about panels at ground level, rather than on the roof. Building regulations are administered by the local council, and they should be contacted to check whether your plans need to be submitted for approval. Most solar installations do not involve structural changes, and do not usually require consent. The local water company should be informed of any planned changes to domestic plumbing systems, including solar water heating installations.

For those looking for further information on this and related subjects, CAT is offering a number of books, products and courses to Electronics & Beyond readers. For further details and to order contact CAT Mail Order Department, CAT, Machynlleth, Powys, SY20 9AZ, Tel. 01654 705959 or visit the website at cat.org.uk and quote the reference E&B002.

Publications

Solar Water Heating: *A DIY guide, Paul Trimby, 28pp*

Offer price £5.40 (£5.99 rrp)

This practical DIY guide is packed with photographs and diagrams designed to help you through the process from design to construction and installation. The panels described in the book can be made by anyone with basic woodworking and plumbing skills and also make ideal practical projects for schools and science courses.

Solar Energy: *a factsheet, CAT, 8pp, A4*

Offer price £2.70 (£3.00 rrp)

An introduction to solar power: covering passive solar building design; the collection of solar heat for storage and use as a low temperature heat for water and space heating.

Hot Water from the Sun: *How to construct your own solar panel, Jurgen Streib, 134pp*

Offer price £13.50 (£15.00 rrp)

The central idea of this book is that solar panels ought to be constructed in the respective countries where they are being used. Covers everything from building panels to testing their efficiency.

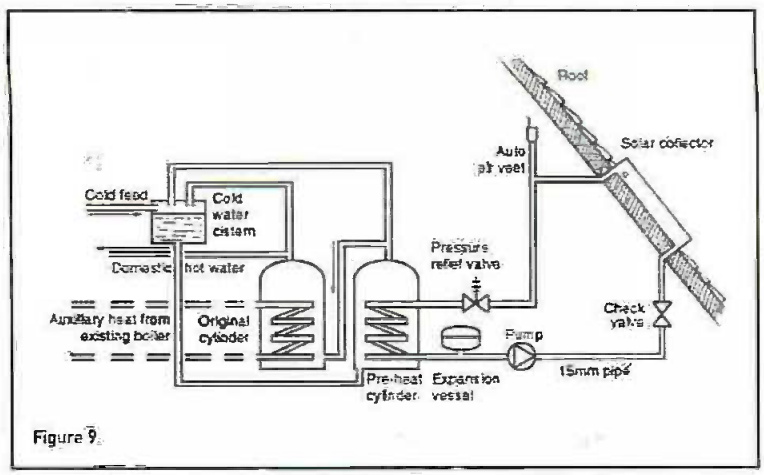


Figure 9.

Solar Water Heating Resource Guide, *CAT, 14pp* Offer price £1.80 (£2.00 rrp)

Complete listing of consultants, manufacturers and suppliers, sources of information, products and courses...names, addresses, telephone numbers and websites.

Products

Clip Fin Solar Collectors

Offer price £4.19 each or £45.00 for 12 (£4.65/£50.00 rrp)

High conductivity aluminium sheet, designed to clip on to standard 15mm copper water pipe as part of a solar flat plate collector. This provides efficient transfer of heat to the water in the pipe, and makes DIY solar collectors easy to construct. Each fin measures 380 x 200mm.

Courses

The Solar House

July 13–15, 2001

Fees: High waged: £230; waged: £170; non-waged/student: £120

If you are interested in utilising the limitless free energy from the sun, then this course is for you. Taking examples from pioneering buildings in the UK, topics covered will include passive solar design, the use of solar water heating and integrated photovoltaic systems for electricity.

Solar Water Heating Systems

October 5–7 2001

Fees: High waged: £230; waged: £170; non-waged/student: £120

This course is ideal for those who want to design or install a solar water heating system. Sessions will cover types of collector, energy storgage, plumbing and controls. There will be practical tuition on the construction of a collector and in-depth instruction on the design of solar heating systems.

For £16.00 per year you can join the Alternative Technology Association, CAT's member organisation, which entitles you to quarterly copies of the journal, Clean Slate, a 10% discount on all CAT publications and other members' benefits. Contact ATA on 01654 705988, quoting the reference E&B002.

CAT is based in Machynlleth in mid-Wales and has been at the forefront of the alternative technology movement since its inception in 1975. The Centre is internationally renowned for its expertise in, and research into, renewable energy systems, organic horticulture, alternative building methods and waste and water treatment systems. It offers consultancy in all its main areas of interest, runs a visitor's centre open to school and university groups and the general public, runs educational and leisure courses, has developed a travelling exhibition and collaborates with two universities on higher degrees. To get a full picture of the extent of CAT's activities check out their website www.cat.org.uk.

Marlec's Green Column - the alternative wind powered street lamp!

New, environmentally friendly and innovative Green Column from Marlec is ideal for footpaths, conservation areas, car parks, countryside roads, bus shelters, etc

The compact, quiet and discreet Rutland 913 Windcharger harnesses the free power of the wind to operate a low energy lamp during hours of darkness. A maintenance free battery provides up to 10 days of back up power. The system is:

- cost effective
- requires no grid connection
- low installation costs
- automatic operation
- plug & play components

Marlec are leading manufacturers of micro wind turbines and the UK Distributor for BP Solar Solarex PV modules. Please call us to discuss potential applications and find out more about the Green Column and the Green PowerEd systems - our latest wind & solar educational packages.

Visit our web site at www.marlec.co.uk

Marlec Eng Co Ltd - Rutland House, Trevithick Rd, Corby, Northants, NN17 5XY
Tel:+44 (0)1536 201588 Fax:+44 (0)1536 400211

Air Your Views

New Look E&B

I am an occasional reader of your magazine and bought the new issue to find out what had changed. Such a lot! But all for the better – well done to all involved.

R. D. Coleman, Hertfordshire

I really do think the coloured sections are a good idea. Green technology too – this is something you just don't see enough about. Well done for spotting such a glaring niche in the market.

Ken Sergeant, via email

The contents page is far more useful than it is in most magazines – I can see at a glance the page number of the article I want to read or was reading. The colour-coding idea is a good one, but does that mean that What's On comes under the heading of Projects To Make?

Sam Jordan, Staines

Iain, Design and Layout replies:
The colour coding is what I would call a 'loose rigidity' by that I mean that articles that have a identifier at the top of the first page (projects to make etc) fall into the colour coding scheme so they are easily recognisable (rigid). Leaving all other pages in more or less a 'Misc' section, the colours of which can change from month to month (loose) as long as they are taken from the same palette as our coding system so we avoid watering down the 5 clear colours impact.

Well done for ditching the boring look of old. The magazine has looked exactly the same for so long that I was getting really fed up of it. I will look forward to receiving my issue far more now. Thanks.

Dean Jacobs, via email

More Colourful Language

Petra Morgan (Letters, June) asks about the visual impressions that IR and UV might give. Of course, we don't know – we don't even know that we all see any colour in the same way. The visual impression I get from 'red', someone else might get from 'blue'. However, we do know a bit about seeing UV.

During World War 2, some people who had had the lens of an eye removed because it had been clouded by cataract were recruited by 'Special Services' to look out for light signals sent, usually by men in small boats, using 'near-UV' – just beyond the violet end of the normal visible spectrum. This radiation is stopped by the lens, and in any case the normal eye can't focus it properly. I don't recall any specific mention of the visual impression created – I suppose it was just 'very deep violet'.

There are flowers, such as gladioli, that can show a continuous colour graduation from very deep red to 'black'. If you look intently at the black, it can be seen as a very deep red. This is verging on 'near-IR'. But I've never heard of anyone who can see the IR reflected from 'green' grass. Photographed with IR film, it is brilliant 'white'.

John Woodgate, www.jmwa.demon.co.uk.

Excel Excursions...

I found Excursions Into Excel excellent and well explained. Has anyone found similar examples and well described explanation on any websites? I searched the Web without any positive results.

Guy North (via www.electronicsandbeyond.com)

A web search for anything from the Microsoft Office suite will normally pick up a lot of links relating to courses run by various universities, colleges, etc. One way to get round this is to follow the links already provided by various Internet search sites which tend to lead to more appropriate information than what you might get otherwise. If you go to www.google.com and click on Directory, then Computers, Software, Office Suites, and finally Microsoft Office, you will be presented with several sites relevant to Microsoft Office itself. Click on any of the individual Office component names at the top of the page to get a list of sites relevant to that program.

...And Equations

I read only part 4 of your series Excursions Into Excel, as published in Electronics And Beyond, and was pleased to see the possibilities with MS Equation. Unfortunately, my version of the MS Office 2000 suite does not include Equation as object type from the Excel insert menu.

Enquiries made to retail software suppliers and their national distributor were unsuccessful. I found there are about four versions of Office 2000 available out here.

My last resort is to enquire for some assistance, if possible.

Thanks for the informative article.

Frans van Zyl

Mike Bedford replies:
The equation editor is a feature of all versions of Office 2000, just as it was a feature of earlier versions. The following explains the situation.

The Microsoft Office suite contains lots of features which aren't installed by default or which system builders may omit in their standard installation to save disk space. So if you upgrade to Office 2000 and find that an applet you previously used is missing, it's probably just that it hasn't been installed. This is certainly the case with the equation editor. Go to Start > Settings > Control Panel > Add/Remove Programs, click on Office, click on Change/Remove and select Change. A dialogue box will open to allow you to select which applications to update. Choose Equation Editor from the Office tools expandable menu. It will probably ask for your Office 2000 discs again.

Short Stories

What a great bit of entertainment. Makes the mag unique! A jolly good yarn, The Factory.

I have always thought that some good fantasy stories would make very good light reading in technical magazines, as even home constructors mags get a little heavy otherwise. I hope other readers find the inclusion of short fiction stories a bit of fun and entertainment too.

Dr. Ken Smith, Canterbury.

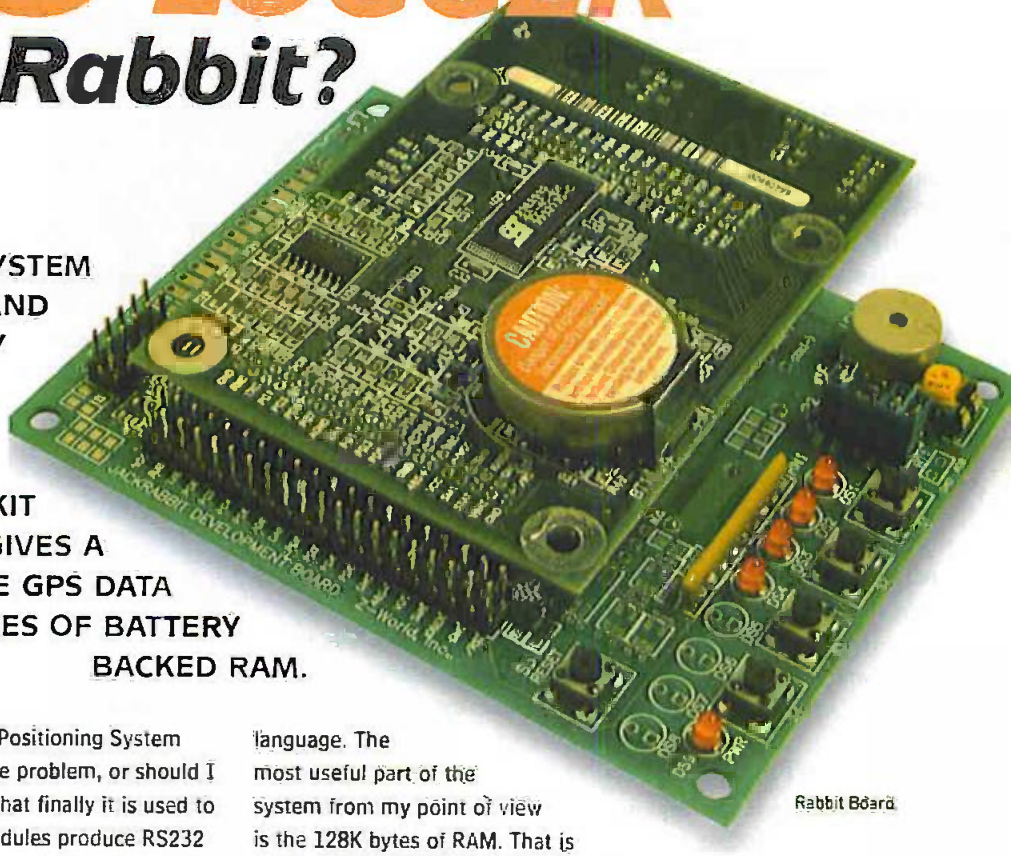
Jonathan Aldred replies:
Thank you for your letter, I am glad you enjoyed the story. We have had a really good response to the inclusion of this feature within the magazine and have already had several come in to the office even before the unveiling of this issue's short story competition. This is an important part of what the new format E&B should be about – interactivity. This is your magazine and we want you to be as great a part of it as possible.

If you have any views or queries, then send them in to:

Air Your Views,
Electronics And Beyond,
17/18 Glanyrafon Enterprise Park,
Aberystwyth, Ceredigion, SY23 3JQ.

Alternatively, you can fax them to 01970 621 040, or e-mail them to jaldred@kanda.com.

A GPS LOGGER with a Rabbit?



Rabbit Board

THE GLOBAL POSITIONING SYSTEM IS USED MORE AND MORE AND CAN BE USEFUL FOR MANY PROJECTS. COMBINE THIS WITH THE NEW RABBIT SEMICONDUCTOR MICROPROCESSOR KIT INCLUDING A C COMPILER GIVES A POWERFUL PROGRAMMABLE GPS DATA LOGGER WITH 128K BYTES OF BATTERY BACKED RAM.

I am working on a project which uses a Global Positioning System (GPS) receiver to measure position. Part of the problem, or should I say challenge, is to save parts of the data so that finally it is used to plot the receiver position over time. The GPS modules produce RS232 data which can be read on the screen through a terminal emulator like Hyperterminal[1] on Windows 95/98.

What I need is a device to store the RS232 text lines. One option is to carry around a portable PC along with the rest of the system. That makes quite a large and heavy unit, which I do not want, so I looked for a different way to make the logger.

There are many single chip microprocessors, such as the PIC range, which can easily do the processing, but they have only a few hundred bytes of RAM.

This is not enough for my design, but looking at the electronic magazines I saw the adverts for a new microprocessor called the Rabbit. I guess what caught my eye was the complete system which consists of a development board with 128K bytes of RAM and 128K bytes of Flash memory, and a C compiler complete with development environment. The price of $99.00 was also afordable, being on a par with the new Flash PIC development kit, but with the added advantage of being C programmable. The price is somewhat higher today, though. Off I went to the web site and ordered the kit[3]. Within a few days the package arrived with all I needed except the power supply. The included one was a 110V US version. I just replaced it with a 220V UK power supply. The kit takes about 150mA with the LEDs turned on and it has its own regulator to provide 5V for the circuit, so a small power module is OK. I see the Rabbit kit can now be bought in the UK, for about £99 plus VAT and delivery, from Impulse Corporation Limited or the distributors 2001[4].

Why use a Rabbit?

The Rabbit is a variation on the Z80 processor, but with many differences which are designed to assist programming with the C language. The most useful part of the system from my point of view is the 128K bytes of RAM. That is plenty of memory to store the data from the GPS logger. The RAM is battery backed, so it could be used to store data when the program isn't running. I haven't figured out how to do that yet, though!

If you get round to building your own hardware, the Rabbit microprocessor provides most of the 'glue' logic to connect four memory chips with no extra logic required. There are four serial ports available though one is used for programming and debugging, but it can be reused. The development kit has two of the serial ports connected to an RS232 interface chip and a third to an RS485 chip. Also the large Flash memory allows easy changes to the program. Overall it is certainly worth looking at for a variety of uses, and its always good to try a new 'toy'.

The Windows based development software provides a C compiler with built in assembler, an editor and a visual debugger. You get a lot of value out of this kit. There are several examples to try straight away. So within minutes you can have the serial cable plugged into the PC and the other end into the Rabbit, load an example, press the run button and within 30 seconds (at least on my computer) the LEDs can be flashing.

Embedded C from ZWorld

Having read the documents my first change was to make sure the program was running in RAM using the menu Options/Compiler. If you use the Flash all the time it will quickly wear out. The C system has its own bios which is compiled and loaded before your own program. The source is included so that you can see how it works and maybe adapt it to your own hardware. All the code is downloaded through a facility of the micoprocessor which provides a hardware

loader using either the serial port or the parallel slave port.

The development system uses the serial port, so loading is quick and simple, and your own hardware could do the same. That is another convenience of this clever design. I'm getting to like it even more. When your program is complete, you change the compiler to load into Flash and then remove the serial debugging cable. The loaded program runs when you apply the power. The ease of development is all worked out. Now all I need to do is devise my code.

The ZWorld version of C is a little different from the ones you will see from others since it is designed to compile quickly and doesn't use header files in the same way. If you are used to C or Basic you should be able to make things work quite easily. Have a good look at the examples and you will see how things work.

There are several extensions to C which are there to help program in real time without having to use difficult program techniques. For instance you do not need a real-time operating system to carry out more than one function at a time. The various 'co' functions are used to group program lines into blocks which in effect are parallel executing programs. Its probably easier to understand by seeing how my program uses them.

Garmin Module and Antenna

The Logging Program

My program does three things in parallel:

1. Read the GPS serial data, analyse and store the data
2. Print out the stored data
3. Read the press button and operate the LEDs.

Each uses a 'costate' to group the instructions related to how it works. I've added line numbers to Listing.1 so that I can point out which part is which. Much of the program is based on one of the samples provided to get you going with Rabbit system, but lets look at it in somedetail.

Reading the GPS data

Function 1, reading the GPS serial data uses lines 30 to 57. Line 39 has the wfd, wait for done, keyword which tells the costate to wait for the rest of the line to finish. In this case that means, wait for the line of serial characters to arrive. The cof_serBgets function refers to serial port B and is a cofunction which allows the program to continue if the whole line has not arrived. With the debugger, you can single step to this instruction and see that the program jumps to after the end of the costate block if it is not complete. So you can see that waiting, maybe for a long time, for the line of text to arrive doesn't stop the rest of the program working. This is the great advantage of the idea of cofunctions. When the line of text does arrive the program runs on to the next lines of code. The rest of this costate looks for a text line starting with $GPGGA.

Its time to explain a little about the data which comes out of the GPS module. The module itself is a Garmin GPS25-LVS which you can buy from Maplin, though, there are several other manufactures who provide similar devices. You could also use any GPS receiver which has an RS232 output and sends standard NMEA (National Marine Electronics Association) sentences. Photo 2 - Garmin Module and Antenna. As well as the module you will also need an antenna. I chose the Sigem active antenae which needed the coaxial connector changing, but was much cheaper than any other in the catalogue. It also contains a magnet for temporary mounting say, on the roof of a car. The module also has an unusual ribbon cable connector, but it comes with a length of cable to make your own connections. I made connections for the 5V power supply, at about 150mA, and three wires for the RS232 serial interface. Most RS232 GPS data is sent out at 4800 baud, which is fast enough to allow a burst of sentences every second. You can usually change the baud rate, though it is best not to go much slower.

GPS Sentences

The NMEA standardises the sentences used by GPS systems and other related electronic devices. A sentence is just a line of text containing identification and data. The first part of the sentence is something like $GPGGA and ends with a carriage return character. The $GP identifies the data as GPS information. The GGA string says this is the Global Positioning System Fix Data. The rest of the line is made up of fields separated by commas. I am only interested in the GGA sentence, because it contains the position and time information. The fields are made up of: $GPGGA,daytime,latitude,north / south,longitude,east / west,GPS quality, number of satellites,horizontal precision,'M',geoid height,'M',differential, differential reference station,*checksum

- daytime - UTC (GMT) time as hhmmss (hours minutes seconds) NOT local time
- latitude - ddmm.mmmm (degrees minutes and decimal minutes)
- north/south - N or S (hemisphere of the latitude measurment)
- longitude - dddmm.mmmm (degrees minutes and decimal minutes)
- east/west - E or W (east or west of 0 degrees for the longitude measurement)
- GPS quality - 0,1 or 2 (0 no fix, 1 just GPS, 2 differential measurement)
- number of satellites - 00 to 12 (tracked satellites)
- horizontal precision - 0.5 to 99.9 (measure of precision)
- 'M' - just the capital letter M
- geoid height - -999.9 to 9999.9 (antenna height)
- 'M' - just the capital letter M
- differential - seconds since last valid differential data
- differential reference station - 0000 to 1023 (differential station ID)
- *checksum - a * followed by a two character checksum

Figure 1 shows some of the data that I recorded. The first three lines show all the data I need. The bottom two lines show the data when there are not enough satellites in view. The good data uses only three satellites so it may not be very accurate. In particular the error in height may well be a long way out. Height errors are often twice the error in Latitude and Longitude.

The data is good enough to test the system, though. Going back to the program, lines 42 to 47 check that the GPS data contains the GGA string and selects readings at 15 second intervals. The GPS data is sent out every second, but to reduce the amount of data I need to

store, only every 15th value is put into memory. I could use the same technique to halve the volume of data again if I selected 30 second steps. The if statement may look a bit verbose, but embedded code has to run quickly otherwise you can run out of time to do everything. The byte by byte comparison is quite fast. An alternative might be to use string comparisions, but that is almost certainly slower to execute. Remember embedded systems may be programmed in C but care must be taken not to waste time or memory.

```
$GPGGA,181930,5314.6826,N,00208.1973,W,1,03,2.8,146.9,M,49.4,M,,*57
$GPGGA,181945,5314.6812,N,00208.2037,W,1,03,2.8,146.9,M,49.4,M,,*58
$GPGGA,182000,5314.6812,N,00208.2037,W,1,00,2.8,146.9,M,49.4,M,,*50
$GPGGA,182015,5314.6812,N,00208.2037,W,0,00,,,M,,M,,*42
$GPGGA,182030,5314.6812,N,00208.2037,W,0,00,,,M,,M,,*45
```

Figure 1 - GPS sentences

Line 48 copies the text line into an array stored in RAM. The integer reci counts through the array. When it reaches the end of the array, lines 50 and 51 point it back to the start. Finally the flag vswitch1 is used to indicate the state of an LED. Each time a valid GPS line is received the LED changes from on to off or off to on depending on its last state. This is really a confidence indicator to tell me the program is working. At line 41 vswitch2 is used in a similar way, but flashes more often, several times a second, in response to any completely received GPS text line.

Printing out the recorded data

Well that gives me a way to filter out what I want and save it into RAM. Function 2, the next piece of code, lines 60 to 76, is to print the saved data. It uses serial port C to write to. For testing this was plugged into my PC running Hyperterminal. Once the code runs, it prints each logged GPS line. You could capture the text from Hyperterminal and put it into a spread sheet to analyse it, or even plot a graph of position. The code is placed in a costate so that it runs without stopping the rest of the program. Again I use another integer, vswitch3, to flash another LED to show this part of the program is active.

Function 2, reading the press button and operating the LEDs.

The last costate in lines 79 to 97 is used to detect if the button is pressed, and has logic to debounce the inevitable multiple makes and breaks when a mechanical contact changes. The whole costate is taken from the example but is very instructive in showing how to insert real time delays without locking up the rest of the program. Stepping through it with the debugger is most revealing. The logic to operate the LEDs is at the top of the program in lines 31 to 36. Each vswitch is compared with the state of the pin attached to a LED, and the program sets or resets the corresponding values.

Well that's the logging part of my project. I am very pleased with how easy it is to use the Rabbit with its C compiler. The 128K bytes of RAM and the 128K of FLASH, gives me plenty of room to add other facilities, but that will have to be at another time, though.

Where to get things

1. A version of Hyperterminal can be downloaded for free from www.hilgraeve.com or you can buy an enhanced version from the same address. It may also be on your Windows CD rom.

2. Software for this article is available from www.visionsoftware.freeserve.co.uk

3. Rabbit 2000 kit www.rabbitsemiconductor.com

4. UK supplier of the Rabbit development kit 2001 www.2001elec.co.uk

Impulse Corporation Limited, Unit 2 Littleton Business Park, Littleton Drive,
Huntingdon, Staffordshire WS12 4TR. Web: www.impulse-corp.co.uk
Email: sales@impulse-corp.co.uk

Part 2 Next Month

Antenna on the car

WHAT'S ON in July & August

Diary Dates

4 – 5 July 2001. Olympia, London.
Linux Expo 2001
01483 469 060 www.itevents.co.uk

9 – 11 July. Manchester International Convention Centre.
The Radio Academy Festival.
020 7255 2010 www.radioacademy.org

11 – 13 July. ICC Birmingham.
Future Cities Conference.
E-mail piazza@bmp.org.uk
www.futurecitiesconference.com

18 – 19 July. The Café Royal, London.
Local Loop Unbundling & Alternative Access Technologies Conference.
020 7840 2700
www.accessconferences.com/TR101

24 July. Doncaster Exhibition Centre.
Computer Fair
01706 299 902

30 July – 2 August. ICC Birmingham.
Royal Society of Chemistry Annual Conference & Exhibition.
01892 518 877

8 – 9 August. Washington DC.
eBusiness World Expo
USA 703-536-2100

21 – 23 August. Scottish Exhibition & Conference Centre, Glasgow.
International Conference on Engineering Design.
020 7973 1316/1304
www.imeche.org.uk

27 – 30 August. San Jose, California.
Intel Developer Conference (Fall 2001).
www.intel94.com/idf/index2.asp

30 – 31 August. Mayfair Conference Centre, London.
Taxation Solutions for B2C Digital Transactions.
0500 821 057.
www.iqpc.co.uk

Also, there are Robot Wars Live Events throughout the months of July and August – see the accompanying article for details.

Exhibitions

4 – 5 July 2001. Olympia, London.

Linux Expo 2001

01483 469 060

www.itevents.co.uk

The market for Linux products and services continues to grow as an increasing number of organisations adopt the open source operating system for their IT infrastructure. The UK Linux Expo, now in its third year, brings together the major vendors who supply Linux tools, support, applications and servers with the users and decision-makers responsible for implementing Linux based systems.

If you are evaluating the importance and impact of Linux technology on your IT infrastructure, you can meet over 80 international players who are leading the Linux revolution. From development tools, e-commerce, security and Internet tools to Linux based training and support;

Linux Expo 2001 is expected to attract more than 10,000 senior IT professionals, and with seminar, conference and debating opportunities, and over 80 major international players to talk to, this is an opportunity to discuss your Linux issues directly with the industry leaders.

11 – 13 July. ICC Birmingham.

Future Cities Conference.

E-mail piazza@bmp.org.uk

www.futurecitiesconference.com

The two-day Future Cities Conference marks the 10th anniversary of Birmingham's International Convention Centre, which was opened by the Queen in April 1991 and has been an integral part of the acclaimed transformation of central Birmingham in recent years.

The conference will bring together experts from every area of urban renewal – from planners, architects and surveyors to local authorities, investors and academics. Policy makers from the UK, Europe and North America will debate issues in 5 main areas: Restructuring the City's Economy, Reshaping the City, People and Communities, Urban Governance, and the Interaction of Cities and Regions. Speakers already confirmed include Professor Michael Parkinson, director of the European Institute of Urban Affairs at Liverpool John Moores University; Professor Brian Robson, of the University of Manchester; and Professor David Hulchanski, of the University of Toronto, Canada.

Delegates will have the opportunity to see first hand how public and private partnerships have already transformed the face of Birmingham, and continue to do so through major schemes like the redevelopment of the Bull Ring, with more than £2 billion of investment completed, underway or currently planned.

18–19 July. The Café Royal, London.

Local Loop Unbundling & Alternative Access Technologies Conference.

020 7840 2700

www.accessconferences.com/TR101

The LLU Regulation came into force on the 2nd of January this year – its purpose: to increase broadband competition, boost the growth of e-commerce and cut the cost of high-speed internet access. There is controversy, however, amongst regulators, operators, etc, over the slow speed with which incumbents are opening up their local exchanges, the prices they charge, and the non-price barriers slowing down competition in so many European markets. Access Conferences in association with the European Competitive Telecommunications Association (ECTA) are holding a 2-day conference on the LLU issue – highlighting the major opportunities and issues facing the industry concerning the realisation of LLU and the introduction of new access technologies.

21–23 August. Scottish Exhibition & Conference Centre, Glasgow.

International Conference on Engineering Design.

020 7973 1316/1304

www.imeche.org.uk

The 13th International Conference on Engineering Design will be held this year in the SECC, located on the river Clyde in Glasgow.

Previous conferences, which have been held in a total of 11 different countries, have focussed on the process of planning, developing and designing technical systems and products. I.C.E.D. covers all aspects and disciplines of engineering design, from general product development and innovation to feature-based geometric reasoning and design for later life-phases, such as design for recycling. It covers

not only mechanical product design but areas such as mechatronics, electronic design, facility design, man-machine interaction, etc. As engineering design is a process to which many disciplines are contributing, an additional emphasis is on design management, organisation, teams and individuals.

The last two I.C.E.D. conferences were held in Tampere, Finland, in 1997 and in Munich, Germany, in 1999. Both these conferences attracted well over 500 delegates from all over the world, from both academic institutions and industrial organisations. According to the organisers, nearly all the leading authorities in the field of engineering design attend to report their latest findings and exchange current ideas with colleagues. It is expected that this year's conference will be equally successful, and attract delegates from even more countries and industrial organisations. The theme for this year will be 'Building a Partnership between Research and Industry'.

On Friday 24th August, after the conference has ended, a number of technical visits will be run in Glasgow and the surrounding area. Places are limited and delegates who wish to participate will be taken to (most of) these locations by coach. Visit locations include IBM's Greenock Site, BAE Systems Marine's yard at Scotstoun, the Scottish Enterprise offices in Glasgow, and Thales Optronics and Optics.

30 – 31 August. Mayfair Conference Centre, London.

Taxation Solutions for B2C Digital Transactions.

0500 821 057.

www.iqpc.co.uk

The last twelve months have seen an explosion in e-business, and there has been a resurgence of major businesses investing large amounts in B2C ventures, but as e-commerce grows, tax authorities are losing more and more revenue. The Taxation Solutions for B2C Digital Transactions conference will explore tax collection solutions for e-commerce for government tax authorities, private sector finance directors, tax consultants and tax lawyers. There will be contributions from OECD, the Institute of Directors, HM Customs and Excise, Canada Customs and Revenue Agency, and others. As well as the usual presentations and debates, there will also be brainstorming sessions and discussion tables.

If you are wondering what B2C stands for, it is an acronym for Business-to-Consumer, and is a variant on B2B, which is short for Business-to-Business.

Robot Wars Live Events 2001

Throughout July and August

18 – 19 July. Glasgow SECC.
21 – 22 July. Manchester Evening News Arena.
25 – 26 July. Cardiff Arena.
28 – 29 July. Sheffield Arena.
1 – 2 August. Birmingham NIA.
4 – 5 August. Newcastle Arena.
7 – 8 August. London Arena.
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At venues all across England, Wales and Scotland, and throughout the months of July and August, BBC2's ever-popular Robot Wars is to take to the road. As you would expect, all the house robots – Sir Killalot, Matilda, Dead Metal, Shunt and Sargent Bash – will be there, along with many of the other participating robots from the television series, including the reigning champion Chaos 2. Robot Wars Live will also provide the testing ground for some of the brave new roboteers keen to test the mettle of their machines. Last year over 1,000 people applied for a place on Series 4 of Robot Wars, but only 320 made it through to the first round. This is your chance to be a robotic Roman emperor and help decide which of the galvanised gladiators will live to fight another day and which will be condemned to the arena's infamous pit.

