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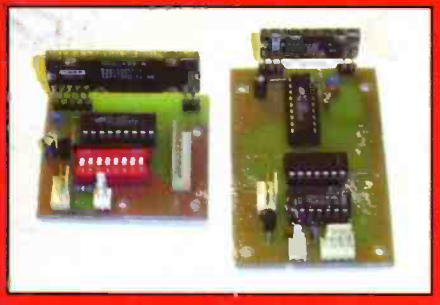

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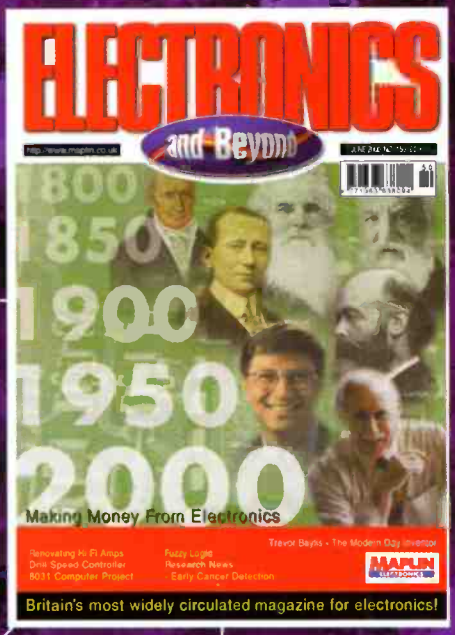

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ELECTRONICS and Beyond

December 2000 Vol. 20 No. 156

Regulars

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25

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Published by Kanda Systems Ltd.
Unit 17/18 Glanyrafon Industrial. Estate, Aberystwyth, Ceredigion SY23 3JQ.
Tel: (01970) 621030.
Lithographic Reproduction by Planagraphic Studios,
18 Sirdar Road, Brook Road Ind. Estate, Rayleigh, Essex SS6 7UY.
Printed by,
Cradley Print. Chester Road, Cradley Heath, West Midlands B64 6AB.

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ELECTRONICS and Beyond

The automated home looms forever nearer. People have long since had thoughts about controlling lighting, heating and turning the oven on remotely using a phone. But as then, MODEMs were used only with computers and not everybody wanted to leave power hungry computers on to control the odd light. Today's embedded automated systems make much easier work of it, typically being in sleep mode until aroused. What will be the next automated gadget in the home that we cannot do without? You often here people say; How did we manage before photocopiers were invented? People even now are saying; How did we manage before mobile phones? Although it is difficult to see at this point, we could be saying the same thing about home internet shopping in a few years from now. When technology can save us that extra time element in order to attend to other urgent matters we might be very tempted to take it on board. The other critical factor for success is one of reliability. Provided the technology works easily and works well and becomes an invisible aid, then we take it for granted.

This month's Mobile Services article examines the options open to us via the burgeoning mobile telecomms market and with it all the news, information and leisure facilities open to us. The main target area could be in the automobile industry. Can it be that in a few years time an entertainment's unit will come as standard in the car? This would include TV, Radio, DVD programming, navigation and information via the internet. In another article, the development of a single crystal LASER at nanometre level makes interesting reading - for who knows what ideas could come out of this at micro chip level - perhaps optical computing on a chip!

Anyway I hope you enjoy this month's selection of articles and if you haven't filled in our questionnaire from last month there is still time.

Britain's Best Magazine for the Electronics Enthusiast

NEWS REPORT

Burglar Alarm Links to Mobile Phone

Now your mobile phone can be connected to an alarm system - an intelligent way of exploiting mobile technology for a real benefit.

BlueLabs has developed a system for Mobile Notifier that allows intelligent alarm communication via the mobile Internet.

The system analyses alarm signals and passes them on to wherever the recipient wants. The system opens up great opportunities for smart security solutions for both individuals and companies.

The system receives alarm signals from an alarm transmitter, analyses the alarm and forwards it on the basis of a profile defined by the user.

The alarm messages can be sent to a mobile phone using SMS messaging, pre-recorded voice messages, via e-mail or directly to an alarm centre. The platform is very flexible and allows alarm and notification services to be tailored to the customer's exact wishes via the Internet.

For further details, check: <www.bluelabs.se>.

Contact: BlueLabs,
Tel: +46 8 470 20 00

There's More To Local Access Than DSL, Warns Ovum

High cost of interconnect leaves new entrants considering other options. All over the globe, telecoms liberalisation coupled with new technologies is laying open the promise of cheap broadband local access.

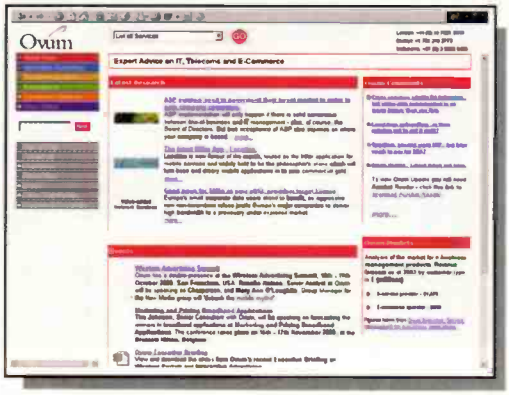
This has brought a band of new entrants into the access market, each eager to carve out a share of the market by forging new connections between customers and the communications network.

Pent-up demand for faster Internet access has led many consumers to seize upon xDSL as the access method of the future.

However, independent research and consulting company Ovum is warning that new entrants may find the cost and complexity of deploying xDSL discouraging: they will have to look to other access methods, with wireless local loop a viable solution in many markets.

Ovum's report, Broadband Access: New Business Models, points out that most early broadband access operator business plans were vastly over optimistic, resulting in greatly delayed deployment plans or an indefinite postponement of plans for general release.

xDSL, wireless local loop, fibre to the home and cable modems all represent viable access technology options, but each type offers different capabilities and restrictions.



So when choosing which to deploy, operators will have to compromise - between deploying quickly to build a customer base; cost effectiveness and lifetime and performance issues. They may also find that geographical considerations are vital to deciding strategy in different countries, since issues such as regulation, population density and sophistication of current networks all have a part to play.

Trial broadband services in the US highlighted the downside of xDSL, which is unable to cover long distances because of noise distortion. xDSL also has bandwidth restrictions which tend to shorten its overall lifecycle.

In fact, fibre to the home is gaining ground as a favoured option in the US. Although initial investment for deploying fibre is significant, its timeframe to profitability can be improved by methods of provision other than digging, such as where it can be fed through existing sewage systems.

Ovum forecasts that although the share of fibre to the home in the broadband access market will decline over the next few years - mainly due to the rollout of xDSL and broadband fixed wireless access - it will rise in the long term.

But for new entrants, the favoured option is wireless local loop. This option allows operators without an existing customer base to build new networks without the need to pay for interconnect licenses or dig up roads. They will be able to bring their customer offerings to market and recoup rollout costs quickly.

For further information, check: **<www.ovum.com>.**

Contact: Ovum, Tel:(020) 7551 9021.

Red Hat Announces Red Hat Linux 7

Red Hat Linux 7 the latest version of Linux announced by Red Hat this month provides enhanced security, new ease-of-use features, optimised software for higher-end Intel chips and increased 3D support, along with dozens of new enterprise-ready applications. For further details, check: **<www.redhat.com/network>.** Contact: Red Hat, Tel: (01483) 300169.

Apple Releases Mac OS X Public Beta

Apple has released Mac OS X Public Beta, a preview version of Apple's next-generation operating system. Users can purchase Mac OS X Public Beta on Apple's Online Store at **<www.apple.com/ukstore>** for £24.95.

Mac OS X features state-of-the-art technology throughout, including advanced Internet and graphics technologies, a new user interface named Aqua, and an open-source UNIX-based foundation named Darwin.

Mac OS X features true memory protection, pre-emptive multi-tasking, and symmetric multiprocessing when running on the new dual-processor Power Mac G4 line.

Mac OS X includes Apple's new Quartz 2D graphics engine, based on the Internet-standard Portable Document Format, for graphics and broad font support; OpenGL for spectacular 3D graphics and gaming, and QuickTime for streaming audio and video.

For further details, check: **<www.apple.com>.**

Contact: Apple, Tel: (0800) 783 4846.

NEWS BYTES

Government Grant Set to Return Chip Manufacture to Tyneside

Trade and Industry Secretary Stephen Byers has announced a £27.8 million Government grant to Atmel to assist in its acquisition of the former Siemens semiconductor manufacturing plant in North Tyneside.

Atmel expects to create between 1,000 and 1,500 jobs in the manufacture of leading edge microprocessors at the plant over the next three years, with a significant number of additional jobs in supply chain companies.

Founded in 1984, Atmel Corporation is headquartered in San Jose, California, with manufacturing facilities in Colorado Springs, Colorado, Irving, Texas, Nantes and Rousset, France, and Heilbronn, Germany.

Atmel designs, manufactures and markets on a worldwide basis advanced logic, mixed signal and non-volatile memory and RF semiconductors.

For further information, check: **<www.atmel.com>.**

Contact: Atmel, Tel: (01276) 686677.

Hughes to Build Three Spacecraft Satellites

Hughes Space is set to build three satellites for New ICO Global Communications. In addition, HSC will modify 11 other spacecraft currently in production for the revamped New ICO system. The spacecraft modifications will assist in the enhancement of the New ICO constellation to provide high-quality voice and packet-data services. New ICO expects to begin service in 2003.

The ICO satellite design is one of the most complex ever undertaken by HSC and incorporates a number of unique design features.

The satellites carry more computing power than 600 Pentium III-based computers; feature innovative transmit and receive antennas allowing direct air link to users; and use a so-called "smart processor" that is capable of adapting beam configuration to match usage and make the most efficient use of the bandwidth available.

For further details, check: **<www.hsc.com>.**

Contact: Hughes Space, Tel: +1 310 364 6000.

NEWS BYTES

Technology Companies Back Biotech

IT giants such as IBM, Sun Microsystems, Motorola, and Compaq are rushing to fulfill the IT needs of an ongoing biotechnology revolution driven by genetics research. Biotech and pharmaceutical companies need high-tech tools to store, access, and analyse millions of gigabytes of data involving the human genetic code and how it factors in disease. Software being developed by IBM and Incyte Genomics will provide academic researchers and other Incyte customers with single-search databases.

For further details, check: **<www.ibm.com>.**

Contact: IBM, Tel: (0990) 426426.

Oxford Joins Internet University Scheme

Oxford University has joined an online learning alliance with Princeton, Stanford, and Yale aimed at entering the £30 billion online education market by offering non-degree courses to former students.

The University Alliance for Life-Long Learning will create an online college that is expected to start offering courses to 500,000 former students by the end of next year.

After an initial trial, the university said that it would examine the possibility of extending the scheme beyond former students.

For further details, check: **<www.oxford.ac.uk>.**

Contact: University of Oxford, Tel: (01865) 270000.

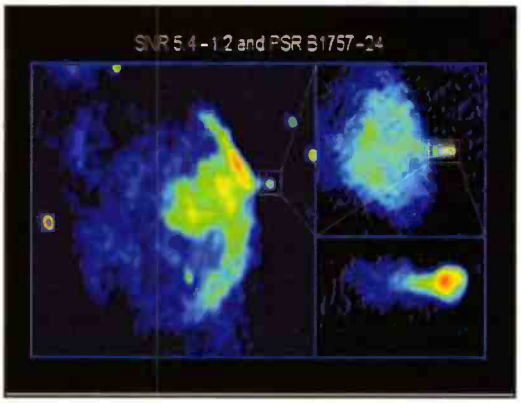
Cirrus Logic Shoots Past Millionth Maverick Milestone in Six Months

Cirrus Logic has shipped its millionth Maverick processor after six months of production. Maverick chips are designed into a variety of Internet entertainment devices including the leading portable Internet audio players, network-based home players, digital car audio players, eBooks, Web-based entertainment, and Personal Digital Assistants (PDAs).

For further details, check: **<www.cirrus.com>.**

Contact: Cirrus Tel: (01628) 472211.

Pulsars Lying About Their Age



Pulsars, the spinning, superdense neutron stars that send powerful lighthouse-type beams of radio waves and light flashing through the universe, have been lying about their age.

Researchers from MIT studied a pulsar 15,000 light-years away in the constellation Sagittarius that has traveled outside the shell of debris from the supernova explosion that created it. The pulsar and the shell, known as a supernova remnant, together are dubbed the Duck, because of their unusual appearance.

Stars much more massive than the Sun end their normal lives in violent supernova explosions, leaving behind an extremely dense neutron star. Some of these neutron stars produce the beams of electromagnetic radiation that characterise pulsars.

For the pulsar, designated B1757-24, to have traveled from the center of the supernova remnant to its present position in 16,000 years, it would have to have moved at about 1,000 miles per second, a particularly high speed compared to other pulsars.

The research team compared the 1993 VLA image of the region to one they made last year to measure the pulsar's change in position over a known time, and thus to calculate its speed. They were surprised to find the pulsar moved at a maximum of about 350 miles per second which meant that the pulsar took much longer to reach its current position, and so it is a much older object than has previously been believed.

For further details, check: **<www.mit.edu>.**

Contact: MIT, Tel: +1 617 253 1000.

eMarker.com Connects Radio Listeners With Music

eMarker.com has launched a free Internet service at **<www.emarker.com>** that puts an end to the most frustrating part of hearing a song on the radio - not knowing the title of a song or the artist's name. By pressing the button on the eMarker device, users can eMark the songs they hear on the radio and locate the song titles and artist information through eMarker.com.

The eMarker.com site offers many unique features for consumers to tailor with their personal preferences, including hearing sample 30-second audio clips, storing favorite song titles, locating artist album information and connecting to various music retailer Web sites.

To activate the personal agent features of eMarker.com after purchasing the device, users download the eMarker software from the Web site and log on, registering up to three favorite radio stations. Additionally, consumers have the capability to roam outside of their local radio station coverage area with the eMarker device, so that their registered stations may be changed at any time.

Priced at under £20, the eMarker device can be ordered on the eMarker Web site at **<www.emarker.com>**

through Amazon.com's Electronic store at **<www.amazon/electronics.com>**

and the Sony Style Web site **<www.sonystyle.com>.**

For further details, check: **<www.sony.co.uk>.**

Contact: Sony, Tel: (0870) 511 1999.

Oakley Releases Digital Sports Watch

Oakley has launched a digital sports watch with an expanded memory core, a proprietary software engine and further innovations that were developed specifically for the training requirements of sports professionals.

Oakley's integrated software package allows the device to store 100 lap times and log 50 separate runs. Lap numbers, lap times, split times and fastest runs are digitally encoded in extended buffers of random access memory.

For further details, check: **<www.oakley.com>.**

Contact: Jess James (Oakley dealer), Tel: (020) 7437 0199.

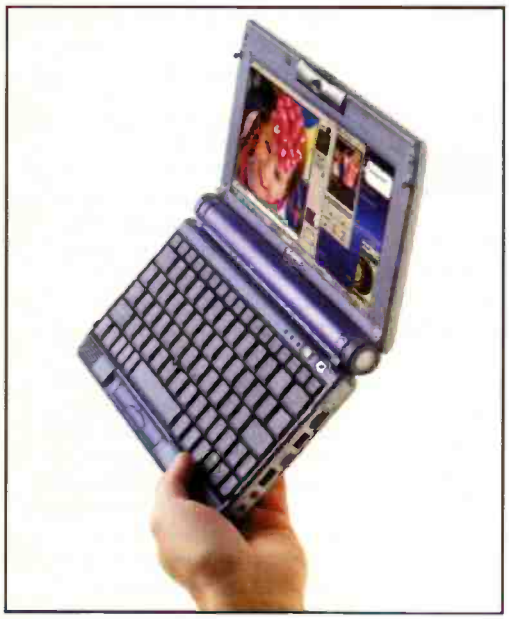
Sony Broadens Projection TV Line-up

In response to the continued expansion in the rear projection television market segment, Sony is introducing its first Hi-Scan 57- and 65-inch models with 16:9 aspect ratio screens.

The new projectors are designed for consumers looking to bring the cinematic experience home with technologies that raise picture quality to a new level.

Sony's newest televisions feature hi-Scan chassis that provides full compatibility with high-definition sources or when used with an outboard converter/decoder.

For further details, check: **<www.sony.co.uk>.**
Contact: Sony, Tel: (0870) 511 1999.



Sony's VAIO PictureBook First to Market with Crusoe Processor

Sony's new VAIO PictureBook notebook computer will feature the Crusoe processor, whose energy-saving capabilities will substantially enhance the popular notebook PC's battery life.

In addition to substantially improved battery life, the PictureBook features a new built-in progressive scan camera for better digital still and video images and a full complement of digital video editing software, making it one of the market's smallest, most powerful business computing and digital video editing systems.

For further details, check:
<www.sony.co.uk>.
Contact: Sony, Tel: (0870) 511 1999.

Casio Incorporates Extended Systems' Wireless Connectivity

Casio is using Extended Systems' infrared wireless communication and data synchronisation technologies in a new line of innovative wrist data devices.

Casio's PC-UNITE Wrist-type Wearable Data Viewers can store and display contacts, calendar, and personal information management data downloaded from a computer using infrared. These new models mark the latest additions to the growing lineup of new wrist data devices.

For further details, check:
<www.casio.co.uk>.
Contact: Casio,
Tel: (020) 8450 9131.

FinePix Camera Integrates Three Hot Digital Technologies

The Fujifilm FinePix 40i Digital Camera combines three of today's most popular mobile platforms - digital imaging, MP3 audio and digital video - into one product. Fujifilm is the first manufacturer to pair MP3 audio technology with a high-resolution digital camera.

For further details, check:
<www.fujifilm.co.uk>.
Contact: Fujifilm, Tel: (020) 7586 5900

NEWS BYTES

AMD Pumps up the Volume

AMD has introduced the 750 MHz AMD Duron processor targeted at business and home users in the value PC space. The AMD Duron processor is a derivative of the AMD Athlon processor featuring a sophisticated cache architecture with 192KB of total on-chip cache; a high-speed 200 MHz front-side bus, and a superscalar floating point unit with enhanced 3DNow! technology.

For further details, check:
<www.amd.com>.
Contact: AMD,
Tel: (01276) 803100.

Venture Fund to Target Mobile Internet Development

Ericsson and Merrill Lynch are to form Ericsson Venture Partners, a £190 million venture capital fund, targeting mobile Internet development.

Ericsson Venture Partners will invest primarily in mobile Internet ventures and technologies, focusing on Europe and the US. Investments will cover all aspects of mobile Internet technology, including network infrastructure, services and applications.

For further details, check:
<www.ericsson.com>.
Contact: Ericsson,
Tel: +46 8 585 342 84.

Motorola and Palm Sign 'Smart Phone' Deal

Palm and Motorola recently announced that they are joining forces to manufacture a line of 'smart phones' -devices that combine mobile phones with handheld computers. The announcement will increase competition in the still-growing sector for next-generation phones, which feature over-sized displays, enabling users to surf the Internet, operate a word processing function, maintain an address book, or use other software.

For further details, check:
<www.motorola.co.uk>.
Contact: Motorola,
Tel: (0500) 555555.

NEWS BYTES

BBC Power Line Programme 'Irresponsible' Says IEE

The IEE, has strongly critised the manner in which scientists at Bristol University collaborated with the BBC in producing a recent edition of Costing the Earth on Radio 4.

According to the IEE, the sensational programme on the alleged harmful effects of overhead power lines on people's health, without providing adequate supporting data.

The IEE has, since 1994, been conducting a rigorous study of peer reviewed papers conceming the possible harmful effects of low level low frequency electromagnetic fields, such as those near overhead power lines. In that time some 1600 papers have been reviewed by a panel of experts who have concluded that there is no evidence of any harmful effects.

The same conclusion was reached recently following a major epidemiological study conducted as part of the UK Childhood Cancer Study under Professor Doll from Oxford University.

Scientists from Bristol University are claiming that the electrostatic fields surrounding power lines can, under certain circumstances, cause particles of pollution to become electrically charged, and the particles are then inhaled by people living near those power lines. Such particles, it is claimed, are more likely to "stick" to the lungs, and therefore cause cancer.

The resulting number of deaths which they claim, are far higher than could be explained on the basis of published data, and no account appears to have been taken of the effects of smoking, which is well known as the major cause of cancer of the lung.

Despite requests by the IEE's experts, the Bristol scientists are unwilling or unable to disclose their research methods. Nor have any peer review published papers been produced to support their claims.

The IEE's Chief Executive Dr Alf Roberts said that the IEE believes that it is highly Irresponsible to make sensational claims about alleged health effects, which appear to contradict work carried out elsewhere, without publication of peer reviewed papers in scientific journals.

Publication via the media, without releasing the associated data and scientific methods, can only serve to cause unjustified alarm in the general public without adding to valid scientific debate.

For further details, check:
<www.iee.org.uk>.

Contact: IEE,
Tel: (020) 7240 1871.

Akoo.com Kima Wireless Internet Audio Appliance

Akoo.com at **<www.akoo.com>** has introduced a new appliance that allows consumers to wirelessly access Internet audio on any stereo or portable radio up to 1,000 feet away.

Ideal for listening to Internet radio, MP3 files and digital music away from one's computer, Kima is available for purchase at **<www.akoo.com/kima>.**

Kima is comprised of two units - a base unit connects to a PC's sound card, or any audio source such as a satellite dish, and wirelessly sends the audio signal up to 1,000 feet away to a receiving unit using akoo.com's patent technology.

For further details, check:
<www.akoo.com>.

Contact: Akoo,
Tel: +1 708 583 9600.

Petrol Buying Behaviour Probed

New research by Imperial College researchers shows that increasing petrol price reduces fuel consumption - but rising incomes and falls in other motoring costs are presently increasing the demand for petrol and the amount of traffic on UK roads.

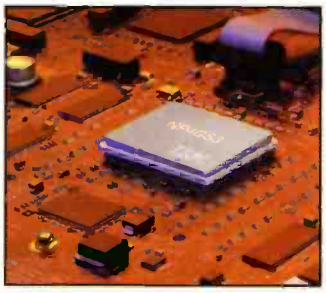
The study, carried out in the wake of the petrol crisis by Professor Stephen Glaister and Dr Dan Graham of the department of civil and environmental engineering at Imperial, and published by the Automobile Association, reviews research on the response of motorists to fuel price changes.

They show that petrol price increases do have a substantial effect upon consumption - a 10% increase in price could reduce consumption by as much as 7%. However, with rising incomes in the UK, and falling costs of purchasing and maintaining vehicles, the demand for fuel and road travel continues to grow.

For further details, check:
<www.ic.ac.uk>.

Contact: Imperial College,
Tel: (020) 7589 5111.

IBM Innovation Improves Internet Experience



IBM has announced a tiny piece of technology that can yield big improvements in the quality and speed of information traveling across the Internet and other networks.

Using just 100 lines of software code, IBM's new bandwidth allocation technology (BAT) can help ensure that more time-sensitive network traffic reaches its destination faster, leading to jitter-free video, uninterrupted e-business transactions and an enhanced Internet experience.

BAT software runs on IBM's PowerNP network processor chip, embedded in networking gear like routers and switches. Together, the PowerNP and BAT can not only prioritise information, but also pack more of it on existing communications lines, potentially doubling their current capacity.

For further details, check:
<www.chips.ibm.com/products/wired>.

Contact: IBM, Tel: (0990) 426426.

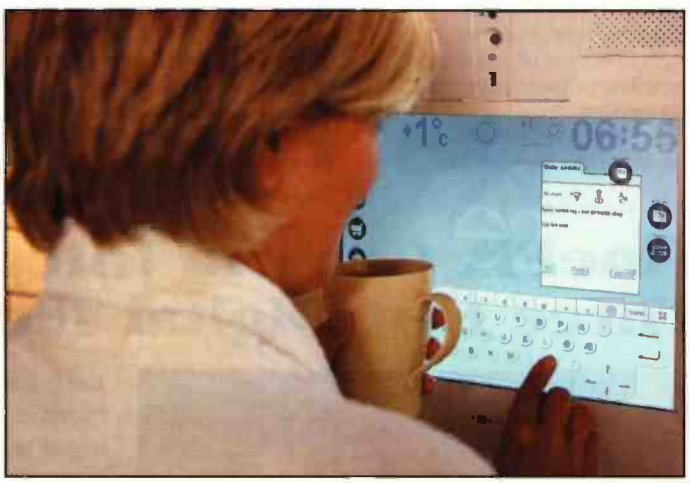
e-Fridges Tested in Denmark Homes

For a trial period of five months, 50 Danish homes outside Copenhagen will test the world's first intelligent refrigerator, the Electrolux Screenfridge.

The purpose of the field test, conducted by Tele Danmark and e2 Home, the joint venture company between Electrolux, is to test the Intelligent Living concept in its intended environment and to study customer reaction to electronic household services.

The Screenfridge is the communication centre of the networked home concept. The Screenfridge has a built-in touch-screen on the refrigerator door that provides always-on, interactive, broadband communication technology, Internet, television and radio.

Shopping is one of the electronic services that simplify everyday life for the test homes.

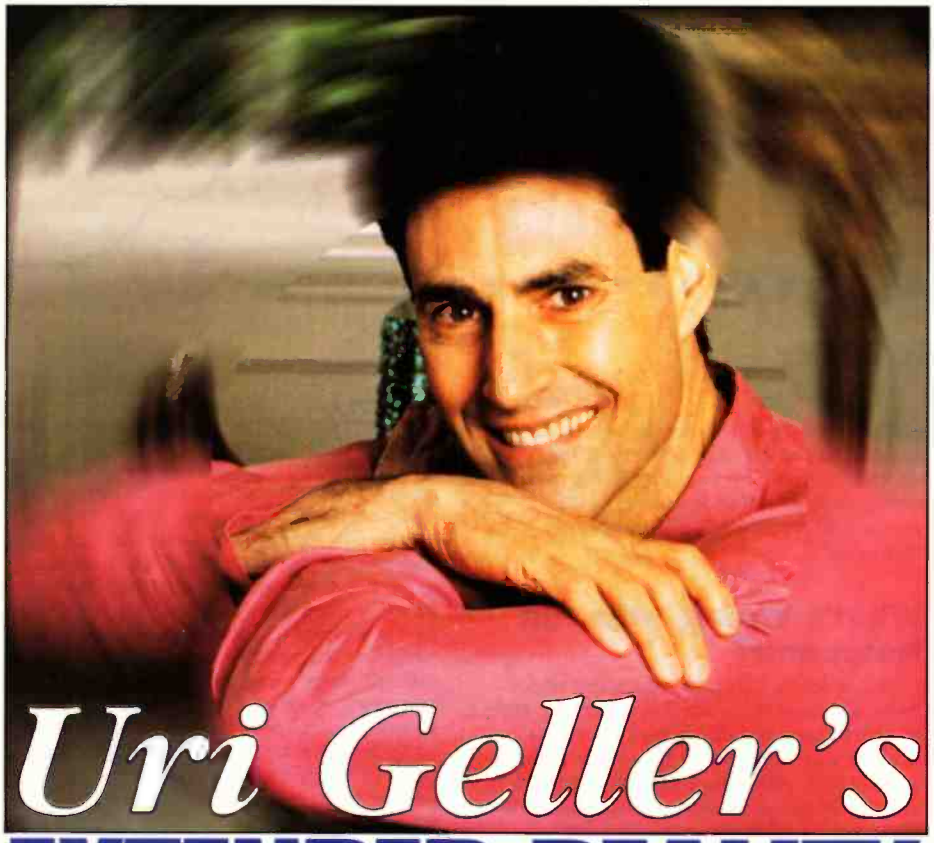


The participating households have WAP phones to be able to access shopping lists stored in the Screenfridge.

Electrolux is also in the process of developing other intelligent appliances that can be networked and thereby controlled from several terminals from different parts of the house or even remotely from outside the home.

For further details, check:
<www.kitchengate.dk>.

Contact: Electrolux,
Tel: +45 70 22 00 47.



Uri Geller's EXTENDED REALITY

Seeing It Coming

One thing I noticed early in my career was that almost without exception, whenever I met somebody who had made it to the top in politics, business, entertainment, sport or whatever - I found that they accepted what I do without question. The people who tried to give me a hard time were the people who hadn't made it to the top (and never did!). It was the chairman of the board of one of Britain's blue-chip companies, Sir Val Duncan of Rio Tinto, who first showed me how to use my talents to make money. Among those who helped me most when I needed it were people like the astronaut Edgar Mitchell, concert pianist Byron Janis, and top businessmen in several countries who would rather not be named in case their shareholders thought they had gone mad.

You don't often hear top people admitting to being 'psychic', but you do hear them talking about gut feelings, hunches and intuition. You hear them describe how they took an important decision when everybody told them they were crazy, and were proved to have done the right thing, as if they were making use of a gift of precognition. Take the case of a car dealer from New Jersey named Lawrence Tynan:

He was having a bad year. People were not buying cars and his showroom was full of models gathering dust. So what did he do? He sent in an order for five times as many cars as he had ever ordered before, although he had nowhere to put them and had to rent extra space everyone thought he was crazy and he even thought so himself.

Then, about two months later, by which time Tynan was afraid he was going to go broke, President Nixon unexpectedly slapped a 10% tax on all imported cars and dropped the 7% tax on home-made ones. The market turned around overnight, Tynan sold his entire stock and soon became a millionaire. Just luck, you might think, but as a team of researchers from the Newark College of Engineering discovered, it was typical of the kind of 'luck' that comes to those who rely on their intuitions, hunches or whatever they like to call them.

Parapsychologist Douglas Dean and engineer/management consultant John Mihalasky did more than just collect cases like that of the car dealer. They set up a series of experiments held during Mihalasky's seminars for company presidents a good many of whom, they found to their surprise, readily admitted to believing in extrasensory perception (or psi, as it is more usually known now) and making use of it.

The presidents were asked to try their 'luck' at a computer generated random number guessing game, designed so that by chance alone they would guess ten numbers out of a hundred correctly. They were also tested to see whether they tended to be dynamic or non-dynamic in their way of thinking. When the results were added up, Dean and Mihalasky found that the dynamics had scored well above chance level, and the non-dynamics well below it. Moreover, they monitored the performance of their presidents' companies for five years and found that while some had doubled their profits, others had not, and there was a clear difference in the averages of their precognition scores - the profit-doublers scoring 43% higher than the also-rans. This was probably the first, and possibly the only test of its kind ever done, the results being reported in Dean and Mihalasky's 1974 book Executive ESP.

James Grayson Bolen, editor of the excellent Psychic magazine (who published the first in-depth interview with me in 1973), managed to persuade a number of top people in the business community to describe their recipes for success. Oil executive William Keeler, property developer John Tishman, radio pioneer John E. Petzer, Ampex founder Alexander M. Poniatoff and publisher Eleanor Friede were just some of those who described how their intuitions had often defied logic, yet led to making the right decisions - and large sums of money. It was Friede, for example, who insisted on publishing Richard Bach's Jonathan Livingston Seagull after several other publishers had turned it down. It became a worldwide hit, sales in the U.S.A. alone passing the ten million mark.

"It hasn't been good business for executives to talk publicly about the intuitive side of their decision making," said Bolen. However, of one thing he was certain: "Intuition is good for business". But what exactly is intuition? It seems to me there are two separate things that share the word; there is the skill you develop when you know your job and keep a careful eye on anything that might affect it, and then there is that impulse that comes out of the blue, sometimes literally hitting you in the gut and giving you no peace until you have obeyed it. This is what I call real intuition, for which there seems to be no normal explanation, and this is what separates the top people from the rest.

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Whatever Happened to NEURAL NETWORKS

By Mike Bedford

Although the von Neumann architecture, which is fundamental to the PC and virtually all modern computers, has served us well for over half a century, it is by no means the only architecture which could be employed to perform a useful role. In the 1940s, well-known names such as Eckert & Mauchley (of ENIAC fame), von Neumann & Turing (who pioneered the mathematical principles of computation), and Williams & Kilburn (developers of the Manchester SSEM) were heralding in the digital computer. Behind the scenes, though, other workers were researching into an alternative type of computer called the neural network which would mimic the human brain. Timing wasn't on the side of these researchers, though. The dawn of the digital age wasn't the best time to research an alternative technology. And as the stored program digital computer became established, and as it went from strength to strength, interest in artificial neural networks waned.

In the 1980s, the world was again on the verge of something new. We're not talking of something as fundamental as the introduction of the first stored program computer but we are talking of something which would affect far more people. Although the microprocessor was developed in 1971, it wasn't until a decade later that it became viable as the heart of a general purpose computer and that anyone dare imagine that computers could become as cheap and as widespread as they are today. This was the time that computers based on the von Neumann architecture were about to make it into the big time and that words such as processor, memory and disk were entering the vocabulary of the more technically-minded layman. It was also the time of a resurgence of interest in neural networks and technological publications world wide were keen to spread the news. "Digital computers are not the universal panacea. Tasks such as pattern recognition are beyond them. We can't explain the processes we use to recognise patterns, let alone write a program to do so. But recognising a face is something a child can do with ease. The future, therefore, is computers which mimic the brain - the future is one of neural networks."

So what's happened to the neural network? Were the prophets wrong? Was this the final swan song of a technology which never managed to escape from academia? Apparently not - the neural network is alive and well in the 21st century and doing a useful job in many diverse applications. The reason that the hype about neural networks has died down is that, rather than being a competing technology to the dominant von Neumann architecture, neural technology has developed into one which is complimentary. In this article, therefore, I'll attempt to answer the question "Whatever happened to neural networks?" and, in so doing, demonstrate something of the power and potential of this important technique.

What's Wrong with von Neumann?

Before looking at how neural networks have advanced since the 80s and at the state of play today it would be appropriate to start off with some basic information on the architecture. After all, since that last flurry of interest fifteen years ago, relatively little has been published in the non-specialist computing, electronics and technology press.

First of all, though, let's consider why there's a need for an alternative to the conventional digital computer. After all, we know that any digital computer can simulate a Turning Machine and, since Alan Turing had proved, mathematically, that this is a universal computing platform, it follows that a digital computer can solve any problem which is computable. Let's not get bogged down with semantics and in trying to make sense of an apparently self-referential statement like "computers can compute anything which is computable". Instead, we'll just take it on trust that, excluding silly questions like "what's the answer to life, the universe and everything?" or "what will next week's National Lottery winning numbers be?", conventional computers are capable of doing pretty much anything. This doesn't mean that there aren't tasks which nobody has ever managed to get a computer to perform. And the reason, of course, is that for a conventional computer to perform a task a program is needed yet some tasks are so complicated as to virtually preclude a proper analysis. Many of the tasks which

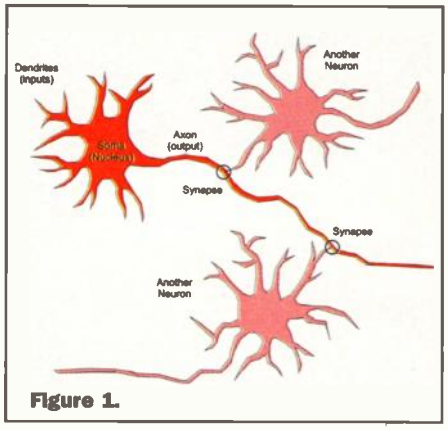


Figure 1.

have proved so difficult have been in the realm of pattern recognition and this could apply in the visual realm (e.g. recognising text or a face), in the audio realm (e.g. recognising and understanding speech) or in data (e.g. recognising trends in the financial markets). The enormity of the task isn't at all hard to appreciate. Although you would be able to carry out the task with no difficulty whatsoever, just try explaining how you would go about recognising the face of someone you know well. Remember that, in order to write a computer program, you need to be able to give an ordered set of precise instructions which, if they're followed through as specified, will give the correct answer. Remember also that if the program is to perform as well as you could - and anything less would be of little practical use - the instructions must cope with different facial expressions, with a wide range of viewing angles, with parts of the face obscured, with different hair styles, with make-up, with ageing and so forth.