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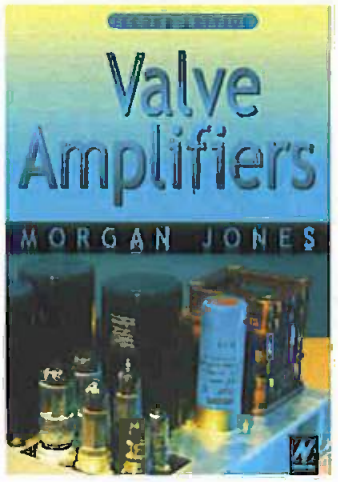


Valve Amplifiers (Second Edition)

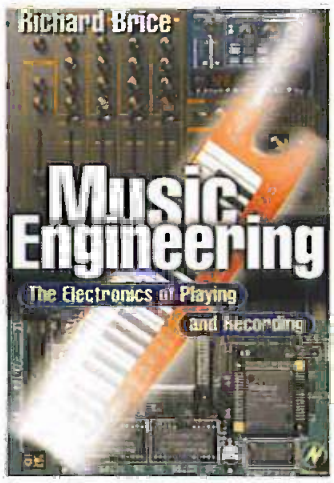
This book enables those with a limited knowledge of the field to understand both the theory and practice of valve audio amplifier design, such that they can analyse and modify circuits, and build or restore an amplifier. Design principles and construction techniques are provided so readers can devise and build from scratch designs that actually work.

Valve Amplifiers is a practical guide in which Morgan Jones takes the reader through each step in the process of design, starting with a brief review of electronic fundamentals relevant to valve amplifiers, simple stages, compound stages, linking stages together, and finally, complete designs. Practical aspects, including safety, are addressed throughout.

Contents: Circuit analysis; Basic building blocks; Component technology; Power supplies; The power amplifier; The pre-amplifier; Construction, safety, testing and repair. The second edition of this popular book builds on its main strength – exploring and illustrating theory with practical applications. Numerous new sections include: output transformer problems; shunt regulators, phase splitter analysis; and hum loops. In addition, three major new constructional projects are included: a low-noise single-ended LP stage; and a pair of high voltage amplifiers for driving electrostatic transducers directly – one for headphones, one for loudspeakers.

Author: Morgan Jones, Southampton Institute.

Pages: 504pp
Price: £24.99



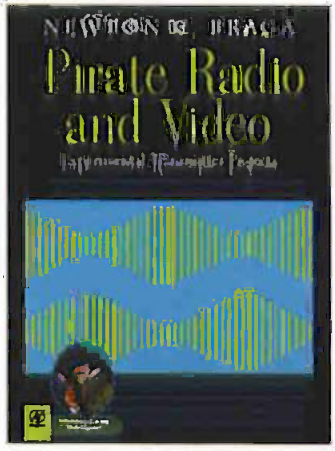
Music Engineering (Second Edition)

Available from 16th July 2001, Music Engineering is a hands-on guide to the practical aspects of electronic music. It is a compelling read and also an essential reference guide for anyone using, choosing, designing or studying the technology of modern music. The technology and underpinning science are introduced through the real life demands of playing and recording, and illustrated with references to well known classic recordings to show how a particular effect is obtained thanks to the ingenuity of the engineer as well as the musician. In addition, specific effects are demonstrated on the accompanying free CD.

Written by a music enthusiast and electronic engineer, this second edition includes an updated Digital section including MPEG3 and there are fact sheets at the end of each chapter to summarise the key electronics and science. The book covers the electronics and physics of the subject as well as the more subjective aspects. As well as instruments and recording technology it covers essential kit such as microphones, sequencers, amplifiers, loudspeakers, etc.

The Author: Richard Brice is Head of Sales and Marketing at Oxtel plc, who specialise in television channel-branding equipment. He is the author of two other books – 'Multimedia and Virtual Reality' and 'Newnes Guide to Digital Television'.

Pages: 512pp
Price: £21.99



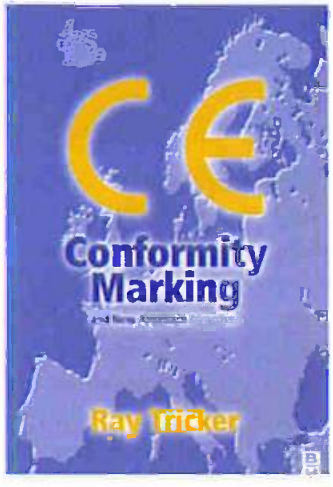
Pirate Radio and Video: Experimental Transmitter Projects

Now that the FCC has changed the laws governing pirate radio and video stations, more and more people across the country are starting broadcasts from their homes. Of course transmitting equipment is very expensive, but now you can build your own transmitters for a fraction of the cost of purchasing. By reading about and building the projects in Pirate Radio and Video (of which there are over thirty), you can construct your own station. With projects for UHF, VHF, AM and FM transmitters, this book covers the gamut of popular bands and outputs. Not only will you learn how to build your own transmitters, but also how to troubleshoot problems, test outcomes and even synthesise several types of equipment into a powerful and unique system.

Written with the electronics hobbyist in mind, each project includes basic diagrams, complete instructions as well as advice on how to make each project work best for you. The list of projects includes over several different FM radio transmitters, AM radio transmitters, microwave transmitters, short-wave transmitters, UHF video transmitters, VHF video transmitters as well as nearly a dozen special projects for test equipment and system set-ups. If you are interested in setting up your own radio or television broadcasting system, then this is the book you are looking for.

The Author: Newton C. Braga is a well-known expert on hobbyist electronics, and a heavily published author.

Pages: 304pp
Price: £16.99



CE Conformity Marking and New Approach Directives

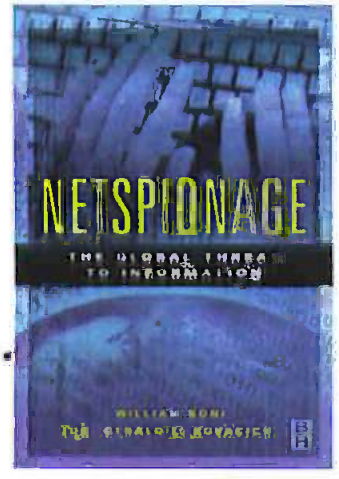
CE Marking can be regarded as a product's trade passport for Europe. It is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements

set out in the European Directive. The prime aim of the CE Directive is to ensure that 'all industrial products that are placed on the market do not compromise the safety and health of users when properly installed, maintained and used in accordance with their intended purpose. Users and third parties should be provided with a high level of protection and the devices should attain the performance levels claimed by the manufacturer'.

This book contains essential information for any manufacturer or distributor wishing to trade in the European Union. It explains the meaning of CE Marking, its history, how the Directive can affect all manufacturers of industrial products, its current status, its associated quality management requirements, and how manufacturers can easily and cost-effectively meet the requirements for CE Conformance. It is a practical and easy to understand text in an accessible price and format.

The Author: Ray Tricker (MSc, IEng, FIIE (elec), FInstM, MIQA, MIRSE) is the Principal Consultant and Managing Director of Herne European Consultancy Ltd – an organisation specialising in Quality, Environment and Safety Management Systems.

Pages: 304pp
Price: £22.99



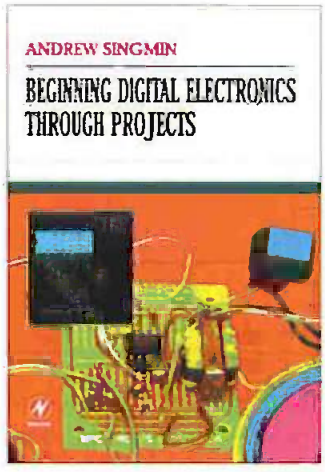
Netspionage: The Global Threat to Information

Written for information security professionals and security managers, as well as executives in non-protection roles (since they also must take a leadership role in safeguarding information assets), this is a practical guide written from the 'front-line' experience of the authors. It explains the evolution of information collection and why it has never been easier, and highlights the tools of the trade and how they can be put to best use.

The book begins by laying out a history of espionage, and how the Internet and associated technologies have already revolutionised the collection and analysis of competitive information. The convergence of dependency on networked and exploitation tools (propagated by everyone from hackers to intelligence agencies) has already resulted in several incidents that could foreshadow a perilous future. Close study of these incidents demonstrates how difficult yet how important it is to confront the challenges of 'netspionage' and also it's less intrusive associates. The authors present a set of the known incidents and then outline protective measures that will reduce netspionage potential and its consequences.

The Authors: William C. Boni CISA, MBA is the Director of Information Security for the Motorola Corporation. He has worked as the Director of Information Protection Practices for Amgen; as a U.S. Army counterintelligence officer; federal agent and investigator; and a security consultant for such firms as Pricewaterhouse Coopers and Ernst & Young. Gerald Kovacich CFE, CPP, CISSP has over 37 years of security, criminal and civil investigations, anti-fraud, information warfare, and information systems security experience in both government as a special agent and as a manager in international corporations. He currently lives in Washington state where he continues to write, lecture and conduct research relative to information systems security, information warfare defensive and offensive operations, high-technology crime and techno-terrorism.

Pages: 224pp
Price: £25.00



Beginning Digital Electronics through Projects

Digital electronics is a little more abstract than analogue electronics, and trying to find a useful starter book can be tough. For those interested in learning digital electronics, with a practical approach, Beginning Digital Electronics Through Projects is for you. It is published in the same tradition as Beginning Analogue Electronics Through Projects, Andrew Singmin's revision to the popular Beginning Electronics Through Projects.

Beginning Digital Electronics Through Projects provides practical exercises, building techniques, and ideas for over thirty-five useful digital projects. Some digital logic knowledge is necessary, but the theory is limited to 'need-to-know' information that will allow you to get started right away without complex mathematics. Many components in this text are common to either analogue or digital electronics, and beginners or hobbyists making their start here will find an overview of commonly used components and their functions described in everyday terms.

Each of the projects builds on the theory and component knowledge developed in earlier chapters, establishing progressively more ambitious goals. Step-by-step learning instructions help you determine the best ways of working with such projects as Schmitt Trigger Circuits, Versatile ICs, Digital Support Circuits, and much more. Two interesting wireless projects (an FM receiver and an FM transmitter) bring the book to a close.

The Author: Andrew Singmin has a Master's Degree in Semiconductor Physics from Brunel University and a Ph.D. in Solid State Physics from the University of London. He is currently working as an ISO 9000 Quality Assurance Manager for Conexant Systems Inc. in Ottawa, Canada.

Pages: 136pp
Price: £14.99

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SOIL MOISTURE TESTER

by Gavin Cheeseman

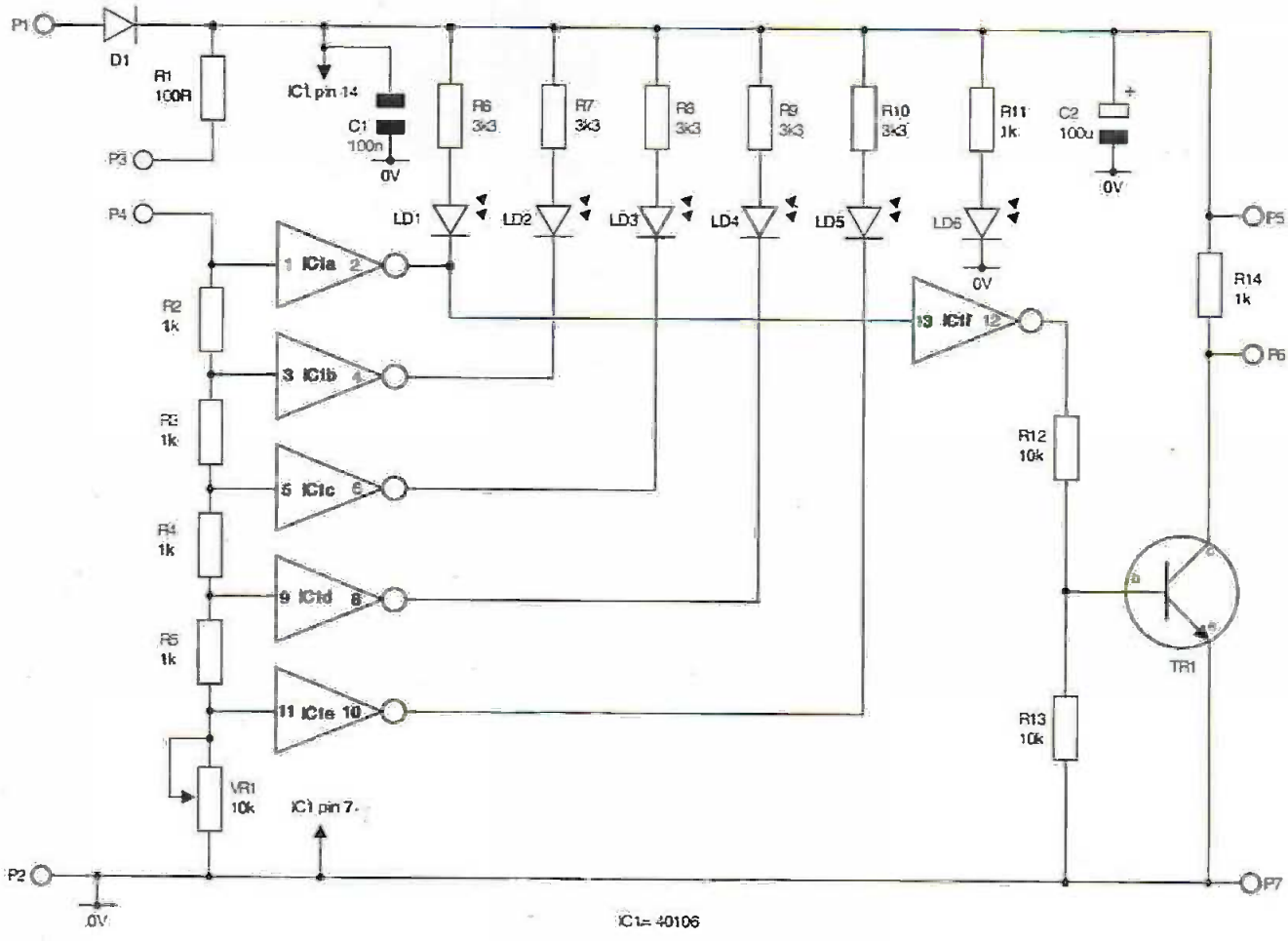


Figure 1. Circuit diagram

HAVE YOU EVER WONDERED HOW TO TELL IF YOUR HOUSE PLANTS NEED WATERING OR NOT. WELL, HERE IS A PROJECT THAT MIGHT HELP YOU DECIDE.

This simple circuit gives a rough indication of the relative moisture content of the soil based on electrical resistance.

How does it work?

The circuit is effectively a kind of resistance meter. Depending on the resistance between the two probes, between one and five LED's illuminate. The more LED's that light up, the lower the resistance between the probes.

The resistance of the soil is dependant on a number of factors including the moisture content. It is not possible to make a definitive measurement of moisture content based on a resistance reading alone, as factors such as salt content and physical structure also influence the result. However it is possible to obtain a relative idea of whether the soil is dry, damp or wet. Also, quite often the soil on the surface may appear dry when the soil below is actually quite moist. Because the probes penetrate the surface layer, the meter will indicate the condition of the soil beneath.

Circuit Description

It may be seen from Figure 1 that the circuit is based around the 40106 Hex Schmitt Trigger IC. One advantage of 4000/40000 range CMOS technology is its wide power supply voltage range. Whereas many other types of logic require a nominal 5V supply, these devices will work happily at voltages as high as 15V making them ideal for 9V battery operation without the need for a regulator.

Diode D1 offers reverse polarity protection should the battery be accidentally connected

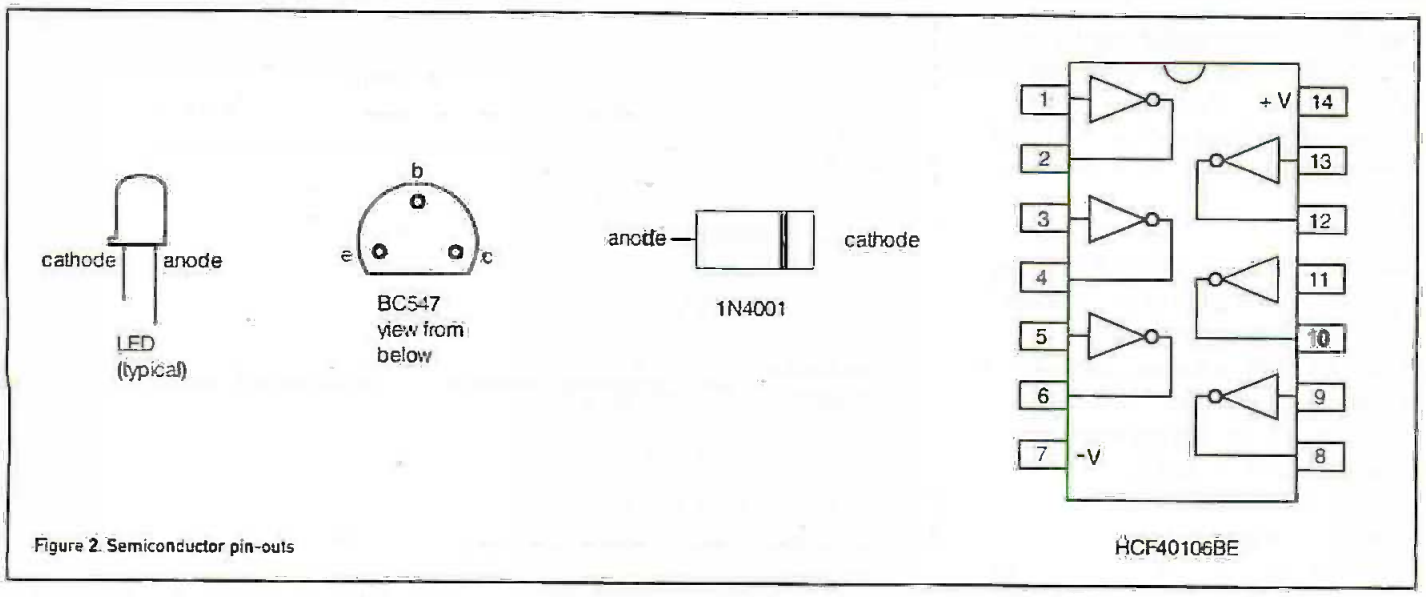


Figure 2. Semiconductor pin-outs

the wrong way round. Capacitor C1 is used to filter the power supply close to IC1 and C2 provides general supply de-coupling.

Two conductive moisture probes are connected to terminals P3 and P4. Resistors R1 to R5 together with variable resistor VR1 and any resistance between the moisture probes form a potential divider. The voltage at any point in the chain is determined by the resistance values in the potential divider. R1 to R5 are fixed and once aligned VR1 does not usually require any further adjustment. So in normal operation, the only variable quantity is the external resistance between the probes (P3 and P4).

The inputs of IC1a to IC1e are connected to different points in the potential divider chain. Each gate has a specific input threshold at which the output (normally high) switches low. When nothing is connected between the probes (i.e. there is an open circuit), the voltage at the inputs of gates IC1a to IC1e is equal to 0V. Therefore the outputs of all five gates remain in a logic high condition. When the probes are inserted into the soil, the voltage at each of the gate inputs will rise by an amount dependant on the resistance between the probes. So in dry soil where there is a high resistance, only a small current flows and the voltage rise is small. In wet soil the resistance is comparatively low and the voltage rise is much greater. Because the voltage is different at each point on the potential divider, as the resistance between terminals P3 and P4 is reduced, the gates connected higher up the chain will switch first. So the most sensitive gate is IC1a followed by IC1b and so on to IC1e.

When the gate switches, the associated LED (LD1 to LD5) illuminates. LD6 is the power on indicator and is not switched by a gate. The current through the LED's is controlled by R6 to R11. The values of R6 to R10 are kept relatively high to maintain a low current consumption. The value of R11 is less, so as to make the power on indicator brighter and more obvious.

The input of IC1f is connected to the output of IC1a acting as both a buffer and inverter. The output of IC1f is used to drive transistor TR1 via R12 and R13. This provides a switched output on terminal P6 that may be used to drive a small buzzer or other low current external equipment.

Constructing the circuit

The circuit may be constructed using any of the usual circuit board techniques including matrix board or strip board. The circuit is not particularly layout critical but it is sensible to mount capacitor C1 electrically close to IC1.

All of the usual precautions apply with regard to soldering. Take care with the polarised components. Semiconductor pin-out information is shown in Figure 2. Capacitor C2 must also be connected the right way round. The negative lead is usually marked by a minus symbol (-) on the case of the capacitor and is usually the shortest of the two leads. A similar system is often used for LED's whereby the shortest lead is usually the cathode (negative). The cathode

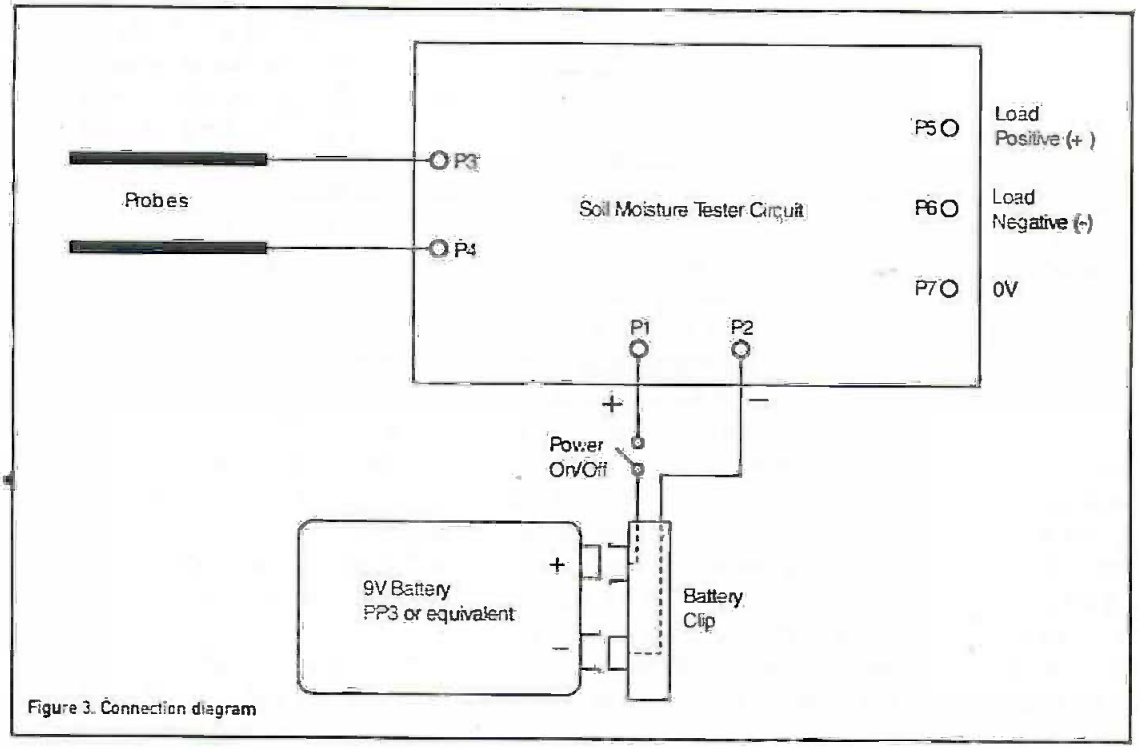


Figure 3. Connection diagram

may also be marked by a flat edge on the LED case. However, with both capacitors and LED's, the marking systems may vary with different manufacturers and types, so always make sure before the component is fitted in place.

It is probably best to mount the LED's directly onto the circuit board but if required they can be connected off board using short lengths of insulated wire. The choice of colours is up to the individual constructor and is not critical to the correct operation of the circuit. LD1 illuminates at the highest probe resistance (comparatively dry) and LD5 lights when the probe resistance is low (including short circuit). A typical colour scheme might be LD1 - orange, LD2 - orange, LD3 - yellow, LD4 - yellow, LD5 - green. Power indicator LD6 could be red as it is easily seen and also if the probe is inserted into the soil and LD6 is the only LED lit this indicates that the soil may be very dry.

It is also necessary to fit a battery clip wire, connect the probes to the circuit board and fit a power switch. Pay attention to the power supply polarity when connecting the battery clip wires. The positive lead connects to terminal P1 and the negative lead to P2. Wiring information is shown in Figure 3.

Probe construction and housing

The probe and housing arrangement may be chosen by the constructor as long as the relative size and spacing of the probes is approximately correct. A small plastic hand held case is ideal for housing the unit. It is necessary to be able to access the battery. Also a small hole should be drilled in the case to allow access to VR1.

As the circuit is detecting comparatively large changes in resistance, a small amount of variation in the probe dimensions will have little practical consequence. The probes should be approximately 50mm long and 20mm apart and may be made from rigid copper wire (at least 16 swg or thicker). A typical probe arrangement is illustrated in Figure 4. They may be soldered directly to the terminal pins or alternatively may be fixed to a separate assembly and wired onto the PCB. Avoid long lengths of wire (over about 1 metre) as these may be prone to picking up external signals. Other types of probes such as those used for multimeters may be used as long as they are fixed a set distance apart. The required spacing will change if the length of the probes is significantly different.

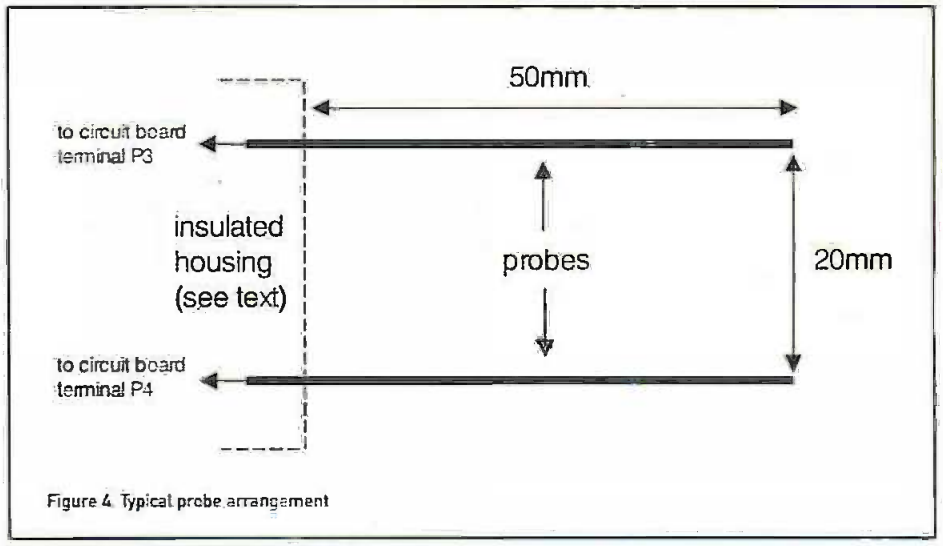


Figure 4. Typical probe arrangement

Testing

The circuit may be tested without any special equipment. However, it is useful to connect a multimeter set to read current in series with the positive power supply line when first switching on, just to make sure that the current consumption is not excessive. Take care that the meter is set to an appropriate current range.

Connect a 9V battery (PP3 or equivalent) and set the power switch to the 'on' position. LD6 should illuminate. If the current consumption is greater than about 40mA at any stage, switch off as this suggests there is a problem with the circuit (often an incorrect or shorted connection).

If all is satisfactory, connect a short circuit between terminals P3 and P4. Adjust variable resistor VR1, observing LED's LD1 to LD5. Start with VR1 set to minimum resistance and slowly increase the setting until just past the point where all five LED's are lit. Disconnect the short between P3 and P4 and connect a 2k2 resistor in its place. Now only some of the LED's should light. If a range of resistors or a variable resistor (22k or 47k) is available, try connecting different resistance values between P3 and P4, observing which LED's if any illuminate. Note that because IC1 is a schmitt trigger, there is some hysteresis. Therefore, the circuit responds slightly differently when the resistance between the probes is being reduced, to when the resistance is being increased. This was not found to present a problem in practice.

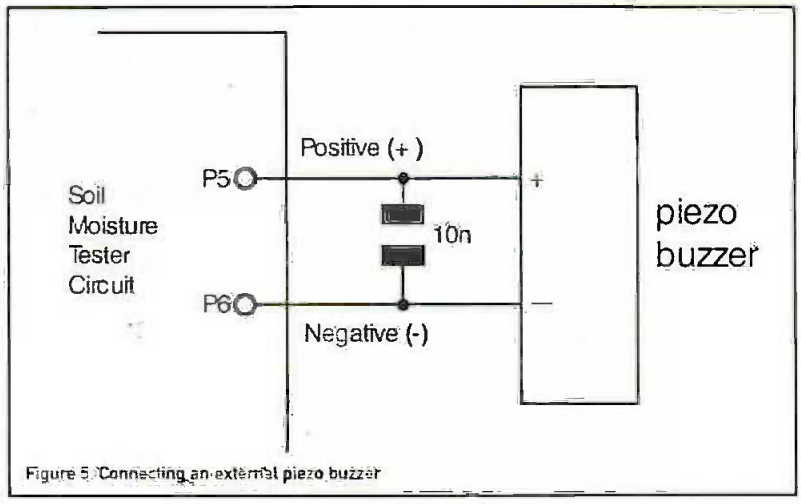


Figure 5. Connecting an external piezo buzzer

The output at terminal P6 can be tested by connecting a multimeter set to read voltage between P6 (positive lead) and P7 (negative lead). The multimeter should be set to a suitable range to read 9V. When terminals P3 and P4 are open circuit the meter should read approximately 9V or maybe slightly less allowing for the voltage drop due to D1. When P3 is connected to P4, the voltage on the meter should drop to almost zero.

Using the tester

In use, the test probes are briefly inserted into the soil to obtain a reading. Very dry soil will light no LED's (except the power LED which remains illuminated whenever the unit is switched on). Very wet soil will light all of the LED's. Conditions in between these two extremes will light between 1 and 4 LED's.

One point to be aware of is that the unit is intended to act as a guide and does not determine the moisture level in the soil with absolute certainty. To get the best from the tester it is important to know its limitations and to become familiar with the sort of readings you get under different circumstances with different types of soil. Also other factors are involved such as how

easy it is for the plant to suck the water out of the soil. For example heavy clay soil may have a high moisture content but very little of the water is available to the plant.

Try testing a range of different soil types, some completely dry, some moist and some wet. Adjust VR1 to give the best range of readings based on the different examples tested. Only allow the probes to become damp. Never let the battery, circuit board or components come into direct contact with water.

The component values are not necessarily optimised for every situation. For those who wish to experiment, the values of resistors R2 to R5 and VR1 may be modified to change the resistance range over which the tester operates. For example, if all of these components are increased in value by a factor of 10, the tester will then respond to a much higher resistance between the probes.

Important Note:

Do not leave the test probes in the soil for any longer than is necessary to take a reading (less than 5 seconds). Also, although the probe voltage never exceeds that of the battery (9V) and does not pose an electric shock hazard, it is recommended that the probes are not touched when moist. As the tester uses a simple DC voltage at a relatively high level, electrolysis will start to take place. Leaving the probes in the soil under these conditions will result in corrosion and poor performance due to the production of gas around the probes.

It is interesting to note that probes intended for accurate long term analysis of soil moisture content are usually driven with a low level AC waveform to avoid this effect and are usually embedded in a block of permeable material such as gypsum. This helps to minimise the effect of physical variations in the soil. However these are specialised techniques and their application to a simple tester of the type described here would lead to increased cost and complexity.

Using the switched output

The switched output on terminal P6 can be used to drive a small piezo buzzer as illustrated in Figure 5 (recommended current <20mA). The buzzer must be suitable for 9V operation and should contain the necessary drive circuit. The output is DC only and therefore will not drive a simple piezo transducer. The positive (+) lead of the buzzer should be connected to terminal P5 and the negative (-) lead should be connected to P6.

Parts List

Resistors (minimum 0.5W metal film)		
R1	100R	1
R2-5		
R11, 14	1k	6
R6-10	3k3	5
R12,13	10k	2
VR1	10k variable trimmer	1
Capacitors (minimum voltage rating 16V)		
C1	100nF ceramic disc	1
C2	100uF radial electrolytic	1
Semiconductors		
D1	1N4001	1
TR1	BC547	1
IC1	HCF40106BE	1
Miscellaneous Items		
Circuit board (eg strip-board)		
14 pin DIL socket		1
P1 - P7	PCB pins	7
SPST toggle switch		1
LED's (see text)		6

Delayed ALARM

by John Edwards

... Continued from page 15

Piezo sounder LS1 is driven on one connection with a continuous signal from IC2 Q4, but rather than ground the other LS1 connection, it is taken to the junction of diodes D5 and D6. This allows the sound to be gated off and on by IC2 output Q14. When Q14 is high, the attached terminal of LS1 is clamped to the range 0.6V above and below VCC by diodes D5 and D6, as D5 is effectively connected in reverse across D6. This allows the full VCC swing of Q4, less 1.2V, to appear across LS1. When Q14 is low,the attached LS1 terminal is free to swing across the whole range of VCC, so once clamped to VCC by D6 on the next upswing, no effective signal appears between the terminals of LS1. Both terminals rise and fall in unison, with LS1 being effectively a charged capacitor with one driven and one free terminal. So the sound from LS1 will be modulated on/off at a rate 1/1024 of the LS1 drive.

The basic equation for the IC1 oscillator frequency is 1/(2.2*VR1*C2), and for IC2 the frequency is 1/(2.2*VR1*C3). (Strictly, this equation applies only when R2 and R3 are big enough to ignore - at least 5 times the VR1/VR2 settings. But it is close enough for this application). With VR1 at mid point (100kohm) and C2 of 100nF, the IC1 oscillator will run at about 45Hz, so the delay will be around 8192/45 seconds befor Q14 goes high and stops the clock. This gives a neat 180 seconds delay before the alarm sounds. This can easily be changed by scaling the values accordingly, but note that though the capacitor can have quite a large value it must be a non-polarised type. Current leakage though the oscillator input pin 11 limits the maximum resistor value, as it results in an offset voltage across the resistors. With VR2 at its mid point (100kohm again) and with C3 of 220p IC2 oscillator will produce about 21kHz, so the drive for LS1 from IC2 Q4 will be around 1290Hz. This will be divided down by 1024 to modulate the tone at around 1.26Hz.

The trimpots VR1 and VR2 can be replaced by fixed resistors, if no adjustments are needed when in use. This will make the circuit physically rather smaller, and the whole thing should then be no larger than the PP3 itself. Of the two, VR2 is the main candidate for a fixed value. It is given here as a variable because different piezo transducers have different resonant frequencies, and tend to have quite a narrow response bandwidth. The small ones prefer to be driven with something around1.5kHz to 2kHz. Of course, the modulation frequency changes directly with the audio frequency. When you know what value works best, replace VR2 with that fixed resistor. The switch allows you to silence the alarm manually. Use a momentary switch for just temporary silence, or a slide or toggle switch for a long term disable. To use temperature as the trigger rather than light, replace photodiode D2 with a NTC thermistor, and R1 with a value equal to the thermistor when it is at the alarm temperature. Note, though, that the smaller the values of these components the higher the standing power drain on the battery.

Replicas & Models

THE AUDIENCE RANGE OF ROBOT WARS IS VERY WIDE AND IT IS PERHAPS TRUE OF THE PROGRAMME THAT JUST AS MANY ADULTS WATCH IT AS ADOLESCENTS AND CHILDREN.

If anyone who has watched the program denies ever having thought, even for a couple of seconds or so, about building their own robot – chances are they are being 'economical with the truth'. But the truth is that now you don't have to build your own robot to bring a little piece of Robot Wars onto your desk, living room or office – you can buy your own model replica of Sir Killalot or any of his other house robot friends, complete with obstacle course accessories and pull-back-and-release mechanism.

The Robot Wars model collection includes all the house robots – Sir Killalot, Sergeant Bash, Matilda, Dead Metal and Shunt – plus three of the most popular competitors – Chaos 2, Razer and Hypno-Disc. The models are extremely detailed, durable and very well crafted. Many have interchangeable weapons and working attack features. Chaos 2, for example, has a quite effective flipping mechanism considering its size. None of the models are in any way unsafe, however, and can be played with by children without any risk of injury.

By collecting the set, you can replicate the pinball obstacle course from the TV series, as each model comes with a different set of arena accessories. Dead Metal has a set of barrels to knock over, Shunt a multiball release mechanism, Sgt. Bash a set of targets to hit and Hypno-Disc a set of bricks to topple.

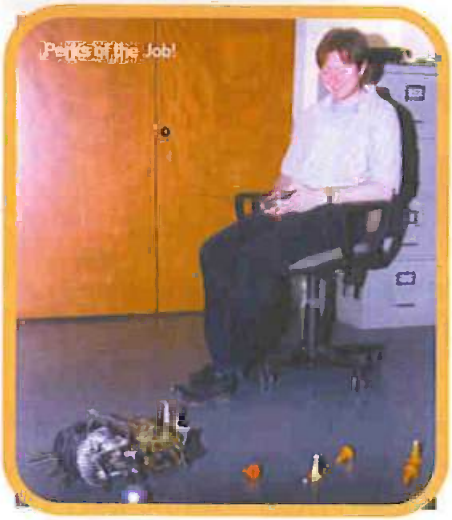
The models make ideal talking points for the office. Oh, and you can also give them to the children as well.

R.R.P. £12.99


Sir Killalot

Robot Wars Remote Controlled Shunt And Matilda

The remote controlled Shunt and Matilda caused quite a stir when they arrived at the Electronics And Beyond offices. The lure of Robot Wars means it is normally unwise to let loose such a powerful people-magnet in a busy office environment – luckily, testing out anything that has electricity running through it comes well inside our job description. Other offices may not be able to use that excuse though...



The 350mm long radio-controlled models are excellent recreations of the house robots known to everyone from the television series. There are, of course, obvious differences – size and weight are the most obvious, but you would have to take a much closer look to realise that some of the weapons are not actually real. Matilda's chainsaw is not sharp and does not move, but from a distance you get the impression that it might. The same is true of the circular saw that can be interchanged with it. Matilda's tusks, however, do move and can lift a weight up to a maximum of 150 grams. Shunt also has a working weapon – an axe that can be raised and lowered using the circular remote control, which is very attractively based around the Robot Wars logo.

Before we could test these miniature house robots we needed to charge the battery (a rechargeable 7.2V NiCd battery pack) up for 15 hours. Once charged, we discovered that the two wheels were controlled independently and this allowed the robots to spin around in victory dances after traversing the obstacle course that is our parent company's production room. Shunt's axe was the favourite feature of the two robots – despite being blunt and having a speed of attack designed not to hurt anyone who it might unwittingly be used upon, it still moves at a fair speed and attracted a lot of attention from those who were in the room at the time. Production is a very big office and we had no problem with the remote control's range – the models were still moving even when their operators were way out of sight.

Not one of the people who saw the models in action had anything bad to say about them. The only member of our offices who seemed unimpressed was the dog, who refused to be photographed looking down at Shunt, even when tempted by a chocolate biscuit!

R.R.P. £56.99

Both sets of models are available through the Robot Wars web site (see this month's Web Electronics for details). All prices are correct at time of going to press.

Write a short story and win...

First Prize: Remote-controlled Matilda house robot!

Second Prize: One of eight different Robot Wars pull-and-go models!

Write a short story for Electronics And Beyond and you could win one of eight different Robot Wars pull-and-go models or, if we pick out your story as the best, a special remote controlled version of the house robot Matilda with remotely operated tusks and interchangeable weapons.

All you have to do to win one of these fascinating replicas is write for us a short story of anywhere between 800 and 2,000 words in length. The overall theme of the story must be electronics, but the rest is up to you. Entries should be typed (no hand-written entries please) and submitted using the submission form provided below. Floppy discs are acceptable, provided the text is in either PC Microsoft Word or Notepad format. All entries submitted will be considered for inclusion within the magazine. The best nine, however, as judged by the staff here at Electronics And Beyond, will each receive a Robot Wars prize. The story that the judges vote to be best of the nine will be awarded the main prize of a remote controlled Matilda. Impress your friends as you spin this fearsome replica house robot around on the spot or drive her around your living room attempting to flip the cat. The eight runners up will each receive a different model replica drawn out of a bag at random – we have Sir Killalot, Sergeant Bash, Matilda, Dead Metal, Shunt, Chaos 2, Razer and Hypno-Disc, all to give away. To enter, cut out or photocopy the submission form and send it in, along with your short story, to the following address: Robot Wars Competition, Electronics And Beyond, 17/18 Glanyraion Enterprise Park, Aberystwyth, Ceredigion. SY23 3JQ. The closing date for the competition is 10th August 2001.

Submission Form

The name of my short story is:

.....

First Name: .....

Surname: .....

Address: .....

Postcode: .....

Phone Number: .....

E-mail: .....

◯ I understand that my story may be published within Electronics and Beyond and I agree to abide by the rules as set out below

Prizes courtesy of Robot Wars Stores – www.robotwars.co.uk

Rules: 1. The closing date for this competition is 10th August 2001. Entries received after this time will still be considered for publication within the magazine, but will not be eligible for the Robot Wars competition. 2. Entries must be sent in accompanied by the submission form or a photocopy of that form in order to be entered for the competition. 3. Illustrations may be included with short story submissions, but these will not be presented to the judges and so cannot in any way affect the outcome of their decisions. 4. By submitting the short story, the author agrees to having it published within the magazine, whether or not he or she is chosen as a winner. Entrants will not be paid in part or by full by the magazine for inclusion of their stories within the magazine. Electronics And Beyond has one-time publishing rights, so the copyright of the short story will remain in the hands of the author. 5. Judging will take place in the week after the closing date has passed. The nine best short stories will be selected by a panel of staff from the Electronics And Beyond offices and the story they agree on as the best will win the first prize. Runners up will each receive a different model robot to be selected at random by means of drawing names out of a bag. Winners will be notified by post, phone or e-mail after the final decisions have been made and their prizes will be sent out either with this notification or shortly afterwards. 6. Electronics And Beyond / Kanda Logical Devices staff, or their relatives, are not eligible to enter. 7. Electronics And Beyond accepts no liability for plagiarism – entrants who submit material other than their own do so at their own legal risk. 8. By entering this competition the entrant agrees to abide by the rules of this competition.

Solar CLUBS

DRIVING DOWN THE PRICE OF SOLAR WITH THE SOLAR CLUB NETWORK

Background

Environ, a Leicester based environmental charity, that works to encourage individuals, groups and businesses to take steps toward a more sustainable way of life.

In 1997, Environ, together with the Centre for Sustainable Energy (CSE) in Bristol, established the Solar Club. Initially based in Leicester and Bristol only, the Club supported householders in fitting solar water heating, by provided householders with advice and training on fitting solar water heating and offered access to discounted equipment from major manufacturers.

After very successful Bristol and Leicester trials, a total of 19 clubs have been established across the UK, run by local authorities, community groups, energy advice agencies and environmental organisations. Environ and CSE now share the role of developing and supporting this network of clubs.

Each club operates in a similar way: presentations, press releases and publicity events generate initial interest, and enquirers are invited to join the local club and attend a one-day training session. Members are advised on suitable installations for their home and supported through the process of ordering parts and completing the installation.

The Solar Clubs are run as a not for profit scheme to keep the costs to the individual to a minimum. The Solar Clubs work with manufacturers in the UK to promote the UK industry, and require that they are members of the Solar Trade Association.

Solar Clubs Concept and Aims

Through research carried out during the initial Bristol and Leicester study, the main barriers to a larger uptake of solar in the UK was not technological. The process involved is relatively simple and most system layouts are within the scope of a competent DIY enthusiast.

The barriers identified were primarily capital costs, lack of impartial information, a lack of understanding within the DIY sector of how to apply basic skills in a new context and a need for some professional input with the installation.

The Solar Club Network aims to overcome these barriers through bringing together interested householders to:

- Install solar systems themselves, supporting each other through sharing skills, labour, tools and equipment.
- Provide professional support at discounted rates, both by phone and through practical assistance.
- Pool purchasing power to provide bulk discounts.
- Make tools available for use by Solar Club members.
- Verify each systems safety and efficiency, through commissioning checks carried out by a professional.

How much will I save and how much will it cost?

In the UK people can expect to save around 50% of domestic water heating costs per annum. The exact amount depends on volume and pattern of hot water usage, by the household.

Solar Clubs charge fees to offset the administrative running costs, for those who wish to proceed with installing a system. These are set by the individual clubs and vary from £50 - £95.

A DIY system will cost you from £1000 to over £2000 depending on the system's complexity, layout and components used.

Warning!

As with double glazing and fitted kitchens, there are an increasing number of unscrupulous companies appearing in the market, such companies usually use high pressure selling techniques to sell expensive systems. Check that the savings promoted apply to the UK, not to sunnier countries in Europe. These companies could ask you to sign on the spot, and there can be a 40 – 50% cancellation fee in the small print. They may offer, a large discount or even a free system if you participate in a trial. But people must be aware of the following:

- A Professionally installed system should cost between £2000 – £4500 dependant on the size and type of system.
- Get three quotes before deciding.
- Ensure that the companies you approach are registered with the Solar Trade Association (STA), or approach the STA if you have any concerns or for advice. (See below for phone number)
- A reputable company should want to help and not try to force a sale and make you sign.
- A solar system will typically save you 50% on your hot water bill, NOT on your fuel bills.
- Always check the small print for terms, conditions and cancellation periods.

The Future of Solar Clubs

Due to the credibility of Solar Clubs and the discounts provided there has been a steady increase in enquiries from, businesses, community groups, local authorities, Housing Associations and others.

Strong links between Solar Clubs and local authorities are being established across the country. The West Yorkshire Solar Club at Hebden Bridge Alternative Technology Centre, has undertaken a feasibility study along with Kirklees Energy Services and the Energy Savings Trust to establish a solar grant scheme. This scheme aims to offer installed systems for £1100 and DIY systems for £850 for 200 homes in Calderdale and Kirklees in its first year, applying to residents of district councils.

This is a pioneering project that will hopefully lead for similar schemes across the country, and an increase in awareness and installations of solar systems.

So big panels and glass tubes should be a regular sight on houses in future. To save for the future, both financially and environmentally, embrace the sun.

For more information on the Solar Clubs Network contact the Solar Clubs Network using the contact numbers below.

Solar Clubs Network:

Åse Wilson 0116 222 0222 (Environ)
OR Mark Letcher 0117 929 9950 (CSE)

Solar Trade Association:

Chris Laughton 01908 44 22 90

WIRELESS of Yesteryear

by Mike Holmes

MIKE HOLMES REBUILDS A VINTAGE AM RADIO SET AND DISCOVERS THAT 1930'S TECHNOLOGY WAS RATHER MORE SOPHISTICATED THAN WE GIVE CREDIT FOR TODAY

PART 1

At the beginning of the year, I was given the opportunity to borrow a 1934 Ekco AC85 AM receiver with the aim of attempting to 'get it working again'. It belonged to a neighbour who in turn had recently been given it by another family member. Before this it had for several decades been banished to the attic after the original owner had acquired a radiogram.

In its favour this meant it hadn't been 'worn out', but unfortunately, since this attic was located in a marshy area noted for encouraging dampness, corrosion was the basis of the set's main problems (apart from one failed valve).

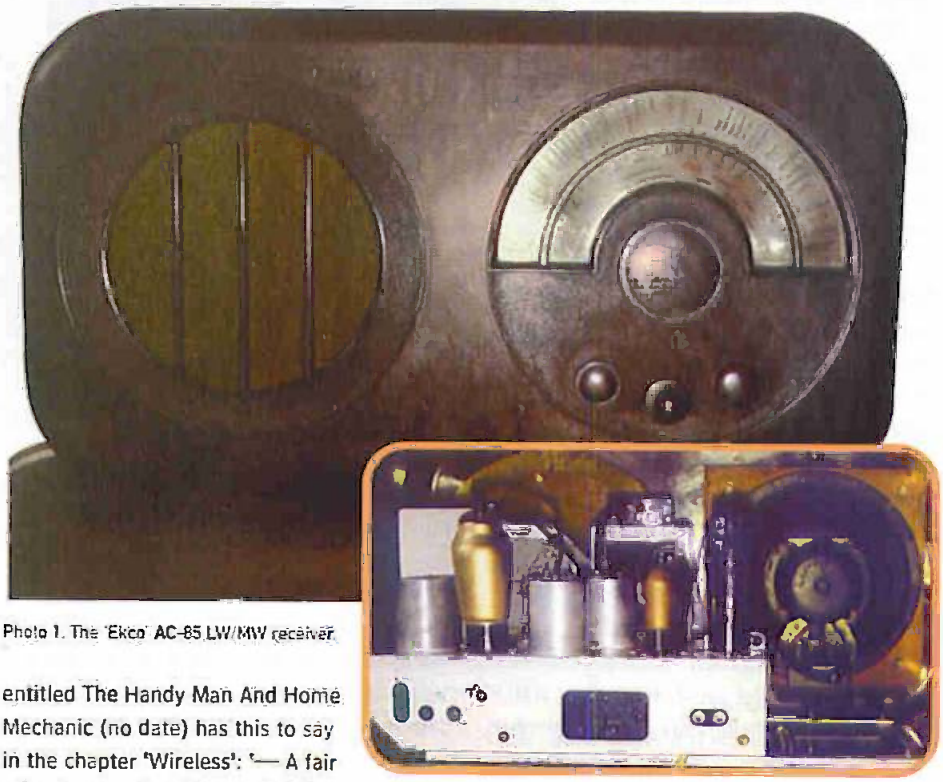


Photo 1. The 'Ekco' AC-85 LW/MW receiver.

Background

The two decades leading up to the Second World War were the heyday of 'wireless' world-wide, with many manufacturers cashing in on the boom. Among the British was E. K. Cole, giving rise to his series of 'Ekco' receivers, of which the AC85 (Photo 1) is so much a classic example of that ilk that today a number of radio museums possess at least one. Similarly it is also quite collectable; the current owner has at least been offered £300 for it even in a non-working condition.

Photo 2. Back-panel legend.

As regards its worth at time of manufacture (1934), a contemporary book entitled The Handy Man And Home Mechanic (no date) has this to say in the chapter 'Wireless': '— A fair price for a mains-driven set of the superheterodyne type varies from £12 upwards, according to the number of valves, while reliable battery sets can be obtained for about £10 including batteries —'

To put this into a modern context you need to multiply those values by 50, so think of some sort of modern home entertainment system costing in the region of £600 — £1000 and you get an idea of the outlay that was involved. It is easy to understand, therefore, that homes in possession of a wireless set rarely had more than one. Furthermore a receiving licence had to be purchased, costing 10 shillings.

As an aside it should be pointed out that battery sets had nothing to do with portability. Many homes were still without a supply of electricity in those days, or if they had one, it might be DC instead of AC, depending on regional differences. Consequently the back panel legend of the AC85 explicitly states 'For AC mains' (Photo 2). Moreover this came in three basic flavours: 200 — 210 Volts, 220 — 230 Volts or 240 — 250 Volts.

Features

So, what did the proud owner of a new AC85 get for his money? Firstly, a proper superheterodyne type of AM radio receiver, which was still a fairly novel innovation at this time and truthfully a 'state of the art', since not many years earlier the trend had been for valve assisted crystal sets and simple TRF type receivers. Only Long Wave and Medium Wave bands are catered for, these being all that were normally available for commercial traffic. (There was no VHF or FM or anything like that, and although Short Wave bands probably existed, they were most

likely populated with CW Morse Code.)

For added value, however, the designers included a couple of 'extra features': the ability to add external loudspeakers, and also to play records through the audio amplifier. With these the AC85 could then form the hub of a broader sound system.

First Impressions

In view of the large initial purchase cost it was, therefore, a bit of a shock to discover evidence of cost-cutting, 'bodging' and plain ordinary mistakes in the construction. Apart from one dry joint (one end of C5 in Figure 1), most of the latter applied to the loudspeaker unit (more about which later).

As far as cost-cutting is concerned, the most obvious item is the case, a single Bakelite moulding streaked with black dye to emulate a polished, dark wood effect. Doubtless there were contemporary critics who bemoaned the sacrilege of using 'plastic wood' in place of real wood, but obviously much quicker and easier to create. The case bottom is reinforced with two steel rails to carry the weight of the chassis, which is fixed in place by four 4BA screws.

The main chassis itself was pressed from a single sheet of steel and includes front and rear panels only, being fully open on all other sides. There are two thick, flat bars welded transversely across the bottom for it to stand on. This was lightly covered in an extremely bland, battleship-grey paint (but typical). Valve holders are secured with rivets, implying that the chassis with sockets already attached arrived at the assembly line as a complete unit.

Speed obviously took precedence over neatness for installation of the components, hence the interior is a right old spider's nest of loose wiring, and connections were rarely wrapped around tags before soldering. While printed circuit boards per se were unknown at this time, it is nevertheless interesting to note the use of a number of square plastic boards, perforated rather like prototyping boards, used to carry groups of components.

The chassis itself is used as a universal earth bus, hence several fixing nuts include solder tags as earth points. Cost obviously prohibited electrical insulation beyond the absolute minimum, so that for example the two valve top connector clips are totally exposed, of which one carries the full HT, and there is a perturbing amount of bare metal connected to the mains.

Restoration

Photo 3a shows the state of the chassis on initial removal. Most steel items had at least some rust, quite bad in places, including the speaker (but fortunately confined to the upper surfaces, so the chassis interior was still in good condition). Aluminium was coated in white oxide and all bare brass and copper parts were black (if not actually green). In addition the inevitable carpet of fluff that high voltages unerringly attract had been reduced by the damp to a disgusting black layer of filth that covered most horizontal surfaces.

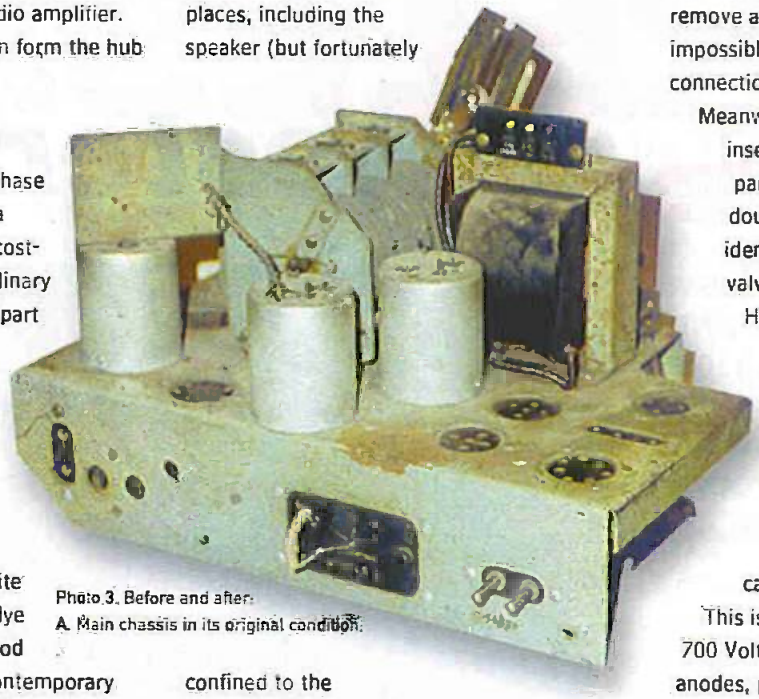


Photo 3. Before and after:
A. Main chassis in its original condition.

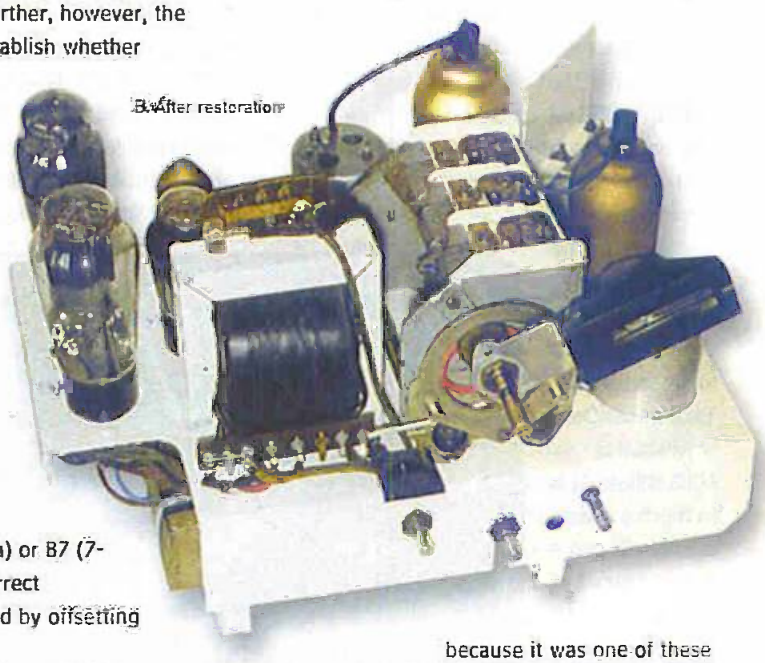
Before going any further, however, the first hurdle was to establish whether replacement valves could be sourced. The AC85 has six valves (see Photo 4), all early types with 4 Volt heaters and which have already been obsolete for several decades. The base sockets are archaic, preceding even International Octal, being either B5 (5-pin) or B7 (7-pin). In each case correct orientation is achieved by offsetting two of the pins.

As an aside, in each case for V1 to V3, what looks like gold or silver paint actually covers a layer of aluminium deposited onto the outside of the glass as a metal screen. Prior to this much less convenient, separate screening cans had to be added.

One valve was already known not to work (V5), but it transpired that two others were also non-operational. The top connector of V2 was broken off, possibly due to an attempt to remove a clip stuck with corrosion. It proved impossible to repair the internal wire connection since it is embedded in the glass.

Meanwhile V3 had been mistakenly inserted into the rectifier socket. It was particularly unfortunate that it is a double diode with pin-outs virtually identical to those of the actual rectifier valve V6, because this had enabled the HT to reach the cathode and thence punch through the heater insulation in an attempt to complete its circuit (V6 has no separate cathode pin, it is combined with one of the heater pins). This left the heater of V3 permanently connected to cathode, rendering the valve useless. This is, by the way, quite apart from the 700 Volts AC that were applied across the anodes, producing an audible arcing that the owner described as 'spluttering'.

Three new valves were therefore needed, and the next problem was correct identification. V1, V3 and V6 were still clearly marked, but the legends for V2 and V4 were completely missing, while that for V5 was partially obliterated. At this point I ought to mention that I am indebted to John Mosely for unloading his valve data books onto me,



B. After restoration

because it was one of these that contained all the answers! By matching the most likely valve type, pin-out diagram and heater voltage, V5 (the failed valve) eventually answered to the name of the PenA4 power output pentode.

V2 was either the VP4A or VP4B. Tracing the circuit established that the top connector

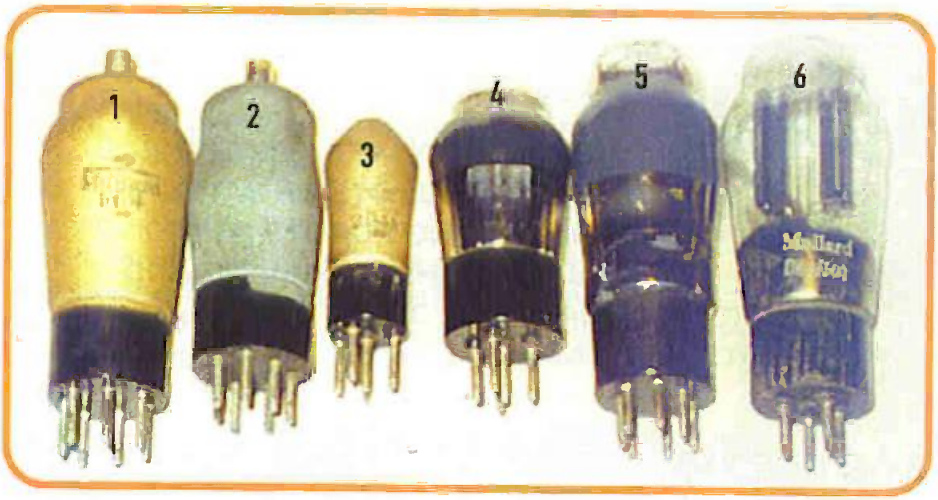


Photo 4. Valves line-up: originally 1. FC4 octode frequency changer; 2. VP4A variable-mu penlode (damaged); 3. 2D4A double diode (damaged); 4. TT4 triode; 5. PenA4 power output pentode (failed); 6. DW4/500 full-wave rectifier.

is anode, meaning it is the VP4A version (in the B version top connector is signal grid). Finally, V4 resolved itself to be the TT4 as the closest match.

It so happened that direct replacements for V2 and V5 were readily available from old stock in the possession of The Chelmer Valve Company www.chelmervalve.co.uk, and at some length V3 was finally located at Crowthorne Tubes of Berkshire (found on the Internet as www.crowthornetubes.co.uk. Restoration could then proceed, commencing with a lengthy process of dismantling, cleaning and repainting of major components.

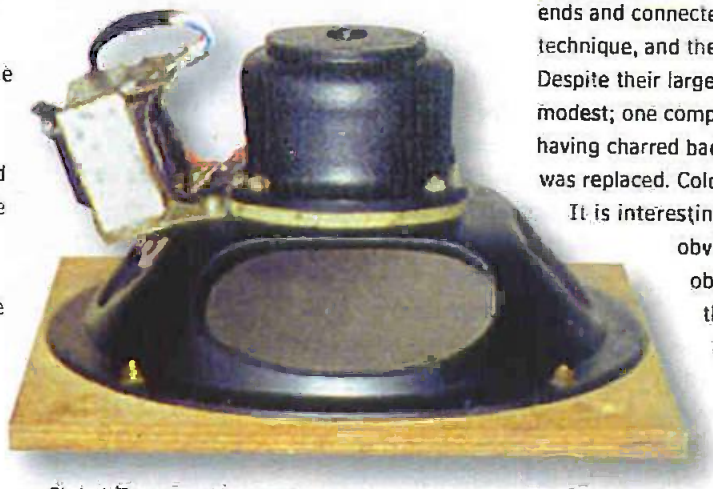


Photo 6. The restored loudspeaker sub-assembly on its plywood baffle.

Problem Areas

With the aim of re-energising old equipment of this sort, the greatest danger is that of wire insulation. Typically this is rubber, as there were no flexible plastics at that time, but being organic in origin rubber perishes with age and becomes brittle, so it merely cracks and falls off as soon as the wire is flexed. All such wires should be replaced with modern, plastic coated equivalents.

Fortunately very few wires in this receiver were rubber sleeved. Most point-to-point wiring is single-core copper, insulated — quite elaborately by modern standards — by a woven cloth sleeving. Underneath this there is an additional layer of whitish material of uncertain composition, but still sound. Colour coding of a sort exists, but is limited to green, yellow, red and, occasionally, white.

Another possible source of trouble is the poor quality, by modern standards, of passive components. Again due to an acute lack of suitable plastics, many capacitors use waxed paper dielectrics with attendant current leakage problems. Small values appear to be mica or ceramic dielectric types encapsulated in Bakelite.

There are only two electrolytics acting as HT reservoir and smoothing filter for the power supply, both sharing the same negative plate and combined in a rectangular block of a white, waxy substance. Strangely, the whole is then enclosed in a cardboard carton.

This 'condenser pack' appears not to be original, more likely replaced as a repair. One clue is that its three rubber leads are still perfectly sound, another that it was very loosely tied in position with a piece of string looped around two other components. At least I hope it did not leave the factory like that! Lastly, the two positive leads were connected the wrong way round; the smaller value (8μF) being used as the reservoir (should be 16μF). These were duly swapped around and the pack better secured to a mounting rail with plastic tiewraps (see Photo 5).

Resistors are enormous and appear to consist of carbon film deposited onto ceramic rods or tubes measuring approximately 1 x 0.25 inches. Leads are wrapped around the ends and connected by a metal plating technique, and the whole insulated in paint. Despite their large size, power dissipation is modest; one component (R1 in Figure 1) having charred badly due to overheating and was replaced. Colour coding is very strange.