Conventional computers are extremely good at performing mathematical manipulations and doing so very quickly indeed. As we've seen, though, stuff which is child's play to the human brain can often be a nightmare for digital computers. Since they mimic the operation of a human brain, though, artificial neural networks are very good at these elusive problems. Furthermore, they exhibit many other characteristics of the human brain. As I've already suggested, they can do tasks without being told precisely how to do them. Children are never taught to recognise faces, they just learn to do so - neural networks can do the same. Having learned to recognise a particular face, children find they can do so if part of the data is missing (i.e. the face is partially obscured) or if the data varies slightly (e.g. a new hair style, make-up etc.) - once again

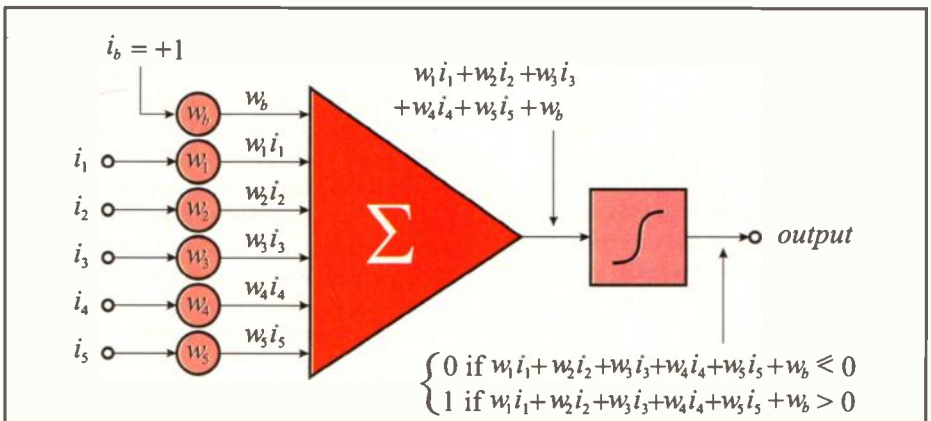


Figure 2.

neural networks can do this, in fact it happens automatically. Children start off by learning to recognise individual faces - Mummy, Daddy, Sally the big sister, Spot the dog and Felix the cat. However, they soon find that the principles they've learned to perform this feat can be generalised. So, for example, they soon find that, when encountering a new face, they're able to decide whether it's a woman, a man, a girl, a dog or a cat. This type of automatic generalisation is also a feature of neural networks. And finally, it's said that millions of brain cells die off every day yet, in most cases, this doesn't result in someone failing to recognise someone they've know all their life. The ability to cope with hardware failures is another important feature of neural networks.

The Perceptron Network

So, what is a neural network? Figure 1 is a stylised representation of a neuron, that is a brain cell. Basically, each neuron is a very simple computing element which takes lots of signals as inputs at its dendrites and produces an output pulse which is transmitted along its axon. The axon is able to connect to the dendrites of many other neurons to create a highly convoluted network. Figure 2 is a block diagram of one of the simplest possible artificial neuron and you'll see that it does little more than apply a weighting factor to each input, sum the weighted inputs and a bias, and then generate a signal on the output if, and only if, that sum exceeds some threshold. Clearly, this type of neuron operates on digital signals - input and outputs can take values of zero and one only.

Now, let's take a look at how this simple artificial neuron can be used to perform a task. Moreover, let's see how it can learn to perform the task automatically, that is, without being programmed in the normal sense of the word. We're only going to use two inputs and the function we want it to perform is a logic AND which is summed up in the following table.

Each of the weightings wb, w1 and w2 are set to any initial values and the learning process then starts by applying each of the input combinations - 00, 01, 10 and 11 - to the neuron in turn and modifying each of the weightings by an amount proportional to the error. Weightings are only adjusted when the corresponding input has a value of one since if it has a value of zero, the weighting is irrelevant to this combination of inputs. The rate at which the weightings are altered can be varied by adjusting a learning rate. In a simple case like this we could get away with just about any learning rate so we can use a high value to speed up the process. In more involved examples, though, picking too high a value can cause the learning process to miss the optimum weightings. The following equation sums this up:

$$\triangle W_n = r\,(output_{target} - output_{actual})i_n$$

where $\triangle W_n$ is the change in the weighting,
r is the learning rate,

i_1	i_2	*output*
0	0	0
0	1	0
1	0	0
1	1	1

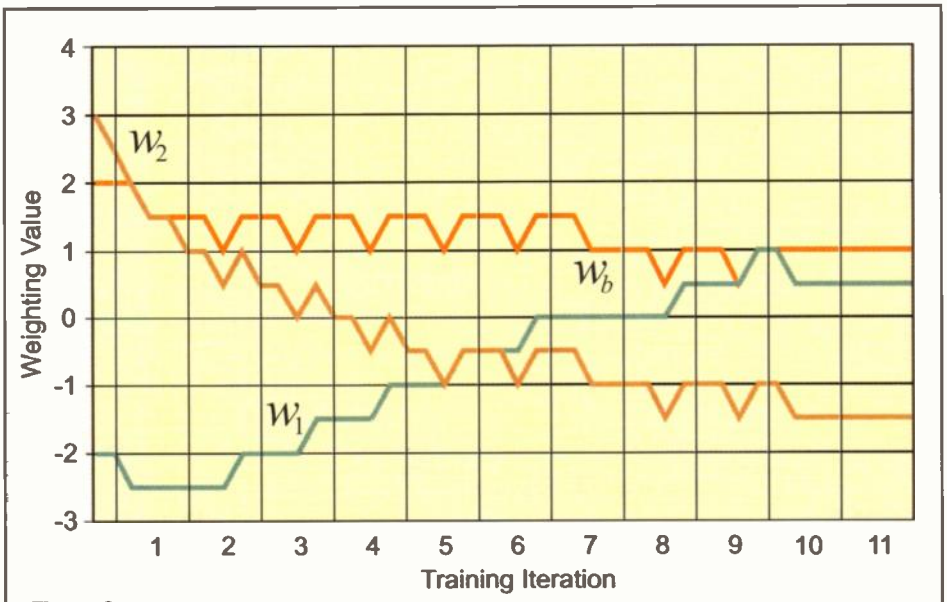


Figure 3.

$output_{target}$ is the target output,
$output_{actual}$ is the actual output
i_n is the input associated with the weighting being optimised.

If, after setting all the weightings according to the equation for each combination of inputs, the total error is zero, that is the neuron gives the correct answer for each combination, the process learning stops. Otherwise, further iterations are carried out. Figure 3 is a graph of the variation of the three weightings from initial random values for w_b, w_1 and w2 of 2, -2 and 3 and a learning rate of 0.5. You'll see that the weightings eventually settle down to values of 1, 0.5 and -1.5. The neuron will now correctly perform the logic AND function.

This type of neuron is called a perceptron and the method of programming, called the perceptron learning rule, was developed in the 60s. The principle can be extended from a single neuron, which can only give a single output, to a neural network, which can have many outputs. Such a network is shown as Figure 4 and you'll see that it has two layers, the input layer and the output layer. The input layer is composed of buffers, only the output layer consists of neurons like the one we've looked at. Unfortunately, this type of neural network isn't a universal computing engine, in fact there are some very simple problems it cannot solve. The most well-known example of the function which this sort of network cannot solve is the logic XOR function in which an output is required if either, but not both of the inputs is 1. If you try to train a single neuron to perform the exclusive OR function, the weightings will fluctuate with every iteration, the output never converging on the correct answer. Furthermore, we've seen that this type of network can operate only on digital values. And whereas this is taken for granted with conventional computers, some neural networks can operate on analogue values as we're about to see.

Beyond the Perceptron

We really don't have to make large changes to the simple perceptron we looked at earlier to cope with analogue values. The operation of the device can be summed up by the transfer function shown as Figure 5 and this is clearly a digital device - the only

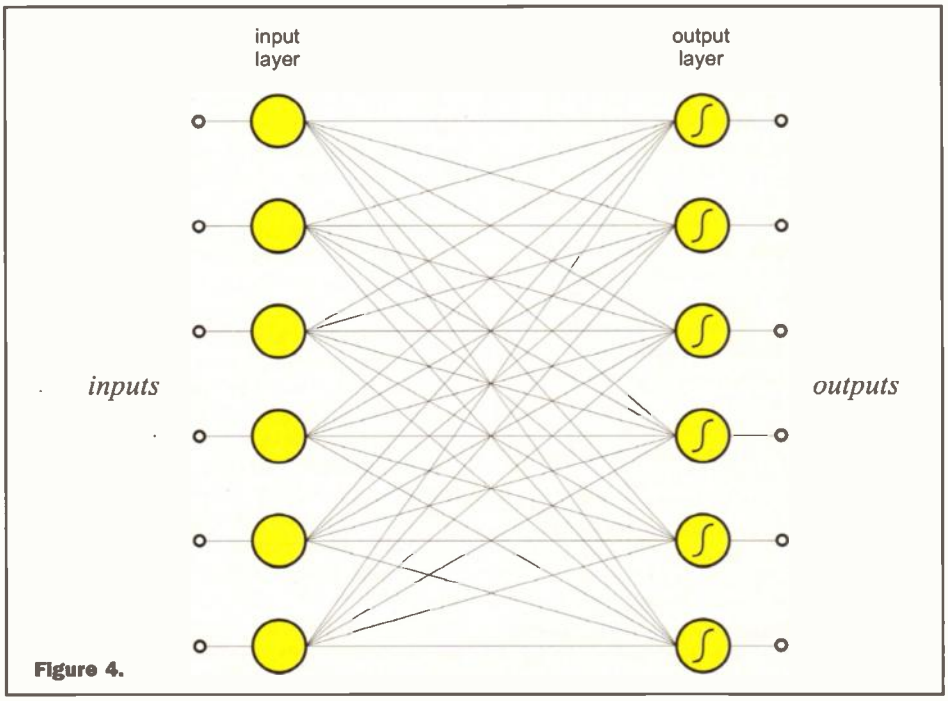


Figure 4.

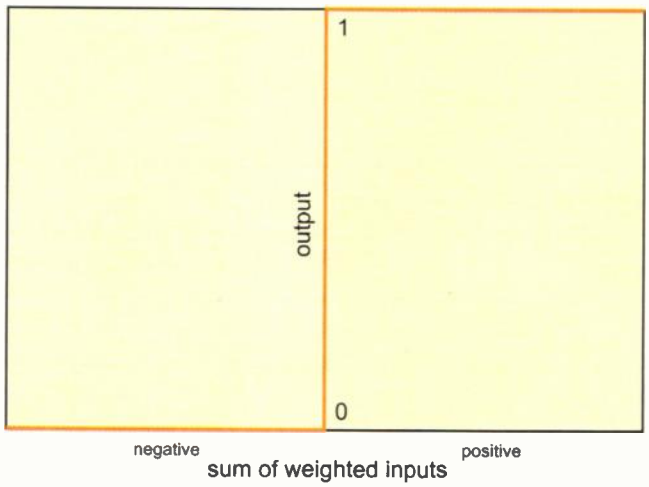


Figure 5.

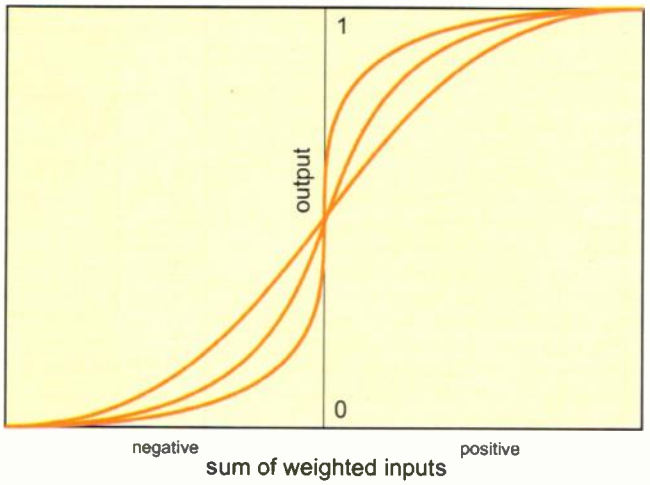


Figure 6.

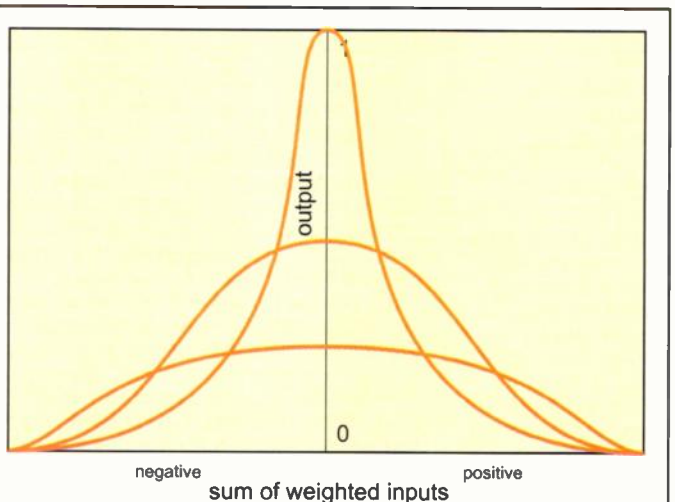


Figure 7.

possible outputs as zero and one. However, by substituting the simple comparator with a slightly different bit of circuitry, analogue computations are possible. Two alternative types of artificial neurons which are commonly used have transfer functions of the forms shown in Figures 6 and 7.

The other major enhancement over the two layer perceptron, though, is the addition of one or more additional layers of neurons between the input and the output layer. These new layers are referred to as hidden layers. The method of adjusting the weightings during the learning process is now rather more involved but it is, nevertheless, an extension of the technique used with the two-layer perceptron network. It transpires that a network with two hidden layers can learn any possible mapping between input and output. This contrasts with the two-layer network in which even the simple exclusive OR function cannot be realised. Figure 8 shows a simple neural network with a single hidden layer. A digital network of this type could be used, for example, to recognise hand-written numerals - the basic architecture is shown as Figure 9. The figure is scanned into an array and each pixel is used as an input to the neural network. The network has ten digital outputs, each corresponding to one of the digits 0 to 9. The network is trained by presenting it with lots of examples of each digit and adjusting the various weightings according to the difference between the actual and the expected output. As before, this continues through many iterations until the error is minimised. Unlike the simple AND function we used as an example earlier, training will generally result in a minimum error which is not zero. And with an application like this it's not hard to see why. Such a network will never learn to recognise figures with 100% accuracy, just as people sometimes misinterpret badly written handwriting.

The Software Neural Network

The power of a neural network lies not in the complexity of the individual processing elements, the neurons, after all we've seen that these are very simple indeed. Instead, the power comes from multiplying up the power of a single neuron many times over, and from creating vast numbers of interconnections. It's estimated, for example, that the human brain has 10,000,000,000 neurons and these may have as many as 3,000,000,000,000 interconnections. We can view this as taking the principle of the massively parallel supercomputer - which has a few thousand moderately powerful processors - to the ultimate limit. However, such an architecture doesn't lend itself too well to mapping onto silicon which is the primary reason that there's not much neural networking hardware around, despite the enormous potential. However, since the von Neumann computer is a universal computing device it can, of course, simulate a neural network. Indeed, to date, most neural networks have been neural network simulators running on conventional computers - PCs and UNIX workstations.

This is quite a useful technique, in fact virtually all the advantages of a genuine hardware neural network are realised in a software neural network. First and foremost, despite the fact that it's running on a conventional computer, a task such as pattern recognition doesn't have to be programmed specifically. Like a true neural network, a software neural network can learn from a set of examples. And other advantages such as immunity from noise on the input also apply. One advantage of a hardware neural network which is lost, though, is its ability to cope with hardware failures. A hardware failure in a PC's memory will cause the program to crash, irrespective of whether that program is a neural network simulator, and a fault in the processor could still be catastrophic. The other main difference between a hardware and a software neural network is that the former is truly a massively parallel device, with all the speed advantages that brings, whereas the latter isn't. Although the software approach simulates a massively parallel architecture, the computer on which the software is running is, of course, still executing single instructions one after the other. Software neural networks can, therefore, be quite slow, and the speed will decrease as the network size increases. This will limit the size of the task which can be performed in a practical time frame.

Applications

So, what has been achieved using neural networks, albeit the software variety? It'll come as no surprise that, in the main, the tasks to which neural networks have been put are the ones that are so difficult to programme on a conventional computer and that many of these are associated with pattern recognition in all its guises. Well-know pattern recognition tasks include speech recognition and optical character recognition, and neural techniques have, indeed, been used here. Less obvious examples of applications which involve pattern recognition are spotting possible card theft by analysing credit card spending patterns, predicting share and currency price movements, mineral prospecting, fingerprint matching and medical diagnosis.

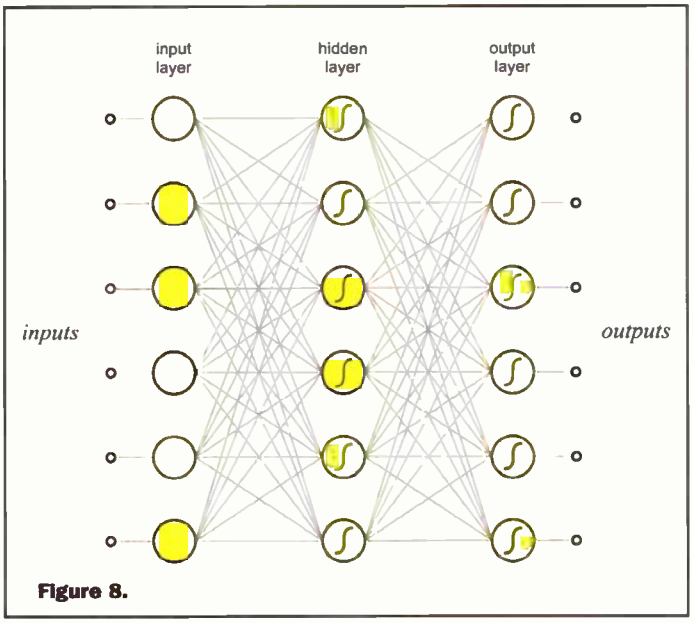


Figure 8.

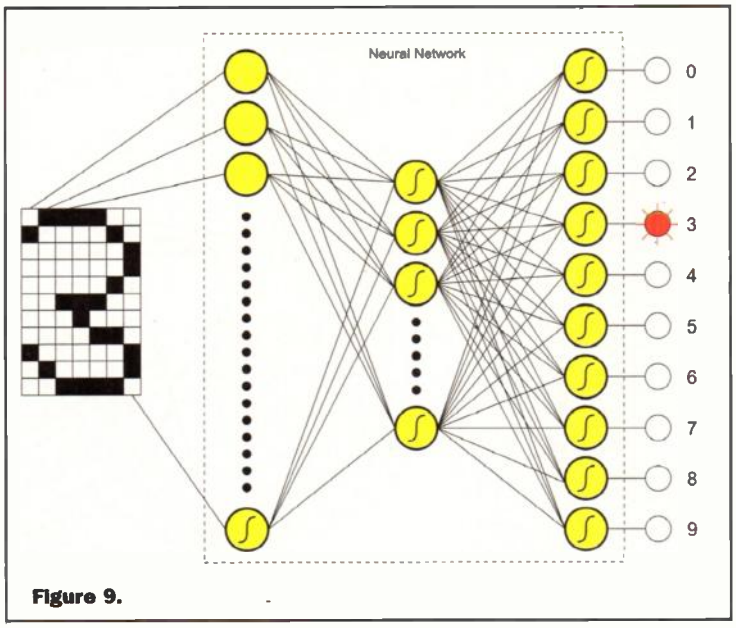


Figure 9.

Brain Maker, a popular neural network package, is even reported as having had success in predicting winners with good odds in horse and dog races.

Another up and coming application of neural software is in process control and specifically in the area of robotics. Of course, neural techniques can be applied to the machine vision required of robots but the control aspect also lends itself to neural techniques. Whereas simple control tasks can be performed quite effectively using the standard method of closed loop control, more generally, this is another example of an area in which computers struggle to do tasks which people find trivially simple. Making a humanoid robot walk is one such example. But considerable success has been achieved using neural techniques to perfect motor skills, even ones which people would find tricky. One robotics research project, for example, has used a neural network to teach a robot to juggle three balls. Less trivially, NASA is carrying out research into neural control and has various projects associated with the automated control of spacecraft. Unlike applications such as spotting credit card fraud, for which a software simulation of a neural network provides adequate speed, as we look at autonomous robots, we really need a true hardware neural network. These will offer the advantages of speed, lower cost, reduced size and weight, and increased reliability due to fault tolerance. But what of these illusive neural network chips?

Neural Network Hardware

The major stumbling block which lies in the path of neural hardware development is the vast number of interconnections which are required. With a fully connected network, for example, the number of interconnections is proportional to the square of the number of neurons. But today's chip manufacturing methods just don't lend themselves to this sort of topology. It would, admittedly, be possible to create a chip containing hundreds, thousands or even millions of neurons, just as it is to produce memory chips with millions of memory cells. But whereas the interconnections in digital chips are, by and large, common parallel busses, the interconnections required in a neural chip are point-to-point. As a result, those chips which have been manufactured, have had quite modest numbers of neurons and, although some products have appeared on the market, they've really been experimental and few have been used in real world applications. Nevertheless, research continues and a few innovative approaches suggest possible ways forward.

Irvine Sensors Corp., partnered by NASA's Jet Propulsion Laboratory and the California Institute of Technology, both in Pasadena, is developing three dimensional silicon technology in order to provide the necessary degree of interconnectivity. The technique involves layering wafers in order to cram multiple chips into the volume of a single large chip. Individual silicon wafers as thin as a sheet of paper are stacked and bonded to form a single unit. Interconnection is achieved using a three dimensional FET which was developed by the US Army's Missile-Defense Organization. The transistor is made in two parts on two separate wafers and operates as a single device when these have been bonded together in a chip stack. This allows a signal to be passed from one neuron to its neighbour, even if the two are on different wafers. The ultimate goal will be pretty impressive if it comes to fruition. According to John Carson, chief technical officer of Irvine Sensors, "I think we are between five and 10 years from having something with human-level computing power: 10 petaflops in less than 1/3 cubic foot and consuming less than 10 watts".

According to other scientists, though, optical interconnections are the way to go. Despite this being a common thread in neural networks, though, little seems to have been published. However, a 1993 paper published by researchers at the Pacific Northwest National Laboratory and Optical Sciences Center at the University of Arizona. show multiple optical neurons can be interconnected. The underlying technology is holographic and, whereas this is usually considered to be a method of 3D photography, more generally a hologram can be thought of as a very complicated lens. The interconnection hologram is actually an array of sub-holograms, each of which takes a single input beam and fans it out to a number of output beams, one per neuron in the following layer, applying the appropriate weighting factors in so doing. These weighting factors are fixed, though, so the technique is limited to applications in which it's not necessary for the network to learn in the field. Despite the fact that this work is now a few years old, analysis concluded that, using a hologram fabricated with electron-beam lithography, it should be possible to connect 6,700 neuron outputs to 6,700 neuron inputs and that the encoded synaptic weightings will have a precision of approximately 5 bits. This will result in

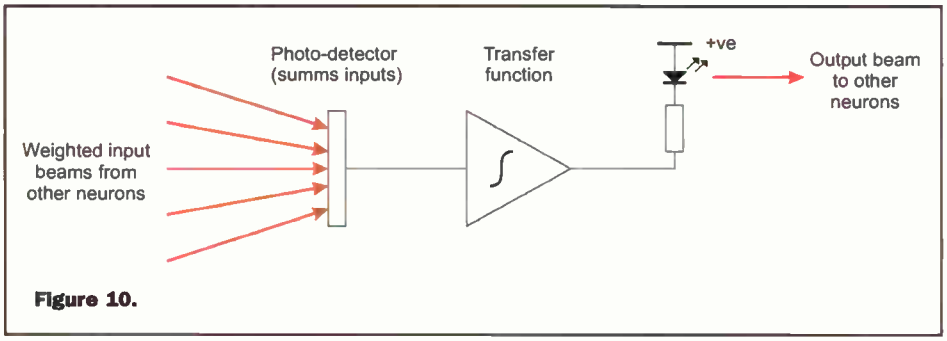


Figure 10.

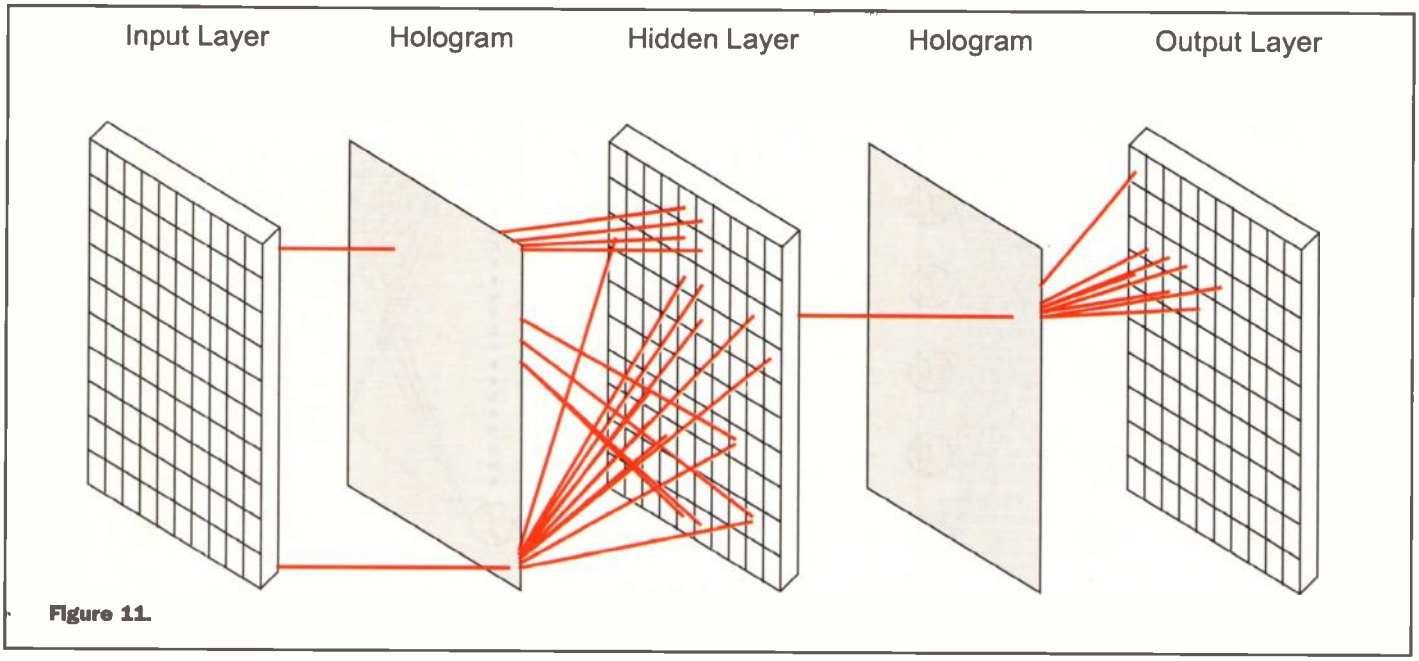


Figure 11.

processing rates in the range of 45 to 720 trillion connections per second.

Another solution, currently being commercialised by start-up company Axeon Ltd., based on research at Aberdeen University, can be thought of as a hybrid between the true hardware neural network and the software neural network. The product, the Learning Processor, is an array of 256 very simple digital processors - specifically dedicated 8-bit RISC processors - which emulate an analogue neuron. And as a digital device, it uses conventional busses for transferring data between the individual neurons. Needless to say, transferring data over shared busses is not as fast as using the dedicated point-to-point interconnections which other researchers are pioneering, but the use of multiple processing elements is certainly a lot faster than performing everything sequentially on a single processor. The Learning Processor is capable of 2.4 giga connections per second when running at 100 MHz with an average training time of 0.45 seconds. The company currently has a range of PC expansion card which encompasses the technology plus various chip sets. Eventually, Axeon plans to make the Learning Processor available as an intellectual-property core. Very impressive results are reported. According to Axeon's Hamish Grant a particular application in the realm of image feature extraction, which takes 10 hours running on a high-powered Silicon Graphics workstation, can be executed in about a second on the Learning Processor. Figure 12 is an overall block diagram of the Learning Processor and Figure 13 provides detail of a single one of those 256 RISC processors.

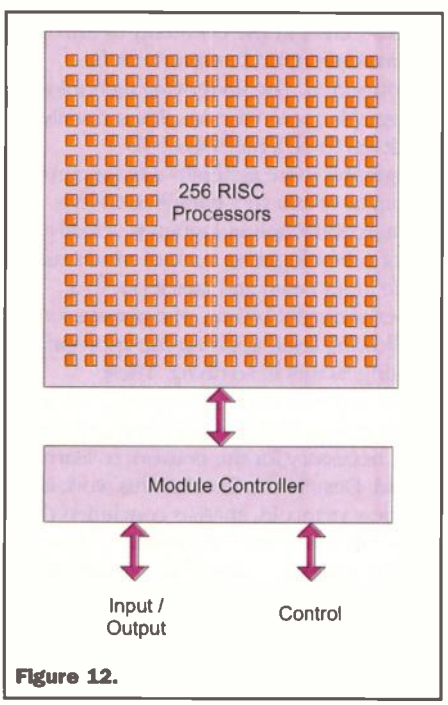


Figure 12.

The Future of Neural Networks

As we've seen, despite the fact that they haven't been in the limelight of late, the artificial neural network is alive and well and living in the 21st century. And the reason that we hear less about it than we once did is that, rather than being a competitor to the conventional von Neumann computers, it is has been re-invented in the guise of a simulator which runs on a standard computer. And packages abound. These range from software tools targeted at vertical markets such as medical diagnosis and fraud detection, through general purpose neural network toolkits, to plug-ins for the Excel spreadsheet package.

The $64,00 question, though, is whether this will be the limit of neural technology or whether neural networks embodied in hardware will ever become more than an academic curiosity. Clearly some companies believe so but, on the other hand, these are not companies like Intel and the AMD, even though both these corporations have dabbled with neural hardware in the past. We could argue, as many have, that it's the incredible performance increases we've seen in the realm of conventional computers which have kept neural computers at bay. Even though a hardware neural network may prove faster for a given application today, all we have to do is wait a couple of years for the conventional digital approach to catch up. And without a doubt, this is easier than tackling the major obstacles which lie in the way of bringing large scale neural hardware to fruition. However, as we saw in these pages a few months ago, major obstacles also threaten development of the silicon microprocessor much beyond another 15 years and some pundits suggest that these obstacles might be insurmountable. So perhaps the neural network's day may come after all. About all we can say is that nothing's certain in this exciting industry and a fair sprinkling of forward looking researchers are still pinning their hopes on embodying large scale neural networks in silicon.

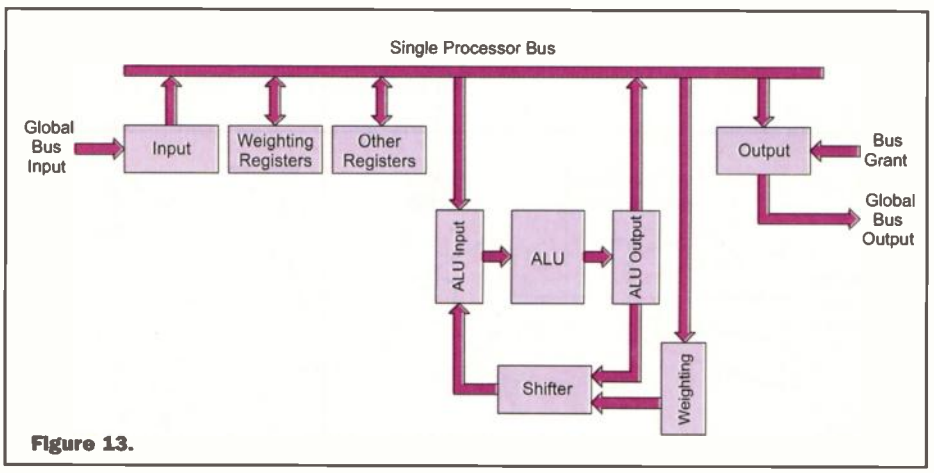
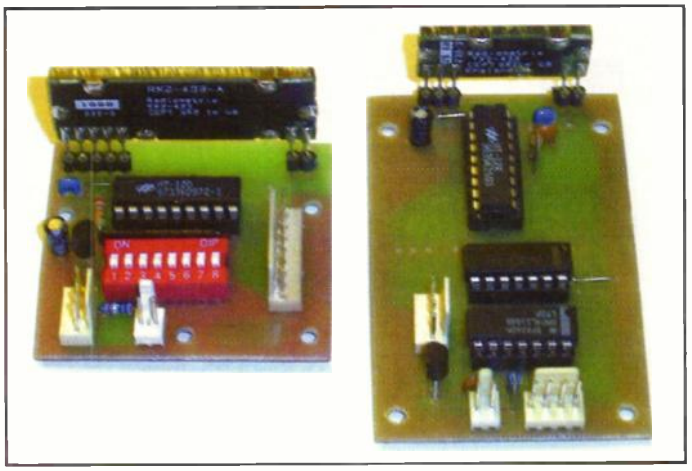


Figure 13.

Computer Digital Radio Link SYSTEM

By Dr Pei An



This system consists of a radio transmitter that is connected to a computer via the Centronic port and up to 256 receivers of different addresses. A four-bit data issued by the port can be transmitted to any one of the receivers. The transmitting distance is about 70 metres in buildings and 200 metres in open fields. This system is illustrated in Figure 1.

The system utilises the FM radio transmitter and receiver modules TX2 and RX2 from Radiometrix. The 418MHz version is type-approved in the UK to MPT1340. The 433MHz version is type-approved to the ETS300-220 for European use. This avoids the need to submit the final project for approval.

The boards are built on single-sided PCB boards. It has a wide range of applications such as remote control, security systems and paging. Some application ideas are given later.

Principle

Digital data transmission from transmitters to receivers is achieved by a parallel-to-serial encoder and serial-to-parallel decoder pairs, HT-12E and HT-12D.

Inside a transmitter, the encoder (HT-12E) converts a 12-bit parallel data into a serial data stream. The first 8 bits of the stream are address bits and the other 4 bits are the data to be sent. This serial data is used to modulate a 418/433 MHz radio frequency signal using the FM modulation scheme. Then the modulated radio frequency signal is transmitted to the surroundings. The FM radio transmitter module, TX2 (see Figure 2a) achieves this.

Inside the receiver, the FM radio receiver module, RX2, demodulates the radio signal picked up by the antenna. The demodulated serial data is fed into the serial-to-parallel decoder (HT-12D), which converts the serial data stream back to the parallel data (see Figure 2b). The address bits are compared with the pre-set address of the decoder. If they match, the 4-bit data is latched to the output. If the address does not match, the decoder ignores the data. As 8-bit binary data has 256 possible combinations, the maximum number of address combinations for the receiver is 256.

Table 1 Variants of TX2/RX2 radio link modules.

Parameters	Description
Frequencies	418.00 MHz for UK use 433.92 MHz for European use.
Supply voltages	5V (4-6V for TX2 and RX2) 3V (2.2V to 4V for TX2, 3 to 4V for Rx2)
RX data rate	-A: 7kHz base band BW, slow data up to 14 kbps -F: 20kHz base band BW, fast data up to 40 kbps

TX2 and RX2 modules

The radio transmitter and receiver modules are 418/433 MHz Surface Acoustic Wave controlled FM radio transmitter and receiver which are specially designed for radio telemetry and tele-command applications. They are type-approved to the Radio-communications Authority. This implies that if the customised circuits comply with the RA requirements, there is no need to submit the project for further type approval.

There are a variety of TX2/RX2 modules that can be used with the present project [Reference 1]. They are shown in Table 1.