It is interesting to note that it was obviously very difficult to obtain values much less than 1 kilohm with carbon film in 1934, since all resistors less than a few kilohms are of a completely different construction, comprising flat, rectangular paper envelopes most likely containing resistive wire.

Next Month Mike will start by looking at the circuit of the Ecko AC35

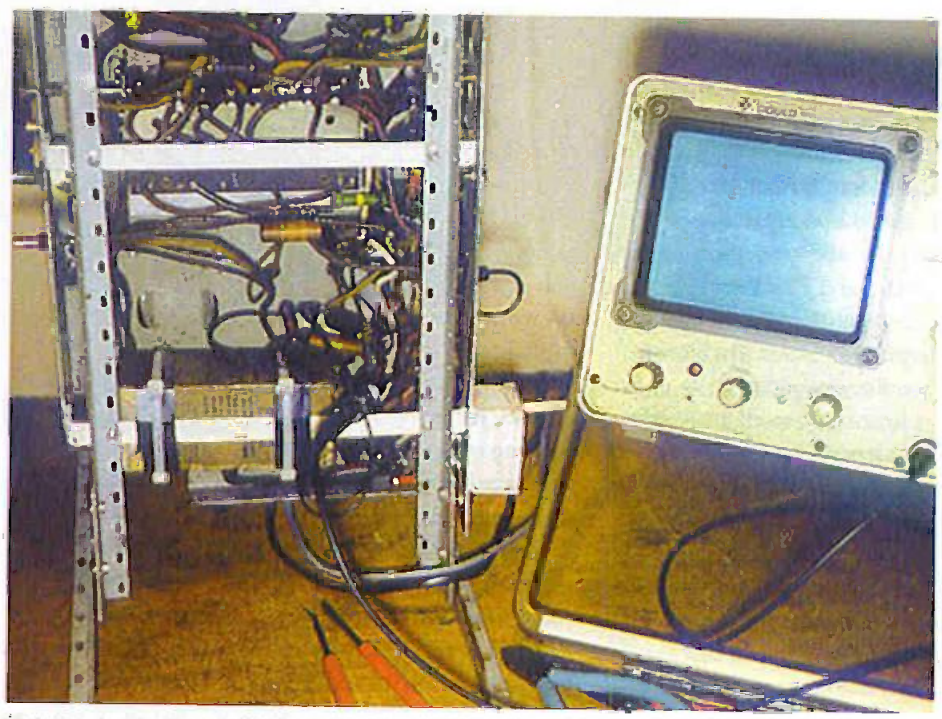
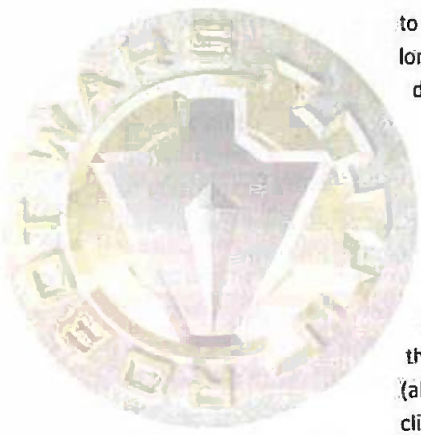


Photo 5. Underside of chassis showing components. Note fabricated support stand for all round access while powered up.

web electronics

THIS MONTH IN WEB ELECTRONICS WE BRING YOU LOTS OF BATTLING AND SLITHERING ROBOTS AS WE TAKE YOU INTO THE INTRIGUING AND EXCITING REALMS OF ROBOT WARS, BATTLEBOTS, AND SNAKE ROBOTICS.

Robotics bring ordinary toys to life and offer fun for all the family, crossing all age barriers and giving each individual the chance to test their own personal competencies and learn new skills. From the beginner to those well-versed in the field, we hope that this month's Web Electronics has something to offer you all as you enter the challenging field of robotics.



Robot Wars Official Web Site

Electronics And Beyond has gone big on Robot Wars this issue, with special features in the What's On and Product Review pages as well as a fantastic competition in which you can win Robot Wars merchandise courtesy of the Robot Wars Stores. The official web site www.robotwars.co.uk is, as you would expect, the place to go to find out more about the series and the robots that compete in it.

The Intelligence section contains technical datasheets, judges' biographies, and, most importantly, information, pictures and statistics on participating robots from the series. At the moment, however, information about the series 4 finals and the entirety of series 1, 2 and 3 are remarkably notable by their absence. There are links to the competitors' own web sites, although they are not directly accessible through these pages – you just have to go through the Links menu in order to get at them, but there is a very long list to choose from when you do. The House Robots section is a bit sparse, however, and could benefit from a bit of extra information as to how the robots were designed and built.

Comms is where you can log on to the discussion board (also available by clicking on Forum), which contains literally thousands of messages on just about every connected and unconnected topic you can imagine. There is also a live chat room, only don't try it early in the morning or you might end up talking to yourself. The Backroom is where you can get put onto the free Robot Wars emailing list, Recruit is where you can register for the Robot Wars Club, News is self explanatory and Video is where you can watch video trailers and Robot Wars footage online. The final main link on the home page is Stores, and you can learn more about the range of merchandise available through the Robot Wars Stores by reading the section in Web Electronics devoted to them below.

All in all, the Robot Wars site is a site that everyone who watches the TV series should look at. The Links page is a very useful resource especially, as through these links anyone who is interested in building their own robots can go to the web sites of previous competitors and find out more about their designs and participation experiences.

Robot Wars Stores

You may already have read the product review for the range of Robot Wars models and remote controlled replicas available through the Robot Wars Stores elsewhere in this issue. Rather than repeat what has already been said, here we will take a quick run through the rest of the merchandise that is available – because there is, when all said and done, quite a lot of it!

There are videos available – 'The First World Championship' and 'The First Great War', a Robot Wars game for the GameBoy Colour, an official guide to series 4, a robot tool, tee-shirts, ski hats, baseball caps, a wallet, signed photos, posters, metal badges, sew-on badges, key rings, and even Robot Wars coasters!

The most notable items in the shop, with the exception of the remote-controlled and pull-and-go models of course, are the Nokia 3210 and 3310 mobile phone covers (£15.99 each).

Good things to buy if you have one of those particular models of phone.

There is a brochure available through the site that can be sent to your door, and if you want to see the items in the real (non-virtual) world, there is also a Robot Wars Shop, which you can visit at Tottenham Street, London W1A 3AR (open Monday to Friday, 10am-5pm).

The Robot Wars Stores home page can be accessed through the official Robot Wars web site, or directly at www.robotwars.co.uk/robo-shop/shopindex.html.

their own robot for whatever reason.

There are also lists of parts and materials, along with links to the web sites of commercial companies you can buy them from. Other interesting articles include a page where one of the competing teams share their experiences of finding sponsors (not allowed in the UK version).

There is also a store, with posters, videos and tee-shirts. No replica house robots however – Battlebots doesn't have any – instead it has a hazardous arena full of killsaws, ramps, spikes and hammers. This 'battlebox arena'

Battlebots On The Web

The viewers of UK Robot Wars have only recently been introduced to America's Battlebots, and www.battlebots.com is a good place to learn more about the history of the programme, its rules and competitors.

Like the Robot Wars site, it has a broad range of material. There are pictures, statistics, match histories and builder/team biographies for all the robots featured on the programme. Its frequently asked questions page (in the press area) is appropriate for UK viewers who might not realise that the show had a history before it was picked up by the Comedy Central network. The pages featuring 'tips from the pros' are useful not just for people who want to build their own robot for competition, but also for those who want to build is also explained in full detail on another page of the web site. An archive covering all the previous events, not just the most recent one, is promised for the near future.

Snake Robots

Dr. Gavin Miller is a member of the research staff at Interval Research Corporation, California. His research interests include realistic rendering of natural phenomena such as terrain, trees, sky, fur and water, as well as interactive computer simulations and the semi-automatic generation of realistic creature motion. He also runs a web site dedicated to the robotic snakes he builds, created from scratch from his own designs.

These remote controlled robots move just like real snakes, and you can see this for yourself by watching the MPEG video clips provided. There are four different snakes on the site, and these have their own pages along with component details and comments.

One of the snake robots was used as the ring bearer for Gavin's wedding (see pic)!

Gavin has formally presented his snake robot research at the year 2000 conference on Neurotechnology for Biometric Robots, and his site has sparked off discussions with the NASA

Ames team creating the Serpentine Robotics Project (see next feature). He also has links to other snake robotics sites, and his web site can be called up at www.snakerobots.com.

Serpentine Robotics Project

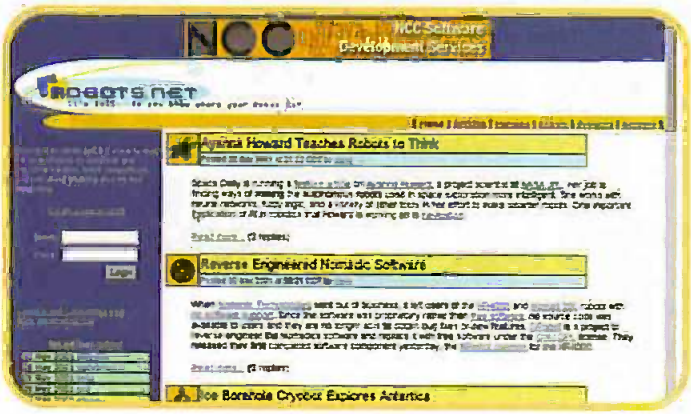
The NASA Serpentine Robotics Project was set up because of the obvious advantages that snake-like robots can bring. They are inherently stable due to their low centre of gravity, offer greater flexibility than a wheeled robot, and can move more robustly and effectively than wheeled or legged robots can.

To quote from the site, 'The unique qualities of a serpentine platform make it capable of digging in loose soil, crawling into existing fissures, and using grasping or springing for special environments like micro-gravity and boulder fields. In addition because they are modular, serpentine robots have the added advantage of being relatively cheap and robust to failure because they are mechanically redundant. The entire mechanism can be sealed in a protective skin making it resistant to harsh chemical, thermal, or abrasive environments.

Like the snakerobots.com site featured above, there are also video clips to watch and links to other snake robot sites on the Internet. This site is a very good place to go to learn more about snake robots – the quote above comes from a thousand word page outlining the rationale behind the project and their plans for the future. http://ic-www.arc.nasa.gov/ic/snakebot/hello.html to access this web site.

Robots.Net

Robots.Net is a site that is dedicated to delivering up to date robotics news, showcasing robotic projects and giving all those with



an interest in robotics a platform to share their comments and ideas.

In its own words, 'Robots.Net uses a community-based trust metric system in which each user certifies other users. In order to certify others or be certified yourself, you'll need to create an account. Initially, your account will have Observer status until you are certified by other users who know you. After you are certified, you will have access to additional features on the site such as posting replies to articles or even posting your own articles'.

The trust metric system used by the site is designed to provide a security infrastructure that resists hackers, spammers, etc. One user certifies another by first logging in, then going to the link with that person's name on, clicking onto the page, and using a pull-down menu to select the certification level he or she believes is appropriate for that person. There are five levels: Observer (new user), Apprentice (those interested in learning more about robotics), Journeyer (someone who is actively involved with robotics), Master (someone who has accumulated a high level of real-world experience in one or more areas of robotics through extensive participation), and System Administrator.

The casual web surfer will be pleased to know that you do not have to create an account to browse the gallery of robots that is also available on the site. There are over 100 robots of all conceivable types, all with pictures, statistics and comments. Many of the pages also feature the e-mail addresses of the robots' creators, so that you can get in touch with them should you have any questions you want to ask. If you want to see more robots still, there are some links to other robot galleries available through the gallery's main index.

The site won two awards in April of this year - About.com's AI Best of the Net Award and NASA Robotics Education Project's 'Cool Link of the Month'. You can visit it at www.robots.net.

Seven Sites

In this new feature of the Web Electronics section, we invite you the reader to send in the Internet address of your own personal or company web site. Each month, we will pick out seven of these sites at random and publish their URLs within the magazine for other readers to type in and visit. All you have to do is send the details in an email to jaldred@electronicsandbeyond.com with the number 7 in the subject line. As well as the address of the site, you should include its name, classification (Personal, Community, Educational, Commercial) and no more than twenty words in explanation of what is in the site or what the site is about. The feature will run from the September issue onwards.

WOMEN in the ENGINEERING INDUSTRY

by Kaitlin Duck Sherwood

THIS ARTICLE DESCENDS FROM A TALK I GAVE TO THE SOCIETY OF WOMEN ENGINEERS AT UIUC. I HAVE TRIED TO TRANSLATE FROM THE SPOKEN WORD TO THE WRITTEN WORD, BUT SOME THINGS MAY NOT HAVE MADE IT OVER PROPERLY.

Being a woman in engineering industry is different from being a man in engineering industry. Not better, not worse, but different. I'm going to try to talk about the things that are going to annoy you and help you when you get out to The Real World.

Please note that not everything I am going to say will apply to everyone here. (Many of them don't even apply to me, as a relatively tall women with very masculine speech patterns.) These are rampant generalizations, but I can't talk about anything interesting if I don't generalize.

Physiology

Men and women have physiological differences, as you may have noticed. You would think that this shouldn't make any difference in the workplace, but it does.

Temperature

Women, prepare now for being cold at work for the rest of your life.

Those of you who have taken thermodynamics know that heat production is a function of volume (radius cubed), while heat dissipation is a function of surface area (radius squared). So the generation to dissipation ratio goes as the radius, and so the smaller you are, the colder you will be. Furthermore, because women menstruate, they are more prone to anemia, which can also make you cold. I've also read that women have much tighter tolerances on their core temperature regulation, to provide for a better growing environment for potential fetuses. So when a woman's core temperature drops by a little bit, all the blood gets sucked back from the extremities to the core. When men's core temperature drops by a little bit, and it just sits there, no problem.

•Toss in that the ultimate control over building thermostats usually lies with large, well-fed men in three-piece suits in south-facing window offices, and you're going to be cold a lot. When I was working, I would always bring a coat to work with me, even in the height of summer.

Now, before you run and slap the next guy you see for being so insensitive, note that men are frequently hot - especially in a tie and a nice wool suit! Furthermore, I've seen some things that lead me to believe that part of why women live on the average eight years longer then men is their superior temperature regulation system. I don't know if this is true or not, but believing it gives me great comfort. On bad days I can sit there and think evil thoughts about the men in charge of the thermostats: 'I may be freezing, but you're going to die!'

Carpal Tunnel

In addition to being colder, women in my experience seem to be more prone to carpal tunnel syndrome. I have a friend whose theory is that because men's shoulders are wider and their handspand greater, they don't have such a big excursion when hopping from keyboard to mouse or reach for funky keys. My anecdotal evidence is that the Sun keyboards with two keys between semicolon and return are the worst, by the way.

It may also be that tables and chairs are the wrong size for people who are substantially bigger or smaller than the average. This can lead to neck strain, back strain, eye strain, brain strain, whatever. If you start getting any of these problems, deal with it right away. Repetitive stress injuries don't go away with time, they get worse. Ask for a monitor stand, a different chair, put your computer on a box, the floor, get a new desk, whatever. And don't feel bad about asking for this: a new desk and chair is cheaper for the company than two years of physical therapy.

(See also Computer Related Repetitive Strain Injury.)

Language

You do need to be careful about how you ask for a more suitable workspace, and this brings me to the other major difference between men and women: language.

Phrase Everything As A Win-Win

Do not walk into your boss' office, throw a hissy fit, and say that you need new furniture NOW! Negative style points. Whenever possible, explain your ideas in terms of how they would benefit the other person, not how they would benefit you. Women tend to be more sympathetic, so tend to expect sympathy more readily. Forget it. You have to make them understand why they want to do what you want them to do.

Learn To Say 'No' Well

You also need to be able to say 'no' well. If the boss says, 'We'd like you to write a statistical process control package for our line in one month', the appropriate response is not 'you're out of your mind', nor is it 'that can't be done'. The appropriate response is, 'Well, we could do that, but only if we hire about five contractors and rent six computers for development.' It may be that the project is important enough that they are willing to do just that.

If your boss really pushes you and basically tells you that you have

to do it all by yourself in a month, you need to tell your boss, 'I will do the best I can to get this done in a month, but let me go on record as stating that I feel that this is a schedule aggressive enough that it is not possible for anyone to do.' If you can back that up with examples of time-to-completion for similar projects, even better. Put it in writing and keep one for your files, even better.

This is very important. The saddest case I ever saw of a woman not fitting into the culture was one of the sweetest women you'd ever want to know. She was universally highly-regarded technically. And she had a reputation for being very difficult to work with.

She is so sweet that when they ask her to do impossible things, she'd end up capitulating relatively easily because she wanted to be nice. She'd work her brains out, day-in, day-out, evenings, weekends, all the time, get all frazzled. Then when it got close to deadline and it wasn't ready, they'd start to come down on her, and she would just explode. She'd go totally non-linear. And nobody would understand what set her off. So she'd get nailed for being hard to work with.

This obviously was extremely frustrating for her, so it would be even worse next time. It was very sad. Here was a human being who spent a lot of time being very unhappy and a company that lost a great resource. Moral of the story: learn to say no! And if you can't say no, you'd better be darn-shootin' sure to keep your boss well apprised of your progress.

Speak Up!

In general, you should not wait for people to poll you for your opinion, for your status, for your needs and desires. You have to speak up and tell them yourself. There is a scholarship in General Engineering - the Elizabeth Ruff scholarship - whose description basically says that it is for sweet, unpretentious, unassuming girls. (Yes, it really does say, 'girls'.) I read the criteria and said, 'Whoever wins this has my deepest sympathy. This is practically a recipe for failure in the engineering workplace.' Especially in meetings, you can't wait for them to say, 'Now, Marilyn, how do you feel about this?' You'll have a long wait.

Expressing Certainty

Also on the subject of pretentiousness, I have a friend who observes that if a man thinks the answer is three, he'll say, 'The answer is three.' If a woman knows the answer is three, she will say, 'I think the answer is three.' Women tend to be more tentative. This is not necessarily bad - you may end up with higher credibility than the man who keeps insisting that the answer is three when it is really is seventeen... but you might look wishy-washy.

Don't Take It Personally

Men also take things a lot less personally. They will yell and scream and call each other bloody idiots over a technical point, then go have a beer together. The fact that someone doesn't like a particular idea of yours does not necessarily mean that they don't like or respect you. They just may lack diplomacy. If someone is in your face, it's probably because he or she feels responsible for but not in control of something. This is a deadly combination.

If some guy gets nasty with you, do what I do: assume he had a fight with his wife, got into a fender-bender, has to come up with $3000 to fix his roof, and left his wallet at home. Then feel sorry for him and see if you can make his day better.

This can have some very nice outcomes. This guy who was famous for being abusive barged into my office, just livid, and started beating on my desk with his fist. 'Your goddamn groupcan'tdoshitright @#$*((R*@&$# (*#$&!' I let him rant and rave until he wound down, then said, 'Yeah, well, we very well might have screwed up, let's take a look at it.'

That stopped him dead in his tracks! He was so braced for a fight that he didn't quite know what to do when I wouldn't fight back. We looked at the code, and it turned out that he had screwed up. I showed him what he had done wrong, explained what he needed to do to fix it, and told him that if he would go fix it right away, I'd stay late to personally oversee my group's part of it so that it would be ready to move on first thing in the morning.

It was priceless! He just sort of slunk away and never gave me any trouble after that. My friend Anne reports a nearly identical occurrence with Customer From Hell, so it wasn't just me.

Accept Blame Properly

Accepting guilt can be really useful. Not just for defusing cases like that jerk, but also for establishing credibility. If you say, 'Yeah, I screwed up' when you do screw up, then when you say, 'No, that was not my fault', people will believe you.

Now, when you do accept blame, DO NOT GROVEL. DO NOT MAKE EXCUSES. I worked with a woman who would spend five minutes apologizing for a screwup... and then make the exact same screwup next week. Contrition and excuses are not useful: I want the problem resolved.

When accepting guilt, do the following:

- Make a brief statement of contrition,
- accept guilt,
- explain briefly how you are going to solve the immediate problem, and
- explain how you are going to prevent this from occurring in the future.

For example:

'I'm sorry,

I didn't clearly explain to Mike which include files to use.

I will personally go rebuild the kernel now - it should be ready at about 4:30.

I'll also go put a comment in the README file about which include files to use.'

(Note that if a subordinate screws up, you accept the blame as being your fault. If they did something wrong, you didn't train them right, you didn't give them adequate instructions or equipment or something. If you blame them you look like a whiner. If you protect your people, however, they will follow you through the depths of hell.)

Insecurity

Now, some people get really nervous about the idea of admitting guilt, being afraid that it will make them seem less competent. Here's what you need to know:

#1: Everybody screws up.

Everybody. It happens all the time. I know you are all freaked because you've all had profs who gave zero partial credit on the grounds that if the sign is wrong, the bridge will fall down. This is true, but there are an enormous number of checks in the real world to make sure that the sign is not wrong.

You design, then simulate, then redesign, then simulate again, then prototype, then test, then redesign, etc. etc. etc. Engineering is an incredibly iterative process, and it is that feedback loop that keeps the bridges from falling down, NOT that everybody but you does everything right the first time.

#2: EVERYBODY is insecure about their job performance.

I read an article in Psychology Today when I was in college that interviewed people at all different levels of corporations. They were surprised to find that the higher you went in a corporation, the more successful people were, the more insecure they were about their jobs!

There was a real strong fear among high-placed people that someday they'd be found out! That everybody would suddenly realize that they were totally clueless! Moral: nobody has a clue, so relax already.

#3 The most successful people are NOT those who screw up the least.

The most successful people are those who learn best from the screw-ups they make, and act fastest to make amends. I was at a startup that was very careful about who they hired. They only tended to hire people who had always had raging successes. Unfortunately, this left them ill equipped to deal with a troubled project.

My friend Anne says, 'I have been on some large, highly successful projects, but I didn't learn as much from them as I did from the small, disastrous projects (which failed because they were small and we thought we didn't have to do all the stuff you have to do for a big project — WRONG!)'

I know someone else who observed that at Intel, the people who were on projects that failed miserably eventually ended up as corporate VPs - because they had learned so much more than their colleagues whose projects had succeeded.

It's very difficult to examine a success and figure out why it went right. It is much easier to take a failure and figure out why it went wrong. So look at your screwups as valuable learning aids!

Measure Your Job Performance

Now, this doesn't mean you shouldn't pay attention to your job performance. It is a really good idea to figure out some way of measuring your performance - something, anything. My friend Anne quoted Gilb's law (from the book Peopleware): any measurement you make is better than no measurement at all.

I'd advise as a minimum generating weekly status reports (regardless of whether your boss asks for them or not). Mention what you are working on, why it has taken you longer than you thought (because it always does), what would help you in terms of equipment, cooperation from other departments, etc.

Benefits of Being Female

There are some benefits of being a woman surrounded by men.

Men Like Women

Most men like women. It's a strong evolutionarialy favorable trait. So all other things being equal, you may well get more cooperation from men than they would give to other men. Part of this also is that men can be really territorial around other men. They can play all kinds of status games with each other that can make them real jerks to other men. Women by and large not only don't play those games, they are oblivious to the fact that they are going on. This means that men can usually relax more around women.

Being Remembered

Because there are relatively few women around, if you are the only woman in a meeting of thirty, guess who the Vice-President is going to remember? Yes, you will be more exposed. Yes, your screw-ups will be more visible. (I don't remember who said it, but I liked the quote: 'Women have not yet achieved the right to be mediocre.') But your successes will also be more visible.

Exploiting the Underground Economy

Women also tend to be more empathic and more diplomatic, two traits that are highly useful in collaborative efforts. Companies are all dependent upon what I call 'the underground economy'. This is an economy based on personal ties that has nothing to do with the formal power structure.

This is what I invoke when I get on the phone and say, 'Psst! Hey Dottie! I got a sputtering system down, and I need some oxide wafer to qual it and bring it back up. The fab manager is breathing down my neck, but hotwall is down and can't get me any wafers. Can you get me about twenty oxide wafers?' And then Dottie shows up five minutes later, slips me a box of wafers, and says, 'Here you go. Don't ask where I got them.' (It isn't that she stole them from somewhere, it's that company policy frowned upon hoarding wafers. I presume that she knew a technician who had some oxide wafers in his or her desk that were left over from some experiment, and she called in a favor from that tech, and I ended up with wafers.)

This kind of thing happens all the time in The Real World. Frequently the unit of exchange is not physical, it is information. Also, exchanges don't even necessarily stop at company boundaries. I have friends call me up and say, 'My boss is afraid to use an aluminum casting for this part because he says it won't be waterproof. What the hell is he talking about?' Or I call up friends and say, 'Honey, sweetie, darling, I'm having trouble with my computer and I think it has to do with file locking; could you explain to me again how file locking works?'

I think that all other things being equal, women tend to be better networkers, because they do tend to pay attention to other people's needs.

The Rules

Women have a lot fewer rules that they have to follow. Men are practically handed a rule book at birth and told, 'If you break these rules, you will be Not Taken Seriously.'

Women used to have a whole set of really rigid rule as well, the whole barefoot and pregnant routine, uncomfortable shoes, etc. That finally became so unbearable that The Rules got challenged to the point where it is common for them to be broken. The remnants of The Rules still linger, and give women all kinds of grief, but if you think you are oppressed, think about all the Rules men have to follow!

- If you weigh less than 200lb and are less than 6' tall, you may not wear pastels.
- You may only wear a skirt or dress on Halloween.
- You must wear a tie to formal occasions.
- You may not be neutral about The Super Bowl.
- You must always have a job.
- You may NOT stay home and raise kids.
- You may not touch another man, unless your are thumping him on the back, shaking his hand, punching his lights out, or participating in a sporting event.
- You are allowed to exhibit only one feeling: blinding anger.

For example, I have one friend who had large sums of money in the bank and didn't like his job. I told him he ought to quit his job and go travel around the world. He rather liked the idea, but couldn't. He absolutely could not bear the idea of someone asking him, 'Where do you work?' and not having an answer.

Men are starting to notice that they have all these Rules, and are starting to rebel: asking for custody of children, staying home, wearing pink, but as we know, it is a slow path to equality.

About The Author

The author is an expert on Internet communications and how to explain them.

Her email writing guide, A Beginners Guide to Effective Email gets 600,000 hits per year, she has written 2 email programs .
She won a GNN Best of the Web award in 1995
Log onto www.webfoot.com for more information about the author.
Any comments on this article, please direct at the Editor...

On Guard LOOP ALARM

by Mark Price

PART 2 OF A CLASSIC PROJECT FIRST PUBLISHED IN ISSUE 109 JANUARY 1997. THIS MONTH WE LOOK AT CONSTRUCTION AND WIRING.

The circuit is constructed on a single-sided PCB which is designed to fit into the guides in the recommended case – refer to the PCB legend and track drawing, shown in Figure 4. PCB assembly should be carried out following the normal guidelines and recommendations.

There are several wire links which should be fitted first. IC sockets should be used for the ICs, as they are static sensitive. Do not fit the ICs into the sockets until all other components have been fitted.

SK1 to SK5 are PCB mounting terminals, and should be fitted with the cable entries towards the edge of the PCB. The LED needs to protrude through a hole in the case, so you may prefer to wait until after the case has been drilled so that you can get the leads the right length.

AWD1 must be fitted with the correct polarity. You may prefer to leave this out until after the circuit has been tested as the noise can become rather irritating (particularly for others). If the relay output is not required, omit RLY1 and R21.

When construction is complete, the PCB should be cleaned with a suitable solvent to remove the flux. At this stage, it is a good idea to check your work, in particular, the soldering.

Assembly

The general layout of the components in the case may be seen from the photographs. Looking from the rear, the alarm sounder is positioned as close as possible to the left to leave sufficient room for the battery to stand beside it.

The sounder is held to the base of the case with two M3 countersunk screws and nuts. Part of one of the PCB guides should be removed so that the sounder sits level. Fitting the sounder will require a pair of long-nosed pliers to hold the nuts – and some patience! A pattern of holes should be drilled in the case in front of the sounder (before the sounder is finally fitted) to let the sound out.

The PCB is fitted in the second set of slots from the top with the components downwards. A 5mm hole is required for the LED. The keyswitch may be fitted midway between the PCB and the sounder. On the prototype, the phono sockets for the Loop were fitted to the side of the case above the sounder.

Additional holes will be needed for the cables connecting to the remote sensors. The layout of the components within the case is not critical and may be varied to suit individual needs. Check that everything will fit inside as you intend before drilling any holes.

The prototype was attached to the wall by means of two keyhole shaped holes in the rear panel (lid) of the case. The unit can,

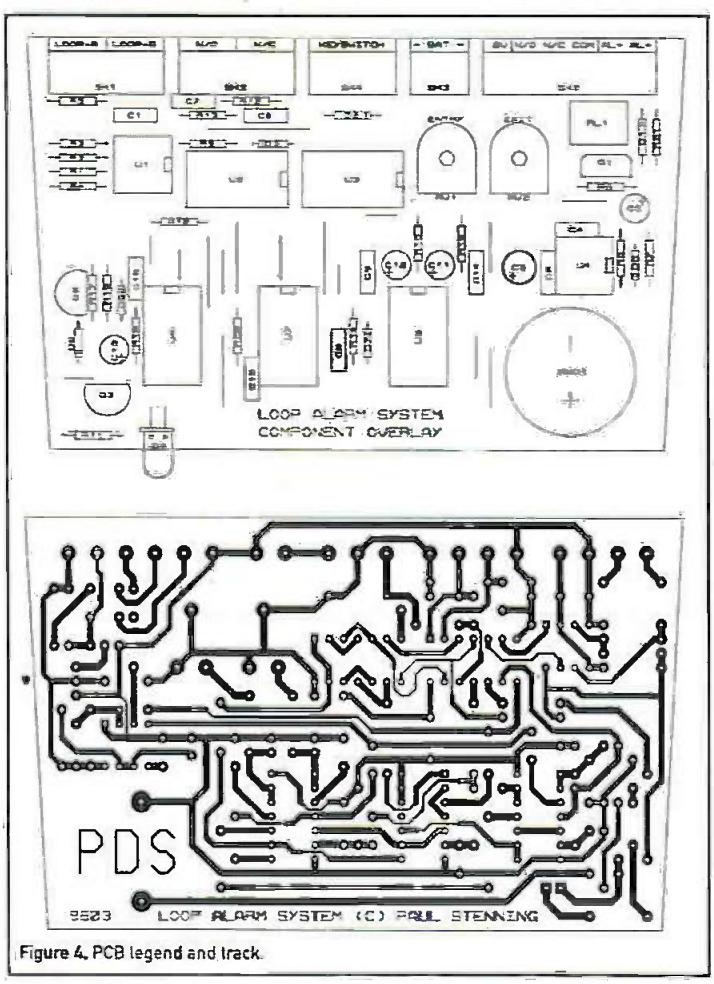


Figure 4. PCB legend and track.

Project Spec

Number of zones	2 (Entry/Exit and Loop Cable)
Maximum Loop Length	Unlimited
Exit Time	5 to 30 seconds (set by internal preset)
Entry Time	5 to 30 seconds (set by internal preset)
Alarm Time	16 minutes (typical)
Entry/Exit Warning	Pulsed Buzzer and Flashing Status LED
Alarm Sounder	Piezo Siren (110dB @ 1m)
Supply Voltage	9V nominal (PP9 Battery)
Low Battery Indicator	Status LED extinguished below 6.5V
Supply Current (Armed)	1mA (typical)
Battery Life	6 months (typical)
Remote Output	Optional changeover relay
PCB Size	172 x 75mm
Overall Size	177 x 120 x 83mm
Weight	500g

therefore, be fitted over two suitable screws once the back is fitted.

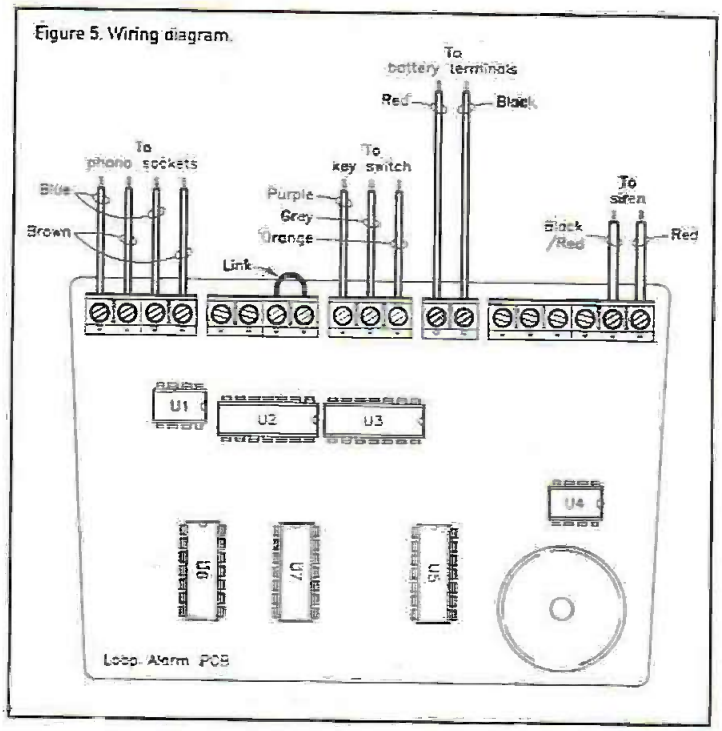
Wiring

The interwiring is shown in Figure 5. The leads from the alarm sounder will probably be excessively long and may be shortened to suit. Because of the noise, you may prefer to leave this disconnected until after the rest of the unit has been tested.

The battery is connected using a pair of PP9 type battery connection leads, ensuring correct polarity. All other connections are made with 7/0 2mm hook-up wire as shown.

The connections on the keyswitch can be confusing. In any position, the centre contact is connected to the pin towards the back (flat) edge of the key. On the prototype, the first (anticlockwise) and third positions were Off, so the relevant tags were not connected. The second position is 'Loop & Entry', so the relevant tag is connected to terminal 1 of SK4. The fourth position (fully clockwise) is 'Loop Only', and the relevant tag is connected to terminal 2. The centre tag on the switch connects to terminal 3. The two operating positions on the key-switch MUST be separated by an 'Off' position to ensure the unit resets correctly when changing mode.

Figure 5. Wiring diagram.



You will also need to make up a lead for the loop cable. This should be made using cheap single-core screened cable, fitted with a phono plug at either end. To prevent an intruder from simply unscrewing the covers of the plugs to link out the cable, secure the covers with a small amount of super-glue once the unit and cable have been tested. If a long length is required, it may be more convenient and flexible to make up two or three shorter leads, and join them with in-line connectors having a phono socket at either end.

Testing

The unit does not require any setting up, apart from adjusting the entry and exit delay periods to suit your installation. The testing, therefore, involves nothing more than checking the various functions of the unit.

Connect a loop cable between the two Loop sockets. Also, link terminals 1 and 2 of SK5 (The N/C entry sensor) with a short piece of tinned copper wire. Set RV1 and RV2 fully anticlockwise.

With the keyswitch set to one of the Off positions, connect a PP9 battery to the battery connector leads. Set the key-switch to the 'Loop and Entry' position. The LED (D4) should flash and the warning sounder (AWD1) should beep in time with it, for about five seconds (this is the Exit period). After this time, the sounder should be quiet and the LED should be off. The unit is now armed, and waiting for someone to break in!

Momentarily link terminals 3 and 4 of SK5 with a piece of wire. The LED and warning sounder should operate as before, for five seconds (the Entry period). After this time, the main alarm sounder should operate, the relay (RL1) should pull in and the LED should remain on (not flashing). Set the keyswitch to off.

Try this again, but this time, trigger the alarm by disconnecting the link between terminals 1 and 2 of SK5. The unit should operate as before.

Set the keyswitch back to the 'Loop and Entry' position, and wait until the end of the Exit period. Now unplug one end of the loop cable. The alarm sounder and relay should operate immediately (no entry delay).

Switch off, and then back to 'Loop and Entry' without reconnecting the loop cable. This time, the Exit delay will not operate, and the LED should remain on (not flashing) to indicate that something is amiss.

Switch off, reconnect the loop cable, and switch back to 'Loop and Entry'. After the Exit period, trigger the alarm by short circuiting the inner and screen of the loop cable at one end (bridge the terminals of the socket inside the case with a screwdriver). Again, the alarm sounder and relay should operate immediately.

Switch off, then switch to 'Loop Only'. After the exit period, link terminals 3 and 4 of SK5. This should have no effect. Now unplug the loop cable, which should trigger the alarm as previously.

If you wish you can leave the alarm sounding, and check the timing of the alarm timer – which should be between 15 and 20 minutes. At the end of this time, the sounder should silence and the relay should release, but the LED should remain lit to tell the user that the alarm has been set off.

Installation

Since every installation is different, I can only give some general comments about installation. The main unit should be wall mounted if possible. Alternatively, it may be free standing in a steady position. You may wish to hide it so that it is not immediately visible but can still be accessed quickly for disarming.

Cables need to be run from the main unit to the entry/exit sensors being used. In many cases, one or two normally closed magnetic reed switch sensors mounted on the entry doors and possibly windows would be adequate. Normally closed sensors must be connected in series, so that if any operate, the circuit becomes open. Connect to terminals 1 and 2 of SK5.

If it is not possible or desirable to screw sensors to the doors, pressure mats may be used underneath carpets or rugs. These generally have normally open contacts, and must, therefore, be connected in parallel to terminals 3 and 4 of SK5.

The connections should ideally be made with 4-core alarm cable, which will fit tidily into the sensors. Alternatively, you could use any convenient thin two-core cable. Hide the cable out of sight where possible.

The loop cable should be threaded through or attached to the items to be protected. For example, with bicycles, thread the cable through both wheels and the frame.

Some items, such as televisions and Hi-Fi equipment have no obvious gaps to thread the cable through, and will, therefore, call for some ingenuity. If you are sure you know what you are doing, and the item is out of guarantee, you may be able to remove the

back or cover and thread a piece of cable through a couple of the ventilation slots before fitting plugs to the ends. Alternatively, you could fix a section of the cable to the item with a suitable adhesive such as Araldite.

If you don't want to mark the item, the best option might be to securely tie the loop cable to the unit's mains cable. A few cable ties can be useful here. Another possibility is a P-clip under a suitable screw on the unit.

External Alarm or Sounder

The relay contacts may be connected to an additional sounder or a separate household alarm system if required. The additional sounder may be a similar type to that used in the unit, mounted in an outdoor enclosure and powered by its own battery.

The unit may be connected to any convenient zone on an alarm panel, depending on the type of protection required. The Panic button input would be suitable if you wish the alarm to operate whether or not the main alarm is set. If you have a monitored alarm system, you may need to contact the monitoring company before connecting this unit to the system.

Greater Tamper Resistance

No alarm system is 100% secure and completely resistant to any attempt to defeat it, and this unit is certainly no exception. However, it should be adequate in most cases.

The following suggestions are offered to more experienced constructors who may wish to customise their system and installation to suit their individual circumstances.

If the unit is connected to an external alarm system, as described earlier, this will continue to sound if an intruder attempts to smash this unit once it has triggered.

The main concern will probably be attempts to defeat the unit to prevent it being triggered. Normally, this would involve trying to bypass the loop, close to the alarm unit, so that it may be disconnected. The system operates by sensing the resistance of the terminating resistance via the loop. This resistance need not be a single component at the far end, it could be made up of a number of resistors along the loop.

If R5 is reduced to 33kΩ, and two additional 33kΩ resistors are added inside connection plugs along the length of the loop, any attempt to bypass the loop at the alarm end would trigger the unit. I would suggest that one of the additional resistors is in the core connection and the other is in the screen. The only drawback of this is that you have to remember to use all the pieces of loop cable, but this could be ensured by using a different type of connector for each joint. You could use any number of resistors, providing the total resistance is between 90 and 110kΩ.

The other likely tampering method would be to disassemble the box and disconnect the battery. This could be sensed by either a tilt switch or micro-switch suitably positioned within the box. The micro-switch would be held operated by the lid, such that it is released when the lid is removed. Fix it inside the case with glue, as the screw-heads on the outside of the box would be a give-away! In either case, the connections that are closed when everything is OK are connected in series with the Loop connections inside the box.

Parts List

Resistors: All 1% 0.6W Metal Film (Unless Stated)		
R1,3-5,12,		
13,15,16,18	100k	9
R2,10,17	22k	3
R6,14,20	10k	3
R7	3M9	1
R8	4k7	1
R9	220k	1
R11	330Ω	1
R19	1M0	1
RV1,2	470k Horizontal Preset Potentiometer	2
Capacitors		
C1,2,4,		
6-9,14	10nF Ceramic Plate	8
C3	220µF 16V Radial	1
C5	10µF 63V Radial	1
C10,11	47µF 16V Radial	2
C12	100pF Ceramic Plate	1
C13	4µ7F 63V Radial	1
C15	100nF Disc Ceramic	1
Semiconductors		
U1	LPC662IN Dual Op-Amp	1
U2,6	4093 Quad NAND Gate	2
U3,7	4001 Quad NOR Gate	2
U4	ICM7555IPA Timer	1
U5	ICM7556IPD Dual Timer	1
Q1	ZTX651 Transistor	1
Q2	BC548 Transistor	1
Q3	BC558 Transistor	1
D1,2	1N4001 Rectifier	2
D3,5-7	1N4148 Diode	4
D4	5mm Red LED	1
D8	4V7 500mW Zener	1
Miscellaneous		
AWD1	PCB Buzzer	1
SK1,5	4-way 5mm PCB-mounting Terminal Block	2
SK2	6-way 5mm PCB-mounting Terminal Block	1
SK3	2-way 5mm PCB-mounting Terminal Block	1
SK4	3-way 5mm PCB-mounting Terminal Block	1
Case MB7		1
Battery PP9		1
PP9 Clips		1
4-way Keyswitch		1
Micro Piezo Siren		1
Chassis Phono Socket		2
Single-core Screened Cable		As Req
Tinned Copper Wire		As Req
Hook-up Wire 16/0.2mm		As Req
M3 3 10mm Countersunk Screw		2
M3 Nut		2
PCB		1
Optional		
R21	68Ω	1
RL1	1A 5V Micro-miniature Relay	1
In-line Phono Connector		As Req
Phono Plug Black		As Req
Reed Switch Surface		1
Pressure Mat		1
Alarm Cable 4-core		As Req

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historical circuits

Inhibited DOOR BELL

by Robert Penfold

THIS CIRCUIT FIRST APPEARED IN THE JANUARY 1997 ISSUE OF ELECTRONICS AND BEYOND

This electronic doorbell is based on the HT2811 sound generator chip, which can produce a reasonably realistic imitation of a standard 'ding-dong' style door chime. The circuit diagram is shown in Figure 1. On the face of it, the circuit only has to produce a short burst of tone, followed by a second burst at a slightly lower pitch. In reality, the sound produced by a conventional door chime is quite complex. Unlike the string of a guitar or violin, the mechanical resonators in a conventional door chimes do not simply generate a fundamental frequency plus harmonics (multiples) of that frequency. The three dimensional resonator of a door chime produces a much more complex sound than that of an essentially two-dimensional resonator such as a string. There are effectively two or more fundamental frequencies and their harmonics, plus further frequencies generated by the mixing of the fundamental and their harmonics.

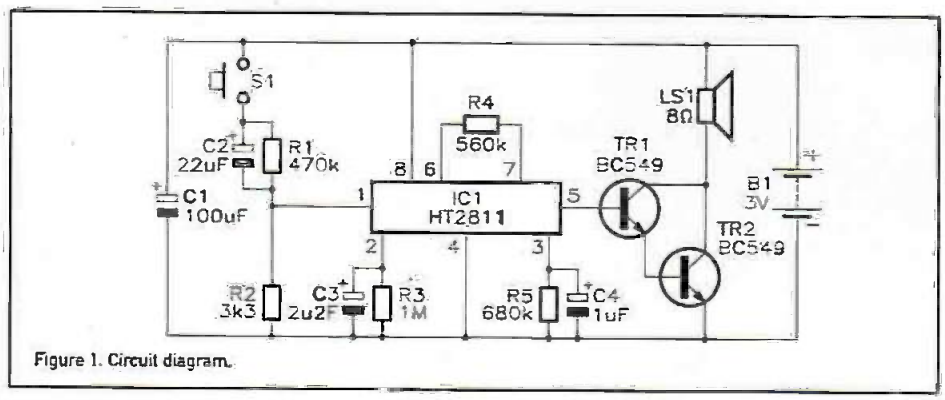


Figure 1. Circuit diagram.

To simulate this type of sound requires two or more tone signals to be mixed together using what is generally called a 'ring modulator' in electronic music circles. This is a form of balanced modulator, which suppresses one or both of the input signals, and generates sum and difference frequencies. It is this complex mixing of signals that is used to generate the 'heavy metal' sound. The HT2811 has built-in tone generators and a mixer which produces the desired effect, and gives a reasonably convincing 'metal' sound.

In order to obtain a convincing chime sound, it is essential to use appropriate envelope shaping. Each 'ding' and 'dong' sound has a fast attack but a much slower decay. Again, the HT2811 has a built-in envelope shaper which gives each burst of sound suitable attack and decay times.

The Circuit

The HT2811 has an extremely low standby current consumption of only about 1µA. The circuit, therefore, has no on/off switch, and is permanently connected to the 3V battery. Taking pin 1 high triggers the device into action, and it then goes through two 'ding-dong' sequences. In order to prevent over-zealous callers 'taking it out' on the doorbell, this design includes an inhibitor circuit which prevents the doorbell being triggered more than about once every 10 seconds or so. Operating S1 causes pin one of IC1 to be pulsed high as C2 charges via R2. C2 discharges via R1 when S1 is released, but due to the high value of R1, the discharge time is quite long. The circuit cannot be triggered again until C2 has largely discharged, and this gives the required hold-off.

C3 and R3 control the decay time of one of the envelope shapers. R5 and C4 provide the same function in the second envelope shaper. R4 is the only discrete timing component in the tone generator circuitry. The drive current available from pin 5 of IC1 is quite low, but a low impedance loudspeaker can be driven via a Darlington pair connected as a common emitter switching stage (TR1 and TR2). With only a 3V supply, the output power is not very high, but adequate volume is obtained, provided the loudspeaker has a diameter of about 66mm or more. Do not use the circuit with a supply potential of more than 3V. The current consumption of the circuit is up to about 40mA when activated, and a couple of HP7 (AA) size batteries are more than adequate to supply this.

Construction

Construction of this circuit is very straightforward, but IC1 is a MOS device which requires the standard anti-static handling precautions. The two batteries are fitted into a plastic holder, and the latter connects to the circuit board via an ordinary PP3 style battery clip. Obviously, S1 is the bell push, and is connected to the main unit via a length of twin cable. If mains-borne noise spikes, etc. give problems with spurious triggering, reducing the value of R2 might eliminate the problem. Using a screened lead to connect S1 to the main unit is the most effective method of combatting this type of problem though. The outer braiding of the cable carries the connection to the positive supply rail, and the inner conductor carries the connection to R1 and C2.

Parts List

Resistors (All 0.6W 1% Metal Film)

R1	470k	1	(M470K)
R2	3k3	1	(M3K3)
R3	1MΩ	1	(M1M)
R4	560k	1	(M560K)
R5	680k	1	(M680K)

Capacitors

C1	100µF 10V Radial Electrolytic	1	(FF10L)
C2	22µF 25V Radial Electrolytic	1	(FF06G)
C3	2µ2F 100V Radial Electrolytic	1	(FF02C)
C4	1µF 100V Radial Electrolytic	1	(FF01B)

Semiconductors

IC1	HT2811	1	(BH69A)
TR1,2	BC549	2	(QQ15R)

Miscellaneous

LS1	66mm 8Ω Loudspeaker	1	(WB13P)
S1	Bell-Push	1	(FS17T)
B1	2 3 AA Cells	2	(JY48C)
	8-pin DIL Holder	1	(BL17T)
	Battery Holder	1	(CL17T)
	PP3 Battery Clip	1	(HF28F)
	Stripboard, Case, Bell Wire, Etc.		

CIRRUS LOGIC: Company Profile

CIRRUS LOGIC, INC., INCORPORATED IN 1984 AS THE SUCCESSOR TO A RESEARCH CORPORATION AND REINCORPORATED IN 1999, DESIGNS AND MANUFACTURES INTEGRATED CIRCUITS THAT UTILISE HIGH-PERFORMANCE ANALOGUE AND DIGITAL SIGNAL PROCESSING (DSP) TECHNOLOGIES.

The company's products, sold under its own name and the Crystal, Maverick and 3Ci product brands, enable system-level applications in the analogue (audio, communications and data acquisition), Internet (embedded processors and optical storage) and magnetic storage (hard disk drive electronics integration and read channels) markets.

Operating from headquarters in Austin, Texas and with major sites located in Fremont, California and Broomfield, Colorado, as well as offices in Europe, Japan and Asia, Cirrus targets mainstream audio, video and Internet entertainment applications in the consumer entertainment market. A 'fabless' semiconductor manufacturer, preferring to use external wafer foundries to build its integrated circuit devices, the company conducts final tests at its own Austin, Texas facilities and at qualified sub-contractors worldwide.

Cirrus' broad profile of innovation includes more than 75 industry firsts since its initial public offering in 1989. Cirrus were the first to apply a RISC based architecture to multi-channel data communications chips, the first to manufacture a 120 dB audio analogue to digital converter and the first manufacturer to design and produce surround sound capabilities for a two speaker PC audio system.

The year 2000 was a pivotal year for the company as it saw the emergence of a 'new' Cirrus Logic. Re-invented for the post PC, Internet age, Cirrus hopes to de-emphasise its magnetic storage division to become the largest pure-play semiconductor company focused on consumer-entertainment electronics. Through mutually beneficial partnerships and acquisitions, Cirrus has repositioned itself to offer consumer electronics manufacturers a 'one stop shop' for 'total entertainment' products.

Left: David French

The Total-E DVD Solution Kit provides a complete Crystal brand DVD solution for manufacturers with solutions for all performance levels – mainstream consumer to high performance professional. Cirrus has the expertise and total system support to bring a Total-Entertainment package to the market.

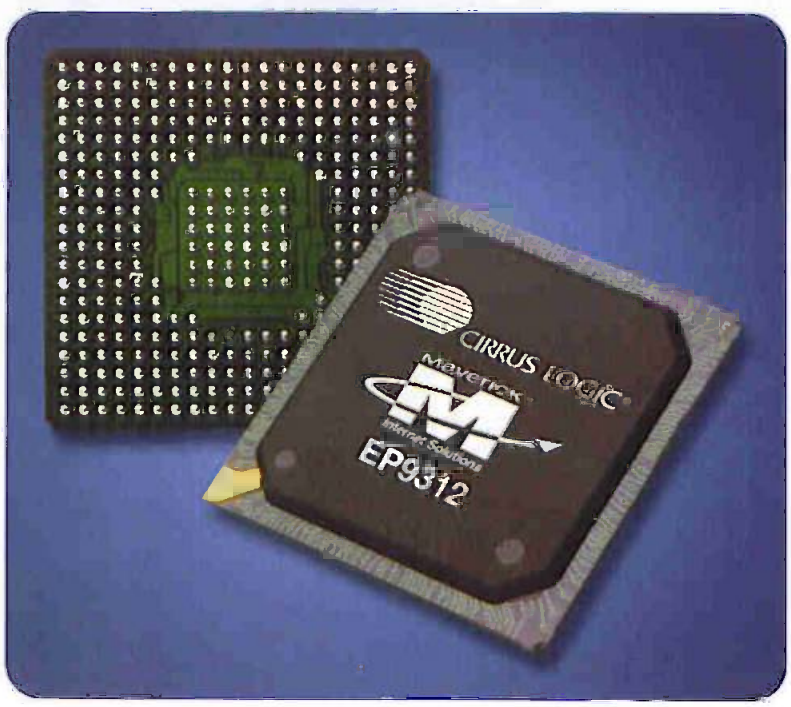
Cirrus Logic has taken early leadership of the emerging Internet audio market. Portable MP3 class audio players powered by Cirrus' Maverick processors have become synonymous with performance and quality enabling the market leading Rio 600 / Rio 800 and the Creative Nomad MP3 players. Additionally, as Internet audio moves away from the hobbyist and into the mainstream market, critical security and digital rights management capabilities have become paramount. Cirrus' patent pending on-chip security is attracting strong interest across a variety of market segments.

The Company's Internet line of products provides solutions for optical storage and embedded processor applications. Cirrus supplies integrated circuits that perform key electronics functions in advanced optical disc drives. The Company entered the optical storage market in the fiscal year 1995 with a CD-ROM decoder product, followed by three more generations of CD-ROM decoders with read speeds of up to 45x. In the fiscal year 1997, the Company introduced its first CD-R/CD-RW encoder/decoder products and is currently on its fourth generation, supporting

up to 16x write and 48x read speeds.

During the fiscal year 1999, the Company created the Embedded Processor Division to develop, manufacture and market highly integrated, system-on-chip solutions for several emerging applications. Utilising its system peripherals and mixed signal components with CPU cores licensed from ARM Ltd., the division's focus is on the Application-Specific Standard Product (ASSP) device category. Cirrus offers products in the areas of handheld information appliances, industrial computing systems, portable digital audio solutions and network and Internet computing devices. In the communications market, Cirrus is the number 1 supplier of embedded Ethernet solutions for residential high speed Internet gateways.

Cirrus has steadily become the leading supplier of stereo audio devices for the personal computer market. Cirrus also serves the high fidelity audio market and supports major audio standards such as Dolby Pro Logic, AAC and MPEG audio decoding. Cirrus' products can be found in a broad range of applications from audio/video amplifiers, set top audio decoders, MP3 players, CD players, powered speakers and DVD players. Its customer list is a 'who's who' in consumer electronics with brand names such as Sony, Panasonic, Nokia, Pace and Kenwood using Cirrus' technology in present and future products. In fact, demand for Cirrus' solutions for consumer products, primarily consumer audio chip solutions, is growing nearly twice as fast as the market as a whole.



The Company's line of analogue products address PC and consumer audio, data acquisition, industrial automation and control and communications applications. The Computer Audio division currently offers over 25 products for the computer market supplying stereo codecs for the PC market. These provide the special effects processing that allows PC gamers to perceive sound as coming from various points around them in a 3D space. Additionally, The Consumer Audio division offers over 75 products for the consumer and professional/automotive audio markets supplying products for the high-fidelity audio market, including analogue-to-digital and digital-to-analogue converters, codecs and a family of DSP-based audio decoders that support the major audio standards.

The Precision Data Conversion business is comprised of the Data Acquisition and Communications product lines. The Company designs, manufactures and markets analogue, digital and mixed-signal integrated circuits for data acquisition, instrumentation and imaging applications. It also designs, manufactures and markets semiconductor products that enable Ethernet solutions for use in emerging broadband communication systems. In addition, the Company develops and markets integrated circuit products enabling telecommunication line interface solutions for telecommunications and data communications equipment.

Cirrus' vision for the future is crystal clear and its commitment to the consumer entertainment market has been reinforced by its recent acquisition of Peak Audio, a company that has developed some of the industry's leading audio networking products and technologies. With this acquisition, Cirrus expects to leverage Peak Audio's industry-leading skills and complementary technologies to develop a broad range of entertainment-centric audio solutions for networked environments in both the commercial and consumer audio markets. By targeting growing market segments that can benefit from its combination of value-added core competencies and innovate chip solutions, Cirrus is committed and positioned to expand upon its strong standing in Internet driven markets and capitalise on the demand for connected entertainment products. As broadband Internet access becomes widely available and as the range of applicable technologies and products for entertainment products grows, Cirrus is poised for prosperity.

Electronics and Technology Recruitment

Senior Appointment — Head of UMTS Development

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A dynamic and fast moving organisation, with an impeccable reputation with the digital audio broadcast market is seeking a high calibre candidate to become Head Of UMTS Development. You will lead a team of development staff, and take responsibility for the quality and functionality of assigned software products from initial concept to customer delivery. A strong management background is crucial, along with a minimum exposure period of 6 years to project life cycles and project scheduling. A degree in computer science, engineering or mathematics is required with a minimum 2:1 pass. You will have related software development experience in C++, realtime, COM, UML, OOA/D and have experience of digital communications. Salary and package will reflect this senior position.

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DSP Software Engineers with ambition, self motivation and the hunger to rise to new challenges.

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Basic knowledge of digital hardware, good knowledge of Digital Signal Processing Theory (Nyquist sampling, GMSK Modulation, Channel Coding, etc) and DSP algorithm design (preferably in communications systems) will be required too succeed. Market leading salaries and packages will be offered to the successful applicants.

Ref : 4424

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L2 & L3 mobile comms. Protocols. This senior position will be challenging, as you will have complete technical authority on the requirements, architecture, design and implementation of

L2 / L3 GSM / GPRS / UMTS terminal protocols.

Ref : SMRU

Audio / Video DSP Software Engineer

Avon
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As a world leader in the design of video communications products, our client is well known for providing low cost, easy to use products with outstanding video quality; its products are in daily use in businesses and in high level government applications. With expansion into new markets, a requirement for Software Engineers has arisen. Candidates will have an Engineering or Science degree, 3 years experience in Audio / Video compression & coding using DSP techniques,

3 years experience programming DSP devices in assembler or C, knowledge of MPEG or H.26x algorithms. A highly competitive benefits package will be offered to the right candidate.

Ref: 3259

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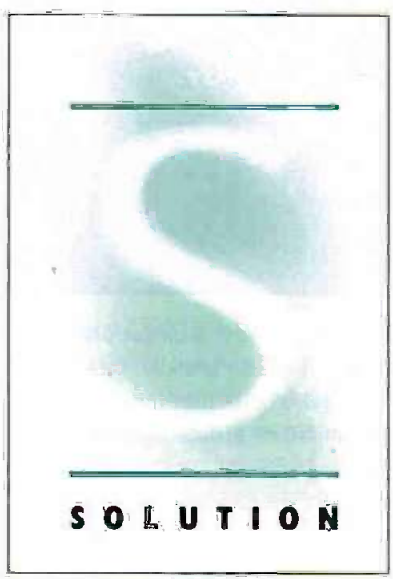

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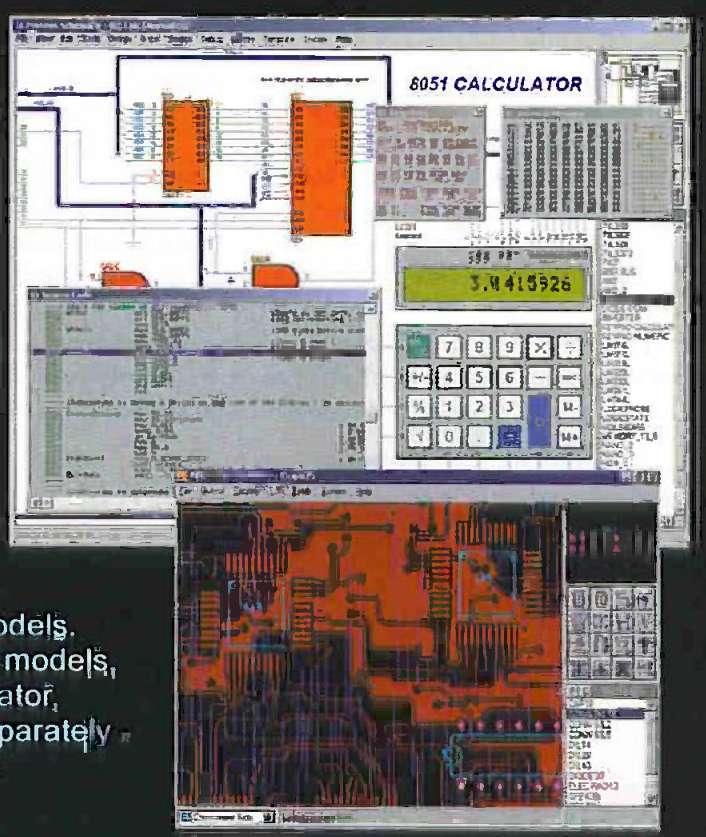

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The BALL

A short story by Frank McCoy.

'But what GOOD is it?' asked George plaintively, looking down at the silvery ball held in a clamp on his desk. 'You say you can't put it AROUND anything like you planned on; so what good is a force-field generator if it can't protect anything?'

'Well, on the bright side,' commented Jenny, the junior partner in the firm, 'at least it doesn't take energy to maintain'.

'So then... How long will it last?' George asked the technician.

'Forever, as far as we can tell so far. Years anyway. You can reduce the size by forming the fields in reverse around the thing; but that's kind of special. It takes stillness of a kind that normally doesn't exist on a planet; only lately being created in laboratories for things like making Bose-Einstein condensates. We suspect (only suspect mind you) that the inside is at true absolute-zero, and a true vacuum to boot. But there's no way to tell, as we can't cut it or even seem to affect it with anything; not diamond-drills or even focused lasers at several million degrees. The hotter it gets, the stabler it seems'.

'They're all perfect spheres?'

'Every one we've been able to create... And we suspect that there isn't any other form'.

'So, what do they weigh?' asked George.

'That's the curious thing... they don't'.

'Huh?'

'As far as we can tell, to the limits of our equipment, that sphere contains the equivalent of a perfect vacuum... and weighs the same. Plop it into a mass-device and it weighs less than hydrogen'.

'Hmmm,' murmured George. 'Maybe there's a use for the thing after all'.

'Well... We thought of that. Kind of expensive to make; as the fields required to produce them goes up by the fourth power of the size. You can get atomic-scaled ones almost 'for free', while inch or two in diameter ones (like that one) take several kilowatt-hours of energy'.

'If they're so cheap to make small ones, then why aren't they around by the millions in nature?' asked Jenny; looking with more interest at the sphere. Energy was becoming expensive these days.

...'If they're so cheap to make small ones, then why aren't they around by the millions in nature?' asked Jenny; looking with more interest at the sphere...

'Well,' hesitated Mike. Being a technician, he wasn't as familiar with practical things like that, 'We can only guess; but MY guess is that they are. By the trillions, in fact'.

'Huh?' Now he had both partners' attentions.

The younger man hesitated, then plunged on, at his employers' obvious attention. 'I suspect that in outer-space, particularly in the spaces BETWEEN stars, and even more so between galaxies, they come into being at a tremendous rate. Who knows, maybe they even are responsible for the so-called increase in the Hubble-Constant that people are talking about lately. They do seem to have what would appear to almost be negative energy; and the damned things go UP when released, instead of down'.

George waved that aside. 'So... what damned use is a bloody stupid ball-bearing that weighs nothing, and can't be scratched with diamond bits or industrial lasers,' he asked with annoyance; gazing in frustration down at the tiny silvery orb.

A stunned silence greeted him, as all four occupants of the room turned to stare again at the small silver ball.

Ten years later, the same four people gathered together in the new headquarters building of Permanent Bearing Inc. to watch the launch of their latest toy: A teardrop-shaped airship that hopefully would soon put the present airlines either out of business, or heavily in debt to PBI. Deliberately held to the same limits as a 747, but not it's shape, the wingless machine looked more like the old Zeppelins of old, rather than the latest powered flying machine. Of course, the fact that it weighed only a few thousand pounds, instead of tens of thousands, had a lot to do with that. Once in the air, water ballast would be dropped until neutral buoyancy was achieved; and the only energy necessary would be that required to push the teardrop-shape through the air. A square building could be floated, if necessary.

The cheers from the launch-pad reached their ears, as the machine slowly rose, dropping water as it did, and then started moving east; faster and faster until it vanished from sight.

'Well,' commented George, 'I guess we found out what it was good for after all, didn't we?'

The other three people raised their glasses to meet his, in grinning agreement.