The transmitter, TX2

The pin functions of the transmitter are given in Figure 3a. For the +5V and 433MHz version, the operation voltage ranges from 4 to 6V DC. The typical current consumption is about 10mA at 5V. For the +3V

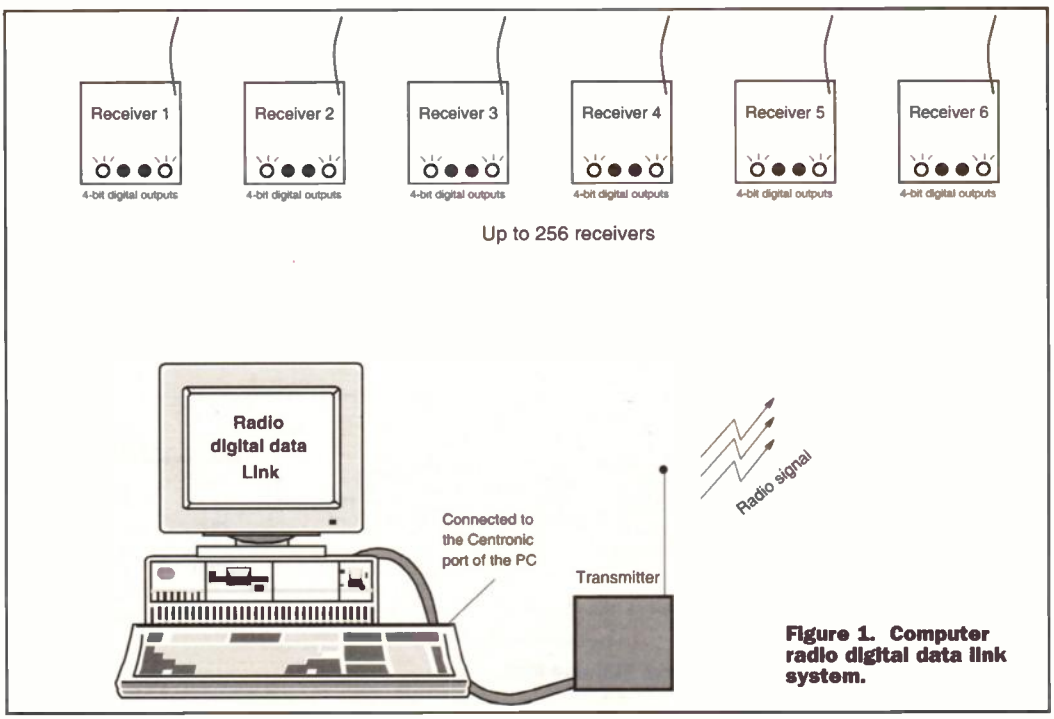


Figure 1. Computer radio digital data link system.

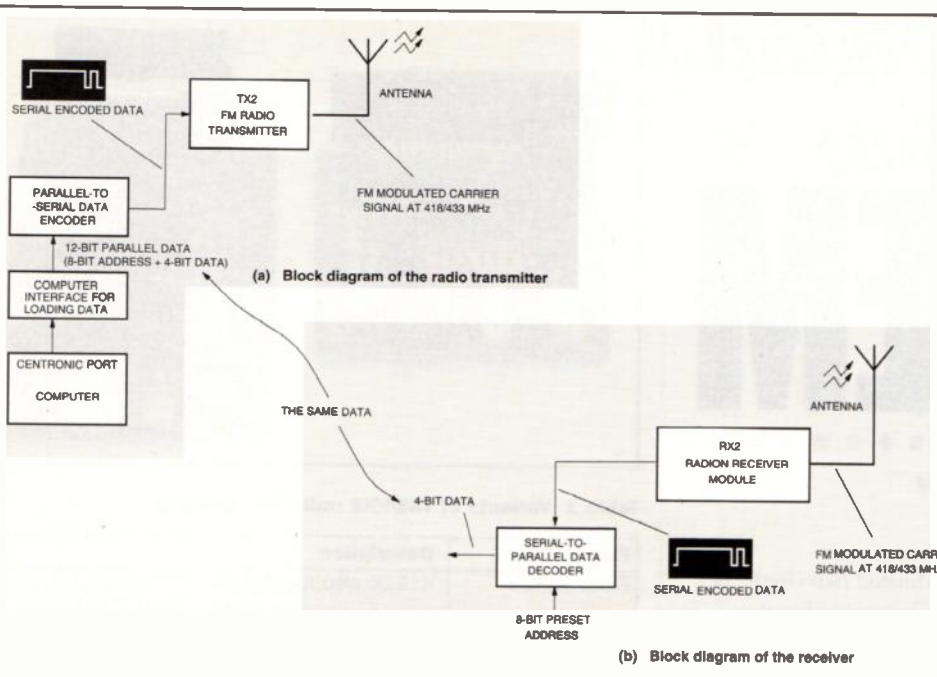


Figure 2. Block Diagram of the transmitter and receiver.

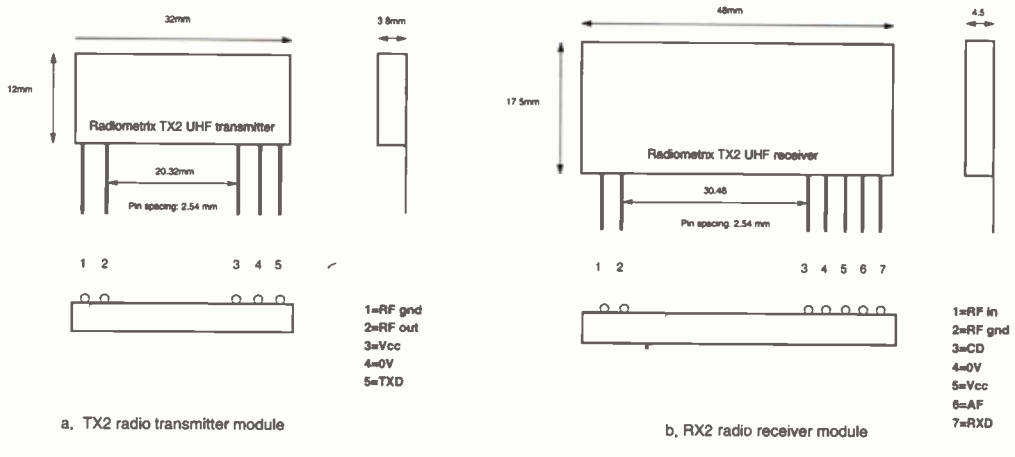


Figure 3. Pin-out of Radiometrix TX2 and RX2 modules.

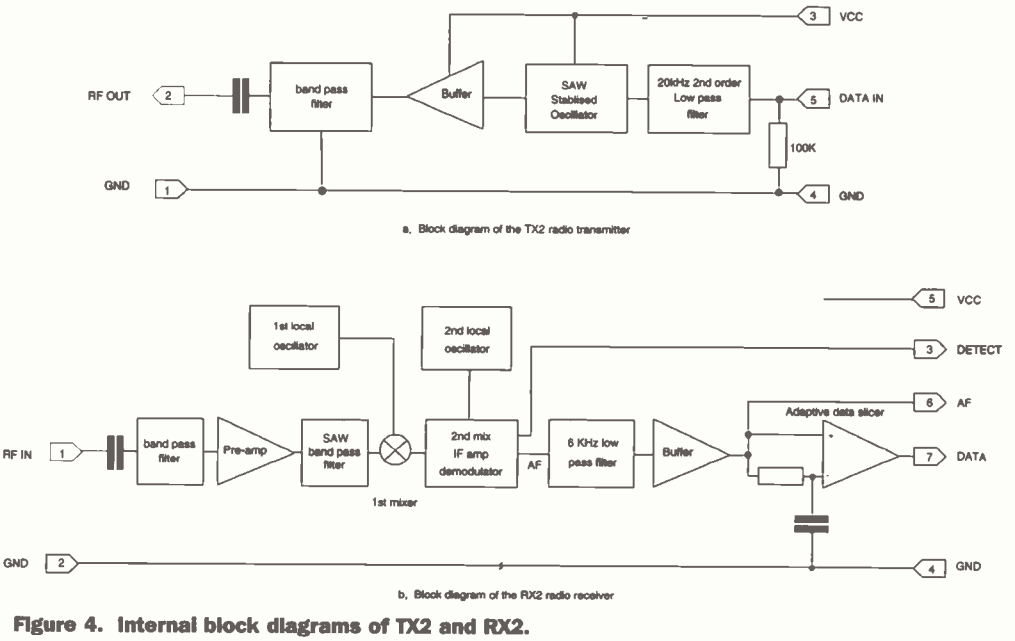


Figure 4. Internal block diagrams of TX2 and RX2.

and 433MHz version, the operation voltage is between 2.2V to 4 V DC with a typical current consumption of 6mA at 3V. Digital data to be sent (which should be a CMOS logic level at the same power supply voltage) is fed into Pin 5. An antenna is connected to Pin 2. The block diagram of the module is given in Figure 4a.

The antenna of the transmitter can have three versions: the helical type, the loop type and the whip type (see Figure 5). The helical antenna has a small size. It needs to be optimised for the exact wavelength in use. The loop antenna consists of a loop of PCB track, which is tuned by a variable capacitor. The whip-type antenna is a wire, rod, PCB track or combinations. Figure 5 shows how the antennas are constructed and compares their performances.

MPT1340 requirement

The radio transmitter module is type-proved to the RA MPT1340 for licence exempt use within the UK for telemetry, telecommand and in-building security, provided that the following requirements are met.

1. The transmitting antenna must be one of the 3 variants given above (see Figure 5).
2. The transmitter module must be directly and permanently connected to the transmitting antenna without the use of an external feed. Increasing the rf power level by any means is not permitted
3. The module must not be modified nor used outside its specification limits
4. The module may only be used to send digital data. Speech or music is not permitted
5. The equipment in which the module is used must carry an inspection mark located on the outside of

the equipment and clearly visible, the minimum dimensions of the inspection mark shall be 10 x 15mm and the letter and figure height must be not less than 2mm. The wording shall read: "MPT 1340 W.T. LICENCE EXEMPT"

6. The trimmer control on the module must not be easily accessible to the end user. This control is factory set and must never be adjusted.

Failure to meet the above conditions invalidates the modules' Type Approval. Further information on MPT1340 specification issued by the RA may be obtained from the RA's library service on +44-(0)171-215-2072 or from their website: **<www.radio.gov.uk.>**

The receiver, RX2

The pin functions of the receiver are shown in Figure 3b. For the +5V version, the operation voltage ranges from 4 to 6V DC. The typical current consumption is about 13mA at 5V. For the +3V version, the operation voltage is between 3.0 to 4.0V DC with a typical current consumption of 13mA at 3.5V. The output digital signal appears at Pin 7 (RXD). It has a COMS logic level. Pin 3 is Carrier Detect output. It may be used to drive an external p-n-p transistor to obtain a logic level carrier detect signal. If not used, it should be connected to +5V. In this circuit only the "A" version can be used. The block diagram of the receiver is shown in Figure 4b.

Any types of the antenna previously described in the transmitter section can be used with the receiver.

Encoder, HT-12E

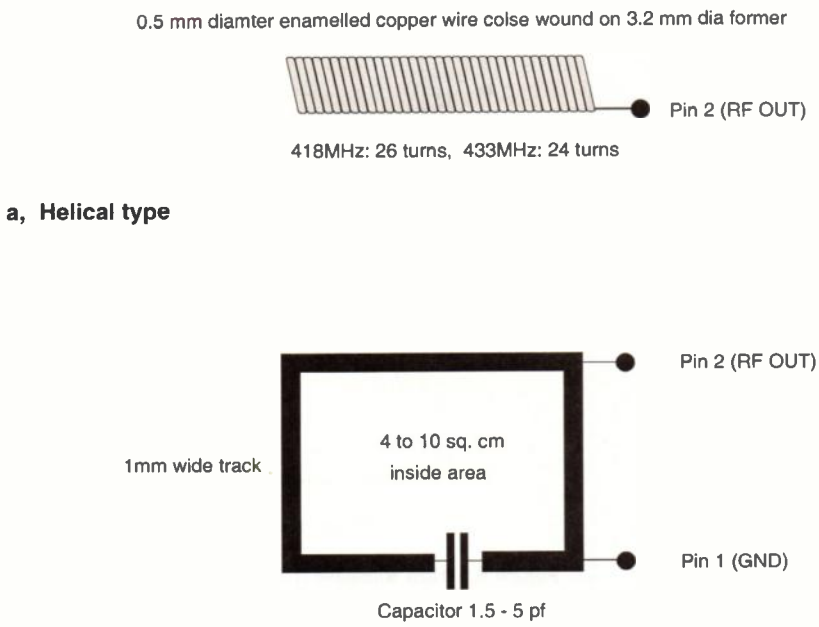
The HT-12E and HT-12D are CMOS LSI encoder and decoder ICs designed for digital code transmitting and receiving [Reference 2]. They have a wide operating voltage from 2.4V up to 12V with a typical standby current typically 1(A (when it does not transmit any signal). During data transmission, the current is 200(A. They have an on-board oscillator which only require one external 5% resistor. The Pin-out and pin functions are shown in Figure 6. Typical applications of the devices are given in Figure 7.

The HT-12E encodes a 12-bit of parallel data into a serial data. It transmits this data upon the receipt of a low-going signal at the Transmit Enable pin (-TE, Pin 14). The 12 bits of data consist of 8 bits of address (A0 to A7 connected to Pin 1 to Pin 8) and 4 bits of data (D0 to D3 connected to Pin 10 to Pin 13). The flow chart of operation is given in Figure 8a.

The operation of the HT-12E encoder is that initially the encoder is in the stand-by mode. Upon the receipt of a -TE signal (low active), it begins a 4-word transmission cycle and repeats the cycle until the -TE signal becomes high. Each word contains 2 periods: the pilot code period and code periods as shown in Figure 9. The pilot code period has a 12-bit length period and is at logic low. The code period also has a 12-bit length period and contains the serial encoded data. The encoder detects the logic state of the 12 bit inputs (A0-A7 and D0-D3) and transmits this information during the code period. The logic levels `0' and `1' are encoded in a manner as shown in Figure 9. The order of data bit transmission is from A0 to A7, then from D0 to D3.

Decoder, HT-12D

HT-12D is a low power CMOS decoder operating in a voltage range 2.4V to 12V. Standby current is 0.1 (A (when it does



Antenna performance chart	Helical	Loop	Whip
Ultimate performance	√√	√	√√√
Ease of set-up	√√	√	√√√
Size	√√√	√√	√
Immunity to proximity de-tuning	√√	√√√	√

Figure 5. Various antenna to be used with the TX2/RX2 modules.

not receive any data). The operating current is 200(A.

The HT-12D receives the 12 bit word and interprets the first 8-bit as the address and the last 4-bits as data. When the received address matches the decoder's pre-set address, the Valid Transmission (VT) output goes high and the 4-bit data is latched to the data output pins. The flow chart of operation is given in Figure 8b.

External oscillation resistor for HT-12E and HT-12D

The resistors required by the devices are 5% resistors. In the current circuit, the resistor is 470K and the oscillation frequency is 6kHz. One transmission takes less than 50ms.

How the transmitter works

Figure 2 gives the block diagram of the transmitter and Figure 10 gives the circuit diagram. The transmitter consists of 4 units: the computer interfacing unit, the encoder unit, the radio transmitter unit and the power supply unit. The first one manages the interfacing between the encoder IC and the Centronic port of the computer and provides a 12-bit parallel data for the encoder IC. The encoder unit converts the 12-bit parallel data into the serial data. This serial data is used as the modulating signal in the radio transmitter unit. The modulated radio signal is sent out from the antenna. How each unit works is explained in detail as follows.

This computer interfacing unit is based on two 74LS164 8-bit serial-to-parallel shift register, IC1 and IC2 (see Figure 10). For IC1, when the CLOCK input (Pin 8) goes from low to high, the logic level on the DATA-a and -b (Pins 1 and 2) is transferred to Q1. The next clock pulse also transfers it to Q1, and the logic level previously present on Q1 is shifted to Q2. The third clock pulse transfers the data to Q1, and in the same time shifts the data on Q1 to Q2, and that on Q2 to Q3. 8 clock pulses will

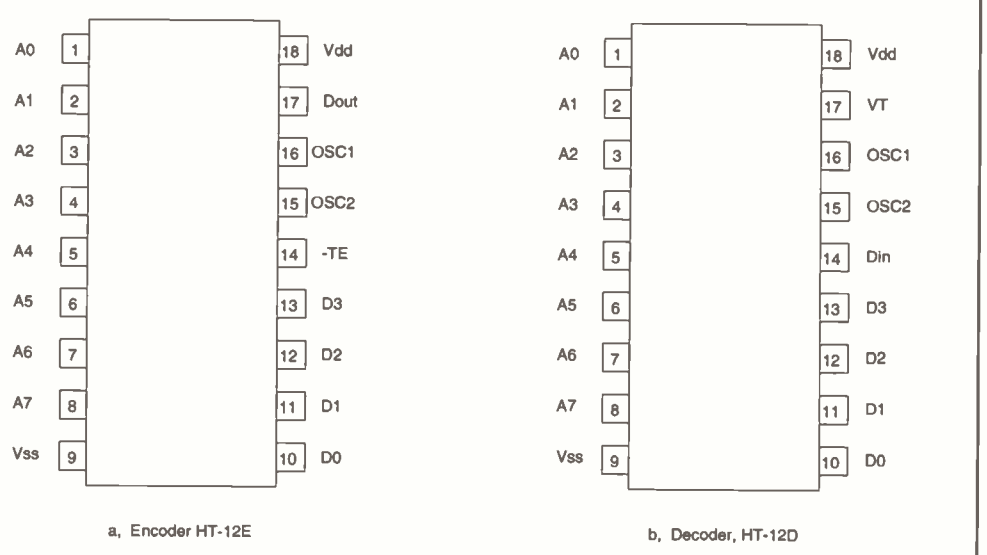


Figure 6. Data encoder (HT-12E) and decoder pairs (HT-12D).

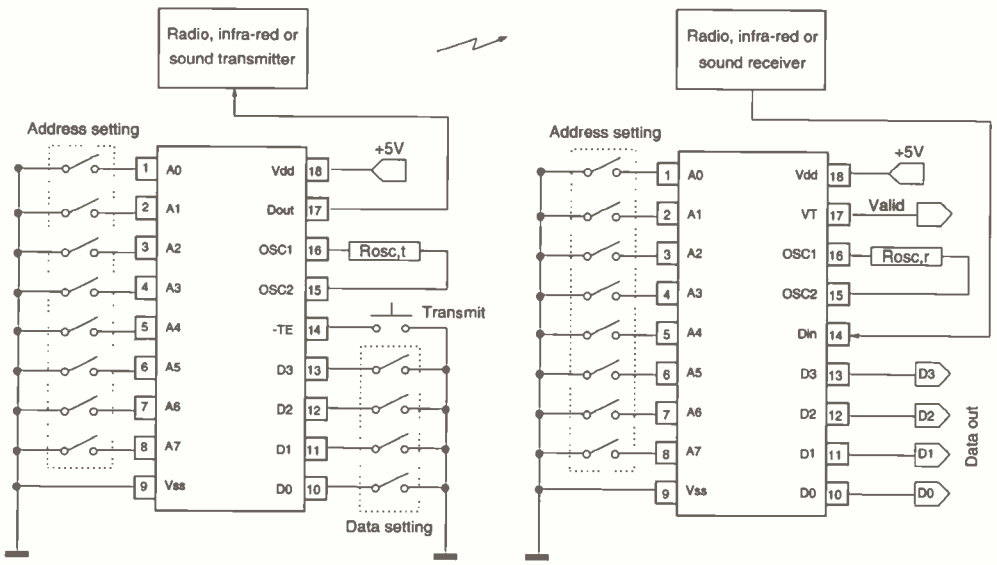


Figure 7. Typical application of the data encoder and decoder pairs.

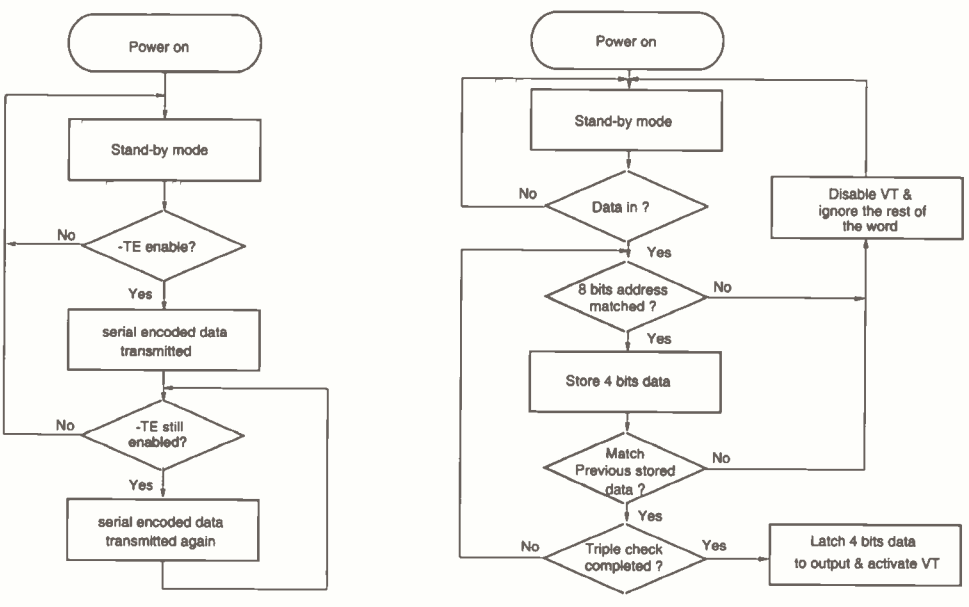


Figure 8. Flow chart of the operation of the encoder and decoder.

Turbo Pascal 6 Program list

```
Program radio_controller;
{Pascal demonstration program for driving the radio data communication system
written by Dr. Pei An, 17/7/96}
{74LS164 latches the data sent serially by the computer's Printer port.
  DB0, DB1, DB2 and DB3 are loaded with address A0, A1, A2 and A3
  DB4, DB5, DB6 and DB7 are loaded with data   D0, D1, D2 and D3}

uses
   dos,crt,graph;
var
  address,i,j,swaddress,sdata:integer;
  weight:array[1..12] of integer;
  delaytime,lighttime:real;
  P_address:integer;


Procedure Input_printer_address;
{Universal auto detection of printer base address}
{ $000:$0408 holds the printer base address for LPT1
 $000:$040A holds the printer base address for LPT2
 $000:$040C holds the printer base address for LPT3
 $000:$040e holds the printer base address for LPT4
 $000:$0411 number of parallel interfaces in binary format}
var
  lpt:array[1..4] of integer;
  number_of_lpt,LPT_number,code:integer;
  kbchar:char;
begin
    clrscr;
    LPT_number:=1; {defaut printer}
    number_of_lpt:=mem[$0000:$0411]; {read number of parallel ports}
    number_of_lpt:=(number_of_lpt and (128+64)) shr 6;
    lpt[1]:=memw[$0000:$0408];      {Memory read procedure}
    lpt[2]:=memw[$0000:$040A];
    lpt[3]:=memw[$0000:$040C];
software controlling the data loading will be discussed later in the article.
    lpt[4]:=memw[$0000:$040E];
    textbackground(blue); clrscr;
    textcolor(yellow); textbackground(red); window(10,22,70,24); clrscr;
    writeln('Number of LPT installed   : ',number_of_lpt:2);
    writeln('Addresses for LPT1 to LPT 4: ',lpt[1]:3,'  ', lpt[2]:3,'  ', lpt[3]:3,'  ', lpt[4]:3);
    write('Select LPT to be used (1,2,3,4)   : ');
    delay(500);
    if number_of_lpt>1 then begin  {select LPT1 through LPT4 if more than 1 LPT installed}
     repeat
       kbchar:=readkey;              {read input key}
       val(kbchar, LPT_number, code);  {change character to value}
     until (LPT_number>=1) and (LPT_number<=4) and (lpt[LPT_number]<>0);
                  end;
    clrscr;
    P_address:=lpt[LPT_number];
    writeln('Your selected printer interface:  LPT',LPT_number:1);
    write('LPT  Address                : ',P_address:3);
    delay(1000);
    textbackground(black); window(1,1,80,25); clrscr;
end;


Procedure bit_weight;
{Find the weight of the binary bits}
begin
   weight[1]:=1;
   for i:=2 to 12 do weight[i]:=weight[i1]*2;
end;


Procedure send_data(address,data:integer);
{Send the address to the 74LS164 shift register}
{When sending the address, the Transmit Enable (TE) must be high to stop transmit}
{During loading, (1) DB0 is loaded with the data sw[i],
          (2) DB1 (CLOCK) is made from lowtohighthenlow
          (3) DB2 (transmit enable) is kept high all the time}
var
  sw:array[1..12] of byte;
begin
   for i:=8 downto 1 do
     begin
       sw[i]:=0;
       if address>=weight[i] then begin
                          address:=addressweight[i];
                          sw[i]:=1;
                        end;
     end;

   for i:=4 downto 1 do begin
              sw[8+i]:=0;
              if data>=weight[i] then begin
                          data:=dataweight[i];
                          sw[8+i]:=1;
                          end;
              end;
   {loading address and data into the 74LS164 registers}
   for i:=12 downto 1 do
     begin
       port[P_address]:=sw[i]+4;   {DB0=sw[i], DB1=0, DB2=TE=1}
       delay(1);             {a delay}
       port[P_address]:=sw[i]+2+4;  {DB0=sw[i], DB1=1(loading into register), DB2=TE=1}
       delay(1);             {a delay for loading the bit}
       port[P_address]:=sw[i]+4;   {DB0=sw[i], DB1=0, DB2=TE=1}
     end;
end;


Procedure transmit(flag:boolean);
{Start or quit the encoded data transmitting depending on FLAG}
begin
   if flag then port[P_address]:=0 else port[P_address]:=4;
end;


Procedure intialization;
begin
   textbackground(blue);
   textcolor(yellow);
   clrscr;
   writeln('              Radio Digital Data Communication System');
   writeln;
   writeln('  This program demonstrates that 255 digital data receivers are controlled by');
   writeln('            a PC controlled transmitter  via the printer port');
   writeln;
   textcolor(lightred);
   writeln;
   write('       Input the address of the receiver (1 through to 255)  : '); readln(swaddress);
   write('       Input the data to be sent to the receiver (1  15 )   : '); readln(sdata);
   write('       Input the light OFF period (in second, minimum: 0.1 s): '); readln(delaytime);
   write('       Input the light ON  period (in second, minimum: 0.1 s): '); readln(lighttime);
   if delaytime<0.1 then delaytime:=0.1;
   if lighttime<0.1 then delaytime:=0.1;
end;
Procedure screenshow;
{show general information about the project}
var
  Gd, Gm ,x1,x2,y1,y2: Integer;
begin
  Gd := Detect; InitGraph(Gd, Gm, '');
  if GraphResult <> grOk then Halt(1);
  setcolor(yellow); setbkcolor(blue);
  settextstyle(1,horizdir,6);
  { Center text on screen: }
  SetTextJustify(CenterText, CenterText);
  OutTextXY(Succ(GetMaxX) div 2, 50,'Innovative Interfacing'),
  setcolor(cyan);
  x1 := 10;  y1 := 20; x2 := 620;  y2 := 100;
  SetLineStyle(0,1,3);
  Rectangle(x1, y1, x2, y2);
  settextstyle(0,horizdir,3);
  OutTextXY(Succ(GetMaxX) div 2, 140,'presents');
  settextstyle(1,horizdir,4);
  OutTextXY(Succ(GetMaxX) div 2, 220,'418MHz Digital Data Communication');
  setcolor(lightred);settextjustify(lefttext,centertext);
  settextstyle(1,horizdir,3);
  OutTextXY(40, 330,'*  Connected to PC Centronic port');
  OutTextXY(40, 330+40,'*  DTI approved 418MHz FM radio link')
  OutTextXY(40, 330+80,'*  4bit data transfer from PC to receivers ).
  OutTextXY(40, 330+120,'*  Up to 255 receiver addresses');
  readln;
  CloseGraph;
end;

{******************Main Program*********************}
begin
   screenshow;
   clrscr;
   input_printer_address;
   intialization;
   bit_weight;
repeat
   transmit(false);                  {stop transmission}
   send_data(swaddress,sdata);            {loading address and data (light on) to the shift register}
   transmit(true);                   {start transmission}
   delay(30);                        {transmission lasts 20 ms}
   transmit(false);                  {stop transmission}
   gotoxy(35,23); writeln('Light On ');
   delay(round(lighttime*100030));         {delay a specified time period1}
   send_data(swaddress,0);                {loading address and data (light off) to the shift register}
   transmit(true);                   {start transmission}
   delay(30);                        {transmission lasts 20 ms}
   transmit(false);                  {stop transmission}
   gotoxy(35,23); writeln('Light off');
   delay(round(delaytime*100030));         {delay a specified time period2}
until keypressed;
   readln;
end.
```

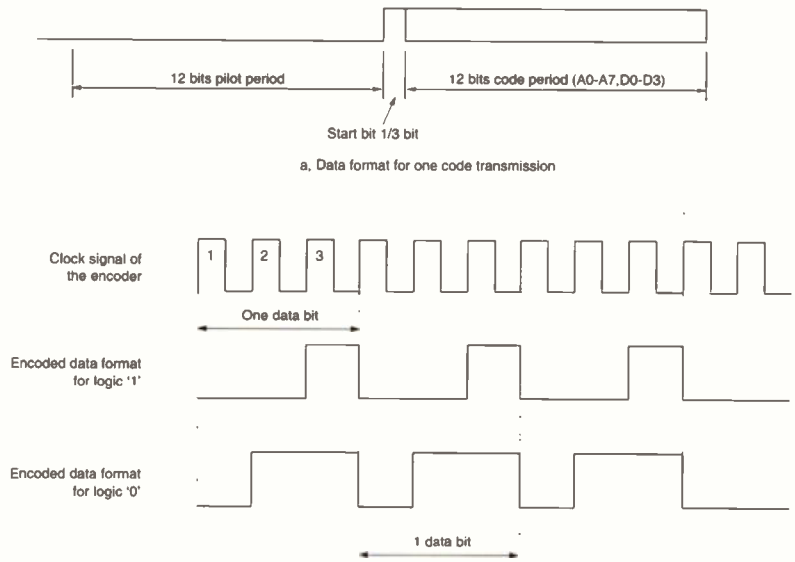


Figure 9. Encoded serial data format.

enable an 8-bit data to be fully loaded into the register serially. In the present circuit, DATA-a and -b are both connected to the DB0 of the DATA port of the Centronic port (Pin 2 of the Centronic port). The CLOCK is connected to the DB1 of the DATA port (Pin 3 of the port). The second shift register is used for loading the data bits from 9 to 12. It can be seen from the circuit diagram, the DATA-a and -b (Pins 1 and 2) of IC2 are connected to Q8 of IC1. The CLOCK input (Pin 8) of IC2 is connected to that of IC1. This scheme of cascading allows a 12 bit of data to be loaded serially into the register. The The first 8 bits of the shift register outputs (Q1 to Q8) supply the address (A0 to A7) to the encoder and the other four bits (Q9 to Q12) supply the data (D0 to D3).

The encoder circuit is built around a HT-12E encoder IC. The IC converts an 8-bit address and a 4-bit data into a serial data form. The serial data is output from the DATA OUT (Pin 15), provided that the -TE input (Transmit Enable, Pin 14) is set to low. In the present circuit, it is connected to the DB2 of the DATA port of the Centronic port (Pin 4 of the Centronic connector). While loading the data into the 74LS164 shift register, DB2 is set to `1' to inhibit the encoder to output data. After the data has been loaded successfully into the shift register, DB2 becomes `0', and enables the encoder to transmit data. The data is fed into the radio transmitter for modulating the radio-frequency carrier signal.

The serial data generated by the HT-12E encoder is fed into Pin 5 of the TX2 radio transmitter module. Radio frequency modulated signal emerges from Pin 2 of the module. In this design, a helical-type or a whip-type antenna is used.

The power supply unit is based on a CMOS TC55RP5002 +5V power regulator which can source up to 250mA of current with an extremely low input-output voltage differential of 380mV at the maximum current output. For a current of 100mA, the input-output voltage difference drops to 120mV. Another feature of the IC is that the current consumption is only

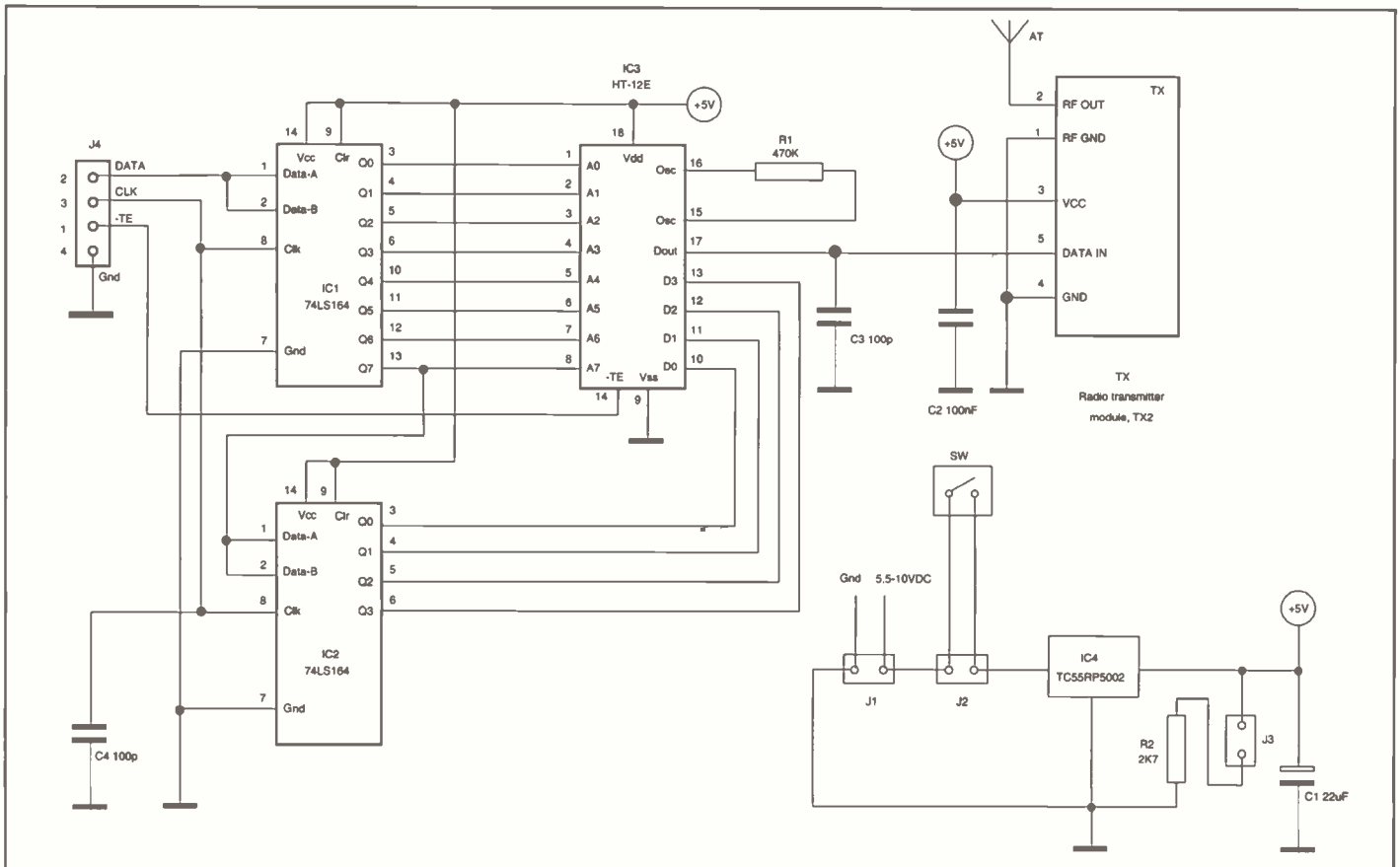


Figure 10. Circuit diagram of the radio digital data transmitter system.