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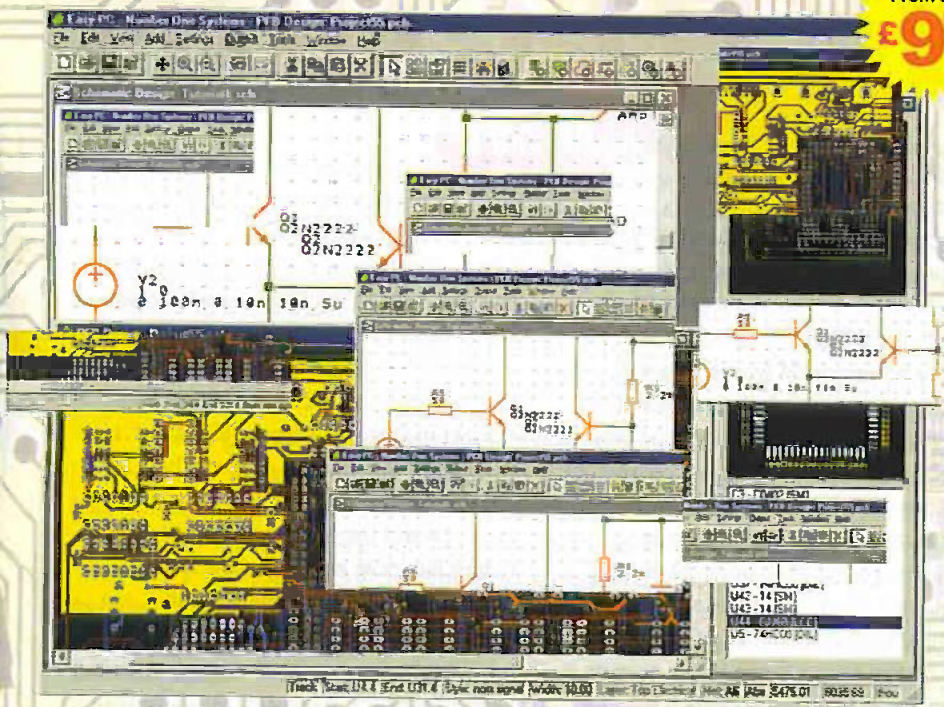

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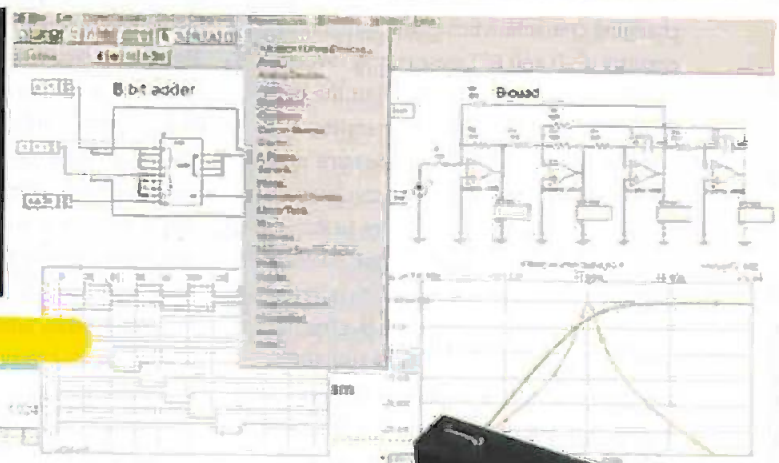

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RD Research

A new approach to ESD PROTECTION

by Paul Martin
of Littelfuse (UK)

THE FIRST GENERATION OF TRANSIENT PROTECTION PRODUCTS WAS DESIGNED TO MITIGATE THE EFFECTS OF A DIRECT LIGHTNING STRIKE. BUT TODAY'S HIGH VOLTAGE TRANSIENTS EXTEND BEYOND LIGHTNING TO INCLUDE THREATS SUCH AS ESD (ELECTROSTATIC DISCHARGE) AND EFT (ELECTRICAL FAST TRANSIENTS).

Why should such transients be a major problem? After all, they are relatively low-energy events (typically <100mJ) compared with lightning (~5J) and typical overcurrent conditions, such as a line surge (~0.5J). The answer to this question lies not so much in the transient itself, as the changing characteristics of the integrated circuitry. ESD and EFT events may involve only small amounts of energy, but the dense physical geometry's and low operating voltages of today's electronic systems mean that a small amount of energy can have catastrophic effects. 'Soft' failure (data corruption or system latchup) and permanent IC damage (junction shorts, oxide punch-through, and melted trace) are the frequent obvious result of a high-voltage (usually > 15kV) transient. Less apparent, but ultimately as bad, is latent damage, which leaves the system operative but degrading over time. In fact, it is estimated that ESD accounts from some 30 of all field failures.

And it gets worse. ESD and EFT events have i/v rise times which are orders of magnitude faster than lightning. In the context of high signal bandwidths, complex signal waveforms and high data transmission rates, this can be a real issue, leading to unwanted signal distortion.

So the question becomes: how can you protect against ESD and EFT? One new solution is the PulseGuard range of ESD suppressors from Littelfuse. We argue that this latest generation of overvoltage protection devices is the best available, offering protection not only against component damage, but the distortion of high-speed signals, too.

How do we support his argument? Well, most people will be familiar with conventional ESD technologies: Diodes and MOV (Metal Oxide Varistors), but PulseGuard devices are based on polymer VVM (variable voltage material) technology, which has a non-linear resistivity response to applied voltage (see Figure1). Most people will be familiar with the use of polymers in the context of the PTC (positive temperature coefficient) fuse, a resettable device used to interrupt or limit overcurrents. The basis of these devices is a mixture of conductive materials and polymers. When current passes through such a device, I2R heating causes the polymers to expand and break the long molecular chains of the conductive material. Thus conductivity reduces (resistance rises), and the current is limited to a predetermined value.

Now, Littelfuse has managed to apply similar technology to create a device which is essentially a shunt; a parallel device which can be used to dissipate the energy of an ESD event. While the circuit is operating normally, the suppressor is electrically transparent. When an ESD event occurs, however, the VVM becomes conductive, shunting the energy away from the circuitry. After the event, the suppressor returns to a consistent high off-state resistance. It is an approach that delivers the performance characteristics of ideal ESD protection: fast response, low capacitance, low clamp voltages and low leakage currents. A comparison of Diode and MOV performance can be seen in the table below.

Technology	Response time (ns)	Capacitance (pF @ 1MHz)	Leakage current (uA @ 5V)	Peak current - Amps (IEC waveform)
Diode	<1	3 - 1000	0.1 - 20.0	2.5 - 45.0
MOV	5-10	75 - 2000	0.3 - 10.0	20 - 150

Compare these figures with Littelfuse Polymer technology. For example, for effective protection against ESD, it is crucial that rise times are very short. PulseGuard devices have the shortest rise times (<1ns) of any ESD technology currently available.

Furthermore, if an ESD suppressor is not to cause degradation to, or attenuation of, data signals in high-speed digital equipment, it is vital that they offer not only fast response, but also very low capacitance. Typical effects of higher capacitance when protecting with alternative technologies include distortion of the digital waveform can be seen in Figure (2). PulseGuard devices offer a capacitance of less than 1pF.

Another very important consideration for ESD protection is lead inductance. Because of the fast rise time of a typical ESD event, high frequency rules must be applied. These rules dictate that the length of wire leads add printed board traces must be minimised to reduce inductive isolation of the ESD suppressor and chassis ground. Also, suppression components constructed with lead frames and wire bonds can allow induced voltages to be experienced by the protected circuitry due to package inductance. The PulseGuard range addresses this issue though wide range of low-inductance configurations, which create an effectively 'leadless' installation.

IEC 1000-4-2

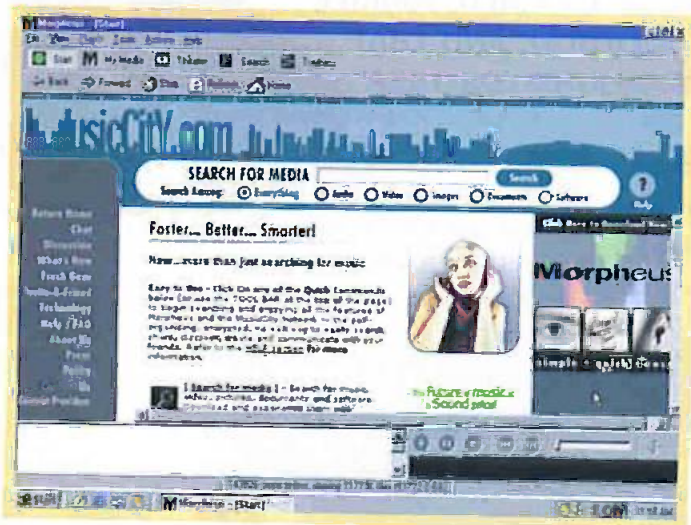
The need for better ESD protection has been recognised by the International Electrotechnical Commission (IEC), and a definition of susceptibility is now enshrined in the IEC 1000-4-2 specification (also known as EN61000-4-2). This provides a definition of an ESD waveform, energy levels and methodologies used to test the ability of electronic equipment to survive multiple severe ESD events. These are shown in the figure. The test specification provides the means for test engineers to inject repeatable test pulses into the device under test (DUT), and evaluate it in terms of ESD survivability. As can be seen from the figure, there are various severity levels that can be used to define the DUT's immunity against ESD.

Currently, electronic equipment manufacturers are required to certify that their equipment can survive testing to the IEC standard if they are selling that equipment into the EU. PulseGuard products meet all levels of the IEC 1000-4-2.

Comment

The downloading of MP3 music files from the Internet appears to be on the wane. This is due largely, of course, to Napster having been forced by American justice to implement software that prevents certain music tracks from being accessed through its service. Effectively, the large music producing companies merely have to provide Napster with a list of its tracks that it doesn't want to be shared over the Napster system, and Napster has to incorporate the list into its blacklisted database. Users of Napster then can't see any of those tracks on Napster, and so can't download them.

The problem for the music industry though, is that Napster is only the first service that has allowed an effective file-sharing system to work. Napster is what is known as a peer-to-peer file-sharing system. This means that each user — as well as being able to download other users' music tracks — can share his or her own music tracks with other users. As Napster has proved, peer-to-peer file-sharing is incredibly easy to use, and actually quite difficult to stop. It is, after all, only following a concerted series of legal moves that Napster has been brought to heel. It has taken a long time (and obviously, quite some expense) for the music industry to reach this position of control, and it is by no means certain yet, whether or not the final outcome of the legal case is anywhere near, or that the music industry will win in the end.



Even if the music industry does win, and Napster is forced to shut down its operation as a free peer-to-peer file-sharing system, it is becoming increasingly obvious that Napster will not be the last such system. The best analogy is of a fairground side-show stall, in which you have a gun and try to shoot moving targets. Yes, you may hit a target and feel justifiably proud, but another target will pop up next. Following Napster, users (and there were millions of users of Napster worldwide at one point) have seen what they want, and will quickly start to use another similar service as soon as one service ceases operation (or, in the case of Napster, is crippled to the extent that it's not worth using).

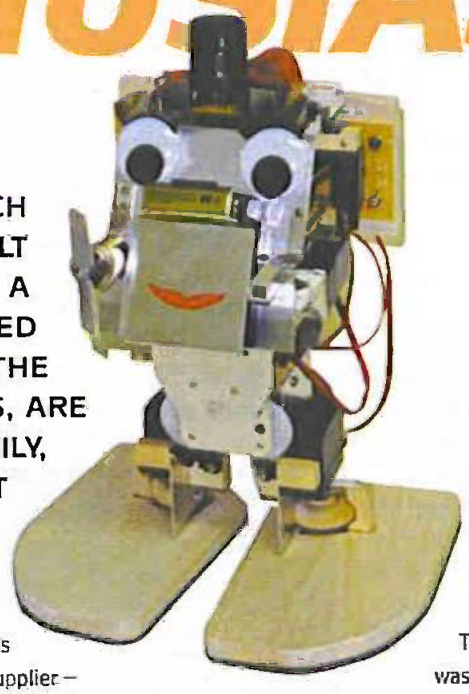
There are several other services now vying for the Napster crown, and it doesn't take long to find them. One such system relies on a client program called Morpheus. This works in a superficially similar way to Napster, in that users can search for files by name, locate them, and download them, all within the client. Where it differs slightly from Napster (as far as the user is concerned, anyhow) is that, first, it not only allows music tracks to be shared by users, but files of any description: movies, applications, images, and so on. Naturally, in time, not only the music industry will be making legal moves against Morpheus, but it's likely that the film industry will too, once it gets its act together. To date, of course, most users rely on a relatively slow modem-based connection to the Internet, which is far too slow to allow downloads of movies, but as more and more users worldwide have a broadband connection to the Internet then movie downloading will become more commonplace. The typical size of a movie at DVD quality is around 5Gb, so even with a broadband connection download is unsuitable. However, by encoding the movie information as an MPEG1 or MPEG4 format file, typical movie sizes can be as low as 600Mb — perfectly feasible to download over broadband.

A second way in which Morpheus differs from Napster is less obvious. Napster, while being essentially a peer-to-peer service in that users shared their files, also uses central servers that store details of users' files. As such, it's easy for Napster itself to control content that's being distributed. Morpheus, on the other hand, is completely peer-to-peer in operation. As users perform a search, they are literally searching directly the shared files of other users, not a central database. This might seem a small point — and actually, means that no perceptible difference is noticed between Napster and Morpheus in use — but it is a huge difference if and when it comes to being able to prevent Morpheus' operation. Effectively, nobody has control over the files that users share. It is therefore impossible for anyone to specify that files be blacklisted in the way that the music industry has legally forced Napster to do. Even if the music industry takes Morpheus' developers through the judicial system, the sharing of files over the network cannot be stopped in that way.

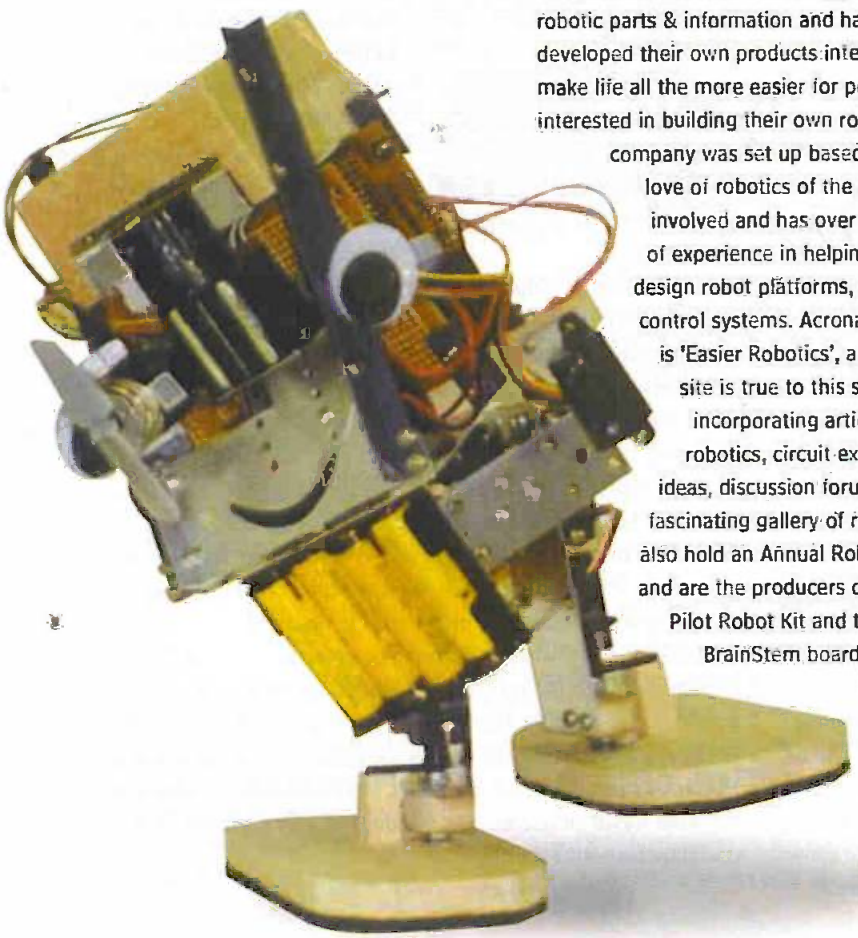
Interestingly, the only way that users can be forced to stop sharing files in such a system as Morpheus is to directly involve each user in legal action. Now, theoretically of course, there's nothing to stop the music industry doing so, although to do so may prove inherently harder to do than taking a company through the courts. A few highly publicised court actions against individual users may prevent other users from sharing files, however, it's doubtful whether such moves would be worth it. All that Morpheus is doing is proving that peer-to-peer file-sharing can and does work, and will continue to do so — whatever legal moves are taken by the music industry. If users are prevented from using Morpheus by such scare-mongering and bully-boy tactics, then another system will pop up in its place. Not only that, the next system that does pop up in its place will likely prevent users' details from being accessible. In other words, the next peer-to-peer file-sharing system will allow users to remain secret, so no legal action can be taken against them. The music industry is on the road to nowhere.

Morpheus is available for licensing by organisations, and the first company to do so is MusicCity. Readers who want to give Morpheus a try should checkout the MusicCity Web site, at: <www.musiccity.com>, where you'll find information about the system, and links to locate the Morpheus client download. Currently, Morpheus is only available for Windows-based computers, but will doubtless be available for other computer platforms shortly.

Robotics Profile: ACRONAME and the ENTHUSIAST



BUILDING YOUR OWN ROBOT FROM SCRATCH CAN OFTEN BE A DAUNTING AND DIFFICULT TASK, EVEN FOR THOSE WHO KNOW QUITE A BIT ABOUT ELECTRONICS. ROBOTS DESIGNED TO WORK ON THEIR OWN, WITHOUT THE REMOTE-CONTROL ASSISTANCE OF HUMANS, ARE EVEN MORE TRICKY TO BUILD. LUCKILY, HOWEVER, THERE IS A SOLUTION, AND THAT IS TO BUILD THE ROBOT AROUND ONE OF A GROWING NUMBER OF COMMERCIALLY-AVAILABLE ROBOTICS PARTS AND CIRCUIT BOARDS.



Here we profile one particular parts and information supplier – Acroname of Colorado, USA – who supply robotic parts & information and have developed their own products intended to make life all the more easier for people interested in building their own robots. The company was set up based upon the love of robotics of the people involved and has over seven years of experience in helping people design robot platforms, projects and control systems. Acroname's slogan is 'Easier Robotics', and their web site is true to this slogan – incorporating articles on robotics, circuit examples, ideas, discussion forums and a fascinating gallery of robots. They also hold an Annual Robotics Expo, and are the producers of the Palm Pilot Robot Kit and the BrainStem board, both now available for purchase.

Palm Pilot Robot Kit

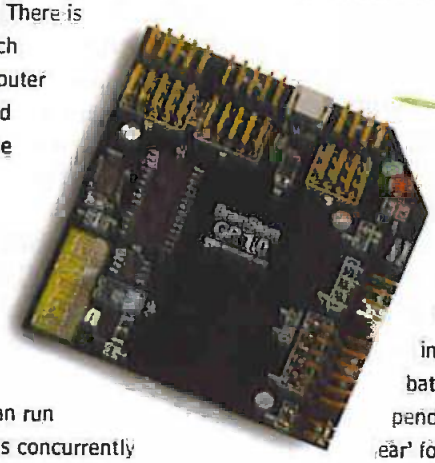
The Palm Pilot Robot Kit was designed in part as a course project by a student – Greg Reshko – and his professors at the Robotics Department at Carnegie Mellon University, Pittsburgh. After the kit idea gained a lot of attention from their web site, CMU approached Acroname to license the basic design and offer it as a kit to be sold to interested customers. They kept the basic design, but redesigned the kit so that it would be easy and accurate to put together.

The kit is available for both the Palm V and all Palm III compatible PDA's. There are two versions – the BareBones version requires the user to modify the servos for continuous rotation and do some soldering, whilst the Easy kit basically just needs a screwdriver to put it all together. The robot uses three Sharp GP2D12 Infrared range detectors to help it navigate and avoid objects. The basic programs, which are downloadable from the CMU site, allow the PPRK to wall follow, target follow and roam. People with programming skills can write more sophisticated programs. According to Acroname, the PPRK has opened this type of robotics up to a whole new group of people that may have never thought about building a robot. 'Instead of our usual robot hobbyist and student client base,' say

Acroname, 'we have seen doctors, lawyers, heads of corporations, etc buying the kits'.

BrainStem Board

Acroname spent several years designing and prototyping their BrainStem technology, which is designed to promote an easier way of working with and approaching robotics. The technology is comprised of both software and hardware that allows direct manipulation and response to the physical world using high level programming and common commodity-based computing hardware. Each BrainStem module can be operated in up to three modes concurrently: There is the slave mode, which allows the host computer to manipulate or read from I/O directly; the reflex mode, where the module can automatically respond to inputs with prescribed outputs; and the TEA mode, where the module can run several TEA programs concurrently to accomplish simple tasks (TEA, or Tiny Embedded Application, is a lightweight programming language intended for extremely small processing environments). BrainStem modules can be interconnected via an IIC bus to communicate with each other as well as third-party detectors, chips, memory, and controllers. Examples might be a clock chip, EEPROM, or an LCD display.



One major goal of the BrainStem technology is to offer support software programs, libraries, and interfaces on as wide an array of computing devices as possible. All the libraries share exactly the same interface allowing development on a workstation and execution on a small device such as a Palm Pilot. Over time, Acroname will introduce an entire family of BrainStem modules with differing I/O capabilities and different link mechanisms to the host computer.

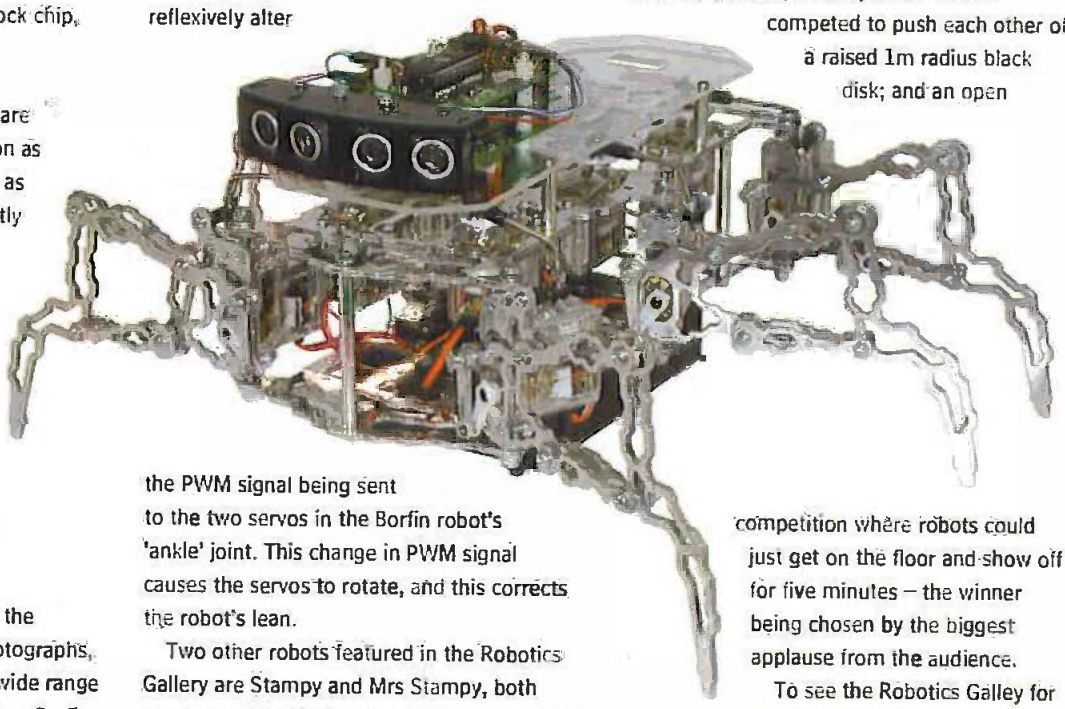
Robotics Gallery

In the Robotics Galley, accessed via the Acroname web site, you can see photographs, descriptions and specifications of a wide range of robots, including the BrainStem Bug, Borfin, and the Stampy and Mrs Stampy robots.

Built using a prototype of the BrainStem board, the BrainStem Bug is a six legged walker, with a futuristic aluminium design. It has SRF04 Ultrasonic rangers for sight, and uses three BrainStem modules to control the 12 metal gear, high torque servo motors. The modules communicate over a 1 MBit IIC Bus, allowing each module to independently handle the reflexes needed to control two of the legs. The BrainStem Bug is currently being tested by Acroname staff using different patterns of gait. 'So far,' they say, 'we have had the best luck with a tripod gait but we are working on a wave gait that shows great promise'.

Borfin, designed by Steve Richards, is a reflexive robot which uses BrainStem technology to balance as the surface it is standing on is pitched or rolled. This is done using an inverted RC gimbal with the battery hanging from it – the pendulum created offering an 'inner ear' for the robot. When the robot starts leaning, this pendulum begins to deviate from the centre, creating a change in voltage in one or a combination of two axes being fed to the analogue ports on the BrainStem prototype board. There are two reflexes set up on the board that modify these changing signals and reflexively alter the PWM signal being sent to the two servos in the Borfin robot's 'ankle' joint. This change in PWM signal causes the servos to rotate, and this corrects the robot's lean.

Acroname
easier robotics



Two other robots featured in the Robotics Gallery are Stampy and Mrs Stampy, both constructed by Mark Whitney and built around Basic STAMP and Serial Servo Controller processors. Stampy is a bipedal, static-gait robot with joints for his torso, ankles and hips. His maximum speed is about 5 feet per minute. Mrs Stampy is similar in design, but is twice as fast and is also more manoeuvrable. In taking a step, the Stampy robot swings its torso (which acts as a counter-balance) to one side so that its centre of gravity is supported by one of its huge feet. It then pivots its hips to raise the opposite leg and turns its ankles to move the raised foot forward. Navigation is done using dead-reckoning and 2 GP2D02 sensors for wall-following (one pointing to the side, and the other pointing straight ahead).

Robotics Expo

The BrainStem Bug was one of the top attractions at the second annual Acroname Robotics Expo, held on March 3rd. The event attracted over 3,000 robotics enthusiasts and featured presentations from Scott Askew of NASA's Automation Simulation and Robotics Division, and Larry Esposito of the Laboratory for Atmospheric and Space Physics.

Amongst the competitions held at this years Expo were a pre-run qualifier for the fire-fighting contest held every spring at Trinity College in Hartford, Connecticut (where robots navigate a small maze, trying to find and put out a lit candle before returning to their 'home base'); a Lego Workshop, where ten teams using a laptop and a LEGO Mindstorm Kit had just the afternoon to build a robot that could traverse around a challenging obstacle course; a Sumo Contest, where pairs of robots competed to push each other off a raised 1m radius black disk; and an open competition where robots could just get on the floor and show off for five minutes – the winner being chosen by the biggest applause from the audience.

To see the Robotics Galley for yourself, learn more about BrainStem and the Palm Pilot Robot Kit, go to www.acroname.com, where you can also find preliminary details of next year's Acroname Robotics Expo event.

electronics classified

ATLANTIC COAST MECCANO CLUB.

CONTACT: Tony Thompson, 71 Moresk Rd, Truro. TR1 1DB. EXHIBITIONS: 11-12th August Summer Court, 17-19th August Steam Rally at St Agnes. CLUB MEETING: 14th October Truro.

HENLEY SOCIETY OF MECCANO ENGINEERS.

CONTACT: Derek Mills, 39 Damer Gardens, Henley on Thames. RG9 1HX. EXHIBITION/MEETING: 1st September 10am-5.30pm at Christ Church Centre Henley on Thames Oxon. An event for Meccano club members, their families and guests but other visitors interested in Meccano are very welcome. CLUB MEETING: 24th November 1.30-5.30am at The Church Hall Walton Ave Henley on Thames Oxon.

HOLY TRINITY MECCANO CLUB.

CONTACT: Jim MacCulloch, 1 Alfred Road, Farnham Surrey GU9 8ND. CLUB MEETING: 27th October, 12-5pm at St Johns Church Hall, London Road, Hildenborough, Kent.

INTERNATIONAL SOCIETY OF MECCANOMEN.

CONTACT: Adrian Williams, 72a Old High St, Headington, Oxford. OX3 9HW. PUBLICATION: International Meccanoman Magazine – covering all aspects of the hobby worldwide.

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Alternatively, why not go to the Forum section of the Electronics And Beyond web site www.electronicsandbeyond.com, where you can post your views, pose questions that other visitors to the site might be able to answer, or publicise your own clubs and web-sites. The most interesting submissions will be reproduced in the magazine, for other readers to see.

Meccano Centenary Year Special

MECCANO SOCIETY OF SCOTLAND.

CONTACT: Bert Hutchings, 11 Eskview Grove, Dalkeith. EH2 1JW. CLUB MEETINGS: 26th August & 18th November 2pm at The Smith Art Gallery and Museum Dumbarton Road, Sterling. EXHIBITIONS: 29th September 10am-4.30pm at The George Heriots School, Laurston Place, Edinburgh. 27th-28th October (provisional date) 10/11am-5pm at Cathcart Model Railway Exhibition Cooper Institute, Cathcart, Glasgow.

MIDLANDS MECCANO GUILD.

CONTACT: Ernie Chandler, 86 Clopton Road, Stratford on Avon. CV37 6SN. CLUB MEETINGS: 6th October at The Arthur Rank Centre Royal Showground, Stoneleigh, Warwicks. EXHIBITION: Town & Country Festival 25-27th August at The Royal Showground, Stoneleigh.

NORTH EASTERN MECCANO SOCIETY.

CONTACT: Ian Mordue, 'Argile', Springfield Road, Durham City. DH1 4LS. CLUB MEETING: 8th Sept 11am-3.30 at Askew Chapel Hall, Bedale, North Yorkshire. CLUB EXHIBITION: 10th November 10am-5pm at The Arts Centre, Darlington, Durham.

NORTH EAST LONDON MECCANO CLUB.

CONTACT: Dave Taylor, The Groves, Clapton Hall Lane, Great Dunmow, Essex. CM6 1JE. CLUB MEETINGS: 14th July & 8th December 11am-5pm at the Church Hall Franklyn Gardens, Hainault, Essex. EXHIBITION: 8-9th (setup on the 7th) September 10am-5pm at Whitewebbs Museum of Transport, Whitewebbs Road, Enfield, Middlesex.

NORTH MIDLANDS MECCANO GUILD.

CONTACT: Julian Coles, 'Little Court', Main Street, Bleasby, Nottingham. NG 7GH. CLUB MEETING: 15th September 9.30am-5pm at The Village Hall, Oxton, Notts.

SKEGEX EXHBITION.

CONTACT: Mike Cotterill, 37 Park Ave, Skegness, PE25 2TF. DATE/LOCATION: 6-8th July

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9.15am-5pm at Embassy Centre, Skegness, Lincs.

LINCOLN EXHIBITION.

CONTACT: Geoff Brown 21 Daniel Crescent Heighington Lincs LN 1QT. DATE/LOCATION: 19-20th August 10am-5pm at The Steam Rally Lincolnshire Show Ground Lincoln.

NORTH WEST MECCANO GUILD.

CONTACT: Frank Smith, 209 Brodie Ave, Liverpool. L19 7NB. CLUB MEETING: 27th October at The Methodist Church, Leyland, Lancs.

RUNNYMEDE MECCANO GUILD.

CONTACT: Nick Rodgers, 21 Copthall Way, New Haw, Weybridge. KT15 3TX. CLUB MEETING: 6th October 1-6am at Brook Hall, Ottershaw, Surrey.

SHEFFIELD MECCANO GUILD.

CONTACT: John Oyzer-Key, 44 Locksley Drive, Thurcroft, Rotherham. SG6 9NU. CLUB MEETING: 13th October 10am-5pm at The Church Hall, Norton Lane, Norton, Sheffield. EXHIBITION: Date to be announced in August at The Heritage Centre, Elsecar, Nr Barnsley, South Yorkshire. EXHIBITION/MEETING: Date to be announced, in December (Club members of Hornby & Meccano) December at Stocksbridge.

SOLENT MECCANO CLUB.

CONTACT: Robert Curling, 42 Highclere Road, Quedgeley, Gloucester. GL2 4HD. CLUB MEETINGS: 2nd September at Chandlers Ford, 20th October at Ferndown.

SOUTH BIRMINGHAM MECCANO CLUB.

CONTACT: Bob Thompson 703 Shirley Rd Hall Green Birmingham B28 9JP. CLUB MEETINGS: 20th October at The Baptist Church Hall, Stratford Road, Hall Green, Birmingham.

SOUTH EAST LONDON MECCANO CLUB.

CONTACT: Geoff Carter, 15 Brathway Road, London. SW18 4BE. CLUB MEETING: 29th September 1-5pm at St Lukes Church Hall, Westmount Road, Eltham. EXHIBITION: Date to be announced, in October (10am-5pm) at The Scout Hall, Glanville Road, Bromley, Kent.

SOUTH WALES MECCANO SOCIETY.

CONTACT: Mike Hooper, 15 Talbot Close, Talbot Green, Pontyclun. CF7 8AS.

SOUTH WEST MECCANO CLUB.

CONTACT: Malcom Hanson, 11 Willow Close, Long Ashton, Bristol. BS18 9DT.

TEIGNMOUTH MECCANO CLUB.

CONTACT: T McNally, 9a The Triangle, Teignmouth. TQ14 8AU.

TELFORD & IRONBRIDGE MECCANO SOCIETY.

CONTACT: John Linder, Eccentric, 6 Grange Farm View, Stirchley, Telford. TF3 1DX. CLUB MEETING: 20th October 10am-4pm at Randlay Community Centre, Grange Road, Telford. Shropshire. EXHIBITION: 22-27th October (setup on the 21st) Sherwood Square, Telford Town Centre, Shropshire.

WEST LONDON MECCANO SOCIETY.

CONTACT: Peter Goddard, 63 Hamilton Road, Hunton Bridge, Kings, Langley. WD4 8PY. CLUB MEETINGS: 15th September & 17th November 1-5pm at The Community Centre Wordsworth Ave Entrance, Greenford, Middlesex.

Contact details provided by Dave Taylor www.meccanoman.co.uk.

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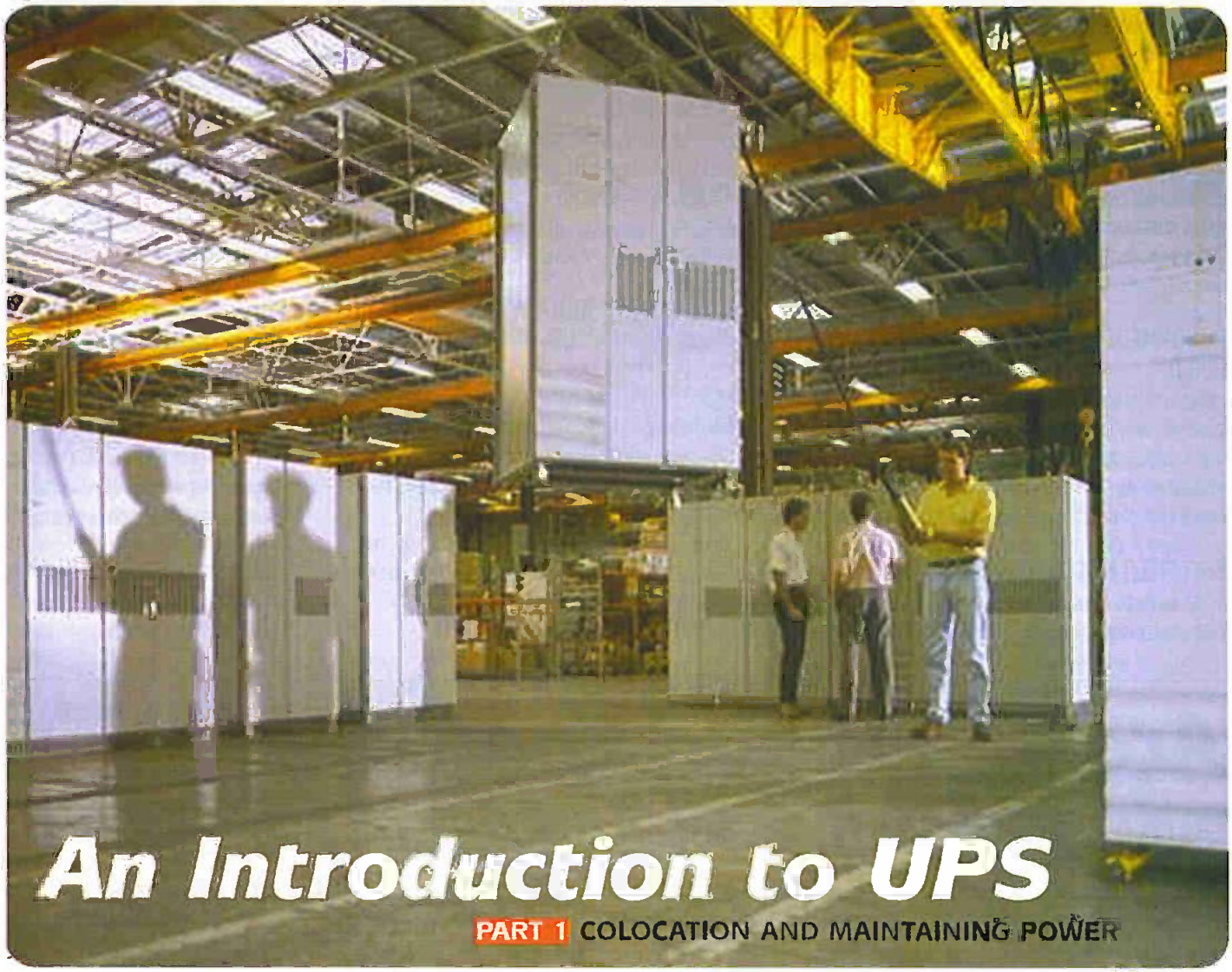
Powering THE INTERNET



An Introduction to UPS

PART 1 COLOCATION AND MAINTAINING POWER

In California ever increasing electricity consumption by Internet Service Providers and the numerous new e-commerce companies to spring up in recent years has put such a strain on the area's power stations that rolling power cuts have had to be enforced. But the rise of e-commerce and ISPs is, of course, not just specific to California – in the UK the potential for a similar strain on local power stations is just as real. The problem would probably not be as pressing were it not for the tendency of ISPs to group together so as to take best advantage of the premium lines of communication.

In the first of a two-part article, Shri Karve – one of the leading authorities on Uninterruptible Power Supplies (or UPS) – examines the rise of colocation centres for Internet Service Providers and the issues surrounding the protection of power supply and power quality for those businesses that rely upon a steady and secure connection 24 hours a day to the Internet.

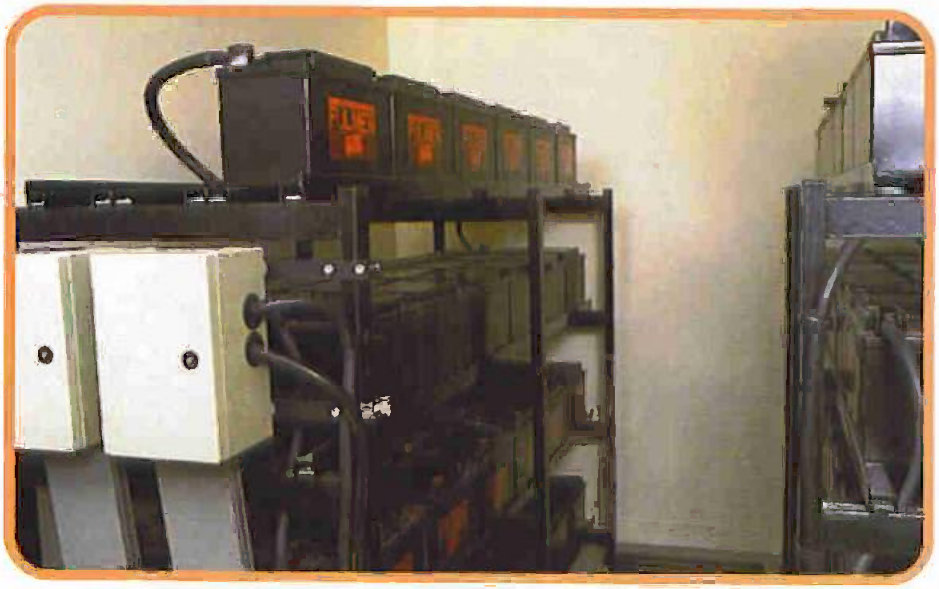
With the exponential growth of the Internet, the ISP market is booming. New UK start-ups are emerging – virtually on a daily basis – and there are, of course, the hordes of US-based ISPs who are keen to stake their claim on an expanding UK and European market. As the competition increases, many of us watch in bemusement as the deals get cheaper and a very Darwinian ethos takes hold.

While the ISPs fight over market share, there is also another very real, yet less publicised battle being waged over the finite resources required to host an ISP server farm, or 'colocation site'.

There are four prime locations in Greater London that have captured the eye of all would-be ISP contenders: Oxford Street, Park Royal, Docklands and Heathrow. These sites offer ISPs the easiest and most economical access to the fibre network that is their one and only means of servicing their market.

Protecting the Internet

With so many ISPs competing for a limited number of sites within easy reach of the fibre, suitable locations are at an absolute premium. To accommodate the ISPs' demand, third party developers have established colocation sites in each of the four key fibre location centres. A colocation site is a purpose-built facility that offers a highly secure environment in which to house ISP servers.



These colocation companies rent space to various customers and typically operate as facilities providers. More recently, the telecom companies have expanded their services to provide complete colocation turnkey project management solutions.

In Frankfurt, for example, the demand for suitable premises is so high that four independent colocation companies currently lease and share space within the same, secure building.

Under Pressure

With such high concentrations of colocation sites in the London West End, Docklands, Park Royal and Heathrow regions, there has been an incredible surge in the localised demand for electricity.

Each colocation site, serving multiple customers, typically draws around 20 MVA of power, 24 hours per day, 7 days a week. With power generation facilities virtually operating at full capacity before the most recent wave of ISPs opened for business in the UK, the situation is fast becoming critical.

Richard Phillips of E-Commerce reports that recent events in California, involving these same issues, are sounding an ominous warning for UK authorities and businesses. 'Exploding demand for electricity from Internet 'hotels' and users has pushed parts of the supply grid close to meltdown...' and 'officials have had to declare a Stage Two Emergency, one step away from a complete blackout'.

Few would disagree that the UK's 'e-revolution' is still in its early stages and many industry experts forecast that the current ISP growth cycle will continue for another three to five years. The London Electricity Board conservatively estimates that the demand for power will rise by 20 in the next four years, mainly as a result of the growing telecommunications and ISP markets.

With such high demand for power in such a small concentration of geographic regions, the quality of supply will inevitably start to deteriorate. And with the time required to establish a colocation site far shorter than the time required to develop and implement alternative energy sources, the problem can only worsen. Many ISPs have already considered generating their own power using gas turbine or combined heat and power (CHP) processes.

To exacerbate the pressure on the utilities, ISPs' power requirements are of a non-linear nature, causing problems with old substations.

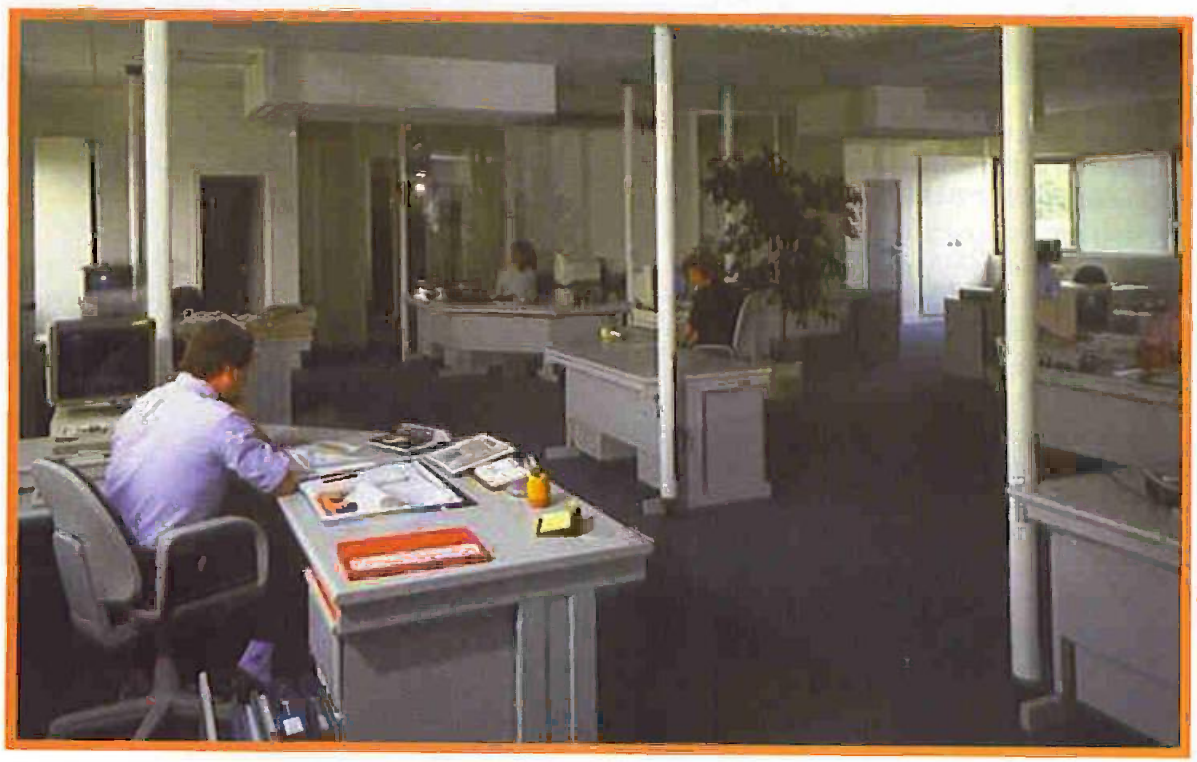
Guaranteeing Power

Due to the critical nature of on-line business operations, companies demand 24/7 Internet availability. To maintain this high level of systems integrity, all ISPs have incorporated Uninterruptible Power Supply (UPS) systems as standard.

A UPS system serves two main functions: firstly, it provides constant and clean power; and secondly, it ensures power back-up in the event of mains failure.

It is estimated that around 90% of colocation centres have opted for static UPSs. Static UPSs offer far greater flexibility than their more generic, rotary counterparts as they can be installed in the most appropriate position in the building. They do not require special re-enforced flooring or exhaust gas emission planning and control. With static UPSs generally 40 more competitive than rotary units, they also offer better value for money and a considerably smaller footprint. The units' batteries can also be located separately (in the basement for instance) allowing more lettable floor space for the server rooms.

It is the battery bank that holds the mains stored energy for every UPS system and



provides back-up power of between 10 and 30 minutes (depending on the system requirements). The battery bank is connected via a circuit breaker to the DC link and is always available in the event of poor mains or failure. Within ISP applications, it is common practice to utilise multiple strings of batteries of 10-year design life.

Given the issues surrounding reliability, colocation centres invariably opt for dual feed power configurations for servers with UPS supply and static transfer switches. Because of the high systems integrity demanded by ISPs, the colocation sites are not only using parallel redundant systems but also 100 redundant UPS configurations, ensuring zero downtime.

Consumption and Quality of Power

As a general 'rule-of-thumb', the UPS systems installed at colocation sites are sized on 1200 Watts per square metre of power consumption of server room footprint. Following this guide, the average site drawing 20 MVA would consume approximately 16 MW.

In addition to considering the power requirements of the servers, it is also necessary to evaluate the power requirements of all support systems such as the air-conditioning and lighting. As colocation facilities become larger, more hardware is installed and, as a consequence, more heat is generated. The flow-on effect is that more air-conditioning is required to control the ambient temperature and therefore more power is consumed.

Given the sensitivity of the server equipment installed in colocation sites, power quality is as equally important as continuity. ISP equipment requires a 'clean', uniform power supply, free from any surges or spikes in the feed supply. The harmonic filter, integral to the design of most modern UPS units, reduces the re-injected harmonics down to 5% as seen upstream of the UPS.

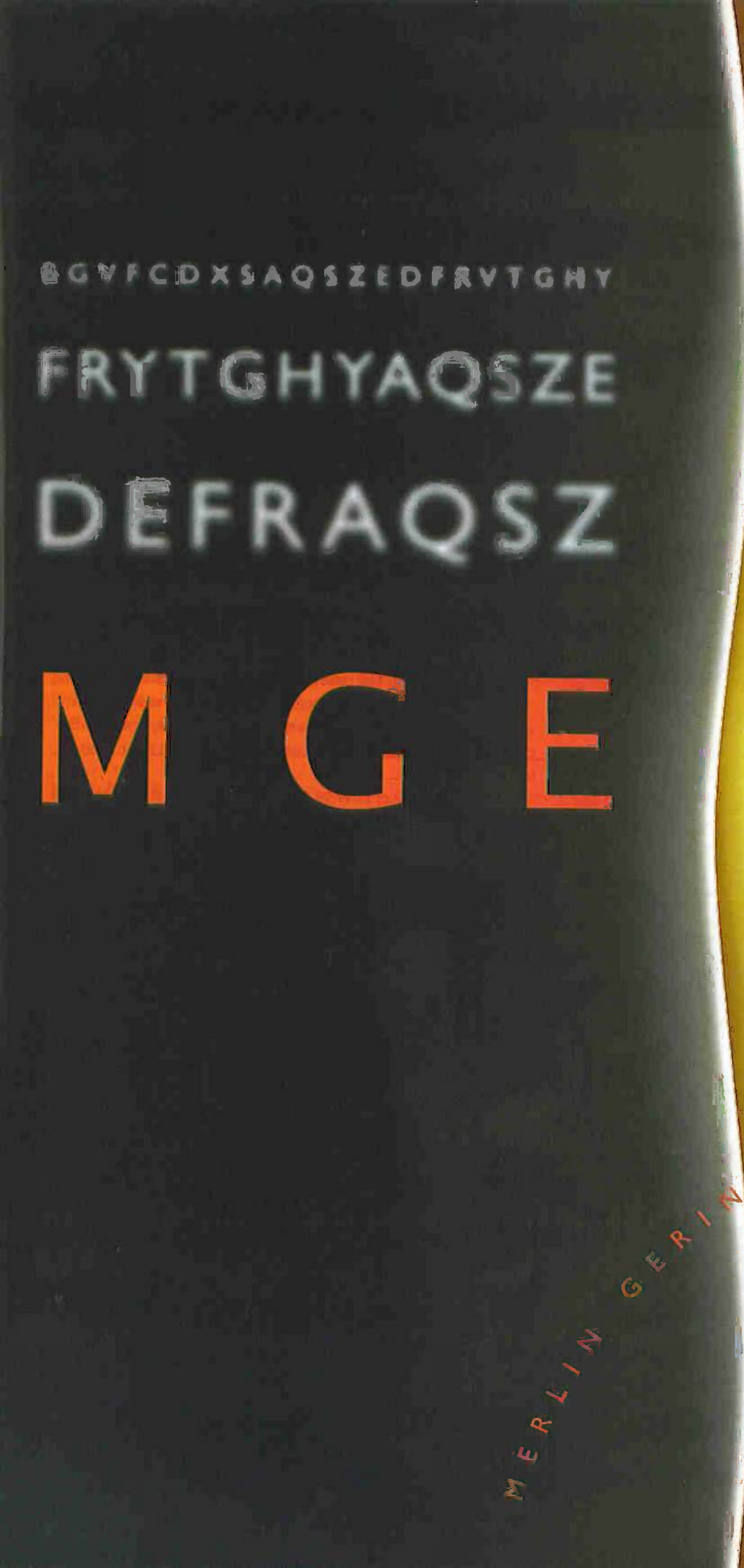
With the inherent non-linear loading of colocation sites, there is no such thing as a standard solution and consultants must carefully consider application of active harmonic conditioners, over-sized neutrals and isolation transformers. It is also important to not overlook elementary matters such as the 'skin effect', due to high harmonic frequency currents flowing in the cables and buzzbars.

The UPS Industry

As colocation sites boom, so too does the demand for associated technologies. This has become particularly apparent within the UPS sector. Most UPS suppliers are now operating at near 100 of their production capacity and as a result, the demand for basic UPS components is soaring. The lead times for many of these raw materials, such as drawn copper, batteries, microchips and semiconductors, are increasing. At the same time, ISP and colocation delivery schedules are being compressed due to commercial reasons.

This incongruent relationship between demand and supply is also drastically affecting the construction of colocation sites at the primary and secondary fibre access points. This situation means that meticulous planning is necessary from the outset of a site's design, otherwise colocation operators may have an empty building on their hands with no way of protecting their potential customers.

Next month Shri delves deeper into UPS, examining the three different types – Passive Standby, Line-interactive and Double Conversion.



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DIGITAL CAMERAS and Accessories

Olympus CAMEDIA C-1

The CAMEDIA C-1 is a new entry-level addition to Olympus' range of digital cameras. Like many other digital camera manufacturers, Olympus also manufacture photo printers (such as the P200, 330 and 400) and are marketing their cameras at those who do not own a PC or Mac as well as those who do. This particular camera is aimed at those who have never used a digital camera before, yet still has enough features to be a useful tool for those who know what to look out for.

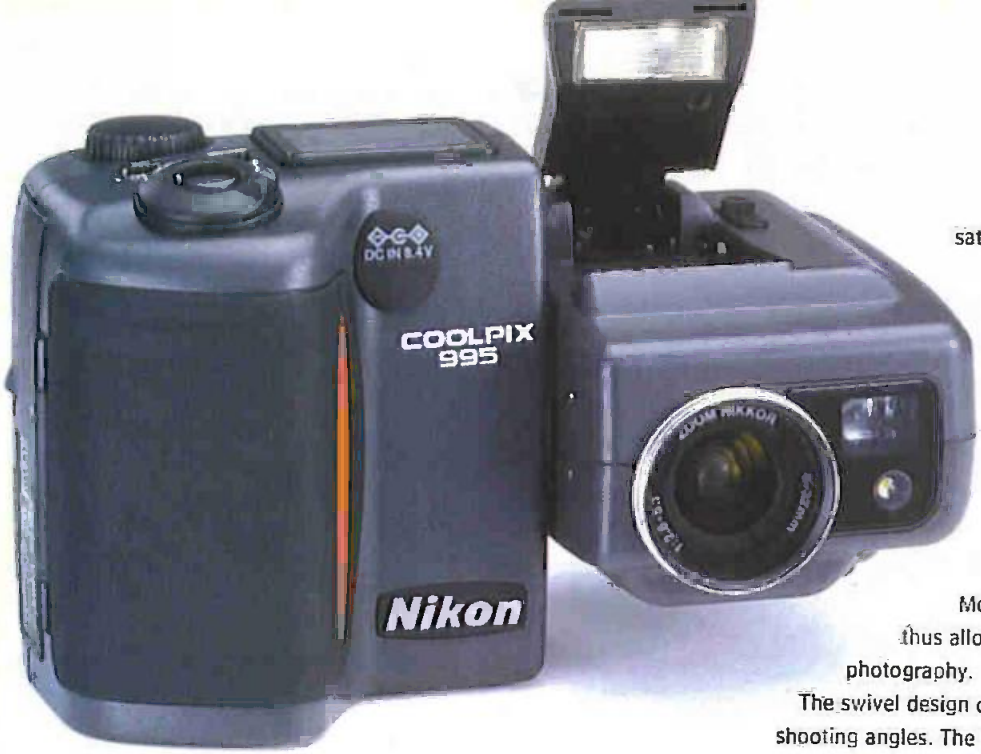
The C-1's CCD (Charge-Coupled Device) chip uses 1.3 million light-sensitive sensors, or pixels, ensuring that the resulting images have sufficient resolution to deliver postcard-size prints to rival those taken with analogue cameras. Today, most high street film processing labs are easily able to print the digital images saved on the SmartMedia storage cards used by digital cameras such as this one.

There are a range of automatic metering options – Through The Lens (TTL) autofocus ensures sharpness, an ESP (multi-zone) metering system takes readings from various points to determine optimum exposure settings, and there is a choice of auto or manual white balance options. Digital zoom is also included.

The C-1 has a RRP of £249.99 (inc. VAT) and is available to buy now. A zoom version – the C-1 Zoom – will also be available later on in the year.

Canon CP-10 Card Photo Printer

The CP-10 is a compact dedicated photo printer that connects up to Canon's PowerShot A20, A10 or any Canon digital camera that supports direct printing. Credit card or label sized 300 x 300 dpi prints can be produced – up to 18 without reloading. Printing times are in the region of 56 seconds per print. Digital Print Order Format is supported, with settings for print selection, number of copies, and shooting date. The camera uses its own dedicated ink and paper trays. A computer connectivity kit isn't included at the moment but should be available later on in the year. It may be a bit too small for most people, and, on top of this, at £300 it may only be an option for those without PCs or people who really cannot wait until they get back to their office to print out their photographs.



Nikon Coolpix 995

Designed for both photo enthusiasts and professionals, the Coolpix 995 has many useful features such as a 4x Zoom-Nikkor lens, 3.34-megapixel CCD, a multi-autofocus, and a pop-up 'Speedlight' which provides several flash modes including auto-flash, anytime flash, slow sync, and red-eye reduction.

The Saturation Control Mode lets photographers manipulate saturation levels in 4 steps, or black and white. According to Nikon, this mode was introduced in response to the growing demand for flexibility in digital photography, where instant results from a printer or computer screen without manipulating the image is of paramount importance. Other modes available on the camera include White Balance Bracketing, which automatically sets the camera to shoot at one of three different white balance settings, and a Noise Reduction Mode to automatically cancel out background noise, thus allowing new opportunities for long exposure photography.

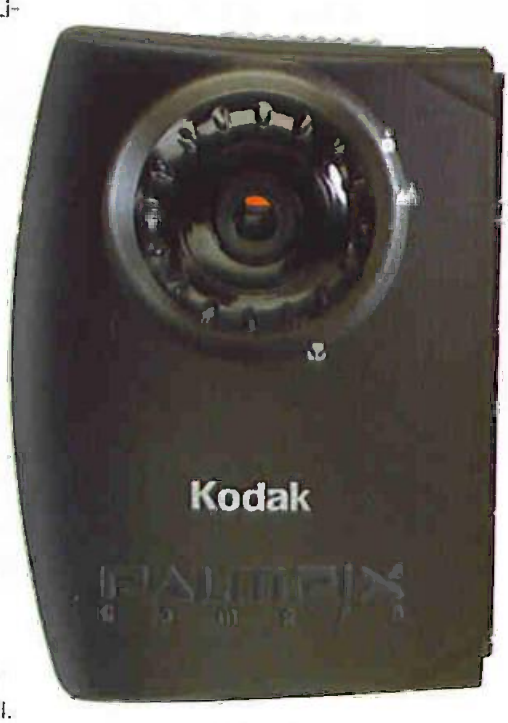
The swivel design of the camera allows for a wider range of shooting angles. The photographer can decide on the camera position while rotating the camera body, and view the LCD panel from practically any angle.

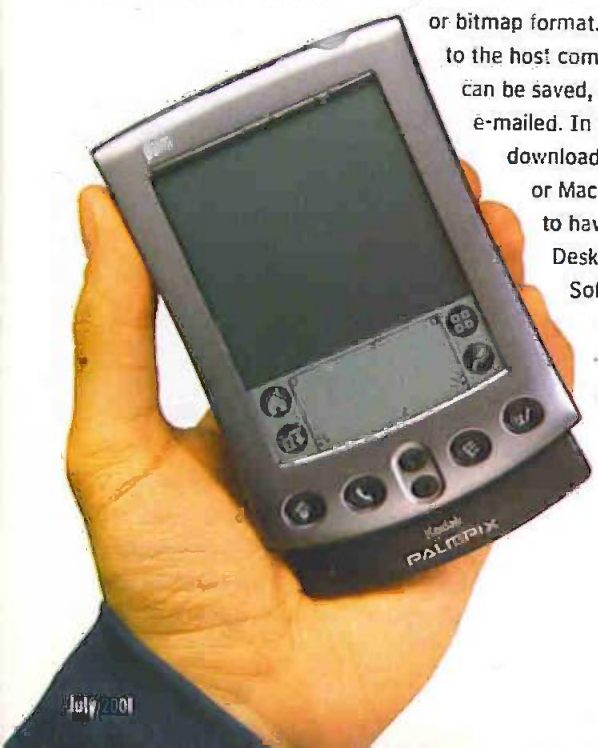
Available from the end of June, the camera comes in two kit formations – the standard kit, which retails at £799.99, and the premier kit, which costs £899.99 and comes with such extra items as a filter set, additional Li-ion battery and a 32mb CF Card.

Kodak PalmPix Digital Cameras

Owners of Palm handhelds already know how versatile this range of organisers can be. This versatility can be extended through the Kodak range of PalmPix digital cameras, which clip onto the various Palm models, allowing you to take 24-bit colour VGA pictures and transfer them direct to the organiser. You can review your images in colour on the Palm IIIc LCD, or view images in greyscale on the other models. You can then transfer the images to your desktop or laptop just as you do with other data.

The standard PalmPix includes a 2X digital zoom (available in VGA 640 x 480 mode, but not 320 x 240) and can store an image in JPEG or bitmap format. Once uploaded to the host computer, images can be saved, manipulated and e-mailed. In order to download images to a PC or Mac, you will have to have the PALM Desktop Software (included with all new Palm models) installed on that machine. The standard PalmPix model is compatible with Palm III, IIIc, IIIe, IIIx, IIIxe, and VII (running OS 3.0.2 or higher), as well as the IBM Workpad, and TRGpro. A Dock V adapter (sold separately) allows connection to Palm V and Vx models as well.





Two separate PalmPix cameras are available for the Palm m100/m105 and m500/m505 models. Both of these have additional support for the Macintosh PICT format. The latter, however, has a number of extra features, including a close up lens capability and an SVGA mode (800 x 600 pixels).

Photo taken with the PalmPix

CYBER-SHOT DSC-P1

Developing A Digital Camera

SONY'S RANGE OF CYBER-SHOT DIGITAL CAMERAS ENCOMPASSES FIVE DIFFERENT MODELS, WHICH VARY IN TERMS OF FEATURES AND PRICE FROM THE NIFTY DSC-P30, ALL THE WAY UP TO THE TOP OF THE RANGE DSC-F505 MODEL.

Here we take a look at the Cyber-shot DSC-P1 and ask just what it takes to produce a high tech product that will satisfy all requirements whilst still retaining that all important compact size and ease of use.

Sony's Cyber-shot DSC-P1 is a sub-compact Digital Still Camera with 3.34 megapixel resolution, 3x optical / 6x precision digital zoom, memory stick, high-speed scan auto focus with 5 manual focus presets and macro mode, selectable JPEG, TIFF and text modes, MPEG and E-Mail Modes, and 12 Bit A/D Conversion. The 'P' in the title, according to the DSC-P1's product planner, Yasuharu Nomura, stands for 'pocket-size', 'portable', 'pleasure' and 'play'. So how did the model first come about?

'We had come up with two series for the Cyber-shot line-up: the F and the S series. The first of the two explored the digital camera's unique possibilities, while the second focused on stamina. Because of the increasing demand for a more compact and portable camera, we decided to combine these two concepts to develop a high-quality portable model. Thus the P1 project was born'.

'The intention was to create a new type of digital still camera setting a new standard for Cyber-shot in the next generation. Since the development process was different from that of previous models, it became an entirely new project in itself. We designed the P1 from the standpoint of consumers. We felt a 3x optical zoom was necessary for shooting a variety of situations. We also chose a conveniently retractable lens with a built-in lens cover since users would be carrying the P1 with them. Furthermore, users not only want to shoot still and moving images but also want to incorporate sound depending on the scene'.