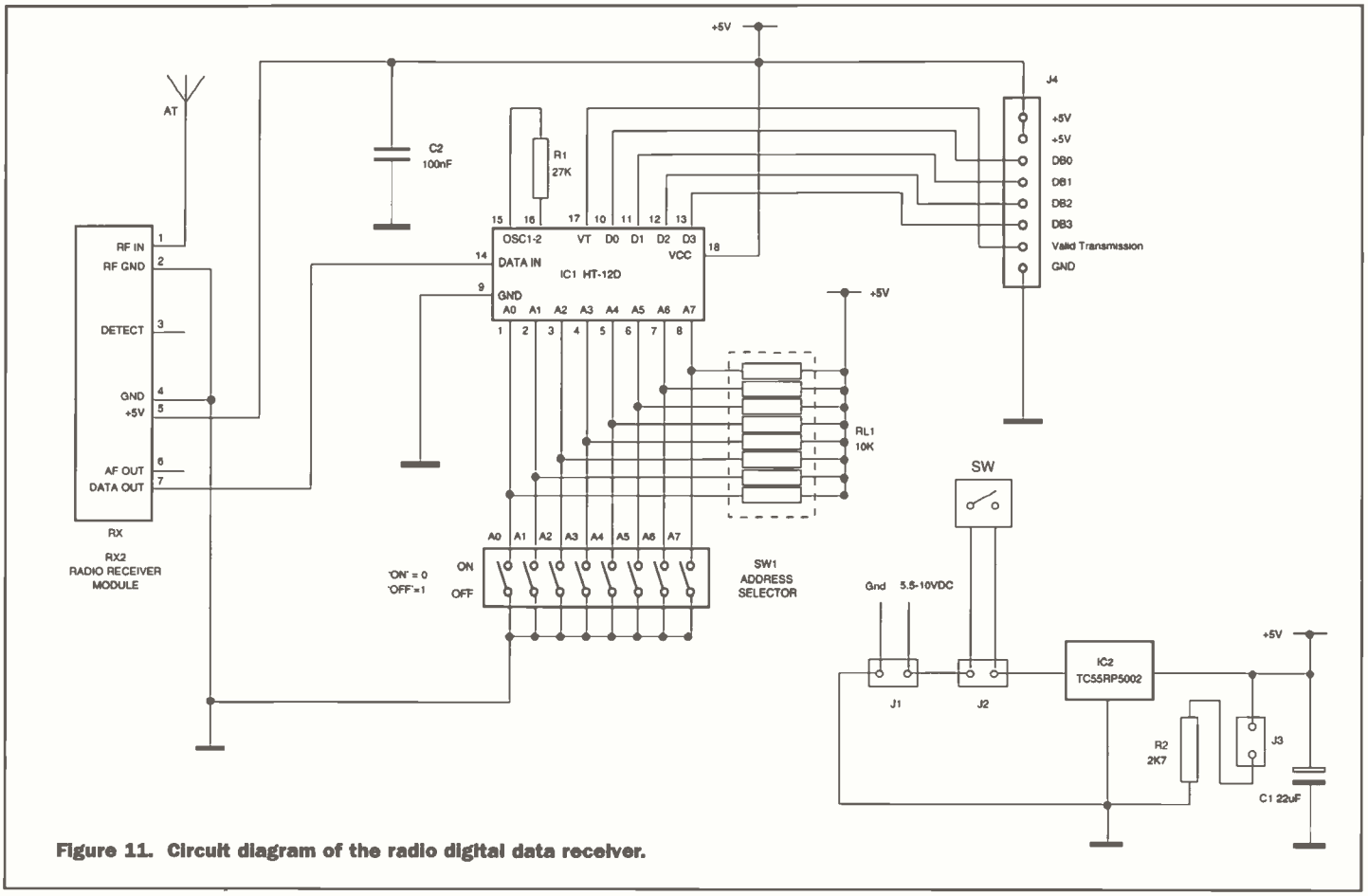


Figure 11. Circuit diagram of the radio digital data receiver.

1.1(A. It also incorporates an output short-circuit protection circuit.

How the receiver works

The block diagram of the receiver is given in Figure 2a and Figure 11 gives the circuit diagram of the receiver. The receiver is composed of 3 units. They are the radio receiver unit, the decoder unit and power supply unit. The radio receiver unit receives the transmitted radio signal, detects it and amplifies it. Then the signal is fed into the decoder unit where it is decoded into parallel data.

In the radio receiver unit, a RX2 radio receiver module is used. A whip antenna picks up the radio frequency signal and the signal is fed into Pin 1 of the module. The demodulated signal is output from Pin 7. This signal is then fed into the decoder unit.

The decoder unit is based on the HT-12D decoder IC. The decoder receives the serial data at Pin 14, checks it for errors and outputs the received data if it is valid. The first 8 bits are treated as address bits and must match the pre-set address of the decoder (set by SW1 dip switches connected to Pins 1 through to 8). If the two addresses match, the next four data bits are compared to the last data stored. If the data matches three times, the Valid Transmission output (Pin17) will go high. If not, the VT output remains low.

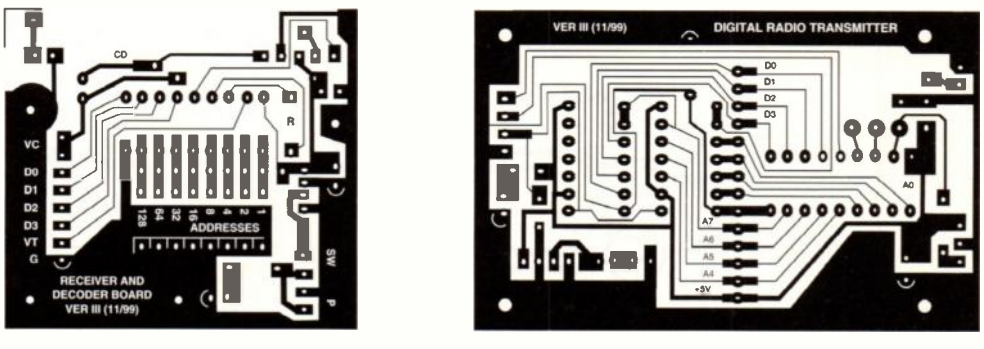
The power supply unit is based on a CMOS TC55RP5002 +5V power regulator.

Programming

B0, DB1 and DB2 of the DATA port of the Centronic port control the whole operation of the transmitter. Detailed descriptions on Centronic port and how to use the port are given in Reference 3.

When loading the address and data into the shift register, first DB2 (which is connected to the -TE input of the encoder) is set to high to stop the IC from outputting data. Then the 1st MSB of the parallel data is put on DB0 while DB1 is low. A low-to-high transition on DB1 (which is connected to the CLOCK input of the shift register IC) will enable the data to be shifted to the 1st register output. The 2nd MSB, 3rd MSB... are then put to DB0 in sequence. The clocks will shift the 8-bit serial data into the register outputs.

After the data is successfully loaded to the register. DB1 is brought low which enables the encoder IC to send out the



(a) Transmitter PCB

(b) Receiver PCB

Figure 12. PCB layout.

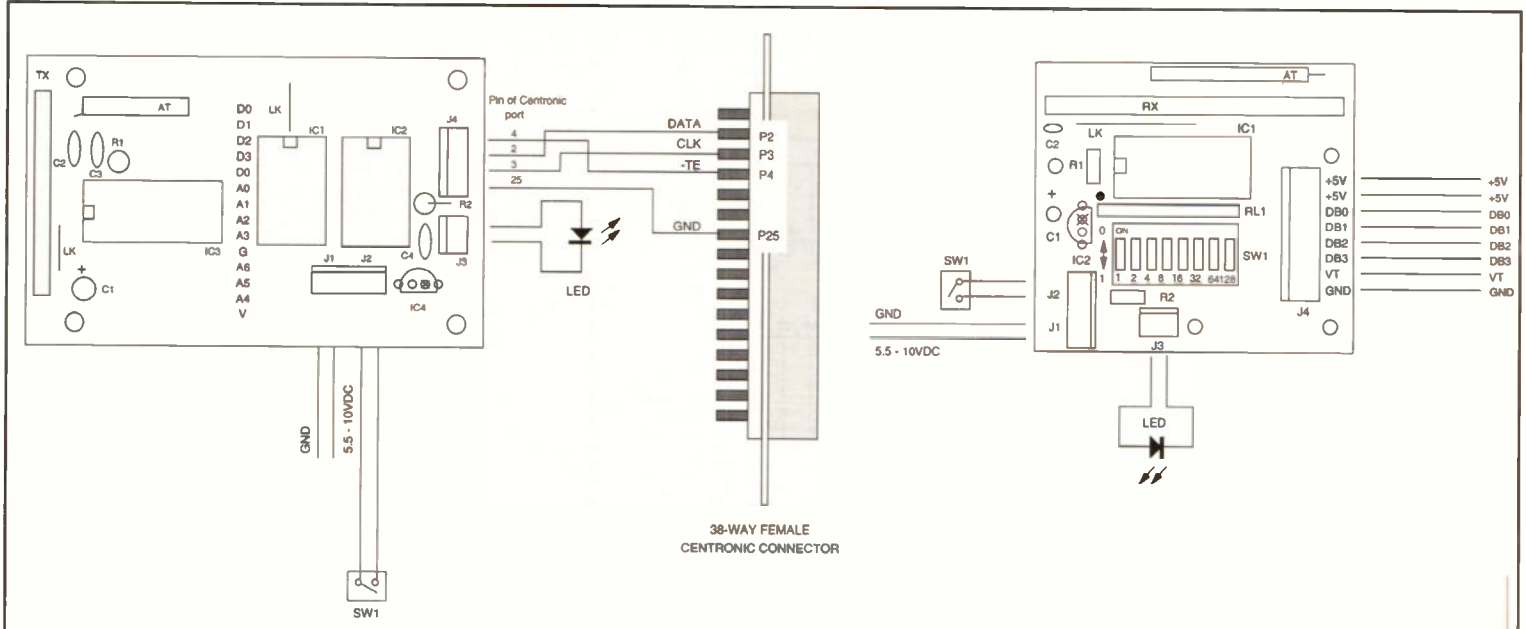


Figure 13. PCB artwork of the radio transmitter and the receiver.

encoded serial data.

A demonstration program written in Turbo Pascal 6 is listed as follows. The program will ask for an address first (0-15), then the first time delay (T1) and the second time delay (T2). After this the program will send `1' for all the data lines. It will delay a time period T1 and then send `0' for all the data lines. After another time delay T2, the transmitter will send `1' again. This will continue until the RETURN is pressed.

Construction and testing

The transmitter and receiver are constructed on single-sided PCB boards (Figure 12). The antenna of the receiver is constructed using a piece of copper wire, 16cm long. It is connected to the antenna connector on the PCB board. The component layouts are shown in Figure 13. The construction is rather simple. After soldering all the components on the PCB boards properly, the system will work straight away. There is no adjustment needed for the transmitter and the receivers.

Oscilloscopes are not essential for the testing. A multimeter and a couple of LEDs are sufficient. The transmitter is connected to the computer and the power is supplied to the transmitter. The demonstration program is loaded into the computer. This program simply loads an 8-bit address and a 4-bit data to the shift register. The value of the address varies from 1 to 255 and the value of data varies from 0 to 15.

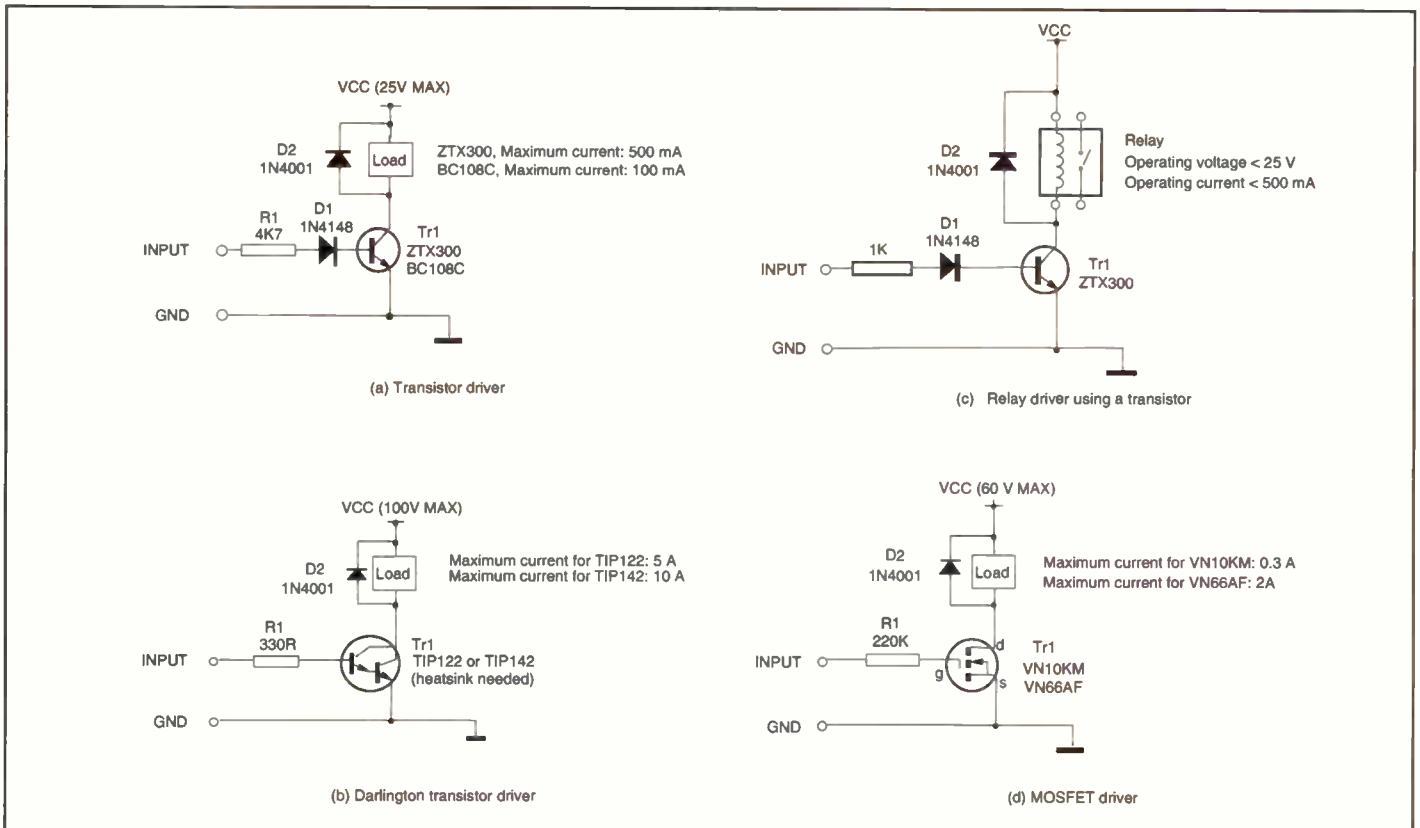


Figure 14. Various power driver for the digital outputs from the HT-12D.

Application ideas

Using relays, solid state relays or other power drivers (Figures 14 and 15), the 4 digital outputs of the receiver unit can be used to control lights, heaters, etc. Since 256 receivers can be connected to the system, in total, 256, 4 individual appliances can be controlled by one transmitter which is connected to a computer. A nice feature of this system is that no connection cable is needed at all. It should be noted that if mains power is to be controlled, electrical isolation between the receiving circuit and the mains must be applied. Relays and opto-isolated solid-state relays should be used.

The 4 digital outputs can used to control on/off and rotating directions of a DC motor. The circuits are shown in Figure 16.

Technical support

Kits are available from the author. Please direct your enquiry to Dr. Pei An, 11 Sandpiper Drive, Stockport, Manchester SK3 8UL, Tel/Fax/Answer: 44-(0)161-477-9583. E-mail: HYPERLINK mailto:pan@intec-group.co.uk pan@intec-group.co.uk.

Acknowledgement

I would like to thank Mr. Kangyan from Radiometrix Ltd

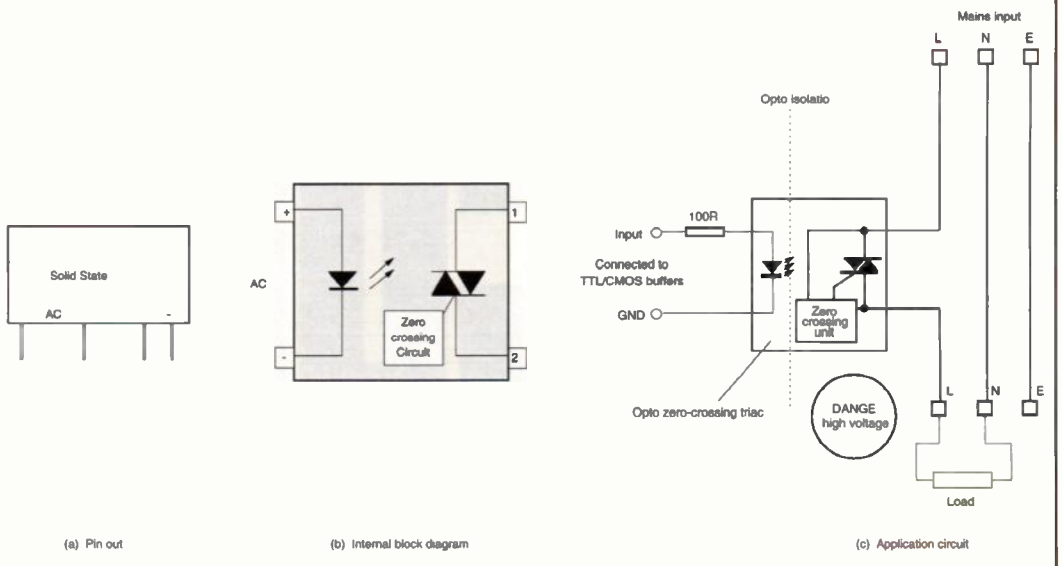


Figure 15. Solid state relay driver.

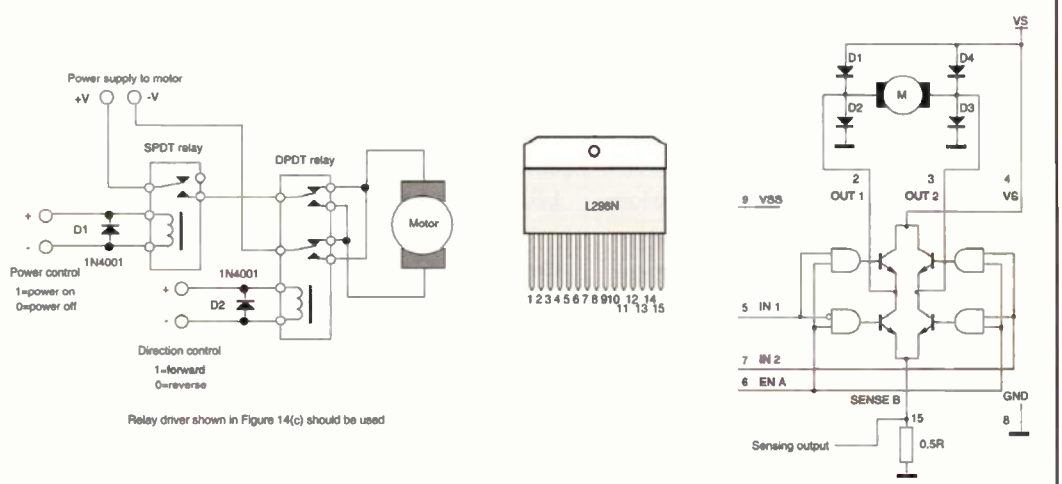


Figure 16. Motor drivers.

References

Data sheets for TX2 and RX2 which are available from Radiometrix Ltd.
Tel: 44(0)1814281220.
Web site: HYPERLINK http://www.radiometrix.co.uk www.radiometrix.co.uk

Data sheets for HT12 series are available from Holtek.
Web site: HYPERLINK http://www.holtek.com.tw www.holtek.com.tw

PC Interfacing - Using Centronic, RS232 and game ports, Pei An, Newnes, Butterworth-Heinemann, 1998, ISBN0240514483

PROJECT PARTS LIST

TRANSMITTER

SEMICONDUCTORS

IC1,IC2	74LS164 shift register
IC3	HT12E encoder
IC4	TC55RP5002 +5V regulator

RESISTORS

R1	470 1% metal film resistor
R2	2K7 5% carbon film resistor
C14,15	10μF 63V Radial Electrolytic

CAPACITORS

C1	22μF electrolytic
C2	100nF ceramic disc
C3, C4	100pF ceramic disc

OTHERS

J1+2	4-way PCB connector, male
J3	2-way PCB connector, male
J4	4-way PCB connector, male
AT	Helical type antenna/Whip type antenna
TX	TX2, 433MHz version, TX2-433-5V

RECEIVER

SEMICONDUCTORS

IC1	HT12D decoder
IC2	TC55RP5002 +5V voltage regulator

RESISTORS

R1	47K 1% metal film resistor
R2	2K7 5% carbon film resistor
RL	10K 8-way SIL resistor array

CAPACITORS

C1	22μF electrolytic capacitor
C2	100nF ceramic disc

OTHERS

J1, J2	4-way PCB connector, male
J3	2-way PCB connector, male
J4	8-way PCB connector, male
SW1	8-way DIL switch
AT	Helical type antenna/whip type antenna
RX	RX2, 433MHz version, RX2-433-5V-A

What's New In SILICON

From our American correspondant

Michael Storm

I'm sitting here today wondering if you actually do this design stuff for a living? Is this just a hobby for you, or are you one of the 11% in a recent Questlink survey <www.questlink.com>, that say they are currently working on seven or more projects? (in some fashion, research, buying, etc...) Is that right? Then by those numbers, just over 37,000 engineers in the US make about 70% of the electronic toys that we love so well. That sure seems like a few people doing a lot of work, and the US government apparently agrees.

By the end of this month the Senate is expected to pass the H-1B visa bill in an attempt to lure EE's and other qualified, employable people from other countries to the American job market. The bill will increase the number of visas offered to 195,000 for 2001, almost double what was planned for the year. It looks to be more and more urgent that we fill the job market with as many potential people as we can, from anywhere we can. With the "Baby Boomers" about to reach retirement age, the American job market will soon be short upwards of 5,000,000 warm bodies, that according to the US Labor Department.

Ready to live the American Dream? Looks like your best chance ever is coming up, especially if you have anything to do with the electronics or computer industries.

If you do decide you want a slice of American Dream Pie, may I suggest finding a job outside the Silicon Valley. "Like, no offence and stuff", but they can keep it. I just returned from ESC in San Jose and the word madhouse comes to mind. Mainly because I can't find another word that quite works and secondly, I think it just descriptive enough to convey the fact that, had I stayed longer than I did, it would have driven me utterly and incurably bonkers. I wont go into it too much other than to say the 3 hours it took me travel 68 miles, in a 70 mph zone, was the proverbial straw.

On the other hand and more importantly, the conference itself was awesome, and totally worth the madness, everything you would ever need to make every toy you've ever wanted. All the big boys were there, from Microsoft with great new embedded OS tools, to Mitsubishi with their latest addition to the M16C Family of MCU's (which I've spotlighted this month) to Parallax with the coolest of cool toys, robots (you can bet I'll get to some of these real soon). I was there for all three days from open to close and I still didn't see everything I wanted to. It's probably best, when all was said and done I had a canvas shopping bag full of datasheets, software, tools, T-shirts and toys that weighed 50lbs, I do not exaggerate this.

And finally, this months spotlight...

The Part: Mitsubishi M16C/20 single chip microcomputer Group (there are a bunch of low cost variations to fit your specific needs, i.e. ROMless versions etc.)

Datasheet Link:
http://www.mitsubishichips.com/data/datasheets/mcus/mcupdf/um/30201eum.pdf
(need Acrobat reader to view, www.adobe.com)

Tool Link:
http://www.mitsubishichips.com/data/datasheets/mcus/m16c20grp.html

Quote: "...combines the advantages of both register and accumulator-based architectures to provide high-speed processing with RISC-like performance ...an easy-to-use instruction set, as well as an architecture optimized for C programming efficiency".

Cool Uses: Wireless Two Way Pagers, Cameras, Cell Phones, or maybe an ABS system for your car.

Killer Feature: The M16C is designed with the industry's first masked ROM program correction function that allows designers to correct a faulty mask ROM program via an external EEPROM.

Example: How to calculate a sum-of-products

Features	
Memory Capacity	ROM (OK to 256 Kbytes) RAM 4 K up to 20 Kbytes
Instruction Execution Time	62.5ns(f(XIN)=16MHz)
Supply Voltage	4.0 to 5.5V(f(XIN)=16MHz) 2.7 to 5.5V(f(XIN)=7MHz with software one-wait)
Low Power Consumption	18mW(f(XIN)=7MHz with software one-wait, V_{CC}=3V)
Interrupts	20 Internal and 5 External Interrupt Sources, 4 Software Interrupt Sources; 7 Levels (including key input interrupt)
Multifunction 16-bit Timer	8 Programmable Reload Timers
Serial I/O (UART or Clock Synchronous)	3 Channels (one of three use for SIM interface) (Note 1)
DMAC	2 Channels (trigger: 16 factors)
A-D Converter	10 Bits x 8 Channels (expandable up to 10 channels)
D-A Converter	8 Bits x 2 Channels
CRC Calculation Circuit	1
Watchdog Timer	1(15-bit watchdog timer)
Programmable I/O	87 Lines
Input Port	1 Line (P85 shared with NMI pin)
Memory Expansion	Available (to a maximum of 1 Mbytes)
Chip Select Output	4 Lines
Clock Generating Circuit	2 Built-in Clock Generation Circuits (32KHz sub clock and 16MHz) (built-in feedback resistor and external ceramic or quartz oscillator)

```
  Flow Chart
  ENTER
  Set Calculation Condition
  Execute Calculation
  Set Result
  EXIT
  ************************************
********
  ;
  ; Mitsubishi
  ; M16C Program Collection No.6
  ; CPU          M16C
  ;
  ;
  ************************************
********
  VramTOP        .EQU      000400H
;Declares Start Address of RAM
  VromTOP        .EQU      0F0000H
;Declares Start Address of ROM
  Vsb            .EQU      0400H
;Sets SB
  ;                                  ;
                 .Section  RAM, DATA
                 .ORG      VramTOP     ;
RAM area
  Data11:        .BLKB     1
;Multiplicand 1
  Data12:        .BLKB     1
;Multiplicand 2
  Data13:        .BLKB     1
;Multiplicand 3
  Data21:        .BLKB     1
;Multiplier 1
  Data22:        .BLKB     1
;Multiplier 2
  Data23:        .BLKB     1
;Multiplier 3
  ANS:           .BLKB     2
;Result of sum-of-products calculation
  ;                                  ;
  ;==================
==========================
=======
  ; Title: Calculation sum-of-products
  ; Outline: Calculates a sum of products.
  ; Input: ----------------------> Output:
  ; R0    ()                   R0
(Calculation result)
  ; R1L   ()                   R1L
(Unused)
  ; R1H   ()                   R1H
(Unused)
  ; R2    ()                   R2
(Unused)
  ; R3    ()                   R3
(Indeterminate)
  ; A0    ()                   A0
(Indeterminate)
  ; A1    ()                   A1
(Indeterminate)
  ; Stack amount used: None
  ;==================
==========================
=======
                 .Section
PROGRAM,CODE
                 .ORG      VromTOP
;ROM area
                 .SB       Vsb
;Declares SB register value
                 .SBSYM    ANS
;
  MOV.W          #0, R0
;Initializes calculation area
  MOV.W          #3, R3
;Sets number of sum-of-products
  MOV.W          #DATA11,A0
;Multiplicand address
  MOV.W          #DATA21,A1
;Multiplier address
  RMPA.B
;Executes Sum-of-products calculation
  MOV.W          R0,ANS
;Sets calculation result
  ;
;
                 .END
;
```

You can get examples like this as well as an entire line of Starter Kits and tools to help you develop with the whole M16C line at **http://m16cmicros-forum.com/** the site is still under construction but still has plenty to offer.

I'm still taking suggestions for a new title for the article; just drop an email to mstormt@hotmail.com. Some real good ideas have come in, but I'm still undecided so keep 'em coming, remember the reader who's title I choose will score a Kanda.com cool tool worth at least fifty smackers!

Invention on the Rise Says PATENT OFFICE

A new report special

by Stephen Waddington

More people than ever want to know about patents, designs, trademarks and copyright according to the Annual Report and Accounts of the United Kingdom Patent Office which was published at the end of September.

With over 50,000 hits daily on the Patent Office Web site - up from 20,000 a day last year - Internet users are wanting to find out how to protect their ideas and inventions, download forms and information, and discover all the latest innovations in patents, designs and trademarks.

This interest has led to significant increases in applications for patents - by 6% to over 30,000 - and trademarks - by 11% to over 84,000 national and international applications. This was matched by an output of 13% more trademarks and designs registered during 1999 - 57,537 national and international trademarks and 9,655 designs.

The Chief Executive of the Patent Office, Alison Brimelow said, "With the pace of development and demand for knowledge we are working even harder to make sure we are accessible, open and responsive to our customers. Our third Charter Mark award and the continuing feedback we receive underlines that what we are doing is both needed and appreciated.

"I am particularly pleased with our successful international work to harmonise and simplify procedures for UK businesses who want global rights, and in our work at home to help consumers by raising awareness of the effects of counterfeiting and piracy."

Welcoming the Report, Competition and Consumer Affairs Minister Dr Kim Howells added, "This Annual Report reinforces another year's fine performance from the UK Patent Office. The protection offered through patents, trademarks, designs and copyright is a vital way of stimulating businesses and individuals to greater heights of innovation and international competitiveness. In return, we are all able to share and enjoy the results of their knowledge and creativity."

Trends

Most patents were granted in the telecommunications sector - 865 patents - but other areas of high activity included machine elements (633), civil engineering (462) and electric circuitry (429).

Scientific trademarks remained the most popular with 5,175 applications published in 1999 followed by miscellaneous services at 4,138, and paper, stationery etc at 3,708. Education, entertainment, sporting and cultural trademarks were also active at 3,176 applications published.

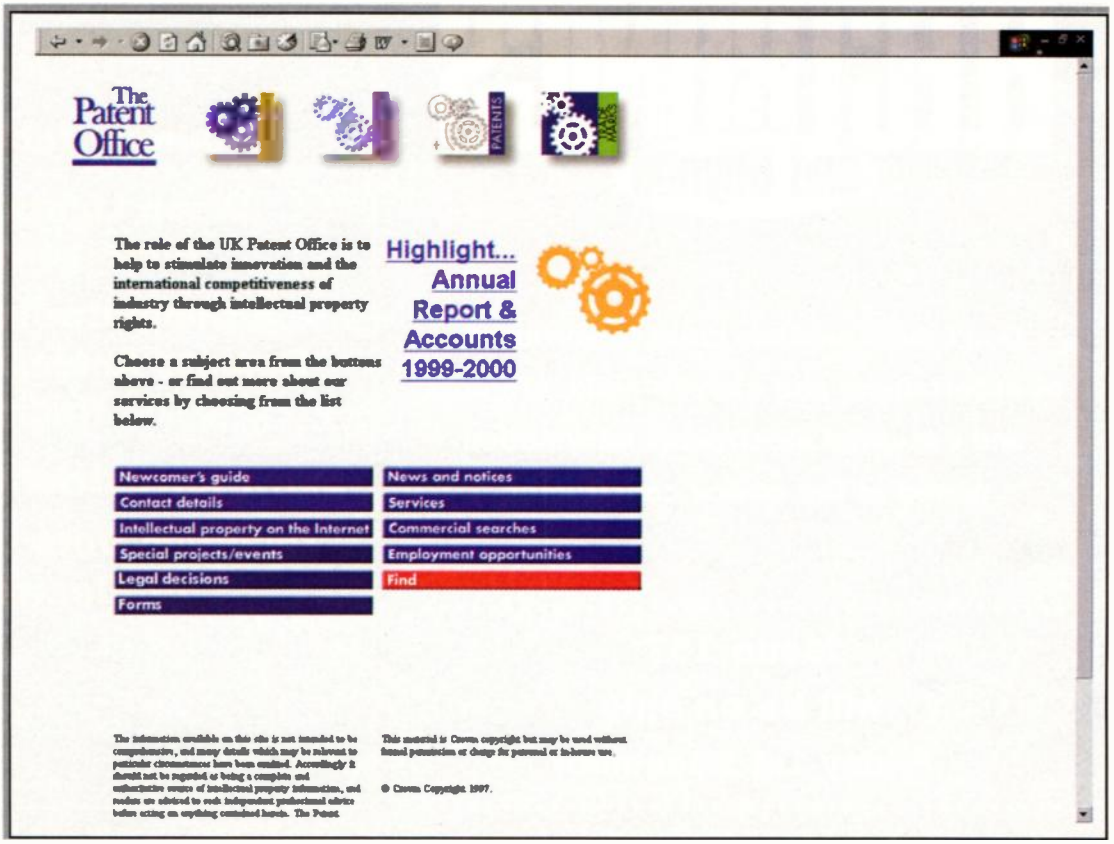
Designs covering recording, communications and information retrieval equipment attracted the largest number of filings - 887. Applications for packaging, containers and furnishing continue to be popular but the biggest percentage increase this year has been for games, toys and sports goods rising 12% to 759 applications.

The Patent Office Annual Report and Accounts is available priced £18.65 from the Sales Office of the Patent Office, Concept House, Cardiff Road, Newport, South Wales NP10 8QQ and from The Stationery Office. It is also available on the Patent Office Web site.

For further details, check:

<www.patent.gov.uk>

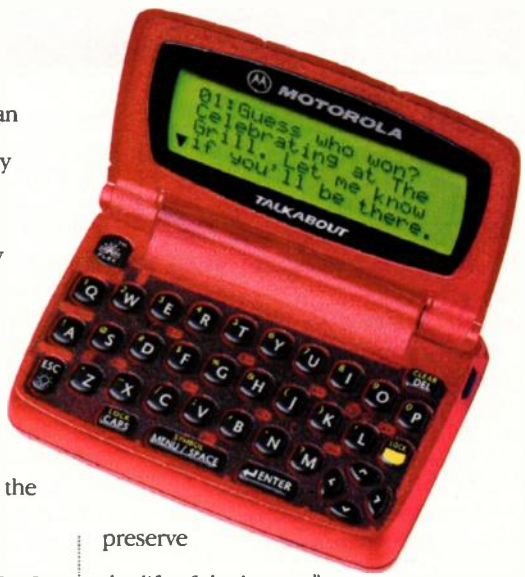
Contact: Patent Office: (01633) 813930



Baffled by BATTERIES

Experts from Motorola claim that there is little point in developing battery-recharging regimes. Modern batteries rely on sophisticated charging technology to prevent them from burning-out.

A report by Stephen Waddington

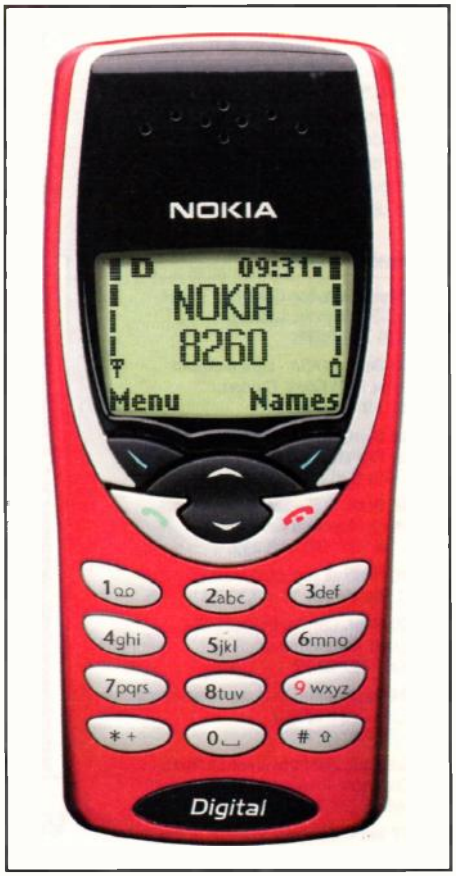


For millions of consumers, mobile phones have become an indispensable part of life. Every where you look, you see people talking on their cell phones - unless the battery is dead.

In the past, batteries had a memory and you had to let them fully discharge before recharging - if not, it diminished the performance and life of the battery. But that has changed.

"Now, actually, it's better not go all the way down but to just use it normally and the randomness of some discharging completely, some not, is actually the best way to preserve the life of the battery," says Brian Kober of Motorola.

We've all been told to be careful not to overcharge our cell phone batteries because it may damage them. But if you use a charger made by the same company that makes your phone, there's circuitry built into the charger that protects the battery by automatically stopping the charging process when the battery is full.



Now that you know when and how to charge your battery, what else is there to know?

"Another thing people should realise is that the temperature can affect the performance of the battery," says Kober.

"It's a very bad idea to leave the phone or the battery on the dashboard of your car. It can get very hot and dramatically decrease the life of the battery. Similarly, in very cold weather, a battery cannot perform very well until you warm it back up to room temperature."

Even when given the best of care, most users will notice a decline in battery performance after about a year. Motorola say that's a good time to go out and buy a replacement. But then they would wouldn't they.

Diary Dates

Every possible effort has been made to ensure that information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

September 2000

3 to 5 Sept. European Computer Trade Show (ECTS), Olympia, London. Tel: (0208) 742 2828.

10 to 13 Sept. PLASA - Light & Sound Trade Show, Earls Court, London. Tel: (0207) 244 6433.

13 to 14 Sept. OnBoard - Electronics Assembly Exhibition, Olympia, London. Tel: (01799) 528 292.

13 to 14 Sept. ECIF - Electronic Components Industries Fair, Olympia, London. Tel: (01799) 528 292.

17 Sept. National Vintage Communications Fair, NEC, Birmingham. Tel: (01392) 411 565.

19 to 20 Sept. Call Centre Expo, NEC, Birmingham, Miller Freeman. Tel: (0208) 742 2828.

21 to 24 Sept. Live - Consumer Electronics Show, Earls Court, London. Tel: (0208) 742 2828.

22 to 23 Sept. Leicester Amateur Radio Show, Donington Exhibition Centre, Derby. Tel: (01455) 823 344.

26 to 27 Sept. Business Systems Show G-MEX Centre, Manchester. Tel: (07000) 464 336.

26 to 28 Sept. GIS - Geographic Information Systems Exhibition, Earls Court, London. Tel: (0208) 742 2828.

27 to 28 Sept. Communications for Business, Barbican Centre, London. Tel: 01923 676 867.

October 2000

3 to 5 Oct. Coil Winding 2000, NEC, Birmingham. Tel: (0207) 417 7400.

4 to 5 Oct. Softworld Accounting & Finance, NEC, Birmingham. Tel: (0208) 541 5040.

9 to 11 Oct. TMA33 - Telecommunications Managers Association Exhibition, Stakis, Metropole, Brighton. Tel: (01372) 361 000.

11 to 12 Oct. SIT - Small Business IT Show, Bournemouth International Centre. Tel: (01934) 420 365.

11 to 12 Oct. TEST - Electronic Testing Exhibition, NEC, Birmingham. Tel: (02476) 230 333.

11 to 12 Oct. Webmaster - Web & Internet Show Olympia, London. Tel: (01256) 384 000.

11 to 12 Oct. JAVA - Computer Software Trade Exhibition & Conference, Olympia, London. Tel: (01256) 384 000.

15 Oct. National Vintage Communications Fair, NEC, Birmingham. Tel: (01392) 411 565.

17 to 18 Oct. Property Computer Show, Barbican Centre, London. 01273 836 800.

18 to 19 Oct. PHOTONEX/FIBRE EXHIBITION, NAC, Stoneleigh, Coventry. 01932 866 766.

25 to 26 Oct. Accounting IT, Business Design Centre, London. Tel: (0207) 221 1155.

24 to 25 Oct. OSPMA FieldComms - Industrial Networking Show, Telford International Centre. Tel: (0207) 417 7400.

31 Oct to 2 Nov. Voice Europe Olympia, London. Tel: (01244) 378 888.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 8LU or e-mail to swaddington@cix.compulink.co.uk.

What's On?

Voice Technology Experts Gather At World Internet Centre

The best minds in voice and speech-related technologies convened at the Silicon Valley World Internet Centre at **<www.worldInternetcenter.com>** last month to brainstorm voice-driven applications for the next 12 to 18-month market.

In the next few years, it is expected that most people accessing the Internet will not do so using a standard PC, but through wireless phones and personal digital Assistants (PDAs). Since these new Internet devices aren't conducive to extended typing, many believe that voice technologies will have to be deployed.

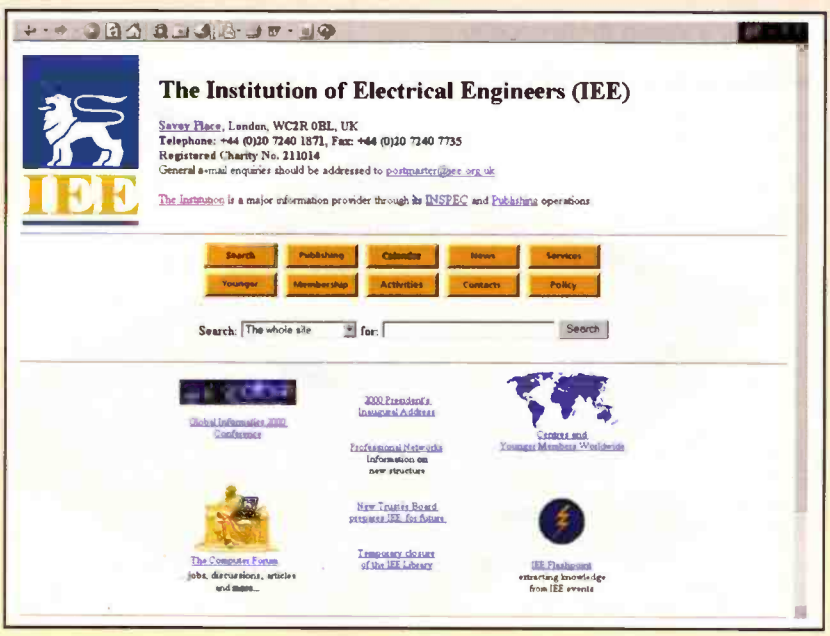
"Today, devices are getting smaller and smaller, but as my boss is fond of saying, 'our fingers aren't,' said Sunil Soares, program director, Product Management, IBM Voice Systems. "So, voice is the most natural way to go for companies that want to deliver simple and faster access to information from anywhere at anytime using any device - no matter what the size."

Additionally, voice and speech-recognition technologies are being aligned for large-scale systems deployment across enterprises. The latest Think Tank Session at the Centre focused on how these technologies could be applied and utilised for cross-enterprise applications.

Thirty high-level executives and technologists represented leaders in the voice markets, including IBM, SAP, Hewlett-Packard, BeVocal, Nuance Communications, TellMe Networks, VOCI, and Speechwise Technologies.

Technologists and executives explored the user experience to-date with voice and speech-recognition technologies and focused on market approaches to voice-enabling enterprise applications. Participants debated suitable applications for voice enablement with the use of VoiceXML and other voice and speech-related technologies.

The characteristics of a "good" voice-enabled interface in contrast to "poor" interface were discussed, as well as the strengths and weaknesses of modularised speech objects or dialogue components, barriers to the development of



natural-language recognition, and the economically viable characteristics of the technologies that do work for voice applications.

What voice market developments are coming up in the next 12-18 months? According to Bruce Grant, key practice director of advanced technologies for US-based Luminant Worldwide "Natural-language Understanding, which allows for conversational interaction, will become more prevalent. Personal information managers will gain momentum; multi-modal PDA's and cell phones will improve as voice drives data and data drives voice; and voice server providers will take off."

For further information, check: **<www.worldInternetcenter.com>.**

Contact: World Internet Centre, Tel: +1 650 462 9800.

Widening Industry-Education Gap Will Worsen Skills Shortage

The furious pace of change in the field of electronic engineering, coupled with a huge decline in student funding and inadequate undergraduate facilities has led to a growing gap between what a University can realistically deliver and what most employers want and need in a new graduate.

This was the message delivered at the beginning of October by Professor John Midwinter OBE in his Inaugural Address as President of the IEE, Europe's largest professional engineering society.

Professor Midwinter, who is Pender Professor at University College London, was addressing an audience of over 350 senior industrialists, professional engineers and academics. "Clearly, hard choices must be made, completely rejecting great swathes of material altogether for later study during Life-Long Learning".

"In addition to understanding many emerging and developing technologies, engineers also need to understand the markets into which they must project their systems, and how the global competition is reacting to them", said Professor Midwinter.

"The dilemma facing educators seeking to convert school leavers into practising engineers, working in fast moving sectors such as Information Technology amounts to a head on conflict between the desire to teach technical width and the desire to cover depth.

"Added to which, heavily indebted students are demanding shorter, not longer, courses and are voting with their feet.

The dilemma, Professor Midwinter warned his audience, was made worse by the huge decline in public funding per student.

"Such a decline hits hardest at those topics that consume the most money or where economies are most easily made, such as laboratory provision for advanced project work, an area usually seen as vital to an engineering student's progression in the final years study".

"Offering a wide range of different specialist options and backing these with meaningful project facilities is virtually impossible."

Close employer involvement, the development of industry-sponsored and technology-specific HE laboratory facilities and significant student exchanges between Universities after completion of a two year core programme might be one answer, suggested the new President.

"Within the HE sector" he concluded, "new thinking is urgently needed to seek ways of delivering high quality degree programmes at affordable prices".

For further details, check: **<www.iee.org.uk>.**

Contact: IEE, Tel: (020) 7240 1871.

Computers for Schools

Michael Portillo, MP for Kensington and Chelsea, and the pop music band S Club 7 met children from local schools who have benefited from Tescos Computers for Schools at the beginning of September.

Tescos Computers for Schools has raised over £62.5 million for computing equipment since 1992 by giving shoppers vouchers which may be converted into equipment for schools.

For further details, check: **<www.tesco.com>.**

Contact: Tesco, Tel: (01992) 632222.

European Computer Trade Show

Visitors to the European Computer Trade Show, better known as ECTS 2000, play the Nintendo Game Boy, Monday, September 4, 2000 in Olympia, London. ECTS is the European showcase for all the new hardware and software products to be launched in time for Christmas. The European market is expected to expand to around £5 billion by 2003.

For further details, check: **<ects.oit.net/2001>.**

Contact: European Computer Trade Show, Tel: (020) 8987 7727.

Police NASA ACTION

Police officers in the US recently have been seeking the help of two NASA scientists who study the Sun and storms like hurricanes. Why are specialists from such different worlds working together?

By Stephen Waddington

NASA researchers - using their expertise and equipment for analysing satellite video - have created technology that can dramatically improve TV images including crime scene videos. With police officers looking over their shoulders, the scientists use their computer software to turn dark, jittery images captured by home video, security systems and video cameras in police cars into clearer, stable images that reveal clues about crimes.

First Case: The Atlanta Olympics Bombing

In the last year, Dr. David Hathaway and Paul Meyer at NASA's Marshall Space Flight Centre have worked on about a dozen criminal cases with the police and FBI. Hathaway, a solar physicist, is usually busy studying images of violent explosions on the Sun, and Meyer, an atmospheric scientist, examines hazardous weather conditions on Earth.

The scientists' foray into the world of forensics began when they helped the FBI analyse video of the bombing that killed two people and injured hundreds more at the 1996 Olympic Summer Games in Atlanta. Hathaway and Meyer successfully clarified nighttime videotapes made with handheld camcorders, revealing important details about the bomb and the explosion.

Since their first case with the FBI, Hathaway and Meyer have worked over the years to refine the VISAR technology, improving it so that it is now ready to be transferred to companies that produce video enhancement systems for law enforcement, the military and even home computers.

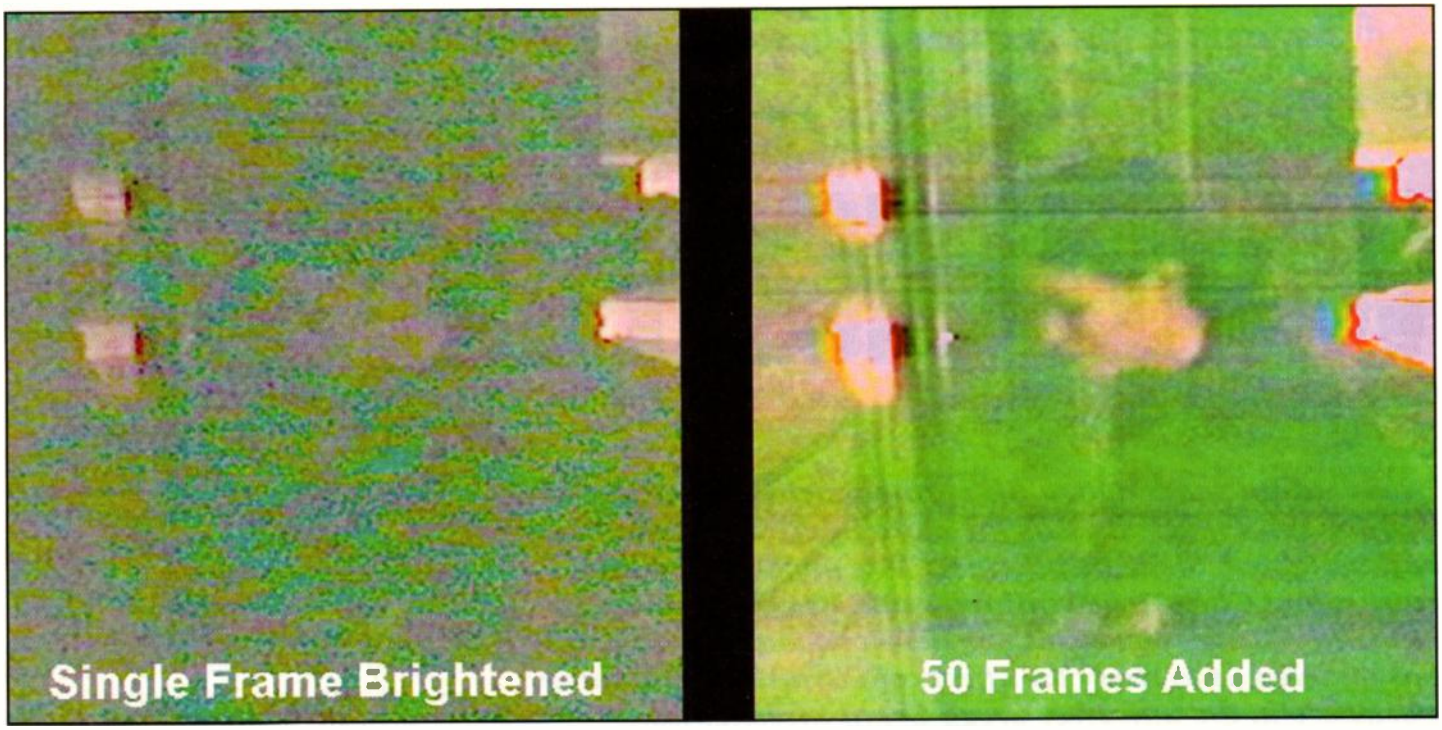
By the end of this year, the FBI and other criminal investigators will be able to use the NASA technology at their own stations. The NASA scientists' invention - called Video Image Stabilisation and Registration, or VISAR - will be available in a video tracking and enhancement system developed by Intergraph Government Solutions The company has signed a licensing agreement with NASA to use VISAR in its Video Analyst System, which offers broadcast-quality analysis features on Intel-based hardware.

"After analysing crime video for detectives and seeing the horrible details of some of these crimes, it gives me great satisfaction that police can use NASA technology to put murderers behind bars," said Hathaway.

Hathaway, for example, helped enhance security camera videotape made during the kidnapping of a Minnesota teenager. In an intensive effort, the FBI and police worked with Hathaway to identify the abductor and try to find the teenager before she was harmed. Police now believe she was killed. This summer, the tape was used as evidence in the trial of a man convicted of the murder.

The VISAR system has proved so useful because it is able to correct the effects of jitter, rotation and zoom from frame to frame in video. Once corrected, the registered video images may then be combined to produce clearer images.

"At NASA, we routinely take satellite images of storm clouds and enhance them



to see what is going on in the atmosphere," said Meyer. "Looking for clues about what is happening in a storm is similar to being a detective and finding out what took place at a crime scene."

Potential Commercial Use

Commercial interest in licensing the Marshall invention is based on its ability to do more than just remove noise or 'snow' from videos. The software also corrects for horizontal and vertical camera motion, as well as rotation and zoom effects. It produces clearer images of moving objects, smoothes jagged edges and enhances still images.

"By adding VISAR to our Video Analyst Workstation, we can now offer the law enforcement, military, intelligence and security communities these powerful capabilities in a comprehensive video analysis system," said Trey McKay, executive manager of Federal Hardware Solutions at Intergraph Government Solutions. "We look forward to working with NASA to integrate this innovative technology to extend our system capabilities and anticipate a significant impact on our customers and the industry as a whole."

Video imagery for defense applications will also be improved through another licensing agreement between NASA and BARCO Display Systems. The company is incorporating VISAR into its new computer hardware, designed for real-time video image enhancement, stabilisation, and tracking.

"The reconnaissance video imagery made by military vehicles, aircraft and ships traveling in harsh, rugged environments is often shaky and unstable," said Michael Garner, a BARCO new business analyst. "Our defense industry customers will be pleased with the improvements NASA's software makes to reconnaissance and surveillance video."

VISAR Technology at Home

These two licenses are for exclusive use in Intergraph's and BARCO's existing or new real-time hardware products. Now, NASA is seeking consumer software companies to license VISAR for home computers, said Sammy Nabors of NASA's Technology Transfer Department at the Marshall Centre.

For instance, to evaluate the use of the video enhancement software for medical purposes, Meyer and Hathaway are working with the Casey Eye Institute at the Oregon Health Sciences University in Portland through a NASA Space Act Agreement.

Officials at the institute have called the initial video evaluations 'awesome'. Through partnerships with the National Eye Institute of the National Institutes of Health, scientists at the Portland institute use an innovative technique to study video of cell movements in the eye associated with immune system diseases.

"Working with the NASA software, we can answer questions that advance our understanding of processes unique to the eye and our understanding of how the immune system works," said Dr. Stephen R. Planck, associate professor for the Casey Institute. "After NASA enhanced the video, we could see cell movements inside the eye that were undetectable before."

The two Marshall Centre scientists have completed test video analyses that show their patent-pending technology can improve home video - an area that may have the biggest market potential. To encourage companies to manufacture and distribute VISAR software for home computers, NASA recently asked companies to submit license applications and commercialisation plans to the Marshall Technology Transfer Department.

"It's amazing to me that software we invented has the potential to be used everyday in home computers worldwide," said Meyer.

The Discovery Of The Ultra-Violet WAVELENGHTS

PART 1

Two hundred years ago, a German physicist discovered that the sun's spectrum was far more interesting than many had imagined. Since then, science has uncovered much more about Ultra-Violet radiation and its effect on our planetary home. Moreover, the development of spacecraft has enabled us to study the effects of Ultra-Violet radiation elsewhere in the universe. Gregg Grant investigates.

1: Terrestrial Ultra Violet Radiation

The New Radiation

In 1614, the Italian chemist Angelo Sala noted that light broke up the white compound silver nitrate. The light darkened the compound by releasing minute slivers of metallic silver. A white crystalline soluble, poisonous substance used as a medical antiseptic and astringent, silver nitrate was also fused into sticks for cauterising, when it was termed Lunar Caustic. Sala had other things on his mind however and almost 190 years would pass before the real cause of the darkening was revealed.

In 1801, the German physicist Johann Ritter was studying the sun's spectrum, as he was interested in the chemical changes it brought about. This was not as unusual as it sounds, for he'd begun his working life as a pharmacist before studying medicine at Jena and - as a result - went on to study electro-chemistry in a biological context.

Another of his interests was electrolysis and the extent to which light influences chemical reactions and in 1800 he'd studied the effect of nitrogen on the glow of phosphorus. Shortly, he found that silver chloride - which decomposes in the presence of light - did so even more speedily when subjected to the invisible end of the spectrum beyond violet.

He began by soaking strips of paper in a silver nitrate solution and then placing them in different areas of the sun's spectrum, to determine how quickly the strips darkened. It shortly became obvious that the least amount of darkening occurred at the red end of the spectrum. As he checked the strips at the other end, Ritter found that the darkening speeded up considerably until, at the violet end, it reached a peak. Beyond the violet end - as shown in Figure 1 - no light of any kind could be observed, and Ritter placed some of his strips of paper here also. It was in this area he noted, that darkening took place at an even greater pace.

This meant that there was radiation beyond the violet end of the spectrum, just as there was at the extremity of the red end. This new radiation was termed ultra-violet, usually abbreviated to U-V, the prefix coming from the Latin word for beyond. The ultra-violet region is composed of shorter wavelengths than visible light but longer wavelengths than X-rays. Invisible to the human eye, U-V light, or U-V L, is frequently termed Black Light.

The U-V spectrum is divided into the three zones shown in table one, overleaf. The zones are shown in both nanometres, (nm), and Ångstrom units, called after the Swedish physicist Anders Ångstrom who studied the solar spectrum, measuring the wavelengths in units equal to one ten-billionth of a metre. Today, the Ångstrom is equal to 0.1 nanometre.

The amount of radiation a heated body emits increases rapidly, the radiation itself being proportional to the 4th power of the body's temperature, in degrees Kelvin (K).

Naturally, as the temperature increases in units of K, so the radiation increases in wavelength, the maximum amount being emitted at a wavelength of 0.29/T cm. To begin with, the heated body emits infrared radiation, it continuing to do so until it reaches a temperature of 3,800K.

1,200K further on, the peak radiation is now in the visible spectrum and when the temperature reaches between 5,000 and 6,000K, there is - as Figure 2 illustrates - strong emissions on all the visible wavelengths.

Once the temperature reaches the 7,500K mark, the peak radiation emanates from the U-V region of the spectrum. It is this band that has had a profound influence on spaceship Earth.

U-V Radiation and Planet Earth

U-V radiation reacts with oxygen, the result of which is a form of oxygen with three atoms in each molecule rather than two. This particular type of oxygen is termed ozone and, as a consequence of its encounter with U-V radiation, it has created a layer about 35km deep, some 20 miles or 32km above the Earth.

This layer however '. . . is not uniform and it follows the same profile as the weather ceiling, coming closest to the ground over the poles and reaching its maximum height over the equator.' [1]

It is this protective blanket that filters out the majority of the damaging U-V radiation, which would probably have destroyed life on earth. The reason U-V radiation is so harmful to life is that '. . the photons of ultraviolet light have just the right amount of energy to split apart some of the

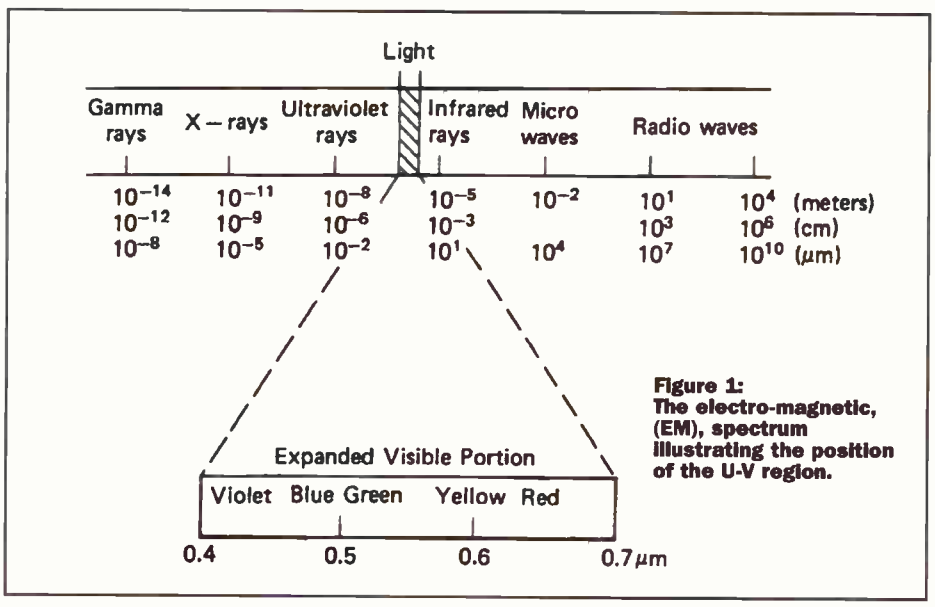


Figure 1: The electro-magnetic, (EM), spectrum illustrating the position of the U-V region.

The Ultra-Violet Spectrum

Zone	Location	Wavelength
Ultra-Violet A	Nearest to the Visible Spectrum.	380 - 320 nm/3800 - 3200 Å
Ultra-Violet B	Middle of the U-V Spectrum.	320 - 290 nm/3200 - 2900 Å
Ultra-Violet C	Close to the Soft X-ray Spectrum.	290 - 10 nm/2900 -100 Å

chemical bonds in DNA molecules.'[2] U-V however was feared before it was found to damage human tissue. Whilst classical physics worked reasonably well for low frequencies at the red end of the spectrum, the blue area was different.

Here, the physics of Newton and Faraday ' . . predicted that a heated body would send out an infinite amount of energy. This absurd conjecture was dubbed the "ultra violet catastrophe" '[3]

U-V radiation in other words can hardly be regarded as life enhancing and U-V C is particularly harmful to human tissue ' . . as, for example, when white skin becomes sun-tanned. causing the production of the pigment melanin, to help prevent the radiation from penetrating the skin. But because such radiation is everywhere in space, life can exist only where it is protected by, for example, a planetary atmosphere.'[4]

Which raises the question of where our planetary atmosphere came from and what part - if any - U-V radiation played in its creation and development.

Scientific Soups and U-V Radiation

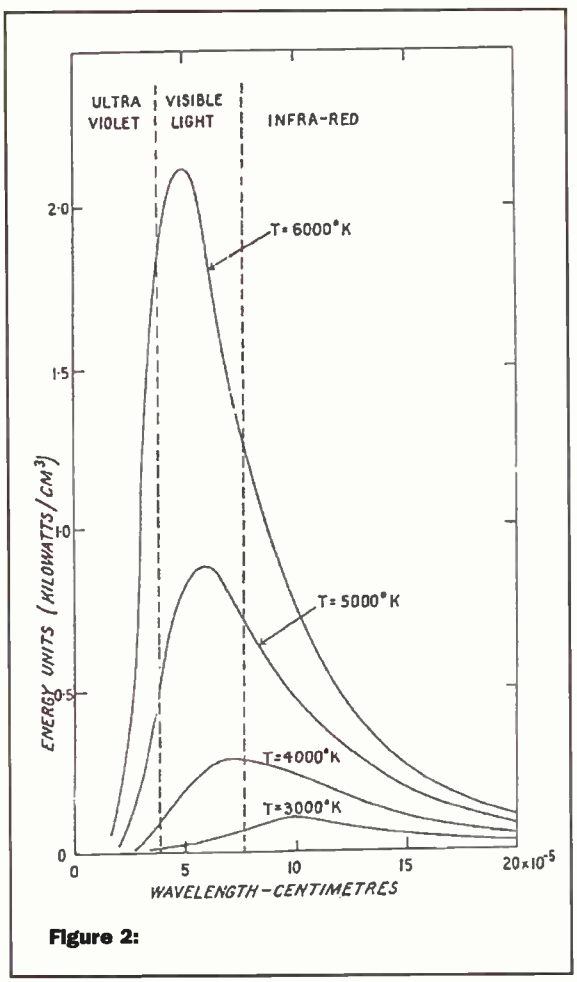


Figure 2:

From the earliest days of the last century, scientists attempted to produce, in the laboratory, the sort of early atmosphere from which - they reasoned - the planet's present oxygen-rich environment and indeed life itself developed.

In 1928, the chemist Edward Baly at Liverpool University ' . . irradiated a mixture of water, carbon dioxide, and ammonia with ultra-violet rays and produced organic molecules, including sugars.'[5] In the following year, the brilliant biologist J.B.S. Haldane concluded that if there had been no oxygen in the Earth's early atmosphere, there would have been no ozone shield either.

Consequently, the planet would have been bombarded by U-V radiation and Haldane noted that when such radiation acted on the sort of mixture Baly had used, a great deal of organic substances were created including ' . . apparently some of the materials from which proteins are built up.'[6]

Almost a quarter of a century passed before a more advanced form of Baly's experiment - shown in Figure 3 - took place, at the University of Chicago. The Nobel Prize-winning chemist Harold Urey and his graduate student Stanley Miller spent a week passing lightning-simulating discharges of 60 kV through a mixture of hydrogen, ammonia, methane and water.

This primordial brew was kept circulating by steam pressure and, after condensing, the byproducts were drained off. When they were analysed, they were found to contain a number of organic acids and four of the 20 amino acids found in natural protein molecules. What Urey and Miller had created - in effect - was a new area of scientific investigation: the creation of life.

Some controversy surrounded such experiments, for those that followed Urey and Miller were all certain that the gases they were using - or intended using - were indeed those that had made up the early Earth's atmosphere.

Eleven years after the Chicago experiment, Drs Sidney Fox and Kaoru Harada at Florida State University proposed an atmosphere devoid of the one substance all the other experiments had contained: free hydrogen. Using an atmosphere of ammonia, water and methane - and heat as opposed to electrical discharge as the energy input - Fox and Harada produced an abundance of amino acids, 12 of which were common to protein production.

The "atmosphere" controversy

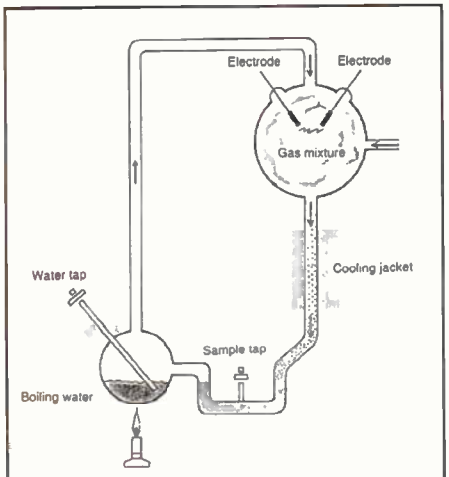


Figure 3 The Urey-Millar experiment of 1953.

still continued, despite this experiment, yet all of those involved were agreed on one thing: the one substance NOT present in the primeval atmosphere was oxygen. Had it been, the fledgling molecules would have become the waste products of combustion rather than the precursors of protein.

No oxygen of course meant no ozone either. Consequently the early atmosphere was battered constantly by U-V radiation! Thus a form of radiation later fatal to life had - initially - been among the major stimulii to its creation.

Medicine and U-V Radiation

In 1893, the Danish physician Niels Finsen established that U-V light not only killed bacteria but also cured the skin disease lupus vulgaris, or tuberculosis of the skin. The son of a senior civil servant, Finson began a thorough investigation into the therapeutic effects of light in general.

Having made a variety of lenses and filters, enabling him to separate and concentrate the different components of sunlight, he found that U-V radiation - whether natural or man-made - had the greatest power. Finsen went on to found the Institute of Photo therapy in 1895 and - as a result of his researches - was awarded the third Nobel Prize for Physiology or Medicine in 1903. He continued to direct his foundation until his early death at the age of 43.

The medical profession however shied away from the use of U-V radiation and the technique became a one-disease treatment only, namely for lupus vulgaris. Nevertheless, carbon tungsten arc lamps and quartz mercury vapour lamps such as the one shown in Figure 4, are occasionally still used therapeutically.

The quartz mercury vapour lamp contains a mercury arc under pressure in a quartz tube, whilst the carbon-tungsten lamp has a high intensity small arc, created between tungsten elements in a glass bulb.

Both generate U-V radiation in the 300 - 400 nanometre range. U-V C light for example is frequently used as a sterilising agent, both for air and for the surface of materials.

U-V Radiation and Nature

Viruses - the 'flu virus being one example - are genetically unstable, the result of making mistakes when reproducing themselves. Moreover, some viruses have a defence mechanism against U-V radiation.

Now, given the fact of the ozone layer, there is no requirement for any Earth organism to develop a defence mechanism against radiation of a specific wavelength, for example 2,500 Å. Yet viruses do have such a defence, which suggests - at the very least - that such viruses have been exposed to precisely this type of radiation. In short, viruses must originate above an altitude of 40km, in other words above the ozone layer.

This hypothesis - that life, or some aspects of it - may have evolved in outer space and was subsequently carried to Earth, is not new. Another Nobel Prize-winning chemist, the Swede Svante Arrhenius, put forward just such a theory, which he termed Panspermia, in 1908. Although he was laughed at, evidence that this could well have happened comes from the laboratory.

Earth-bound microbes such as the mould Aspergillus fumigatus, a club-shaped fungus and the bacterium Bacillus subtilis a rod-like, spore-producing bacteria have demonstrated that they can handle exposure to an ultra-high vacuum. Nor is this all. The micro-organism Bacterium coli, long a resident of the human intestines, appears more than capable of surviving high laboratory doses of U-V light.

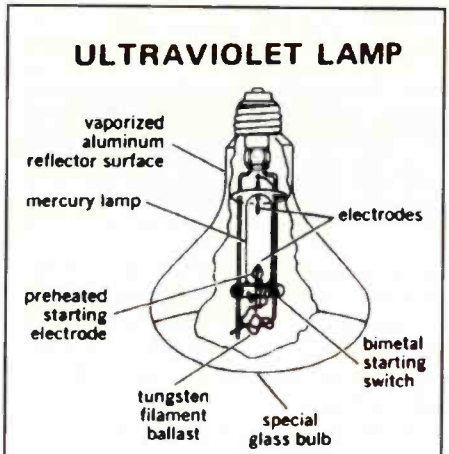


Figure 4 A quartz mercury-vapour lamp.

On another level, marine biologists have long wondered why deep-sea bacteria glow. Recent research by Polish scientists reveals that the major reason is U-V radiation. U-V light can penetrate deeply into the world's oceans, much deeper that sunlight can. In doing so however, it damages the DNA of the bacteria, and so the reason the bacteria glows - or bioluminesces as it's termed - is to repair the U-V-damaged DNA.

Yet not ALL U-V radiation is harmful. Flowers for example lure bees using U-V patterns, because bees can see U-V radiation that humans cannot. Flowers therefore have evolved so as to exploit this ability. They have U-V markings on their petals, which the bees use as navigational and landing aids to guide them to the flower's nectar. The advantage to the flower comes from pollination.But what of the extra-terrestrial sources of U-V radiation? What do we know about them? Until the advent of the space age practically nothing, really. However, orbiting satellites, telescopes and special cameras have greatly increased our knowledge of inter-stellar U-V radiation, which I'll cover in part two.

References

1. **Watson, Lyall (1984):** ***Heaven's Breath: A Natural History of the Wind.*** Hodder & Stoughton, London. Part 1, Ch 1, Page 24.
2. **Gribbon, John (1998):** ***Almost Everyone's Guide to Science.*** Weidenfeld & Nicolson, London. Ch 8, Page 150.
3. **Highfield, Roger (1998):** ***Can Reindeer Fly? The Science of Christmas.*** Metro Publishing Ltd.,, London. Ch 5, Page 98.
4. **Ronan, Colin A. (1991):** ***The Natural History of the Universe.*** Marshall Editions, London. Ch 7, Page 156.
5. **Sharpe, Mitchell R. (1970):** ***Satellites & Probes.*** Aldus Books Ltd., London. Ch 7, Page 167.
6. **Warshofsky, Fred (1977):** ***Doomsday: The Science of Catastrophe.*** Readers Digest Press, New York. Ch 8, Page 139.

Unbundling deadline

BT comes under increasing pressure to unbundle its local loop services, allowing third-party communications operatives to site their ADSL equipment in BT exchanges, due to a new European directive that forces completion of unbundling by 1 January 2001. Only where the unbundling process is deemed out of BT's control will it have additional time to do so.

Unbundling of the local loop (the last mile, as it's sometimes called, between local exchanges and the consumer's residence) has become a political hot potato, and many communications operators have complained to Oftel, regarding BT's slow compliance. Indeed, BT recently launched its new high speed ADSL Internet and communications service, but most operators have not yet been able to launch their own, giving BT an unfair advantage in their eyes.

Previously BT had agreed to work towards a July 2001 deadline for unbundling, but the new European law brings that forward, hopefully meaning that cheaper high-speed Internet access and communications will be available.

WAP a pity

The Office of National Statistics' recent report highlighted the poor standing of WAP mobile technology. While almost half of the UK's adult population has Internet access for non-work-related means, 98% of them do so from a personal computer at home, and only 1% access the Internet via a WAP phone. The other 1% access the Internet through a digital TV.

Interestingly though, another report (this one by Price-waterhouse Coopers) confirms that the UK is losing out on Internet share, simply because of the fact that we have a relatively weak telecoms infrastructure. The result of this weak infrastructure is that companies who trade on the Internet are less profitable than companies in other countries with stronger telecoms infrastructures.

Put into figures, the Price-waterhouse Coopers survey looks at the top 150 European Internet trading companies. These collectively have £121 billion between them. The UK, however, is home to only 35 of these top European companies, and has only 16% of the total market. The strongest telecoms infrastructure in Europe belongs to Germany, with the result that 56 of the top companies reside there, owning some 45% of the market.