P1 product manager Yoshitsugu Nomiyama says that his goal for the P1 project was a camera that would be carried often and used just as easily by users of all generations all over the world. 'More than anything else, this required it to be compact. Nonetheless, if we downsize by eliminating functions, we would be defeating the purpose of miniaturisation. It would result in a camera that is appreciated by only a narrowly defined audience. We knew we had to make the camera compact without sacrificing functions'.

Mr Atsushi Nakanishi – project manager – gives an illustration. 'Take the viewfinder, for example. Since the camera has an LCD, we could have easily removed the viewfinder to make the camera smaller thus making our job to design the product easier. However, while we wanted to make the camera smaller, we realised that many people would enjoy having the viewfinder, taking snapshots just like a standard camera. Our goal was to create a fully-equipped camera that fits nicely in the hand'.

The P1's slim and stylish appearance is the work of Kaoru Sumita – director of design at the Sony Corporation's Personal IT Network Company. Kaoru says that its design deliberately resembles that of a typical compact camera, and that makes it easier for compact camera users to start enjoying the P1 right away. 'We could have made it vertical,' Kaoru says, 'but it would have distanced many potential users'. And as for the positioning of the lens... 'While this allowed us to reduce the size, it is also one of the very unique design elements of Cyber-shot cameras. As experience shows us, camera makers would surely place the lens in the centre of the body. Another point to notice is the rounded design of the body near the lens. We were very particular about this. In fact, we made many mock-ups until we were satisfied with the look. A rectangular shape would have been easier to

implement, but it sure would make it look boring. I could not accept such a design as a Sony designer. In this sense, the shape of the P1 suggests a new kind of entertainment. I wanted the design to be familiar, yet new and able to express a sense of freedom by moving away from such fixed preconceptions.'

So what about the inside of the camera? Compared to a contemporary digital still camera, the compact P1 has numerous high-quality features such as its 3x optical (6x digital) zoom and a 3.34 mega pixel CCD. But even the best cameras can succeed or fail based upon how compact they are and how easy they are to use. If a component can be miniaturised, the general rule is that, as long as it does not affect performance or reliability, it should be. Lens miniaturisation was an important part of the design brief for the P1. 'Not only is the lens the most important component in a digital still camera, it is also the only component that can be miniaturised,' says Mr Nomiyama. 'You can't change the size of the battery or the Memory Stick slot'. Mr Nomiyama goes on to talk about the development of the internal circuits and features. 'We also completely re-examined the functions from the user's point of view. For example, we included a built-in battery charger function. Now, all you have to do is plug in the AC cord directly. We adjusted the circuits to accommodate this function even though it was not possible previously with smaller InfoLITHIUM batteries'. He says that each member of the team had specific demands that they weren't all that willing to compromise. 'They were so passionate about their demands! So, we considered everything down to the last detail. Even the Product Planning guys told us we were being too scrupulous'.

The P1 uses the same system as other Cyber-shot cameras but the parts that make up the system are all newly developed. 'If you remove the exterior you can really see what we mean. We developed a new high-density mounting method, which eliminates the need for a connector to the circuit board and provides greater flexibility. Also, if you strain your eyes you may be able to make out some of the many miniature parts we mounted with precise accuracy. Compared to other Cyber-shot cameras, the P1 has a main circuit board that is only 1/3 the size. None of this would have been possible without our newly developed production technologies. Mr. Nakanishi really outdid himself trying to get the circuit board to fit in the miniaturised body.'

'If the thickness of the board increases by even a tiny amount,' Nakanishi says, 'it won't fit in the body anymore. We dealt with mounting in micrometers to ensure the most compact board'.

The development of the user interface was the responsibility of Hiroshi Abe. He says that his team created the perfect software with the users' needs in mind. This software, of course, had to go through rigorous testing. 'Since it is more difficult to assure quality of software as it cannot be visually inspected, we fully tested the software with prototypes and prototype circuits as the project progressed'. Later, they organised a special diagnosis team dedicated to P1 to run a comprehensive diagnosis, which included 50,000 different check points. 'Each manufacturer struggles trying to create a method for bench testing their software. I believe the P1 testing was done in the most desirable environment'.

So what do the people responsible for the Cyber-shot DSC P1 think of their finished project, now that it is on the market?

Mr Abe – 'I knew this product would satisfy users when I looked at the initial design. And now that it is completed, I can say with confidence that it has surpassed all standards of reliability'.

Mr Nomiyama – 'Though I have been in charge of product development for quite some time, I have never felt this kind of fulfilment. I am completely satisfied with all aspects of the P1 – size, style and functions'.

Mr Nakanishi – 'I agree completely. We worked very hard making it sturdy so people could carry it with them everyday. And I am happy that it is so easy for first-time users to use and to appreciate its high-quality look and feel'.

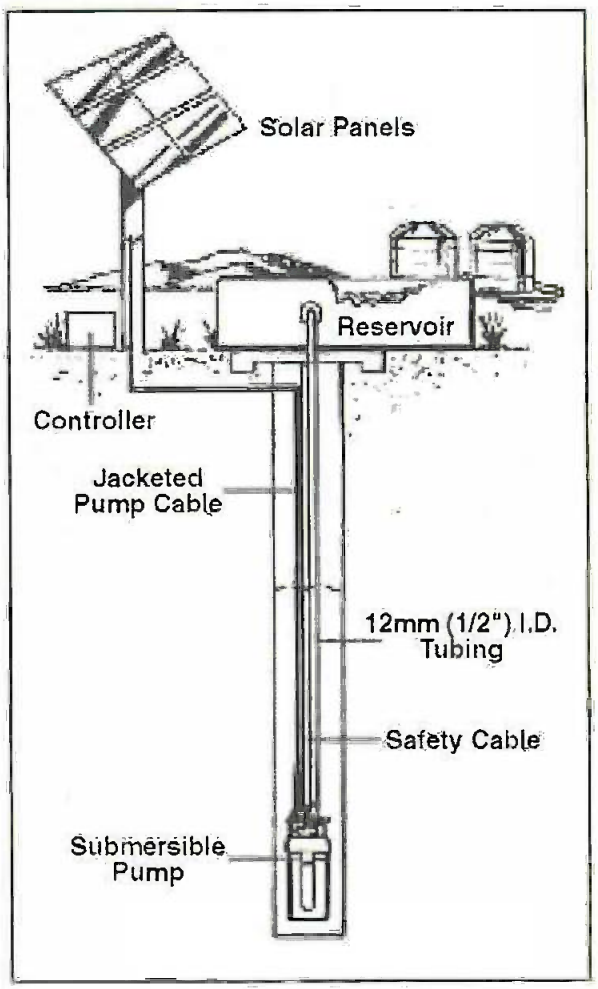
Mr Nomura – 'I have developed many digital still cameras but the P1 is definitely special since it makes me feel close to the people it was designed for. I would definitely choose a P1 for myself.'

Mr Sumita – 'Most young people nowadays carry cellular phones. I would like the users to treat the P1 just like cell phones. Carry it with you all the time, so you can get snap shots anytime. That's why I compare the P1 to everyday clothing like tee shirts and jeans, because it's easy on you. Imagine a woman taking her P1 out of her purse and taking snap shots at shopping malls with friends. That's the type of scene I would love to see often'.

Find out more about the Sony Cyber-shot range of products at www.sonystyle.com/digitalimaging

POWER PUMPS: Solar Panels for Hot Water Heating and Electricity

AN INSIGHT INTO WHAT SOLAR POWER CAN DO FOR YOU, IF YOU REQUIRE POWER FOR PUMPING, WITHOUT NEEDING TO LAY 240 VOLT CABLES.



Energy-saving solar powered water features are not just limited to the garden - they also can provide the relaxing sound of running water in the home and office. Our wide range of pumps and fountains, from small self-contained stand-alone indoor features up to lake-sized units, can be powered by energy-saving solar panels or by conventional energy sources. Water pumps come in many formats and can be powered from a number of sources of energy. Our web site www.powerpumps.co.uk demonstrates how pumps can be used to save money as well as provide a water feature in the garden powered by sunlight.

Solar Energy

An increasing number of people are aware of solar energy, but still believe it only works when the sun is out and it is hot. This myth is not just confined to the UK but also in hot climates.

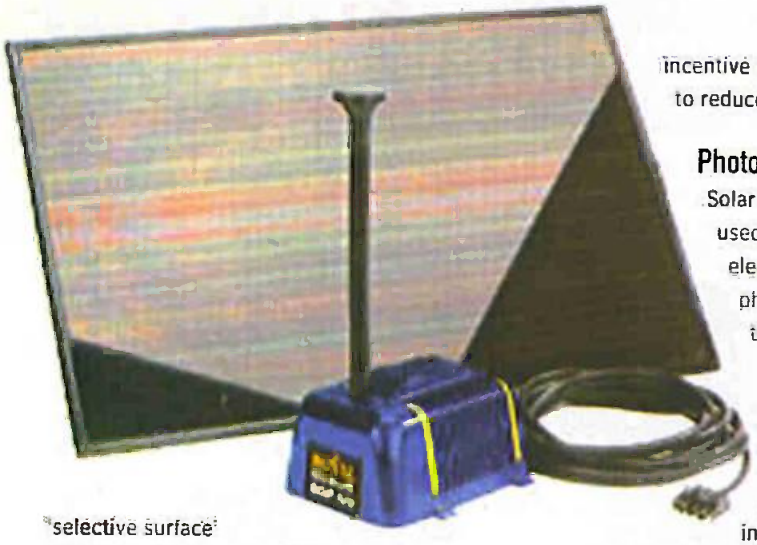
For the past 50 years, energy derived from coal, oil and gas has not increased in line with inflation and wages, hence affordable energy. This century, even if new oil and gas fields were found, the pollution each family in the West is creating, is adding to global warming and climate change. If we continue as we have done over the past 50 years, we, and our children will not see past the next 40-50 years. Every pond pump installed in Britain, which has been plugged into a 240-volt supply, adds to that problem.

There are two solar technologies on the world market.

Solar Water heating is the most popular application of the sun's energy in the UK, with an estimated 42,000 domestic systems currently in use in this country. The incorporation of the system into houses while they are being built is extremely cost effective, and as this fact is becoming more widely known, self-builders are turning to solar power as a means of heating their dream homes.

To capture the sun's heat, you will need a collector. In the UK either flat-plate collectors or the vacuum ('evacuated') tube collectors will be used, as both are designed for the lower temperature range. As well as a collector, you will need a heat transfer medium, such as water, to move the heat to where it is required by way of a standard central heating pump. This could be powered from a solar panel, which produces electricity. As solar energy is by nature intermittent, efficient heat storage systems have to be incorporated into solar installations.

The flat plate collector consists of an array of pipes connected to a metal absorber plate, often coated with low emmisivity black paint to maximise absorption and effectively heat the through-flowing water. In the simplest designs, the panels are placed on the ground and the water, when heated by the sun, rises into a tank above. If the panels are placed on the roof, (usually the highest point,) then a pump is required to transfer the heated water to the storage tank below. Recent improvements in design include the use of



"selective surface" materials which are good at absorbing solar radiation but do not radiate much energy back to the atmosphere. This design is also suited to heating swimming pools and for commercial applications.

Vacuum tube collectors operate on similar principles to the flat plate collectors, but the absorber is enclosed in a vacuum. The vacuum acts as insulation preventing the heat loss and is generally considered, in UK conditions, to be more efficient per unit absorber area. Other advantages are that collectors are frost resistant and lightweight, which makes transportation and assembly on site relatively easy.

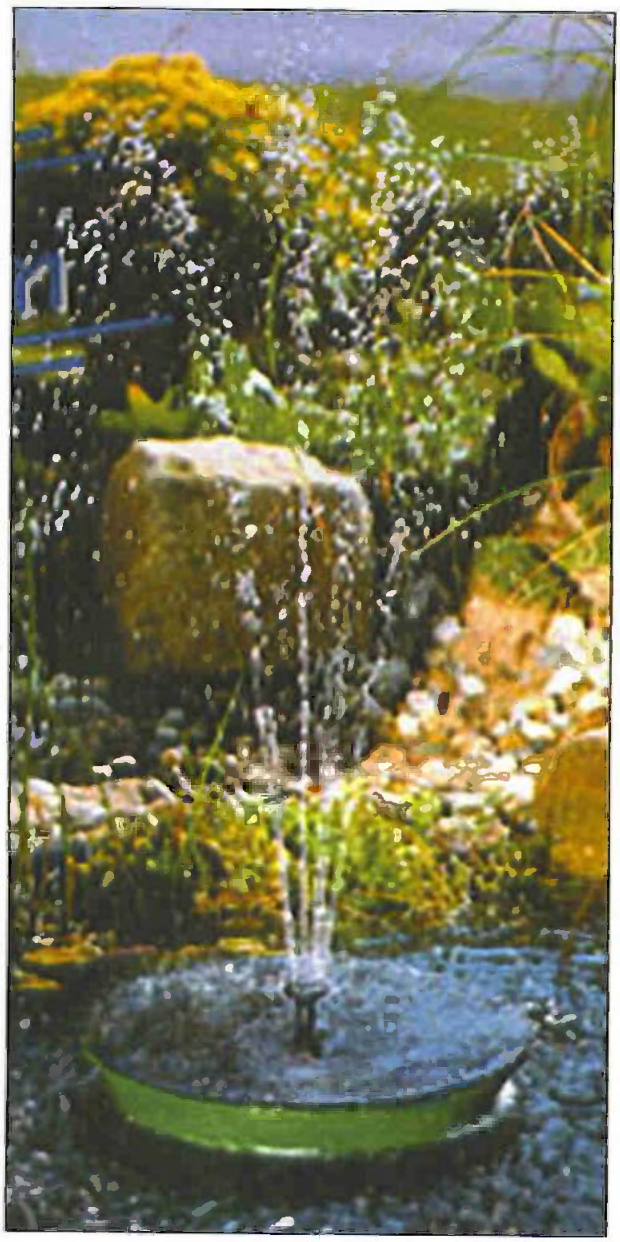
The roof area taken up by a solar water-heating collector will vary according to the design you choose and the hot water needs of your house. As a general guide this tends to average at 4 sq.m. This area of solar panel on a roof should provide the average family household with about 40%-50% of their hot water needs spread throughout the year, with most of their requirements met during the summer.

For optimum performance, solar panels should be sited in a shade-free area on a roof, preferably facing due South. Panels should also be inclined at an angle of 35 degrees to the horizontal. Low angles will result in higher summer collector efficiency, while high inclinations will favour winter collector efficiencies.

Solar water heating systems cost between £1500 and £4000, and although it can take some time for the initial cost to be met in savings, maintenance to solar water heating systems is minimal and a lifetime in excess of 20 years can be reasonably expected. The April budget reduced VAT from 17.5% to 5% on all solar hot water heating installations as an incentive from the Government to reduce Co2 emissions.

Photo-voltaic Panels

Solar energy can also be used to generate electricity, using photovoltaic (PV) cell technology. Instead of harnessing heat, sunlight is 'captured' and converted into electricity by the interaction of photons – tiny particles of ultraviolet, visible and near infrared light - with the electrons in a semi-conductor cell.



A PV installation covering 15 sq.m. of a south-facing roof area is capable of providing about 1,500kWh of electricity per year, and satisfying as much as 50% of the family household electricity demand. How much of your electricity derives from the sun will depend on you, your roof and your budget.

Many photovoltaic systems are designed so that they can be added on to existing roof structures, which is convenient if you are working on a present property. Although these systems are readily available, the cost of production PV systems is still relatively high. They compete very successfully with conventional systems for a wide range of applications in remote locations such as lighting and water pumps.

A PV array can be 100 watts or 1000kw subject to how much energy is required over a period of a day/week and how many hours of sunlight is available all the year round. In the UK where sunlight is very limited during the winter period we recommend the use of a wind turbine to support the PV output during the winter months.

The PV/Wind hybrid system provides all year round power, which reduces the overall capital cost. There is no set system as each enquiry depends on individual needs.

The simplest PV system consists of an array feeding a direct current load. A storage battery with a charge regulator must be added if power is required during the night and in cloudy weather. For alternating current loads, a device called an inverter is required to convert the dc to ac at the correct voltage. Sometimes a wind, diesel, petrol or hydro generator is integrated into the PV system to reduce the required storage capacity and to boost electricity production. Various control and protective devices complete the system.

The system designer has to work out the cheapest combination of array area, tilt angle and storage capacity that will meet the load demand with an acceptable level of security over the expected lifetime of the installation.

1 M? of PV panel is equivalent to 100 watts at 12 volts

Measurement of Power

- A 5 watts PV panel produces .4 amps at 12volts DC
- A 12 watts PV panel produces 1 amp at 12volts DC
- A 20 watts PV panel produces 1.6 amps at 12volts DC
- A 50 watts PV panel produces 4 amps at 12volts DC

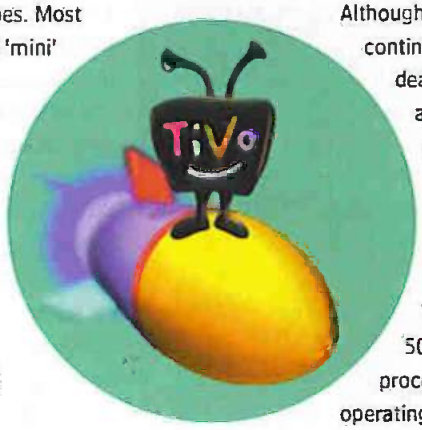
(WATTS DIVIDED BY VOLTS = AMPS)

Technology Watch

with Martin Pipe

AS I WRITE THIS, THE NEW DIGITAL VIDEO RECORDERS ARE BEGINNING TO MAKE THEIR PRESENCE FELT.

In this article and the next, we'll concentrate on domestic formats intended for home use - the DV format, introduced back in 1996, is specific to camcorders. So too is a digital version of Sony's 8mm format. Interestingly, a few home DV VCRs are available. Most of these 'edit decks' have been partnered with computer-based non-linear video editing systems. They do have in-built tuners and timers, though, and can be used as high-quality VCRs. The DV format is capable of exceptional video quality, as one would expect from the 25Mb/s data transfer rates involved. Off-air recordings - even ones from analogue terrestrial TV broadcasts, which arguably beat both satellite and terrestrial digital hands-down in terms of picture quality - lose nothing obvious relative to the original. One manufacturer, JVC, sells a combi DV/S-VHS deck. With this unit, DV master recordings - off-air or camcorder - can be dumped to analogue VHS or S-VHS tapes. Most DV equipment employs the 'mini' version of the format. The tiny tapes may be ideal for camcorders, but their 1-hour recording time is insufficient for home use. Sony and Panasonic sell DV recorders compatible with the full-size DV cassette. These 3-hour tapes work out at over £20 each.



As we've said, the DV and Digital-8 systems are, as far as the average consumer is concerned, relegated to camcorders. As far as home use is concerned, we currently have the digital version of VHS (D-VHS) and TiVo. Waiting in the wings are DVD-RAM (a 'mini' version of which forms the basis of a new Hitachi camcorder), and the incompatible DVD-RW and DVD+RW formats from Pioneer and Philips respectively. Of the digital video systems currently available, TiVo probably has the highest profile here in the UK. Right now, you can buy the hardware from high-street retailers like Currys, Comet and Dixons. Currently, only one European manufacturer - Thomson - makes TiVo boxes, although the situation is rather different in the USA, where the system was invented. There, units from Sony and Philips are also available. TiVo differs from DV and D-VHS insofar that it relies on hard-disk storage rather than tape. Inside the Thomson PVR1OUK TiVo box, you'll find two Quantum IDE hard disks with a combined unformatted capacity of 45GB. Later models are said to have a single large-capacity drive, and a spare drive bay for adding a second drive!

Although the hard disks are spun continuously, the box is a good deal quieter than the average PC. Noise is only apparent when the disk heads shuttle around, but it's never obtrusive. All software is upgradable; indeed the TiVo is based around a 50MHz IBM PowerPC processor running the Linux operating system. Most of the software in question is stored on the hard disks. Also in the box, by the way, is a Sony MPEG encoder, IBM MPEG decoder, Philips video DAC, Philips video ADC, Conexant/Rockwell modem chippery and 16MB of RAM. The amount of recording time available depends on the compression ratio selected - TiVo presents the user with four user-friendly options described as 'basic' (a data rate of 2.24Mb/s), 'medium' (3.62Mb/s), 'high' (4.77Mb/s) and 'best' (7.65Mb/s). At the 'basic' setting, you'll be able to squeeze over 40 hours of recording from the 40GB drive, although the presence of obvious compression artifacts makes the picture only really suitable for non-critical usage. At the other end of the scale, the 'best' setting equates to around 12 hours with that 40GB drive. In this mode pictures are, however, very difficult to tell apart from the original.

The benefits of the hard disk's random-access nature are fully utilised by TiVo. Your archive of previously-recorded programmes are listed in a 'now playing' menu. The one of interest can be selected from the remote (which, by the way, is essential because the TiVo recorder itself lacks any controls!) and it will start playing. You get free reverse/forward speeds, slow-motion, noise-free stills and frame advance - all of which are noise-free. Programme details, such as programme synopsis and recording time, are also displayed. Now isn't that preferable to rewinding or fast-forwarding through a stack of unlabelled VHS tapes until you eventually find what it is you're after? One of TiVo's most important advantages is the ability to 'pause' live TV. In actuality, it's not 'live' - there's a delay of a few seconds, as you'll discover if you're watching Digibox-derived channels and try to change channels with the receiver's own handset! Variable-speed and trick playback is still possible over the portion that has been recorded - this is shown on a status bar at the bottom of the screen.

The system records the last 30 minutes of the programme you're currently watching, and so you can come back to it after you've had to deal with phone calls, errant children, home deliveries and so on. 'Live TV' recording is always conducted in the 'best' quality setting. The hard disk recording system does have its drawbacks, though. One - fragmentation - isn't an issue, says TiVo, owing to the file system employed. I have been using TiVo for several months now, and have never had any problems with dropped frames and so on - despite disks that are nearly full of timeshifted TV programmes! The system does suffer from a rather more obvious problem, though. You will need to delete programmes to make space

for new ones! The Thomson TiVo box does, however, have a Scart socket for your VCR - programmes you want to keep can thus be transferred to tape. Note that the VCR Scart socket caters only for composite video - S-video and RGB are not possible.

TiVo's exceptionally user-friendly menu system provides all kinds of intriguing possibilities that are denied to VHS recorders. Finding the programme you want to record is a cinch, thanks to a clever combination of genre categorisation and alphanumeric searching. You can also book a 'season pass' that will automatically record all of the episodes of a TV show you want - and, based on your viewing habits, the system will recommend shows that might appeal to you! The system is even clever enough to realise when one of the programmes on its 'to-do' list is a repeat of one that's already on the hard disk - something that's a distinct possibility if you've booked a 'season pass' to, for example, record every Simpsons episode going. All great stuff, considering the number of channels currently being beamed into British homes. So how does it know when they're on? Every 24 hours, the TiVo box calls up a call centre via its in-built v90 modem and downloads the latest schedules for all UK channels. All of this is part of the subscription, which works out at around £10 a month - in addition to the once-off (£400) purchase price of the hardware. In case you were wondering, the number called is a 'freephone' one (08081 050005).

As an alternative, you can pay £199 for a 'lifetime' subscription (lifetime of the recorder, that is!) The schedules provided through subscription cover not only the terrestrial channels (like your average Nicam VCR, the TiVo recorder has a stereo TV tuner built-in) but also the satellite/cable/terrestrial digital ones. Your satellite receiver hooks up to another Scart socket, and we're pleased to report that it's compatible with the RGB outputs of digital set-top boxes. The main Scart, to which your TV is connected, is also RGB-compatible. When your designated satellite programme is about to start, the TiVo sends a channel-change instruction to a trailing infra-red emitter that simulates the receiver's remote control handset. If my experience with a Pace-manufactured Sky Digibox is anything to go by, the system is less than 100 reliable. Sometimes, the last digit of the three-digit channel number is not understood, and the receiver is stuck on the current channel - as a result, it may record the wrong programme!

Another Sky-related disadvantage stems from the tendency of Digiboxes to go into standby after an over-the-air software update. If this happens just after you go on holiday, nothing will be recorded. The TiVo recorder flashes up a warning if no video signal is detected - why can't it issue an 'on' command to your Digibox under such circumstances? Another limitation of the TiVo hardware is its lack of support for PDC (Programme Delivery Control), a teletext-based system that automatically adjusts the timer to compensate for late-running programmes. As a result, it's not uncommon to miss the last few minutes of a show - particularly if it's a BBC one (our wonderful public service broadcaster doesn't seem to believe in adhering to its schedules particularly rigidly!). The worrying thing is that all modern VCRs - including the £70 'supermarket specials' - are all PDC-compatible. What's more, TiVo doesn't have the simple facility to 'add time' to a recording. The vast majority of cheap VideoPlus-equipped VCRs, on the other hand, do. TiVo claim that PDC support will be forthcoming, hopefully as a software upgrade. The only way around the problem is to set the system to record not only the wanted programme, but the one that follows immediately afterwards! An alternative would be to set the timer manually (there's a 'record time/channel' feature). The present situation presumably arose because PDC and teletext are unheard of in TiVo's US birthplace.

In all other respects - RGB/Scart, UK-spec stereo tuner, PAL compatibility, automatic compensation for BST/GMT and so on - Thomson has done a bang-up job in bringing TiVo to this country. The hackers are already at work, although none of their efforts so far have focused around starving TiVo of subscription revenue - something that would ultimately be counterproductive. Instead, they've looked at expanding the storage capacity by adding to, or replacing, the existing hard disk. The process is rather convoluted and requires access to a Linux PC, which is used to prepare the new drive and copy the system files across. Another hack adds an ISA slot to the TiVo box - most of the required bus signals are already accessible, courtesy of an factory-test edge connector on the main PCB - so that a NE2000-compatible network card can be fitted. This hack involves adding another circuit board, which features a GAL device (details from http://samba.org/tridge/tivo-ethernet). All great stuff, if you want to play previously-recorded video on a networked PC, or copy files across so that you can archive them onto CD-Rs.

Hard disk recording is set to accelerate in popularity. You can already buy PCs with TV tuner cards, together with processors fast enough to encode high-quality MPEG-2 video in real-time using software codecs. In Japan, JVC has brought out two products that combine a hard disk video recorder with a TV in one instance, and a conventional VHS VCR in the other. In the UK, we will shortly see Sky Digiboxes with in-built hard disks. These will score over TiVo insofar that the MPEG-2 off-air bitstream will be written directly to disk. In other words, recordings will have exactly the same AV quality as the original transmissions, and data storage requirements will be no more than is absolutely necessary. It remains to be seen, however, whether the user interface offered is anywhere near as flexible or powerful as TiVo's.

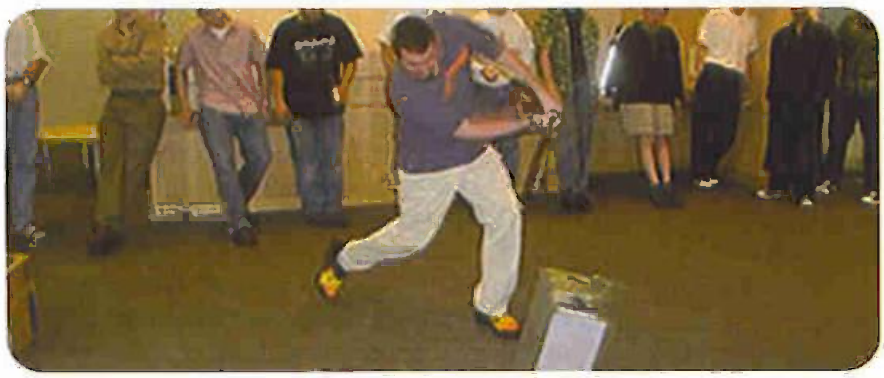
Next month, we will examine other up-and-coming formats, including D-VHS, DVD-RAM, DVD-RW and DVD+RW.

Web links

www.uk.tivo.com (Official TiVo site)
www.thomson-europe.com (Manufacturers site)
www.tivocommunity.com (Third-party information, including hacking information)
www.tivoukfaq.com (UK-specific TiVo FAQ)

Martin Pipe welcomes comments and ideas. E-mail him at: martin@webshop.demon.co.uk
Or look out for him online! His ICQ ID is: 15482544

Beyond Belief



Bashing Up An Xbox

Prior to E3 the development team behind the Xbox Development Kits – prototype machines used by software developers who need to make ready their software long before finalisation of the console – took part in an astonishing piece of symbolical vandalism on their own machines. Now that the Xbox is so close to completion and manufacture, more accurate kits are now available for developers to test their software on. The XDK team decided that the fact that the shiny silver tower unit XDKs were no longer necessary was a milestone worth celebrating, and they did so by taking it in turns to bash one of them to pieces with an aluminium baseball bat.

'It was time to send the old kits out with a smash,' says Jeff Henshaw, Executive Producer of department XDK. 'With an aluminium baseball bat in hand, each member of the XDK team took a ceremonial swing at a first generation kit, until there was nothing left except a pile of circuit boards'.

Watermarking Text

One of the more unusual pieces of news to arrive at our office this month was an e-mail from a reader pointing out that researchers at Perdue University claim to have come up with a way of digitally watermarking text by altering the grammatical makeup of selected sentences throughout a document. An encryption algorithm based on a long random number is used in the process to introduce the watermark into the text. Like to point out, Electronics and Beyond would, that, digitally watermarked, thus far, none of its articles have been. Erm, with the exception of the previous sentence, that is.

Cranial Implants...

Cranial implant technology, or to put it another way, having a chip inserted into your head (either with or without your consent on the matter), has been a recurrent theme in science fiction programmes such as Farscape, Star Trek, Seaquest DSV and even Buffy The Vampire Slayer. Following an article on the CNN website in December about Kevin Warwick – head of the Cybernetics Department at the University of Reading – having a chip wired up to his nervous system through nerve fibres in his left arm, CNN started a pole on its Internet site asking the question 'Would you be willing to have a chip implanted into your body?'

The result? Well it was much closer than you'd think. Of the 12,500 people who cast their votes in the poll, 51% said yes, 49% said no.

...And Space Tourism

On a similar note, the question 'If money was no object, would you consider taking a holiday in space', had a much more emphatic result – of the first 29,000 people to respond, a massive 86% said yes. However if, like the first space tourist Dennis Tito, they had to pay $20 million (£13 million) to do so, it would perhaps be a different story – of the first 24,500 people who responded to 'If you could afford it, would you spend $20 million for a trip into space?', only 52% said that they would part with that amount of money for the privilege. Perhaps they were thinking they would like to keep the money and spend it on more down-to-Earth things.

First Online Massacre Put Down To Black Magic

Apparently, several of the more reality-challenged players of the online version of the PC swords and sorcery game Diablo II have been in mourning after hackers took advantage of an upgrade in the game's sign-on system to gain access to other players' characters. Hundreds of heroes were killed and pillaged, leaving some people to describe the event as 'the first online massacre'. Some players had spent hundreds of hours building up their character's statistics and inventories, and perhaps felt more of an affinity with their virtual characters than they should have done. The official word from the makers, Blizzard Software, is that at no time were they hacked and 'anything implying or implicitly stating that is pure speculation'. There is another possibility, of course – it could all be down to black magic.

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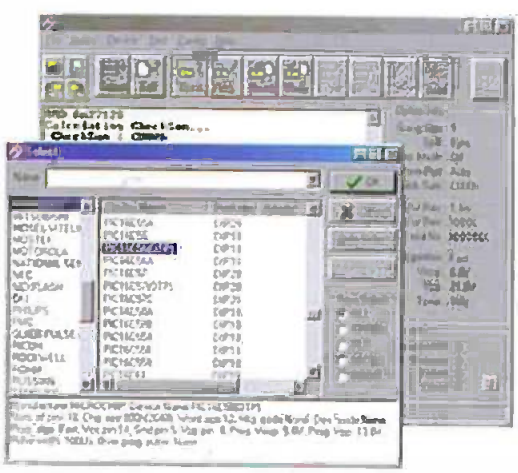

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