Bluetooth

We're on the verge of several new devices being made available that conform to the Bluetooth standard. Introduced in May 1998, Bluetooth allows radio transmission of audio, graphics, and even video between local devices. Bluetooth replaces the IrDA spec of infra-red in mobile and computing devices, although it's still a low-range (onle a few metres) technology. Most of the hype concerning Bluetooth at the moment, is around how a mobile phone can interact with office devices, but there is no question that the technology will go far beyond this. Eventually, it's proposed that many household devices, fridges, cookers, central heating systems, cars even, will be sold with Bluetooth technology on board, allowing remote control of them all, either manually by mobile phone (imagine phoning home to tell the oven to turn on, and the central heating system to warm up the water for your shower), or even automatically by computer via the Internet.

The revolution is about to start. Motorola recently announced that they had received full certification from the Bluetooth standards body for its two Bluetooth PC products. This makes the Motorola products the first from any company to be allowed to carry the Bluetooth trademark and the much esteemed Bluetooth logo.

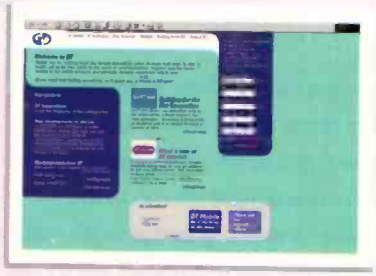
Napster's still up

Napster is the system whereby users can swap digitally recorded music files (in the MP3 format) over the Internet with other users. At the time of writing Napster's fate is still in the balance. The hearing at the Ninth Circuit US Court of Appeals is to decide shortly whether Napster can go ahead with its operation while a full court case proceeds, or whether it has to shut down awaiting the full trial.

Napster is relying for its defence on a 16 year old prior ruling on copyright, which occurred when Sony was found not liable for contributing to copyright infringement by users using Sony videocassette recorders to record copyrighted material. The Sony decision as it's known, means that VCRs can be used to do so under the 'fair use' provisions of copyright law. Napster argues that while Napster can be used for violating music copyrights, it's the users - not Napster itself - that is doing so. In fact, as Judge Robert Breezer of the hearing said of the fact that while the Napster servers allow swapping to occur, Napster itself doesn't 'even touch it, their fingerprints aren't on it.'

It's expected that the decision to suspend Napster or allow it to continue will be in another three or four weeks, but the final outcome won't be for years yet. Whoever loses in whatever court case in the future, it's taken as read that the losing party will appeal, until the case is finally heard by the US Supreme Court. So if Napster gets through the next few weeks intact, it's probably going to be there for years yet.

Organic Launches Next Generation of BT.com



Organic has announced its completion of the first stage of a major re-design of BT's portal <www.bt.com> which acts as a gateway to information on all of the services the company offers its consumer and business users.

Organic, a leading international Internet professional services firm, has worked with BT to revise the existing site and to put in place a framework for future development.

The new site features innovative navigation, enhanced functionality and greater personalisation to enable BT to communicate more effectively on-line.

The primary home page has been restructured to make key areas within the site easily identifiable. Organic has revamped the navigation to include a pull down menu system and quick links to key BT services, unearthing hidden areas on the site that have the potential to generate high traffic including directory enquiries, bill payment and call management.

In addition, the site has been updated to highlight BT promotions and encourage greater customer interaction and feedback. Organic has also developed BT's implementation of BroadVision, using the platform to introduce new levels of personalisation to support the company's service delivery to its different customer segments.

Organic will also be working alongside BT and its portfolio of other agencies to migrate over 100 existing sites into this new simpler single site, using a design system it has created.

The system defines not only look and feel and layout, but also a strategic and technical framework. Organic will continue to provide guidance to BT internal stakeholders

Small Businesses Rise to E-Challenge

Small businesses have smashed the Government's target for getting online, Prime Minister Tony Blair and e-Minister Patricia Hewitt announced this month at the launch of UK online at <www.ukonlineforbusiness.gov.uk>.

1.7 million small and medium sized enterprises (SMEs) are now online, according to figures from the DTI's International Benchmarking Study. This is an increase of 1.1 million over last year and exceeds the Government's target of getting 1.5 million businesses online by 2002 two years early.

Other figures released in the report which was published at the end of September include:

- 81% of UK businesses are now online compared with 63% last year; 9 out of 10 of the UK's workforce work in businesses connected to the Internet;
- 55% of micro businesses (those with less than 10 employees) are now online compared to 15% last year; and;
- 27% of UK companies are trading online, of which 450,000 are SMEs.

The Prime Minister and Patricia Hewitt also announced £15 million of funding for UK online for business - formerly the Information Society Initiative. This is in addition to the £10 million announced in this year's budget. The money will be used for expanding UK online for business and providing a further 100 advisers.

AOL UK to roll out Flat Rate Service

We've been here before. AOL UK at <www.aol.co.uk> has announced the roll-out of the AOL FLAT RATE pricing plan that will provide its members with unmetered access to the Internet service for a flat-rate monthly fee of £14.99.

AOL claims that the unmetered pricing plan will offer members flat-rate access to AOL's infrastructure - without imposing hidden charges, dodgy contracts or the need to change telephone provider.

In a roll-out schedule designed to maintain a reliable unmetered online experience for members, the AOL FLAT RATE plan will be made available in stages:

- AOL FLAT RATE will be offered first to the existing AOL membership base. Members will become eligible for the £14.99 plan depending on the length of time they have been with the AOL service. AOL's longest-standing customers will immediately be able to switch to unmetered access, effective from their next monthly billing date, to be followed in subsequent weeks by others who have joined the service prior to 19 September.
- AOL UK anticipates making this flat-rate plan available to all UK consumers as soon as possible after its roll-out to members, as telecommunications providers accelerate the rapid build-out of unmetered network access across the UK.
- AOL UK is also offering a completely free trial of the AOL service to consumers who join AOL after 19 September, 2000. This plan will waive the first-month subscription fee and give up to 24 hours of usage with absolutely no subscription or Internet telephone charges. After the free-trial month, new members will enjoy the popular 'AOL Off-Peak, All the Time' rate of £9.99 a month plus 1p per minute, 24 hours a day, until network build-out allows AOL FLAT RATE to be available to them.

For the last 18 months, AOL UK has been leading the campaign for the right of UK consumers to experience the same kind of unmetered Internet access enjoyed by tens of millions of consumers in the US.

The AOL UK Stop the Clock campaign began to bear fruit in May when the UK regulator, OFTEL, forced British Telecom to begin offering a wholesale flat-rate tariff to its telecoms competitors.

That tariff, known as Flat Rate Internet Access Call Origination (FRIACO), was devised by economists commissioned by AOL UK in the Spring of 1999. The regulator mandated that BT should offer this flat-rate tariff after reviewing a formal complaint from the telecommunications operator MCI Worldcom last December.

Although FRIACO-based, flat-rate Internet access tariffs are only now being made available to Internet Service Providers, AOL UK believes the pace of that roll-out is set to accelerate in the coming weeks.

Fuel Protest Reveals Power of Fast Communication

The dispute itself has not been driven by trade union leaders or powerful organisations, but by a network of individuals connected up by mobile phones, e-mail and the Internet.

For example, the Ananova at **<www.ananova.com>** news service has shown how new types of interactive news services are changing the way that people access the information they need to know and act on it.

Throughout the fuel dispute Ananova e-mailed her newsroom with minute-by-minute reports on what's happening around the country.

Through those e-mails, in addition to a range of other live information sources, Ananova was able to alert people to details of petrol stations that still have supplies, convoys gathering for motorway protests, knock-on effects on public services, and other events the moment they happen.

Ananova users can subscribe to alerts on any subject and this week thousands have been signing up for specific alerts on how the fuel crisis is hitting their own region.

The fuel protest shows the power of fast communication. As picketing farmers and hauliers called off their blockades, they warned that they could use their mobile network to resume the action at an hour's notice.

Don't Trust What You Read Online Says NOP Research

Results published by NOP Research reveal that nearly eight out of ten of UK companies are publishing out-of-date information on their company Web sites.

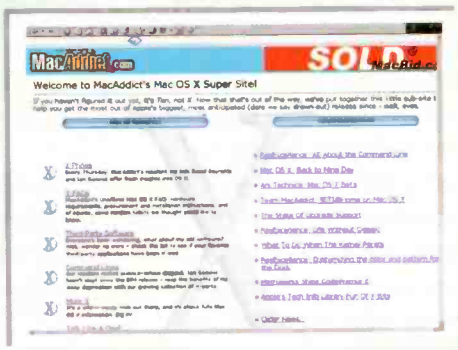
The research, commissioned by Mediasurface at **<www.mediasurface.com>**, the Web content management software specialists, has raised concerns over the accuracy of the information that business and consumers rely upon on the net.

Perhaps more worryingly, the research indicates that businesses have lost control of the content published on their Web sites. The report found that:

- 77% of companies publish out of date information on the Web.
- 41% believe that information was duplicated across their company's Web sites.
- Despite this, 83% of respondents said that their Web sites were important business tools used by senior management.
- 56% admitted that it takes over a day to get information published on their Web sites.
- 58% of respondents said it often took more than one working day to get essential information up onto the site, lessening both the usefulness and the longevity of that information.

54% of companies have no content management software in place to help manage this process. Reflecting the fact that companies start to depend on the Web, 75% of respondents said it would be useful to have software to simplify and speed up this process.

MacAddict.com Expands Macintosh Coverage

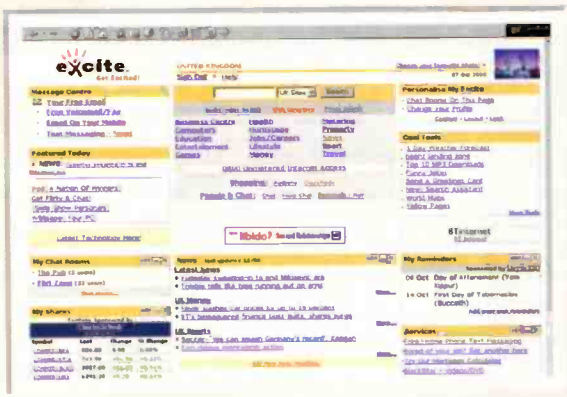


MacAddict.com at **<www.macaddict.com/osx>**has added a Mac OS X section to its already extensive Macintosh online network. This sub-site is dedicated to the Mac OS X Public Beta.

Features include news, weekly insights from top editors, FAQs, discussions, software recommendations and a Geek-to-English dictionary. Celebrating its fourth year online this month, MacAddict.com has increased its unique visitors by more than 400% since its launch in 1996.

The site is featured in the self-published Internet Cool Guide, second edition, and is widely recognised as the voice of the Macintosh enthusiast online.

Excite Prescribes Netdoctor to Users



Excite at **<www.excite.co.uk>** has signed a two-year marketing alliance with NetDoctor.co.uk, Europe's leading health portal. The agreement, which covers content, online advertising and offline marketing, brings the UK's most extensive online medical resource to the fingertips of Excite users.

Visitors to Excite's Health channel will be able to tap into NetDoctor.co.uk's content including the latest information on diseases and medical conditions, accompanied by full details on symptoms, causes and treatment options. The deal will also partner the two brands off-line, as Netdoctor.co.uk marketing material will carry Excite's logo.

MadOnion.com Introduces PC Hardware Recommendation Service

MadOnion.com at <www.madonion.com> has announced the release of XL-R8R, the first intelligent PC hardware upgrade recommendations service. XL-R8R allows a user to profile their PC configuration and get personalised recommendations on how to improve the PC's performance effectively and affordably.

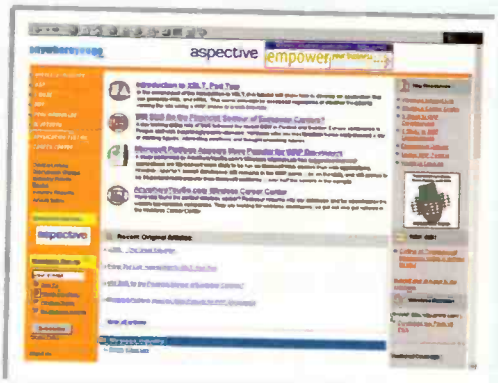
Developed for the PC user interested in exploring their system, XL-R8R tells individuals precisely how to enhance their PC's performance. XL-R8R not only tells the user how to maximise the efficiency of their home office applications and improve their gaming experience, it also offers solutions for issues such as how to improve their PC's performance in order to optimise their Video/DVD experience.

XL-R8R works by gathering a matrix of performance indicators from the user's PC system in order to inspect the PC's hardware configuration.

Having attained this information, XL-R8R then accesses MadOnion.com's Internet PC Performance Database in order to provide detailed performance analysis and upgrade recommendations tailored specifically for each individual user.

The performance database contains hundreds of thousands of 3DMark, Video2000, and SYSmark2000 results and provides the user with a PC Performance Score that reflects results from comparable systems from around the globe.

Study Shows 19% Error Rate in Wireless Portal Applications



AnywhereYouGo.com at **<anywhereyougo.com>** has launched an application monitoring service for carriers, wireless portals, and application providers. This new service is the first of its kind and simulates real-life customer access scenarios across multiple devices to monitor performance and help eliminate technical errors that result in high levels of complaints.

The application monitoring services are conducted by AnywhereYouGo.com's Wireless Internet Labs in London and Dallas, and complement the Labs' application testing services, which are performed prior to the deployment of applications.

Testing and analysis conducted by AnywhereYouGo.com was one factor that led to this new service. A study of 12 large US and European wireless portals found that 19% of the 689 links tested contained serious errors that would have kept pages from being displayed or transactions from being completed.

Register.com Launches FirstStep Starter Kit

Register.com at **<www.register.com>** has announced the launch of FirstStep Starter Kit, an enhanced domain registration package that makes it easier than ever for customers to build a presence on the Web.

Offered as part of its £35 domain name registration service, FirstStep Starter Kit includes URL forwarding, a three-page starter Web site, and now Web-based email from Critical Path, ensuring customers have everything they need to put their name to use immediately.

FirstStep Starter Kit provides a complete bundle of services that would cost £80 at Network Solutions, £40 at Namesecure, and £150 at Netnames.com. It includes:

- A customised domain name such as **<www.my_name.com>.**
- One customised email box, such as **<me@my_name.com>**, accessible on the Web or through the clients preferred email program, such as Eudora or Outlook. The email box also includes email forwarding,
  allowing customers to access their branded email through their current email box.
- A FirstStepSite, register.com's click-and-build, graphics-enabled 3-page Web site, that can be edited on the Web in real time.
- URL forwarding, allowing customers to point their domain to any existing site on the Internet, such as an already established Web site or a community site such as **<theglobe.com>.**
- Manage My Account Application, providing user-configurable DNS.

Employers Monitor Employee Web Use

Employees beware: according to a new survey by Vault.com at **<www.vault.com>**, 41.5% of employers are monitoring or restricting their employees' Internet/e-mail use, an 11% increase from last year's survey results.

The 36-page Vault.com study is based on responses from 451 employees and 670 employers. Respondents were surveyed on topics ranging from an employer's right to monitor employees' Web use to the Internet's effect on workplace productivity.

The substantial increase in monitoring may continue to rise in lieu of the number of employers using monitoring software or restricting employees' Net access with firewalls. When asked their methods of monitoring, employers' responses include:

- proprietary internal software
- access history files
- observe employees directly
- tracking the amount of time spent online
- IT monitoring

To view the full survey results, visit:

<vault.com/vstore/surveyresults/internetuse/index2000.cfm>.

Sega.com Beta Testers Rave Over SegaNet

Sega.com at **<www.sega.com>** has officially closed the beta test that had 100 SegaNet beta testers competing against each other in a test-drive of SegaNet, the first high speed online console gaming network and Internet Service Provider.

Feedback regarding the SegaNet experience and gameplay has been overwhelmingly enthusiastic. To date, 98% of testers would recommend Sega Sports NFL2K1 to others and found it superior to other sports games. Beta testers were also impressed with the network's speed and low-latency game play.

SegaNet was built from the ground up and specifically designed to minimise the number of steps it takes to play high quality games over the Internet. As a result, gamers can connect from a 56K modem and enjoy consistently flawless game play and low latency.

The SegaNet high-speed online gaming network offers Dreamcast users the ultimate in 3D multi-player games, chat, community, cheat codes, exclusive tournaments and content. The close of the beta test clears the way for SegaNet to launch for consumers in the UK later this year.

MyInternetDesktop.com Redesign Increases Functionality

MyInternetDesktop.com at **<www.MyInternetDesktop.com>** has launched a completely redesigned version of the Web-based personal information manager, an integrated suite of applications including eMail, Calendar, Addresses, Bookmarks, Photos, Storage and ToDo.

MyInternetDesktop is specifically designed to capture and add value to users who are not anchored to PCs for their Internet experience. The new version of MID adds fully customised and branded functionality and usage to users of other Web sites and makers of Internet appliances.

Lycos Launches VideoCentre

Lycos has launched a video centre at **<video.lycos.com>**, a free Web site from which members can easily create, edit, store and share streaming videos online.

Lycos VideoCenter makes it easy for anyone with Internet access to create streaming video content and share his or her stories in a rich way. Videos, recorded by any digital device, are stored in easy-to-use online folders kept in a member's personalised My VideoCenter on the site's servers.

Members can now go from digital video device to streaming video in a few minutes. Using their streaming video in the Lycos VideoCentre, members can share these videos, send video e-mails or post their videos to the Web. This opens up new possibilities for communication on the Web.

audiohighway.com inches on broadcast.com in PC Data Ratings

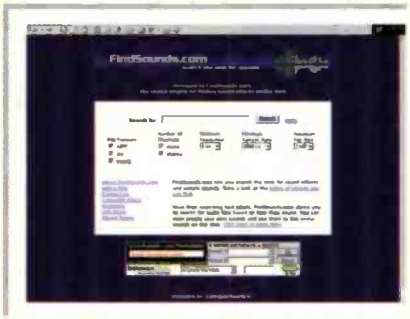
audiohighway.com at **<www.audiohighway.com>** was placed second in the Internet radio rankings last month behind broadcast.com, according to rating service PC Data Online. This is audiohighway.com's second month at the number two spot.

According to PC Data Online, although audiohighway.com generated nearly more than 3.2 million unique users, placing it second behind broadcast.com at 3.3 million unique users, it surpassed broadcast.com's 25 million page views with 39.1 million page views.

The gap between unique visitors to broadcast.com and audiohighway.com has narrowed from 300,000 in July to only 100,000 in August. At the same time, audiohighway.com's lead in page views has broadened. In July, audiohighway.com produced 3.5 million more page views than broadcast.com. In August, the number jumped to 14.1 million more page views.

In addition to its second place ranking in the Internet radio category, PC Data Online also placed audiohighway.com among the top Web sites in three other entertainment categories.

FindSounds.com is First Web Search Engine for Sound Effects



Comparisonics has announced FindSounds.com, the first Web search engine focused on finding sound effects on the Web. Looking for the sound of a race car, a siren, a scream, or an explosion?

Look no further, as FindSounds.com at **<www.findsounds.com>** provides quick and easy access to thousands of sounds on the Web. Unlike general-purpose Web search engines, FindSounds.com excludes songs and speech recordings from its audio index. As a result, when you search for elephant, you get elephant sounds and not songs about elephants or people speaking about elephants.

FindSounds.com is a valuable resource for Internet users, including audio/video content creators, videographers, filmmakers, Web site developers, teachers, and students. The site provides a bonanza of choices for electronic musicians seeking sample sounds. Because obscenities have been filtered out, the site is safe for children.

In addition to searching for sounds by keyword, FindSounds.com allows you to search based on sound similarity. Given any sound, similar sounds can be located automatically. You can even mimic a sound into a microphone and find similar sounds on the Web.

The Comparisonics waveform display provides visual information for each sound. File formats, number of channels, resolution, sample rate, and file size can be specified for any search.

2MuchNews.com Launches Free Service

2MuchNews.com has launched a free Web based service that helps busy professionals stay on top of their profession.

While many good resources exist, such as the Internet, professional journals, magazines, there is simply far too much news and information available for most busy professionals to review.

In order to cure this information overload, the free service provides a profession-specific, weekly e-mail report that summarises the best new content from pre-eminent, profession-specific Web sites, journals, and magazines.

Professionals can learn more about this cure for information overload at **<www.2muchnews.com>.**

2MuchNews.com editors identify and summarise the best new content and provide a link to its source. This eliminates the time it would otherwise take to review each relevant source, and enables professionals to view only the best and most relevant new information.

Oneupweb.com Introduces Search Engine Bridge Technology

OneupWeb has announced the introduction of bridge, its new search engine placement technology. The new technology is an addition to their search engine placement services located at **<www.oneupweb.com>.**

The revolutionary new bridge Technology and allows search engines to penetrate database driven sites. With the development of this new technology, thousands of Web sites that once had limited recognition in the search engines can now compete with traditional sites that have historically dominated search engine listings.

AOL Acquires Quack.com

AOL has acquired Quack.com at **<www.quack.com>**, a voice portal company that uses simple spoken commands over a telephone to provide consumers with convenient access to online information on subjects like stocks, traffic, weather, movies, and sports.

Quack.com provides effective voice access to Internet and Intranet content through its proprietary tools and technology. These include its speech design and execution environments, its development environment for Web-agents, and its unique data fusion technology.

TechOnLine Strikes Alliance with PartsDataNet

TechOnLine at **<www.techonline.com>** has brokered a deal with PartsDataNet, enabling TechOnLine to connect engineers with searchable, comprehensive information for more than 300,000 commercially available and discontinued semiconductor devices, from more than 400 manufacturers.

The alliance between TechOnLine and PartsDataNet represents a significant addition to the extensive collection of services offered by TechOnLine. TechOnLine's registered users will now have direct and free access to the most current IC specification data available, as well as an alternate source directory that provides information on pin-for-pin replacements.

TechOnLine provides design and electronic engineers with continuing education and training and offers its users extensive technical information. By decreasing research time, this new resource will ultimately make the time-to-market cycle more efficient for systems designers.

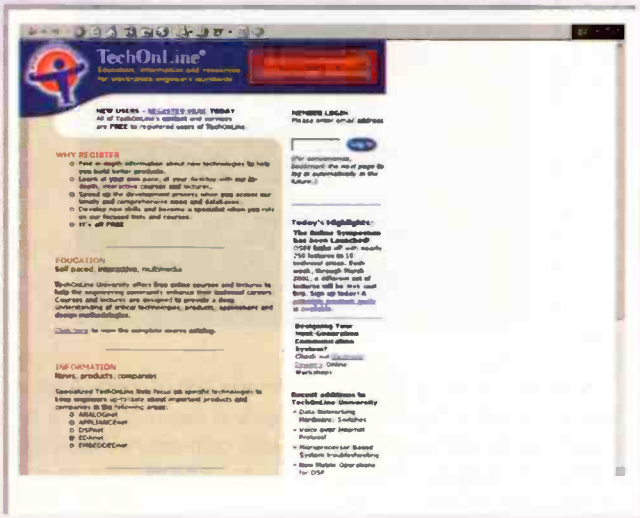
Voquette BBC World Service Partner for Audio News

Voquette a Web audio specialist, and the BBC World Service, have announced a partnership to provide live, streaming BBC audio content to listeners off line and on portable devices.

The deal will enable, BBC World Service listeners can to use the free Voquette Media Manager software, a VCR-like application, to record their favorite live audio programs and then play them back on portable audio devices such as MP3 players, MiniDiscs, cassette recorders, CD players and laptops.

As part of the new relationship, BBC World Service's international audio news, information and entertainment programs will appear in the Voquette Web audio directory at **<www.voquette.com>**, together with links back to the BBC World Service at **<www.bbc.co.uk/worldservice/index.shtml>.**

TechOnLine's APPLIANCEnet is Comprehensive Internet Appliance Directory



TechOnLine at **<www.techonline.com>** has announced the launch of the most comprehensive, easy-to-use Internet Appliance database available.

The database is accessible from TechOnLine's APPLIANCEnet, an online community that focuses on providing Internet Appliance engineers and developers information on the technologies and innovations relevant to their industry or market segment.

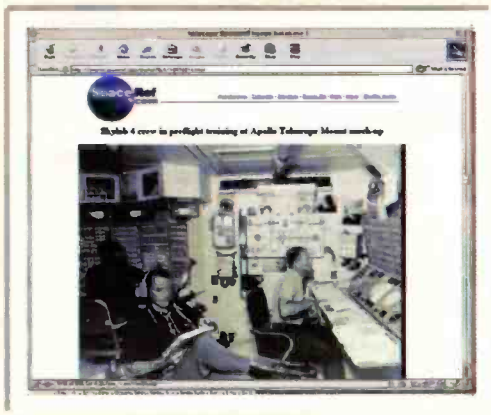
Similar to all five of TechOnLine's Nets, or communities, APPLIANCEnet supports thousands of design engineers and engineering managers daily, with product, technology and company information to help them make design decisions and keep up-to-date with the latest advances.

The product database currently contains 167 products, categorised into 16 extensive comparison tables for products ranging from set top boxes to servers, with plans to almost double the size of the database in the upcoming months.

In addition, developers and engineers may link to the TechOnLine Store, where they can immediately purchase several of the appliances or devices that meet their needs.

Site Survey

Destinations of the month



If you want to keep up-to-date with all the latest news about all things space, then SpaceRef, at: **<http://www.spaceref.com>** could be the perfect place for you. It's literally crammed full of goodies about current space missions, past space missions, photographs, news, titbits and everything else you need to have at your fingertips when space is at a err, premium. Pictured is Skylab 4's crew in pre-flight training. It's a fascinating site, and well worth a visit.

Coming back down to earth with a thud, one of the best

places to get information about the recent people's revolution in Yugoslavia was the Internet. Belgrade Cam, for example, is a Web cam set up overlooking the streets of Belgrade, and provided an exceptional glimpse of what was happening at street level during the upheavals. Check it out, at: **<http://www2.inet.co.yu/kamera>.**

Of course, we're not likely to have a revolution anytime soon here in the UK, but if we were planning one, we couldn't have an easier ride of it than by using our own Government's open Web access. Those of us wanting to overthrow the Monarchy, for example, could head straight to the Royal Family's Website, at: **<http://www.royalinsight.gov.uk>** for a personal tour around the Royals and their residences prior to fighting in the streets. Shown is the White Drawing Room in Buck House. See if you can find the secret door in the room°

Talking of royal residences, Ireland's got a few, and many of them are grouped together on the Historic Irish Castles Website, at:

<http://www.historic.irishcastles.com>. There's plenty of photographs, QuickTime movies and facts about the castles covered.

Mobile SERVICES

More on the mobile comms revolution
by Reg Miles

If you are one of those people who are irritated by the use of mobile phones then you had better think about heading for cover because, in the immortal words of Al Jolson, "You ain't heard nothing yet..." The world is apparently on the verge of a mobile explosion. And it will not be just a matter of hearing; just about everything that can be transmitted will be transmitted, inluding the Internet and television. Todays mobile services will seem primitive indeed when tomorrows' are available.

But even today's mobile (cellular) phones are capable of accepting a greater range of services than has hitherto been offered. These smartphones use the Wireless Application Protocol (WAP) to enable Internet access, e-mailing and various other fairly simple services. This set of communication protocols was conceived jointly by Ericsson, Motorola, Nokia and Phone.com (formerly Unwired Planet). However, it has not been without its problems; and these are compounded by it being carried on the Global System for Mobile communication (GSM). This is a time division multiplex (TDM) system, implemented on 900, 1800 and 1900 MHz frequency bands; and it is the most popular of the second generation (2G) wireless standards, having spread from Europe, where it was developed, to most of the world. But because it is a circuit switched system that takes time to connect, and when the connection is made the data transfer rate is only 9600bps, it can be frustratingly slow to access and use these new services.

Which was the reason why a European project called Flexible Information and Recreation for Mobile Users (FLIRT) was initiated. Anticipating the problems (the project began two years ago, and finished at the end of September); it has explored the possibilities for additional GSM services, and investigated the technology required to enable new forms of user interactions. It was coordinated by Philips Research at Redhill, with the other partners being: Elisa Communications (formerly Helsinki Telephone Corporation), Infogames Entertainment (France), Philips Consumer Communications (France) and Royal College of Art. The last having the role of conceiving concepts for both information and entertainment services. This includes a game for younger users called 'The Lost Cat', which relied on cell broadcasting (CB), with the cat appearing and disappearing from the phones' display as a player passed through different cells until reaching the final location in a cell associated with a shop or cafe (see Figure 1). A service that could link up people with shared interests whom happen to be in the same area is to be called 'Pixel Kiss' and 'Reindeer Stampede', a community game that was tested in Finland.

One area that was explored is the result of knowing a users' location: enabling them to be provided with information that is relevant at that time and place - local news and events, special offers in shops, etc. These would be largely 'pushed' services - pushed to the phone - by service providers to whom the user had subscribed. This is the opposite of 'pulled' services, in which the user looks for them in the same way as surfing the Web and pulls them to the phone.

Among the requirements for the phone to be used for the FLIRT services were a minimum width display of 12 characters, vertical scrolling, an ASCII character set, alpha-numeric character entry, data entry editing, at least one programmable key, a message waiting indicator, storage of state, and a bitmapped display capability. Philips developed a special version of its Genie dual-band handset for FLIRT. Rather than using

Figure 1.

the Wireless Markup Language (WML) for the browser as WAP does, it used the similar Handheld Device Markup Language (HDML). The Short Message Service (SMS) for text transmissions on GSM was used as a carrier for the HDML services.

The handset and server communicated by using a lightweight protocol developed by FLIRT, called Packet Data Transport Protocol (PDTP). This consisted of two layers: a Transport layer, in which each message is divided into discrete packets, and provides message identification and error checking; and a Session layer, consisting of a header giving the type of command, user agent information, etc, and the data itself. The advantages of packet switching is that the network resources are optimised because they are only needed for the handling of each packet, and the handset appears to be permanently connected to the network rather than requiring the seemingly long wait.

In order to expedite further matters, FLIRT reduced the download time of images by developing a vector graphics language specifically designed for mobile use, called VGX. This is a data format designed for the definition and transmission of static or animated graphics. The file syntax is comprised of a frame header, followed by a

Figure 2.

Figure 3.

series of command words. The vector graphics engine interprets the file as it constructs the current frame. This avoids the necessity of loading the data into the phones' limited memory before drawing to the screen. The header is used to provide the basic frame structure, so describing the frame size (X and Y - specified in pixels), frame rate, and the number of frames. The command words define the starting point of each frame and whether frames should be repeated. They also define the shapes, from a compiled dictionary of shape descriptions. Text and small bitmaps can be added. In addition to defining the shapes and where they will go on the display, the command words specify whether they will remain static or be moved each frame by a given coordinate, or be resized (excepting bitmaps and text). Philips has asked for VGX to be made an accepted standard for use with mobile devices.

The FLIRT infrastructure allowed users to tailor the services to their needs: thus they could download sounds to accompany animation, and decide whether they wanted location-dependent services or not. The infrastructure also inherently coped with handsets of differing capabilities, adapting the content to their screen size and animation capability. Such services need much larger screens than are available at present, something like that of the Nokia Concept phone (see Figure 2).

The concept was tested in focus groups in Helsinki, and was generally well received. A follow up project is planned to investigate the possibilities that will come with greater bandwidth and processing power.

Packet-switched connection is one of those so-called 2.5G protocol extensions of 2G that provide additional features. The General Packet Radio Service (GPRS) is another packet-switched protocol; this supports flexible data transmission rates of 20-30kbps, with a theoretical maximum of 171.2kbps. There are also systems that provide enhanced data rates. Enhanced Data Rates for GSM Evolution (EDGE) uses an enhanced modulation technique to push data rates up to 384kbps. Another one is High Speed Circuit Switched Data (HSCSD), which increases the GSM data rate to 14.4kbps in a single channel and, by aggregating channels, this can go up to a maximum of 57.6kbps. Service providers can offer alternative services, such as allocating one channel for the uplink and several for the downlink, and provide a fixed bit-rate(transparent mode) or a variable one (non-transparent mode). An alternative to WAP, using a proprietary packet-switched system, is i-mode, which is very popular in Japan and is being looked at elsewhere.

According to Symbian, the next revolution in mobile communication will be the Wireless Information Device (WID). Who or what is Symbian? This is the result of an independent joint venture between Ericsson, Matsushita (Panasonic), Motorola, Nokia and Psion. They intended to define the platform for the marketing of WIDs and promote standards for the interoperation of them with wireless networks, content services, messaging and enterprise wide solutions. The WID will come in forms such as Communicators and Smartphones - the former being essentially a palmtop computer combined with a digital phone, and both allowing connection to a PC. Ericsson's R380 smartphone was recently launched - the first Symbian-based product, with more to follow from them and Matsushita, Nokia and Sony. Ericsson, Matsushita, Motorola, Nokia, Psion and Sanyo are developing phone-pad and keyboard based communicators.

The phone-pad, or tablet type will use Symbian's Quartz design with a 240x320 resolution, portrait orientation, colour screen, pen operation and GUI. The keyboard models will use the Crystal design with a 640x200 resolution colour screen. They will share applications such as: word processing, e-mailing, WAP and web browsing, and a voice recorder. The smartphones will use the Pearl design. All three are variations on Symbian's 32-bit EPOC software platform - a combination of operating system, application framework and application suite.

Tablets, or web pads, are also begining to appear that provide access to Internet based services. At present they are portable, with wireless connection to a basestation which is connected via a phone line to an ISP, but mobile devices are being developed. The National Semiconductor WebPAD design provides a good example of the features that are offered. It has a touch-sensitive LCD colour screen with an 800x600 resolution, software keypad, scroll pad, user configurable buttons, microphone and speakers.

The basic design, using the Geode GXLV integrated processor, allows manufacturers to put together a customised product with the minimum of development time (see Figure 3). Each of the WebPAD devices demonstrated at CeBIT by Acer, Boundless, Qubit, RS Cordless Technology, Samsung, Screen Media, Tatung and Vestel had been customised to incorporate alternative web browsers, operating systems - such as Windows CE, QNX and Linux, peripheral hardware and wireless technologies. Eventually, tablets may be used for digital TV reception.

In Japan, the mobile e-mail terminal is becoming popular. These allow communication with the Internet via mobile phones. One of the latest models is that from Panasonic. This uses a 32-bit RISC processor, and features a colour backlit LCD with a resolution of 320x240 and a colour camera with a resolution of 144x144 (xRGB) pixels for attaching pictures. It is also the first to use the new SD Memory Card, developed by Matsushita, SanDisk and Toshiba, with 32 and 64MB versions available at present.

Motorola has introduced the first in a new category of multiple communication handsets that can run local and networked applications. The computing capabilities of the new devices are enabled by Java 2 Platform, Micro Edition (J2ME) from Sun Microsystems. J2ME is a Java software environment that enables secure, dynamic downloading of applications to a range of wireless devices. The new handset platform uses Motorola's iDEN technology. This enables users to make and receive phone calls, communicating with one or hundreds of individuals with just the touch of a button. Text messages can be received and depending on the network and subscription, access Internet information, send and receive e-mail, and allow the phone to function as a wireless modem.

Having a variety of devices to use begs the need for synchronisation between them, so that things like diaries, address books, and backups are all up to date. Which is where SyncML comes into the picture. This new standard is the only open industry synchronisation specification that offers universal and global interoperability. It uses eXtensible Markup Language (XML) for specifying the messages that are used to synchronise devices and applications.

The World Wide Web Consortium (W3C) is also busy. They are overseeing the development of many of the standards that will enable largely troublefree communication with the Internet.

The first consideration is, what kind of mobile device is attempting to access the Internet? Is it a mobile phone with a tiny display and memory or some form of tablet

with a medium size display and adequate memory? Obviously the former cannot download the amount of information that the latter can. The answer that is being explored at present is the use of device profiles, providing information about the device - and some user preferences, which would be stored in a database on a web server. The W3C has been working with the WAP Forum to arrive at a suitable standard - which is the Composite Capability/Preference Profile (CC/PP) - also used by FLIRT.

This is written in Resource Description Framework (RDF), a language developed by W3C for modeling metadata (descriptive information) - in this case about devices and their users. RDF always links information to web addresses - in this case the address of the device concerned. So, when requesting a web page, not only would the device request a Uniform Resource Identifier (URI) in the usual way, but it would also send a pointer in the form of a second URI to say where in the CC/PP database its device profile can be found (a URI is the generic set of all names and addresses that refer to resources: these encompass the Uniform Resource Locator (URL), and the Uniform Resource Name (URN).

On the basis of that information, and any changes that have been made - to the device profile and/or user preferences, it is then up to the web server to provide the right content. It will do that by comparing the device profile with the document profile. This is possible by employing a modular approach to web pages through the use of eXtensible HTML (XHTML), a variant on XML. This reduces pages to their functional groups - text, tables, forms, graphics, etc (future versions of Cascading Style Sheets (CSS) and Synchronized Multimedia Integration Language (SMIL) specifications will also feature this modular construction). When the comparison has been made a web page will be constructed from the available modules using the best possible match for the device concerned.

The means of defining other services is also being worked on by W3C. This includes similar things to those addressed by the FLIRT Project. The Point of Interest Exchange Language (POIX), for example, would provide location related information and the location of a shop, or whatever, with additional information provided in a main document. POIX is complemented by the Navigation Markup Language (NVML), which is used to give directions in the same manner as a car navigation system does. Other uses for it will include travel planning, a guide for sightseeing and such like.

A just-ended European Project addressed this point of sightseeing - Tourist Orientation and Support in Cultural Assisted tours (TOSCA). This envisaged the tourists being provided with a Multimedia Personal Terminal (MPT) which would access available communication platforms such as mobile radio and wireless or contactless local loops for regular updating of information and indeed remote access to ISDN. A basic MPT will provide audio guidance and data; while an upmarket version adds graphic images and virtual reality (using the VR Markup Language - VRML). The unit will also have additional functions including electronic payment of services, including ticketing, using a pre-paid chip; speech recognition for

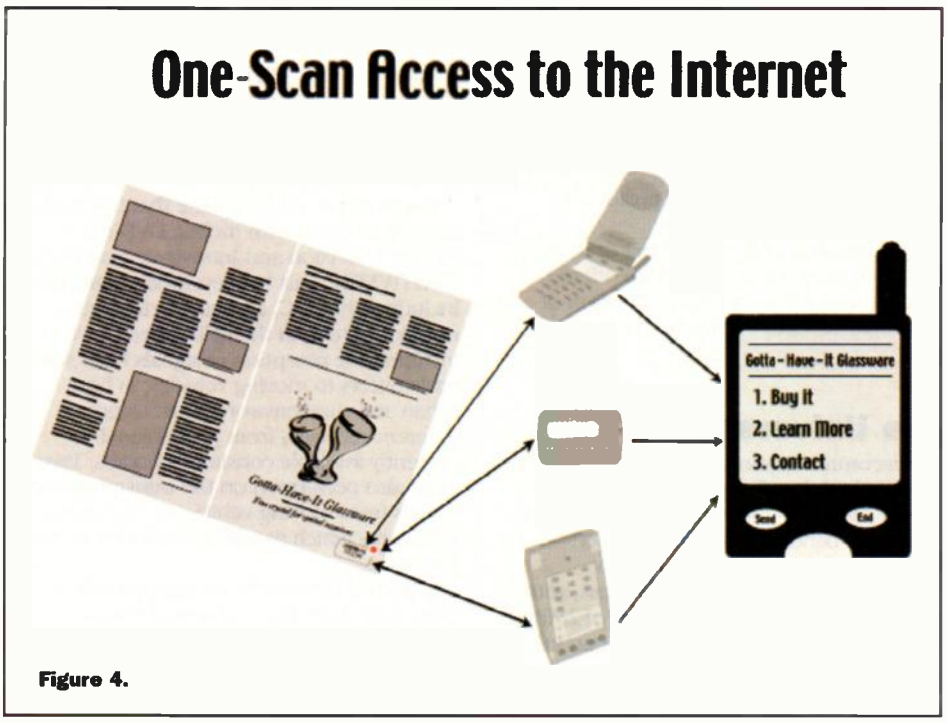


Figure 4.

interacting with gallery and museum exhibits, automatic paging, guidance and animation on demand. The system was tested in the Edinburgh Museum, in Greece on an archaeological tour, and in Florence on a city tour.

An alternative way to access information would be via web codes - barcodes containing instructions to execute specific tasks. A number of companies are forming a new company for this purpose - AirClic, Connect Things (an Ericsson subsidiary), Motorola and Symbol. AirClic's wireless network includes a web code registry, that makes print media interactve via an Internet-enabled device such as a mobile phone, personal digital assistant (PDA) or a two-way pager. Connect Things has developed a database linkage service in Europe that provides direct links between bar codes and web codes. Motorola, of course, manufactures the devices that will provide the Internet access. Employing the barcode scanning technology that has been developed by Symbol.

If they have their way, web codes will be on products. These could be publications - including brochures and company advertisements, and on television (see Figure 4). By scanning a web code people will be connected directly to Web sites to order products, find information, and manage everyday tasks and transactions. Information will be sent instantly to the new company's web code registry, which interprets the nature of the inquiry and delivers corresponding information to users. The system will also support 'Internet-enhanced' standard UPC and EAN bar codes already on millions of products worldwide.

For all these things to happen, requires a vast expansion of the Internet addressing system, because the 32-bit Internet Protocol version 4 (IPv4) is running out of addresses, and every device requires a unique address to connect with other devices on the Internet. These IP addresses are the sequences of numbers that underlie the familiar domain names - which only exist for user convenience. They are then converted to the IP numbers for use. IPv6 uses a 128-bit addressing system, in addition to having

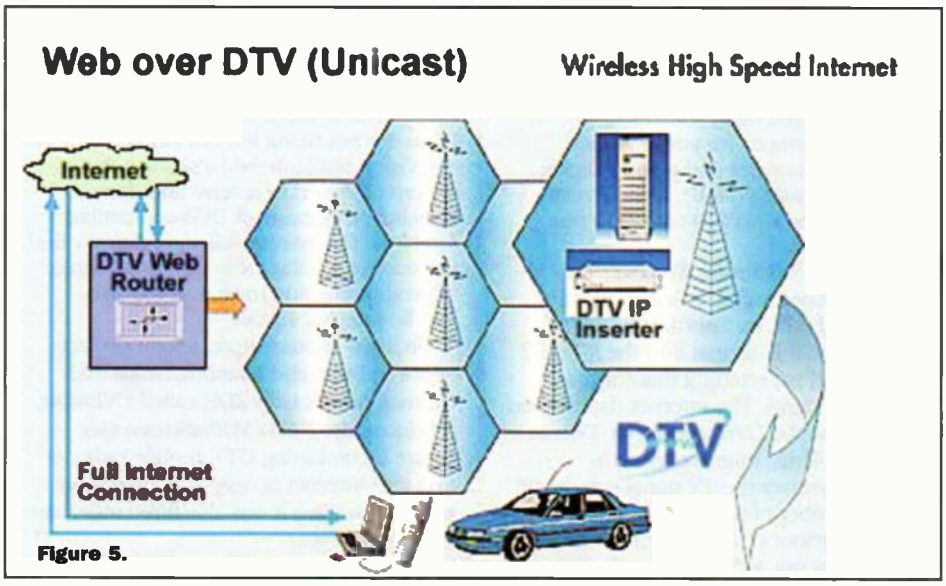


Figure 5.

various improvements. IPv6 will gradually replace IPv4 but in the meantime a means of inter-communication is necessary because the two will have to coexist for some time. To this end the Network Address Translation - Protocol Translation (NAT-PT) mechanism is being developed to translate IPv4 addresses and protocol to IPv6 versions, and vice versa.

This limitation on the number of devices, and also the services that can be offered, would restrict the full implementation of upgraded services - 2.5G and particularly 3G.

The Universal Mobile

Telecommunications System (UMTS) is a 3G standard. It will support the existing mobile facilities - including WAP; but has the additional bandwidth to provide such services as full-motion video, video conferencing and full Internet access, with its theoretical maximum data rate of 2MBps. It is expected to be launched in Japan in 2001, and in Europe the following year.

Many TV broadcasters and manufacturers see this as one way of promoting Digital Terrestrial Television (DTT) in those countries where cable and/or satellite services have dominated the analogue field. Samsung already has a mobile phone combined with a TV (only analogue NTSC at present), with a 1.8in LCD screen for both phone and TV displays, that is similar in size to a normal mobile phone. An additional reason for this enthusiasm for mobile services is the existence of three basic digital TV (DTV) systems: the European Digital Video Broadcasting (DVB), the US Advanced Television Systems Committee (ATSC - the ones who chose it from competing systems, following the tradition begun with the National Television Systems Committee), and the Japanese Integrated Services Digital Broadcasting (ISDB). Each player wants their system to be adopted by those countries that have yet to make a decision; and any additional feature may just swing it if they can prove that theirs gives the best results for the country in question.

A number of European projects have been and are still looking at the various aspects of the increased 3G bandwidth. Assessment of Quality for Audio-Visual signals over Internet and UMTS (AQUAVIT) is one self-explanatory project. Another is Dynamic Radio for Internet Protocol (IP) Services in Vehicular Environments (DRiVE): which will attempt to make the most of restricted radio sources by developing methods for automatically allocating frequencies and getting Digital Audio Broadcasting (DAB), DVB-Terrestrial, GSM, GPRS and UMTS to coexist in one frequency band.

The Rohde & Schwarz Web over DTV system overcomes that, at least with the Internet and DTV, by inserting selected Internet data in IP format into the MPEG-2 data flow and transmitting that together with the TV signal. The internet data is then processed on the DVB receiver or TV capable PC. Thus, Internet access is available wherever the TV signal is received. And the number of users has no influence on the behaviour of the system because the web server is not accessed directly. The DTV IP Inserter slots the internet data into the MPEG-2 data signal (see Figure 5), this is transmitted through the server DTV Web Carousel along with the TV signal to stationary or mobile subscribers, where the DTV Web Proxy stores the Internet data for retrieval with a browser.

Returning to projects, one that has been directly involved with mobile DVB-T is Mobile Television and Innovative Receivers (MOTIVATE). This has seventeen members, including the BBC, and has performed a number of tests in the field. These have included the reception of signals from static transmitters to moving vehicles, in both urban and rural environments, using different receivers from professional to currently available consumer models. Tests were also performed on the transmission of signals from moving vehicles to stationery receivers - which would be useful for news gathering.

The BBC demonstrated the potential at one of its Open Days. A vehicle with a camera, MPEG coder, and a DVB-T modulator set to its most rugged mode used a 10W transmitter to send a signal to an aerial on the Reigate transmitter mast. This was up-converted and sent back to Kingswood Warren over an SHF link. And, in the opposite direction, the rugged DVB-T signal from Kingswood Warren was sent to the Reigate mast, transmitted, received by an omnidirectional aerial on the vehicle, and demodulated using the same circuitry as a domestic set top box. The UK DVB-T specification does not allow the robustness necessary for public mobile uses; but that could change if the shutdown of the analogue system made a greater bandwidth available. Then it could be received in buses, coaches and trains, and in the rear seats of cars (with drivers possibly receiving an audio description service so that they do not feel left out). The MOTIVATE partners also demonstrated it on trams in Amsterdam carrying people to and from IBC '99; 15in LCD screens were showing live transmissions.

But such demonstrations are not confined to MOTIVATE or to Europe. In Singapore, for example, having chosen DVB-T over the rival systems, the Singapore Broadcasting Authority has reserved one multiplex for mobile uses. It has been tried on both trains and buses - and the bus company has subsequently been licensed to proceed in installing the equipment. In Australia, the DVB-T system was demonstrated in a drive round Sydney to TV representatives from Argentina and Brazil, visiting there for the Olympic games. Boats are not being left out either: TracVision has launched a single-antenna system designed to receive and decode signals from a range of DVB-compatible satellites. The system will automatically find the correct satellite from the users' choice of programme and track it. It will also handle Internet signals.

On a less esoteric note, a joint project between Deutsche Telekom, Nokia and German broadcaster ZDF, called DVB@air, produced the Nokia MediaScreen (see Figure 6)combining DTT, mobile radio, e-mail and Internet access. In cooperation with Volkswagen it was also fitted into a car for mobile tests.

Whether people will want TV in their cars

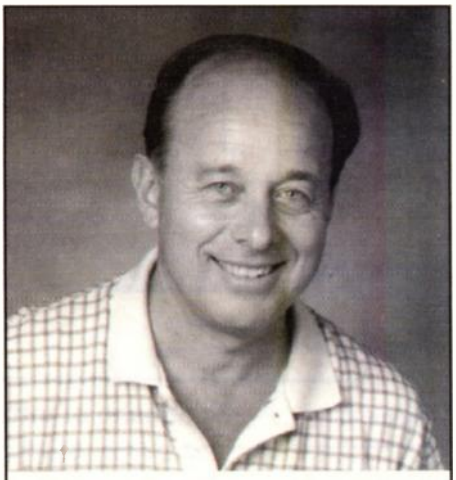
Figure 6.

remains to be seen? Or any or all of the additional mobile services and products that are being promoted? If all the companies involved have their way then we will all be wirelessly linked wherever we go, but there is always the off switch.

A Glossary of Terms

ATSC	Advanced Televsion Systems Committee
DRIVE	Dynamic Radio for Internet protocol in Vehicular environmenta
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcasting
DVB-T	DVB -Terrestrial
EDGE	Enhanced Data rates for GSM Evolution
FLIRT	Flexible Information and Recreation for Mobile Users
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
GUI	Graphical User Interface
HSCSD	High Speed circuit Switched Data
HDML	Handheld Device Markup Language
ISDB	Integrated Services Digital Broadcasting
MOTIVATE	Mobile Television and Innovative Receivers
MPT	Multimedia Personal Terminal
NVML	NaVigation Markup Language
PDA	Personal Digital Assistant
PDTP	Packet Data Transport Protocol
POIX	Point Of Interest eXchange language
RDF	Resource Description Framework
SMS	Short Message Service
TDM	Time Division Multiplex
UMTS	Universal Mobile Telecommunications System
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
VRML	Virtual Reality Markup Language
W3C	World Wide Web Consortium
WAP	Wireless Application Protocol
WID	Wireless Information Device
WML	Wireless Markup Language
XHTML	eXtensible HTML
XML	eXtensible Markup Language

Single Crystal LASER



Professor Coldren

by Reg Miles

At the University of California, Santa Barbara (UCSB) a research group, headed by Larry Coldren, director of the Optoelectronics Technology Center and the Fred Kavli Professor in Optoelectronics & Sensors, has successfully demonstrated the operation of a high performance long wavelength (1.55μm) Vertical-Cavity Surface-Emitting Laser (VCSEL) that had been grown as a single semiconductor crystal (VCSEL, incidentally, is pronounced 'vicsel').

VCSELs are used to transmit information in optical fibres. To be cost effective the mass production price should be no more than about $10 each. The thrust of VCSEL research therefore, is to produce tens of thousands of these 3μm long lasers inexpensively and reliably on a 50mm semiconductor wafer. This demonstration by UCSB researchers is claimed to represent a significant step forward in that direction.

The UCSB research group has approached the problem by growing VCSELs on indium phosphide (InP) semiconductor wafers as single crystals using Molecular Beam Epitaxy (MBE) to deposit the layers, first a layered mirror (or distributed Bragg reflector - DBR) then the active region then the other DBR to form the complete VCSEL structure (photons are generated in the active region by the combination of electrons and holes and are reflected back and forth by the DBRs at top and bottom; this reflection resulting in the 'stimulated emission' of coherent laser light). When the crystal is grown, the individual VCSELs are isolated by etching down to the cavity where the active region exists. The result is a wafer dotted with perhaps 25,000 wells - each of which is a miniscule laser.

In order to grow a perfect crystal by the epitaxy method, the lattice constants (i.e., the spacing between atoms) of the semiconductor substrate and the overlaid layers have to match. The problem then was to find combinations of semiconducting elements (from Periodic Table groups III and V) with a lattice constant match to indium phosphide that have a large range of refractive indices for good DBRs as well as providing for high quality active regions.

Conventional VCSELs in production today are based on a substrate of gallium arsenide. These VCSELs operate at shorter wavelengths (850 and 980nm). One significant problem that arises from using short wavelength VCSELs for transmitting light through a fibre optic cable is dispersion - the information is blurred if it is transmitted at a high data rate and propagates a long distance. Longer wavelengths reduce the blurring problem. But unless very exotic active regions are used, they require a different substrate wafer, indium phosphide instead of gallium arsenide.

Unfortunately, the lack of mature DBRs on InP has proved a difficulty that has led researchers to build lasers around fused, metamorphic, or dielectric mirrors. But while these approaches have resulted in continuous wave (CW) operation, an all-epitaxial, lattice-matched approach removes many of the questions regarding manufacturing and reliability. And such lasers would be the most similar to the proven shorter wavelength devices. Combinations of aluminium, gallium, arsenide and antimony (AlGaAsSb) and aluminium, arsenide and antimony (AlAsSb) do enable an all-epitaxial, lattice-matched laser to be produced - the high refractive index contrast of this system giving highly reflective DBRs. Examples have already been demonstrated; however their poor electrical and thermal properties has proved to be a limitation.

The UCSB device has overcome these limitations by employing a double intracavity design and an air aperture. The double intracavity contacted structure works by cladding the aluminium, indium, gallium and arsenide (AlInGaAs) active region with two, thick, n-type InP layers. These cladding layers provide for efficient injection of the

Figure 1.

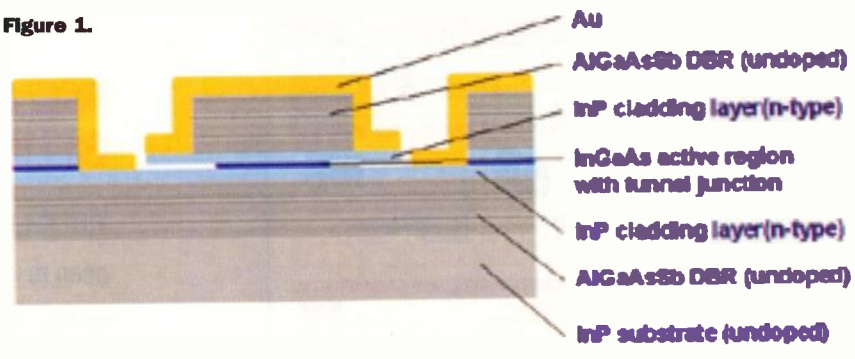
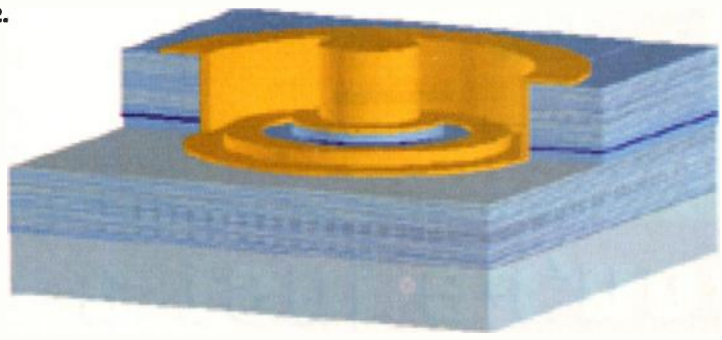


Figure 2.



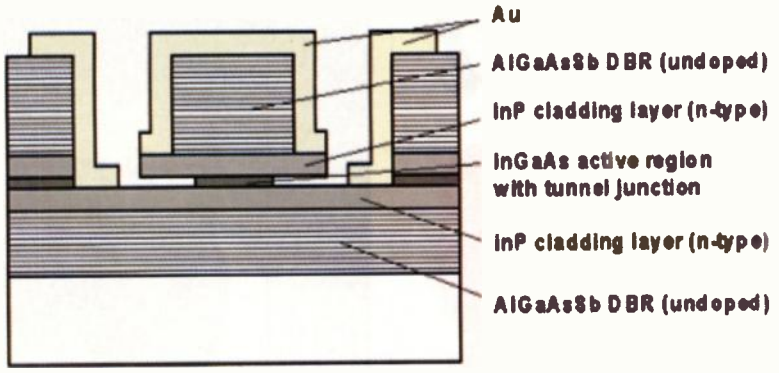


Figure 3. Schematic of intracavity contacted design.

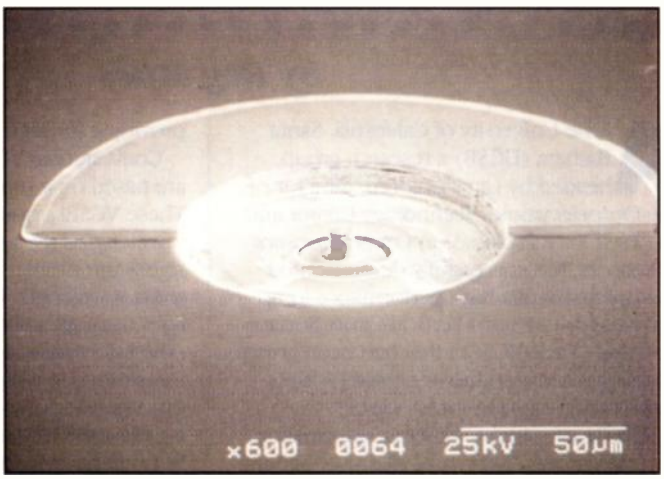
current as well as lateral conduction of the heat. This contact scheme enables the heat and injected current to bypass the DBRs. Since the electron mobility in n-InP is very high, the thick cladding layers introduce very little lateral resistance even for low doping levels. The top and bottom DBRs are undoped, so the optical loss in the structure is very low. A tunnel junction placed at an optical standing wave null just above the active region generates holes for the quantum wells, and an underetched aperture funnels the current to the center of the etched mesa.

The experimental results from the UCSB device have shown that it has a maximum CW output power of 1.05mW at 20 degrees C; while at its maximum operating temperature of 88 degrees C the CW output power falls to 0.11mW. At 25 degrees C, the threshold current and threshold current density are 800uA and 1.6kA/cm2, respectively, and the differential quantum efficiency is 23%.

Coldren described the current results 'as the best obtained anywhere in the world by any technique.' Previously, the best results for long wavelength VCSELs had been achieved by another technique, 'wafer fusion,' mastered by Coldren's UCSB colleague John Bowers, professor of electrical and computer engineering. The wafer fusion technique pieces together the mirrors and active region from layers grown on separate wafers.

What distinguishes Coldren's approach, not only from Bowers' but all others, is the single step growth process of nearly defect-free, single crystal material on indium phosphide. The single step approach promises much greater reliability when the process is scaled up for mass production than do the multiple step approaches of other techniques. Coldren claims that not only is his group's approach to VCSEL manufacturing intrinsically less expensive than other techniques, it is also inherently more reliable. An unbeatable combination, in other words!

For additional information contact: Jacquelyn Savani. E-mail: jsavani@engineering.ucsb.edu.



Excursions INTO EXCEL

PART 2

by Mike Bedford

Last month, to introduce Excursions into Excel, I demonstrated how a very simple Excel workbook could be used to generate a Sierpinski Triangle and, in so doing, showed that a random processes can produce a highly ordered result. This was an interesting curiosity, admittedly, and it adequately demonstrated that Excel is capable of much more interesting tasks than adding up sales figures. However, it wasn't the sort of exercise that engineers are likely to need to perform on a regular basis, in fact I expect to return to topics in recreational maths on a number of occasions. Nevertheless, this month we will cover a rather more down to earth subject - the preparation of technical illustrations, a job for which I frequently use Excel. This is something which I do as part of my writing of technical magazines articles but it will also be of relevance to engineers, technical writers and marketing professionals involved in generating technical presentations, user documentation, brochures and many other types of document.

What does Excel Offer?

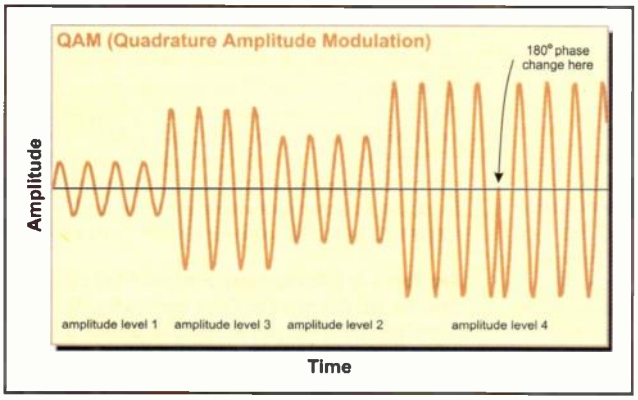
Most people are aware that Excel can sum columns and do basic arithmetic and many users also know that it can generate the bar charts and pie charts which tend to be used to illustrate concepts such as sales trends and market shares. This series shows that Excel can do far more than accountancy and business graphics. Excel supports all the common functions used in mathematics and engineering and that its graph plotting capabilities go well beyond the sorts of things you'd find in a sales presentation. Excel's vast repertoire includes trigonometric inverse trigonometric, hyperbolic, logarithmic, exponential, factorial, double factorial, power series and statistical functions. And for the engineer there are another forty or so including Bessel functions, base conversions, and complex numbers. And turning to graph plotting we find standard line graphs, XY plots, polar plots, we have logarithmic axes, and a great deal more.

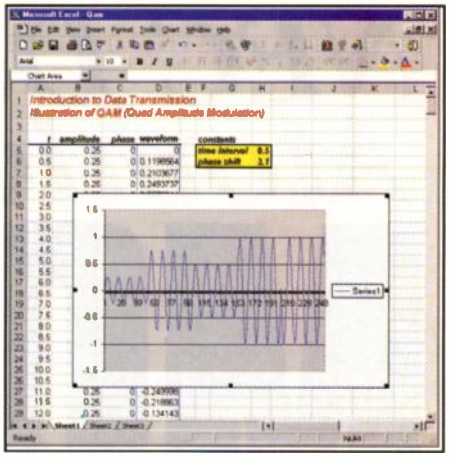
An Example

Now let's move on to a real example. What I've chosen is the generation of a graph I produced for an article on digital TV to explain the concept of QAM (quadrature amplitude modulation) in which groups of bits are each represented by a particular combination of amplitude and phase. The most common variants of QAM are 64QAM and 256QAM in which 64 and 256 combinations are used to represent 5 bits and 8 bits respectively. Normally, QAM modulation is summed up using a so-called constellation diagram, a polar plot showing the amplitude and phase of each combination. However, I also wanted to show how different amplitude and phase combinations would appear as a waveform. To simplify things I used just four different amplitudes and I showed just the one phase transition - of 180 degrees - at full amplitude. All this is simple using Excel and the screen shot tells the whole story. However, although Excel's graphs are functional, the default settings often don't produce works of art. Certainly this graph could have been improved from within Excel by changing the colours, the line thickness, the axes and so forth, but for optimum results, I find that it's necessary to export the graph to a third party package such as Corel Draw! for a bit of tidying up. However, this isn't always as simple as you might expect as we're about to see.

Exporting Graphics

Copying the graph to the clipboard in Excel and then pasting it into your drawing package won't have the desired effect. All this will do is to embed Excel Chart object into your drawing. You won't be able to edit this from within your drawing package and any attempt to do so will launch you back into Excel. What you need to do, therefore, is to use the Paste Special option within your drawing package to paste it as a picture (not a bitmap). However, even this isn't always possible - it all depends on what your drawing package supports. With earlier versions of Corel, for example, Paste Special only provided the option of Microsoft Excel Chart. If you encounter this problem, one solution you could adopt is to use another package as an intermediary. So, copy from Excel, Paste Special as Picture (Enhanced Metafile) into Word, copy from Word and then Paste into the drawing package.





The second point you'll discover is that an Excel Chart, when imported into a drawing package, will appear as hundreds or thousands of separate objects, or as a group of these objects. Attempting to move or alter the appearance of a line on the graph will affect just a single segment of the trace. What needs to be done in the editing process is to select all the segments associated with a particular trace and group them together. This could be difficult if you have multiple traces on the same axis so you may have to create a number of graphs, each with a single trace, and export them individually to your drawing package where they can eventually be recombined. Axes, especially those with lots of tick marks and labels can also make editing the exported graph difficult so it would be better to disable as much of this sort of thing as possible in Excel before generating and exporting the graph. It's comparatively easy to re-generate the axes in your drawing package and they'll probably look better than Excel's default axes too.

The Finished Result

The second illustration is the final result, as generated in Excel and edited in Corel Draw! First of all, in Excel, I used the Chart Wizard to remove as much of the extraneous material as possible. Really, the only part of the graph which I wanted to keep was the basic trace, I intended to redo everything else in Corel Draw! Having got the chart down to the basic minimum I copied it to the clipboard and pasted it into Corel as a Picture. Selecting the result showed that it was a group of 257 objects. Ungrouping turned this into 257 separate objects of which a handful were associated with the frame, the background as so forth. These were deleted and the remaining objects, the segments of the trace, were regrouped so that I could handle them easily. I now changed the line thickness and colour to suit the artistic style of the article and I re-applied axes and provided the necessary labelling. The results can be as good as those produced using a more specialised tool.

NEC Develops Atomic Beam MOVIE

By Reg Miles

Researchers at the NEC Fundamental Research Laboratories in Japan, led by J. Fujita, together with F. Shimizu and S. Mitake of the University of Electro-Communications, have developed the worlds' first 'atomic beam movie' - a new electric field modulated atomic hologram by which atomic images can be shifted, erased or switched in real-time by controlling the applied voltage.

This is a continuation of earlier experimental work on atomic holography at the NEC Laboratories and the Department of Applied Physics, University of Tokyo. Which, in that case, resulted in the very first pattern generation of neutral atoms by a holographic technique - appropriately enough forming the letters 'NEC'. That was a fixed image; but the means of achieving it were essentially the same as those used to achieve this latest development.

Atomic holography is essentially the same process as optical holography. However, there are also significant differences: among which are the shorter wavelength of atomic waves, the fact that atoms cannot pass through a solid material, and the interaction of atoms with each other as well as with external fields. Because an atomic beam cannot be photographically imaged to directly produce the interference pattern that would result between object and reference waves, the alternative technique of computing the interference pattern was used to generate a pattern from an atomic de Broglie wave.

The 0.5mm square hologram consisted of a silicon nitride membrane 100nm thick, with 513 parallel platinum electrodes 0.5μm in width with a 1.0μm pitch, with 0.5μm square holes in the spaces between to represent the transparent area of a binary hologram. To form the electrodes from the deposited platinum two layers of electron beam resists (PMMA/MMA) were coated on, and the electrode pattern was written by an electron beam writer; the platinum film was evaporated to a thickness of 30nm, and the electrodes were formed by lifting off the unwanted areas (leaving each one either grounded or connected by one or other end to two horizontal conductors). Another resist was then coated on to produce the pattern of holes (again using an electron beam writer), and they were opened by CF4 plasma etching.

The positions of the holes and the electrode connections to produce the required interference pattern were calculated by dividing both the object and the hologram into 1024x1024 cells, each 0.5μm square. The transmission function, that would diffract a reference wave and generate the required wavefront, was calculated from the object cells and applied to the cells of the hologram in the form of a binary pattern. A fast Fourier transform algorithm was used, incorporating a lens function to focus the image on the detector.

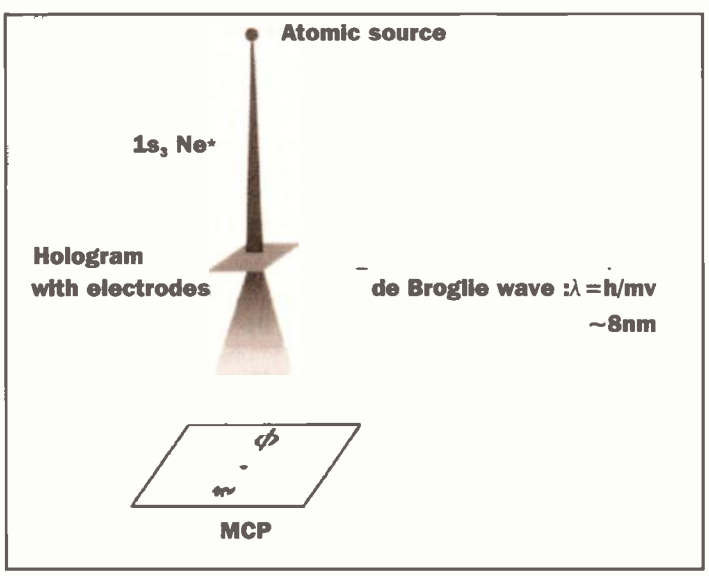


Figure 1. Schematic diagram of experimental setup. The atomic source, the hologram, and the screen of microchanical plate (MCP) were placed vertically.

The experiment used a point-source of laser-cooled metastable neon atoms. This atomic beam passed through the hologram 28.5cm beneath and an image was formed on a microchannel plate detector - a total distance of 112cm (see Figure). The vertical arrangement allowed the atoms to be accelerated by gravity, which improved the resolution of the image.

When the electric potential of V was applied between the two conductors on the hologram, the electric field that was generated shifted the energy of the atoms downwards. Those atoms that passed between adjacent electrodes with different electric potentials accumulated an additional phase proportional to V squared, while those passing between electrodes with the same potential were unaffected.

By applying voltages of 0, 0.53 or 0.75V between the two conductors the resulting phase shifts of the atomic wave at the holes shifted the relative positions of the images of two letters, or switched between them, or removed them. The researchers claim that this can be extended to the manipulation of n patterns, if the phase shift is controlled in smaller steps by changes to the wiring of the electrodes.

The researchers and the company anticipate that this will have a significant impact on nano-manufacturing technologies, in which current lithography techniques will eventually be constrained by the wavelength of light.

Enormous strides have been made in refining process technologies to ever finer degrees, while semiconductors have seen ever higher levels of integration and leaps in performance as the technology of the electronics industry advances. Current process technology is beginning to reach the 0.15-micron level; but already there are moves to implement 0.10-micron (or nanometre) level processes. The advent of such ultra integration will see the introduction of structures utilizing the quantum effect in quantum devices, and make the development of nano-manufacturing technologies indispensable.

Currently, photo-lithograhy and other forms of photolithographic etching technologies are being developed but these face serious issues in scaling to nanometre-level production. Among these issues is the limitation of the wavelength of light to 100nm or greater, making it increasingly difficult to manufacture devices with complex structures without adding an overwhelming number of processes during manufacturing.

NEC is considering what will be necessary to integrate the use of atom beam lasers with the results of the research to take further steps toward the development of production technologies enabling the use of both Aluminium (Al) and Germanium (Ge) circuitry in nanometre-level ultra LSIs and quantum devices of the future,that will avoid increased changes of mask patterns and steps required with conventional technology.

For further information contact: Aston Bridgman, Corporate Communications Division, NEC Corporation, 7-1 Shiba 5-chome, Minato-ku, Tokyo 108-8001, Japan. E-mail: a-bridgman@ak.jp.nec.com

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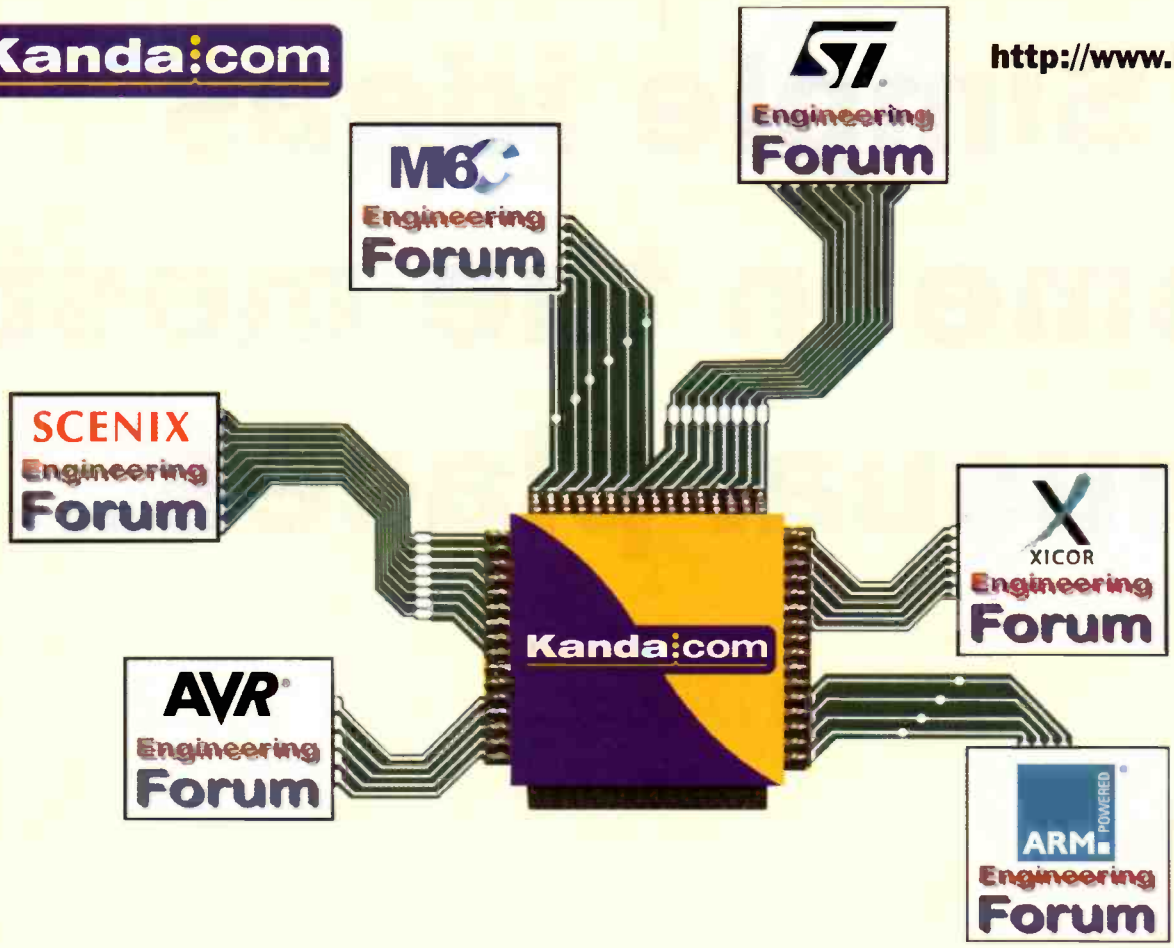


Did you know that Kanda.com has a range of diverse engineering forums providing you with interactive, up-to-date information. These sites offer you a free and reliable engineering service, backed by the worlds leading silicon companies. Our world-wide web arena provides the first point of reference with lists of frequently asked questions, hints and tips for engineer and hobbyist alike. Why not stop at our six Engineering Forum sites to get expert help, to see what the worlds leading silicon companies have to offer and learn about the latest cutting edge technologies. All our sites offer you the opportunity to interact through our discussion forums.

The Atmel AT91 Arm/Thumb series are a range of high performance, low power 32bit microcontrollers. These controllers are targeted for use in hand held performance computing. Some typical uses of the AT91 are MP3 players, GPS handsets, pagers and mobile phones.

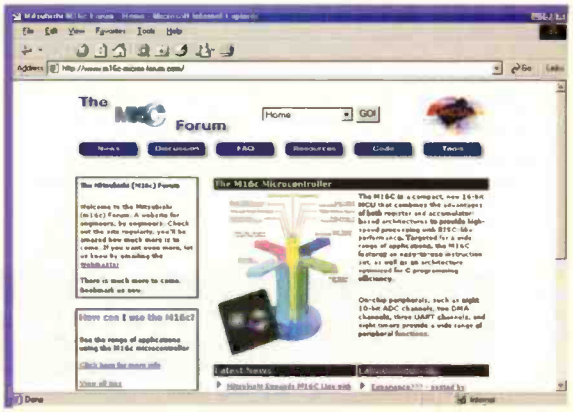
NEWS:

AT91 goes Flash

News on the AT91F40416, the first Flash based ARM/Thumb microcontroller.

Tutorials:

We have managed to obtain a range of tutorials for our visitors, these were previously only available to AT91 seminar attendants. These exclusive tutorials should help you get to grips with your first AT91 project in no time at all.



m16c Forum

<http://www.m16cmicros-forum.com>

The m16c series from Mitsubishi are an extremely versatile and secure range of 16-bit flash microcontrollers. Featuring large I/O (87-129), ADC/DAC, plentiful Flash and Ram(48KB-256KB) and a variety of additional peripherals available throughout the range such as: DRAM interface,CRC generation, SIM, USB, 12C, On-Screen Display, ISA, CCD and LCD.

These advanced features are well suited to any project which requires a user interface, such as Digital TV, Mobile Telephones, VCR, Pagers and Digital Cameras. Its low power, noise resistance and excellent analogue capabilities make it equally at home with safety critical automotive applications such as Airbags, ABS and engine management.

The newly launched m16c forum is aimed at making this excellent product more accessible to new users. As you would expect there are a range of tutorials, device datasheets and information on a range of development tools.

AVR Forum http://www.avr-forum.com

The Atmel AVR microcontroller is an extremely versatile and well-supported 8bit flash microcontroller. Available in 8 to 64 pin packages, flash memory sizes from 1kb to 128kb and features such as ADC, Infrared Generators, PWM , SPI, UARTS and Comparators coupled with its flash In-System programming make it an ideal projects controller.
The AVR Forum has a lively discussion forum, a good library of code samples, free tools, datasheets & schematics downloads, regular competitions and details of a range of development tools.

Tools: USB Programmer
Software: ISP Gold software update.
Content: Book Review

SX Forum http://www.sx-forum.com

The Scenix SX Microcontrollers are an amazingly fast (100MHz!) range of Flash Microcontrollers. Instruction sets and pin-outs are compatible with the popular PIC controllers.
With a range of software add-ons known as Virtual Peripherals the SX controller is able to perform many functions almost completely in software. Some examples are a V23 modem, 8-channel UART, DTMF detection and a complete PPP/TCP/IP stack enabling you to internet enable your projects.
The SX Forum contains a great deal of information on using these virtual peripherals, including application notes, tools & demo kits as well as a discussion forum to discuss your designs and ideas with other experienced users.
Tools: SX TCP/IP Stack and 10-Base T Ethernet.
Tutorials & App Notes: Including interfacing SX to ISA Bus, Caller ID, 3 Phase AC motor control.
Notes: We welcome contributions and ideas from visitors.

Xicor Forum http://www.xicor-forum.com

Xicor produce a wide range of IC's which allow you to easily add additional features to your circuit including: Battery Management, EEPROM, Real Time Clock/Calendar/Alarms, Digital Potentiometers, Smart Op Amps. There are also products suited at protecting other digital electronics on your circuit by providing CPU supervisor features including: watchdog, voltage detection, low voltage reset and voltage monitoring.
The real benefit of using these products is that various combinations of the features listed above are available in a single package. For example: Real Time Clock plus 2 Alarms, 2 Kbytes EEPROM, Low Voltage reset and watchdog available in a single 8-pin SOIC package.
The Xicor forum contains everything you need to start using these devices including: tutorials, application notes, FAQs and full details of obtaining development kits for PC based configuration of these devices. There is also a discussion area which is frequented by new and experienced users as well as Xicor & Kanda staff.

ST7 Forum http://www.st7-forum.com

STMicroelectronics (formerly SGS Thomson) micro controllers are renowned for their Quality, Ruggedness and Reliability, but were previously only available in mask ROM, OTP and expensive EPROM.
STMicroelectronics have now added Flash programming capability to the ST7 range of 8 bit general purpose micro controllers and with very competitive pricing and availability these are now very desirable devices.
ST7 has a full range of packages with a wide variety of onboard general purpose peripherals such as ADC, PWM, SPI, UART, Timers, Watchdogs and low level detection as well as specialist peripherals including Motor Control, CAN and USB meaning that there is an ST7 device to suit all needs.
Easily programmable using 'C' or Assembler and with widely available development tools including Evaluation Kits, Emulators and Production Programmers make the ST7 micro controller the choice of the discerning engineer.
The ST7 Forum is designed to give the engineer all the resources required to use and implement an ST7 solution including datasheets, application notes, tools, sample programs and demonstration kits as well as a discussion forum where you can discuss your designs and ideas with other ST7 users.

Kanda ST7 Tools

ST7 Starter Kit for OTP, EPROM and Flash devices
ST7 ISP for Flash devices
ST7 Evaluation boards for Flash devices
ST7 Keyfob Kits for Flash devices
ST7 Keyfobs for Flash devices
ST7 Motor controller Development Kit for OTP and EPROM

Other Tools

STMicroelectronics ST7 Toolchain
Softtec Emilators
Cosmic 'C' COMPILER
Hiware 'C Compiler

Digital POTENTIOMETERS

By Joe Ciancio

Due to the dynamic nature of a fibre optic communications link and the variability of laser diodes, mechanical potentiometers do not work well in a fibre optic circuit. Adjusting a mechanical potentiometer requires that a technician makes a physical change with a screwdriver while viewing the output on an instrument such as a voltmeter or oscilloscope. This presentation will describe new approaches on how to optimize performance in these modules.

LASER Diode Drivers

Optical fibre communication links often use a laser diode (LD) as the transmission light source. This device has the advantage that the digital modulation at logic circuit voltages can be directly applied to the

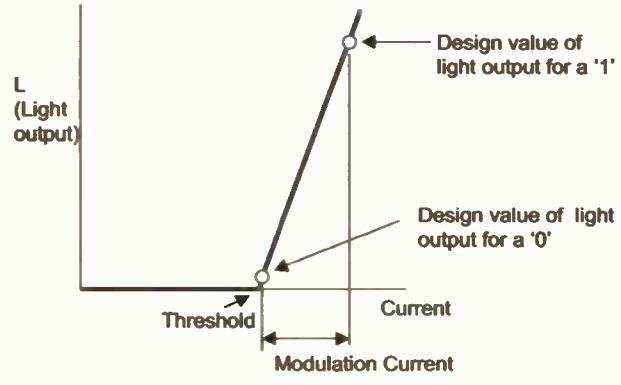


Figure 1a. Idealized Light output vs control current of Laser Diode.

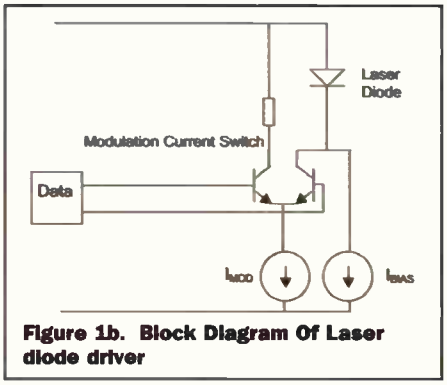


Figure 1b. Block Diagram Of Laser diode driver

operating bias current of the diode, which in turn varies the output power. Further advantages for optical fibre communications are the high coupled power and cutoff frequencies allowing data rates in excess of 1Gb/sec.

Some challenges presented by the laser diode to control circuits are:

- The very wide spread of parameters for production devices,
- Significant changes of these parameters with temperature or ageing
- The limited high-frequency response of the internal monitor photodiode, and
- The non-linear knee or threshold effect, below which optical output is minimal (Figure 1a).

Data rates requiring rise times of less than 500pico seconds calls for purpose-designed electronic circuits to control the laser diode current. Many such chipsets for laser diode control exist, having a similar architecture [1,2]. This comprises:

- One current source to bias the laser diode near threshold (the '0' power point) and
- A second current source to further bias or modulate the laser diode into the '1' (high optical power) condition.
- A common-emitter differential transistor pair switch. The function of this switch is to divert the modulation current away from the laser diode when a '0' is required. The differential pair can be readily interfaced to an ECL or PECL input.

The '0' level is chosen to be close to the threshold as this reduces the rise time to a similar value to the falltime, improving the eye diagram and reducing intersymbol interference [3]. In practice a small amount of light is expected at the '0' level as the knee at the threshold of L vs. I is somewhat rounded.

For maximum extinction ratio the '1' level is often set near the maximum safe level of laser diode power output.

The two control currents IBIAS and IMOD shown in Figure 1b are typically set by currents through set resistors RBIASSET and RMODSET These are shown in Figure 2.

Effect of LASER Diode Parameters

Laser diodes exhibit a very wide range of tolerances of their various parameters, and this requires a number of reference values to be adapted to suit the individual component. In addition these values vary significantly with temperature. It is

important to limit the spread of parameters to obtain sufficient range and resolution in the calibration process.

Parameters from a cross-section of laser diode devices is shown in Table 1.

In edge-emitter laser diodes the threshold varies strongly with temperature and a control loop is employed to stabilize the setting, as shown in Figure 3. The quantity measured for control of threshold is taken from the internal monitor diode, which is a measure neither of threshold nor '0' power level but of the average emitted power. In other words the control loop stabilizes a mean of the '0 and '1' levels weighted according to the ratio of '1's to '0's. Where a line code such as 8B10B is employed (eg in a GBIC interface), this fixes the ratio over a sufficiently small number of bits so that the power feedback is constant.

Ideally it would be possible to monitor extinction ratio and include a feedback loop for modulation current. At least one commercially-available chipset [4] attempts to stabilize

'0' level and '1' level independently, but the peak detectors used require a stable '0' level for at least 6ns (8 bits at 1.25Gb/s), and a monitor diode with sufficiently small risetime. These conditions are not commonly met in state-of-the-art interfaces. With fixed modulation current, the slope efficiency (slope of light output vs. modulation current) fixes the differences between the '0' and '1' levels. Should the slope reduce with temperature, the optical signal levels will approach each other (Figure 4a). Should the slope increase, the '0' level will be driven below the threshold (Figure 4b).

In vertical cavity surface emitter (VCSEL) laser diodes the threshold is differently influenced by temperature and has a parabolic relationship of temperature vs. threshold. The vertical-cavity process allows the threshold minimum to be set at near the operating temperature (eg 40°C)[5]. If the threshold is considered sufficiently stable, the threshold

current can be fixed and feedback applied to the modulation current.

Design Calculations

To calculate the range of resistor values required, some basic design equations are required:

$$I_{PIN} = (\Delta V_{PINSET}/R_{PINSET}) \quad 1$$

(we assume zero error current in nominal conditions with normal data signal being transmitted)

$$\Delta V_{PINSET} = V_{PINSET} - V_{INM} \quad 2$$

V_{INM} = input voltage of current mirror

I_{PIN} = monitor current

With the laser diode giving P_1 at each '1', an equal number of '1's and '0's, the monitor current will be 50% of the full-power value

$$I_{BIAS} = (\beta_{BIAS}\, \Delta V_{BIASSET}/R_{BIASSET}) \approx I_{TH} \quad 3$$

$$\Delta V_{BIASSET} = V_{BIASSET} - V_{INM} \quad 4$$

V_{INM}= input voltage of current mirror

β_{BIAS} = bias current mirror gain

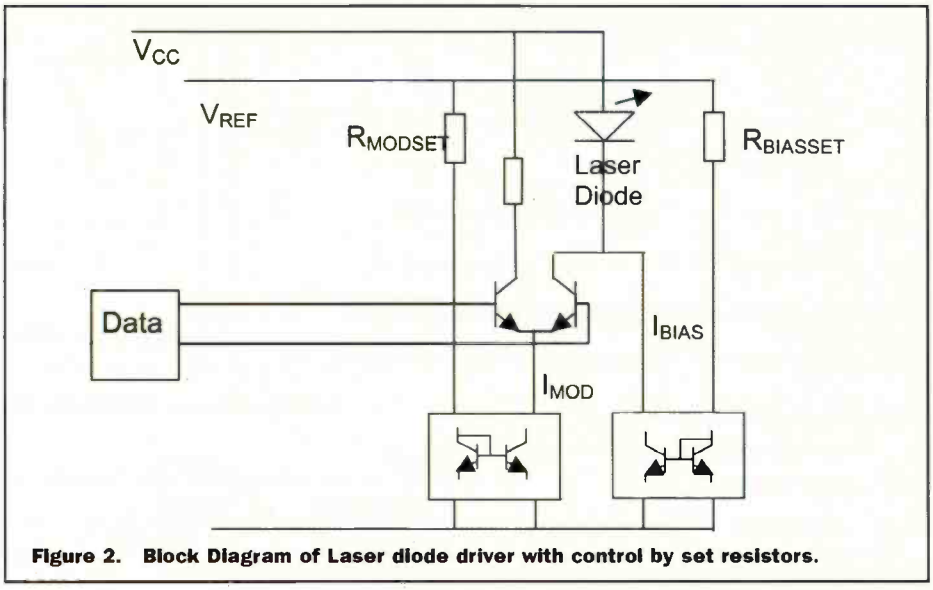


Figure 2. Block Diagram of Laser diode driver with control by set resistors.

Table 1 Representative Values for Semiconductor Diode Devices of Differing Types

Device	*Type*	*Wave-Length At mW*	*Threshold range/ mA*	*Modulation Range/*	*Slope efficiency µW/mA*	*Tracking error*
QLM5S790	DFB 1mW	1550nm,	5 to 50	10 to 50	20 to 100	+/-0.5dB
D571	DFB 2mW 15 at 25°C)	1550, (but 5 to to 35 at 25°C)	2 to 50 (but 15	7.5 to 60	57 to 133	+/-1.5dB
D370	MQW-FP	1310, 1mW	2 to 45 (but 5 to 15 at 25°C)	8 to 35 (but 10 to 20 at 25°C)	50 to 100	+/-1.0dB
STH61008G	DFB	1310, 1mW	5 to 55		25 to 150	
FLD3F11CX	MQW-DFB	1310nm, 2mW	2 to 20	33max	60 min	+/-0.5dB
FLD3F8HF	MQW-DFB	1310nm, 2mW	2 to 40	8 to 40	50 to 250	+/-1dB
HL6712G	Index-guided	670nm, 5mW	20 to 70		30 to 70	
HL6713G	Index guided	670nm, 5mW	20 to 50	6 to 20 (3mW)	16 to 45	
HFE-4380-321	VCSEL	850nm	to 6	3.5 to	20 to 100	0.2%/°C
RLD-78MA	Edge	0.35mW 785nm,	(typ. 3.5) Typ 35,	17.5 10 to 50		
QLD3S501	LED	5mW 1300, 5uW	max 50 NA	150mA	0.053min	

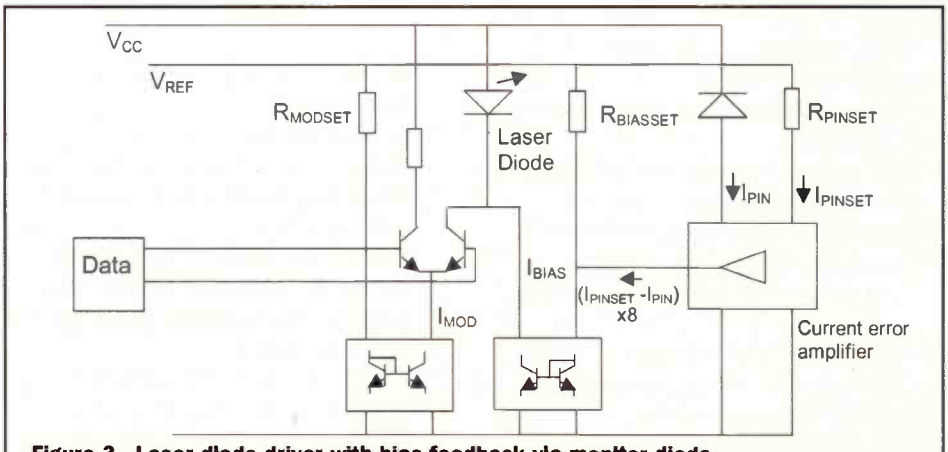


Figure 3. Laser diode driver with bias feedback via monitor diode.

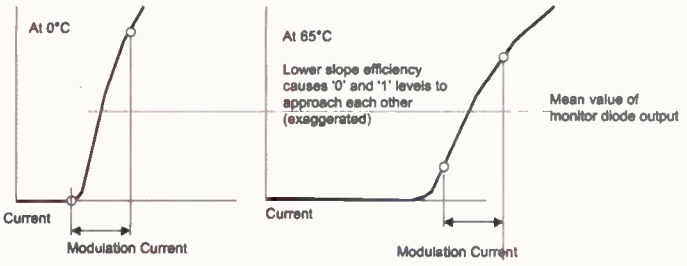


Figure 4a. Effect of Change in Slope Efficiency due to Temperature

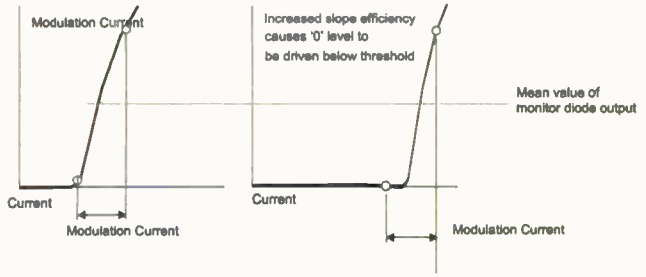


Figure 4b. Effect of Increase in Slope Efficiency.

$$P_1/(\eta\beta_{mod}) = (\Delta V_{MODSET}/R_{MODSET}) \quad 5$$

P_1 = nominal optical output power of a '1'

η = slope efficiency

β_{mod} = modulation current mirror gain

Each resistor depends upon three or more parameters some of which can have tolerances as high as (+100%/-50%). A simple calculation of minimum and maximum values reveals a potential range of values like that for RMODSET of 10:1.

However, common-sense engineering would dictate that absolute minimum or maximum possible values represent the combination of the "three-sigma" limit of every component, an extremely unlikely scenario or gross overdesign. An approach which acknowledges the statistical nature of product parameter distributions would use a root-mean-square method, where the square root of the sum of the squares of the possible variation (in relative terms) is calculated. Even the three sigma limit could be considered overkill, since a two-sigma threshold still gives 95% of products within the design range.

This approach assumes a normal or gaussian distribution for each parameter. For components which are selected from a population with a much wider distribution, this may not be valid. For parameters which vary over a 1:4 range, this method is obviously only approximate.

For the laser diode selected however, the distribution of threshold is indeed close to Gaussian[6], and these parts are not selected for any parameter.

Setting Resistors

Evidently the resistors used to control critical circuit currents need to be set-on-test for each individual combination of devices.

Ideally the setting device would:

- Have high resolution
- Allow adjustment over a wide range of resistance
- Be ready immediately after power-up
- Have low temperature coefficient
- Be immune to vibration and shocks
- Introduce minimal noise, both internally generated and coupled from the exterior
- Have low "wiper" resistance
- Be very stable with age and other environmental conditions
- Be proof against tampering
- Be resistant to accidental mechanical bumps
- Allow readjustment many times (at maintenance, and at regular checkups)
- Permit a given setting to be reproduced with high accuracy
- Have a small (probably surface mount) package for small form-factor package
- Avoid out-of-range values which may overdrive components
- Readily allow automatic adjustment under digital or computer control
- Allow multiple units in one package
- Be integrated with other ancillary functions
- Require no power supplies other than those available for other functions
- Be non-volatile (does not require power to retain settings)
- Allow a link to documentation of settings, with time/date stamp, serial number and operator data

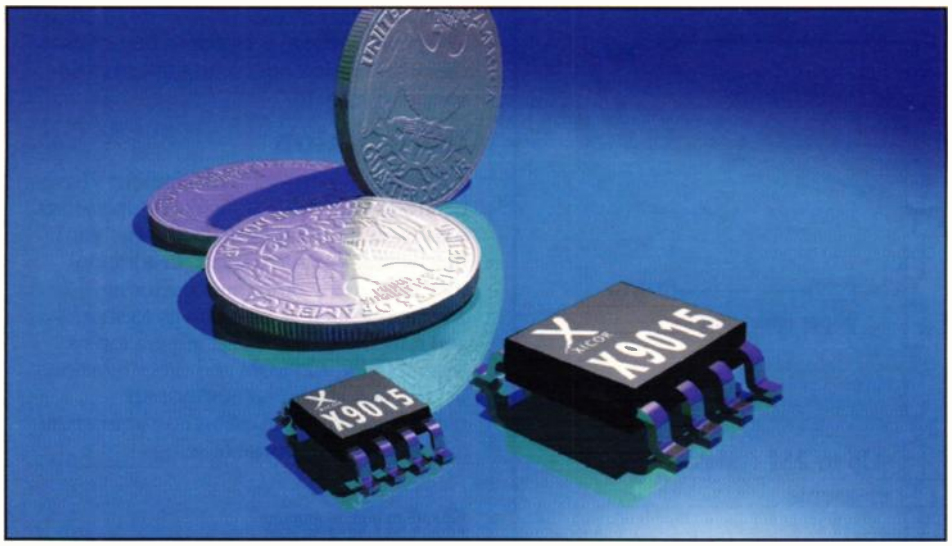
Digitally-controlled potentiometers (DCPs) are an established technology which provide solutions to many of the manufacturing and quality-assurance (QA) related issues.

Some other potential methods include

Table 2 - Relative Advantages of Mechanical vs. Digital Potentiometers

Item	*Trimpots*	*Digital Controlled Potentiometers*
Resolution	**Infinite**	**As low as 0.4% of R_{TOTAL}**
Resistance	**=/-100ppm/°C**	**+/-300ppm/°C of R_{TOTAL}**
Temperature Coefficient		
Wide range of R_{TOTAL} values	**Yes**	**Limited**
Number of readjustments	**200**	**1 000 000**
Contact resistance variation	**1% of R_{TOTAL}**	**Negligible**
Wiper resistance	**1% of R_{TOTAL}**	**300 ohm**
Setting Reproducible	**No**	**Yes**
Effect of shock	**1%**	**None**
Power-up ready	**Yes**	**Yes**
Noise	**Minimal**	**Minimal**
Ageing, humidity...	**1% (each)**	**Negligible**
Operator independant	**No**	**Yes**
Size minimum	**4 x 4 x 3mm + adjustment tool clearance (surface mount package)**	**2.6 x 3.9 x 0.43mm (BGA package)**
Computer control	**No**	**Yes**
Rapid set-up	**No**	**Yes**
Multiple resistors	**No**	**Yes**
Power supplies	**Not Applicable**	**+3.3V or +5Vdc**
Non-volatile	**Yes**	**Yes**
Other functions	**No**	**Yes - alarms, memory, power-up**
Records	**No**	**Yes (EEPROM)**

Note: For the purposes of meaningful and consistent comparison, a trimpot Bourns 3224 was compared with DCP Xicor 9520.



laser-trimmed hybrid resistors or switch-selected fixed resistors, but these are considered less appropriate in the case of fibre optic modules which require very compact design and a setup procedure automated as far as practicable.

The traditional technology of multi-turn trim potentiometers has a number of shortcomings. Table 2 summarises the relative advantages:

Clearly the technology of digitally-controlled potentiometers offers many advantages, as long as sufficient resolution and temperature stability can be obtained.

Product Example

A recent product release from Xicor, the X9520, combines the best features of digitally-controlled potentiometer technology. It includes three DCP devices, containing a large number of steps of resolution (up to 256), and two different resistance values with good temperature-stability. These are chosen expressly to allow realization of fibre optic interfaces. The DCPs are integrated with 2K of EEPROM memory for data storage and three alarm comparators with trip levels programmed as analog voltages. The whole is controlled by a two-wire digital bi-directional bus, and includes power-on-reset circuitry. Resistor settings are set as programmed immediately after the power-on-reset sequence is completed. The power requirement is a single supply (2.7V to 5.5V), and the device is available in packages as small as 2.6 x 3.9mm (XBGA).

Design Example

To explore the need for resolution in setting, an example design will be made with a VCSEL, Honeywell type HFE4380-321, and a transmitter controller chipset Micrel Synergy SY88922 / SY88905.

An initial design decision is that the laser diode will be operated at the nominal value of 0.35mW. Assume operation at close to room temperature of 25°C.

At high data rates the monitor current is a measure of the "average" value of optical power, weighted according to the line code 1/0 ratio. Assume in this case that the line code has a 50% ratio (eg Manchester, 8B/10B or many other line codes).

With the laser diode giving 0.35mW at each '1', the monitor current will be 50% of the datasheet value, ie between 0.035 and 0.1375mA.

From the datasheets of the respective devices, component parameters can be determined (Table 3)

Using the above design equations, the potential range or resistors can be calculated, both as absolute minima / maxima, but also as statistical limits (Table 4).

Using the "three-sigma" values, the potentiometer values and series fixed resistors can be selected as shown in Figure 5.

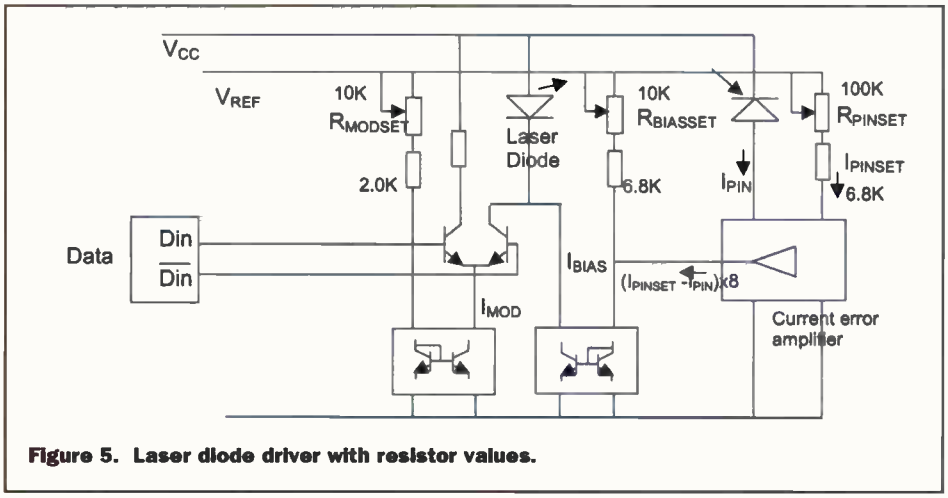


Figure 5. Laser diode driver with resistor values.

Table 3 - Component Parameters Including Range of Values

	Min.	Typ.	Max.	Units
β_{mod}	30	38	44	µA/µA
β_{bias}	28	37	44	µA/µA
ΔV_{PINSET}	0.95	1.13	1.35	V
$\Delta V_{BIASSET}$ and ΔV_{MODSET}	0.8	1.0	1.2	V
μ	0.02	0.04	0.1	µW/µA
I_{TH} [6]	2.5	3.5	5.0	mA
I_{PIN}	0.07	0.15	0.275	mA at 0.35mW

Table 4 -Range of Calculated Resistor Values

	Min.	-3σ	Typ.	+3σ	Max.	Units
R_{PINSET}	6.9	7.2	14.4	29	38.6	kohm
$R_{BIASSET}$	4.5	6.9	10.6	16	21.1	kohm
R_{MODSET}	1.4	2.0	4.3	9.5	15.1	kohm

Table 5 - Estimates of Resolution for Setting Resistors

Item	Number of resistor steps	Resolution $=R_T/N$ in ohm	Resolution worst case $A_R=R_T/(NR_O)$
R_{PINSET}	256	400	6
$R_{BIASSET}$	64	160	2.6
R_{MODSET}	100	100	4.5

Resolution and Stability of Setting

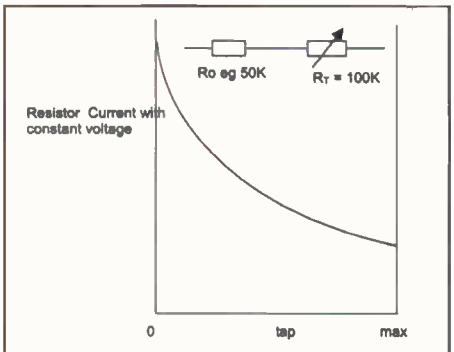


Figure 6. Resistor Currebt with constant voltage as Variable Resistance Caries

The use of resistors with discrete steps can potentially make the resolution overly coarse. The worst case is where the variable resistor is at a minimum (current maximum) as shown in Figure 6.

We define a resolution parameter AR of the worst case percentage change in current due to a single step as

$$A_R = \frac{(\text{current at } N=0 - \text{current at } N=1)}{(\text{current at } N=0)}$$

$$A_R = \frac{\left[\frac{V}{(R_O)} - \frac{V}{(R_O + R_T/N)}\right]}{\left[V/R_O\right]} = \left[\frac{R_T}{N R_O}\right]$$

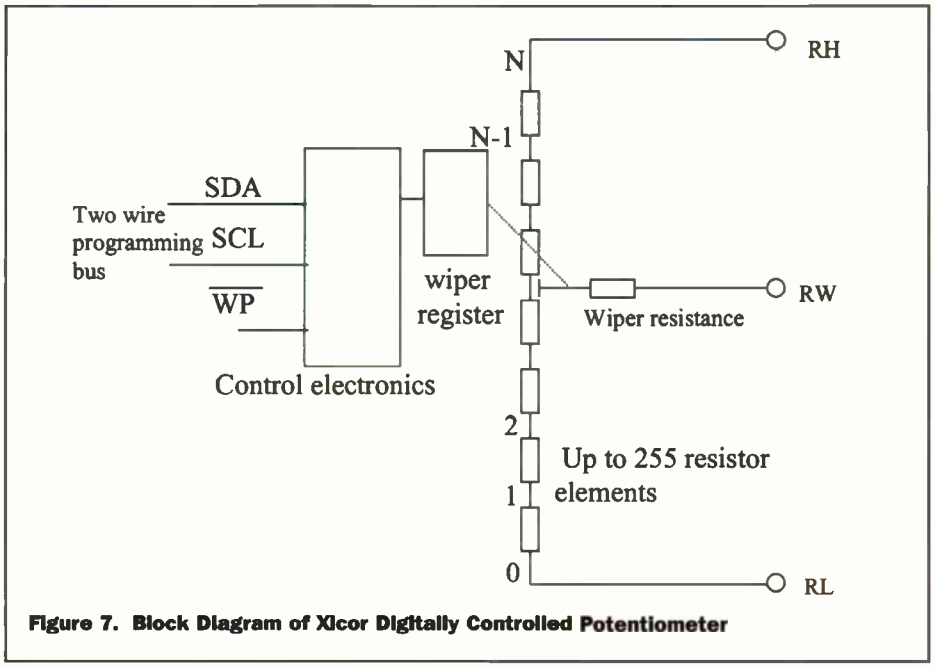


Figure 7. Block Diagram of Xicor Digitally Controlled Potentiometer

where R_0 is the series fixed resistor value and RT is the variable resistor total value and N is the number of steps. The resolution for each resistor is estimated in Table 5.

The worst case value of 6% means that the setting can approach any desired target value to within +/- 3%. Since RBIASSET and RPINSET form part of the same control loop, the actual resolution is the lesser of the two contributors, ie +/-1.3%. The resolution of RMODSET is well within the +/- 7% we require.

The worst case temperature drift of 300ppm/∞ C implies a maximum possible change of only 1% for a (large) 33°C change.

These values are similar to the uncertainty of mechanical potentiometer settings due to environmental influences alone.

About Digitally Controlled Potentiometers

The architecture of the DCP used in the example includes a chain of (N-1) poly-silicon resistors, having N tap points. A CMOS transistor switch selects one of these taps, under control of the contents digital register, which can also be stored in non-volatile EEPROM as well. Other data, such as time/date, serial number, maintenance or calibration history can be stored in supplementary EEPROM.

In the example Xicor device, three potentiometers with values 100K, 10K and 10K are integrated into the one package. This technology also permits analog voltage storage in EEPROM cells so that alarm levels such as for compliance voltage or low-power can be programmed as a dc analog voltage. Integrated comparators provide digital warning signals. Retention time of the EEPROM process is very long (100 years, 1E6 write cycles)

The programming is via a two wire interface, of which one line is bi-directional to allow acknowledgement of commands. Each resistor has a digital "address" to allow it to be individually commanded, and several devices can be individually addressed. A write protect feature gives improved integrity to the settings. The block diagram in Figure 7 shows the main features of the digitally-controlled potentiometer.

Should greater resolution be required, an alternative method is available, that of using the potentiometer to control the resistor voltage (Figure 8).

Conclusion

Digitally Controlled Potentiometers have been shown to have sufficient temperature stability and resolution to "compete" with mechanical potentiometers. In addition they offer many other manufacturing advantages such as insensitivity to shocks and tampering, small size, integration of several DCPs, EEPROM and other functions in one package, compatibility with computer-controlled calibration equipment for high-speed repeatable setup.

References

1 Micrel Synergy Datasheet, SY88922
2 Sony Datasheet , CXB1549Q
3 Honeywell Optoelectronics Application Sheet, "Modulating VCSELS"
4 Philips Semiconductors, datasheet "TZA3041AHL; TZA3041BHL; TZA3041U Gigabit Ethernet/Fibre Channel laser Drivers", 22 Feb 2000
5 Honeywell Optoelectronics Application Sheet, "Modulating VCSELS", Figure 2
6 Honeywell Optoelectronics, Honeywell VCSEL Manufacturability", 8 Aug 2000, p.1

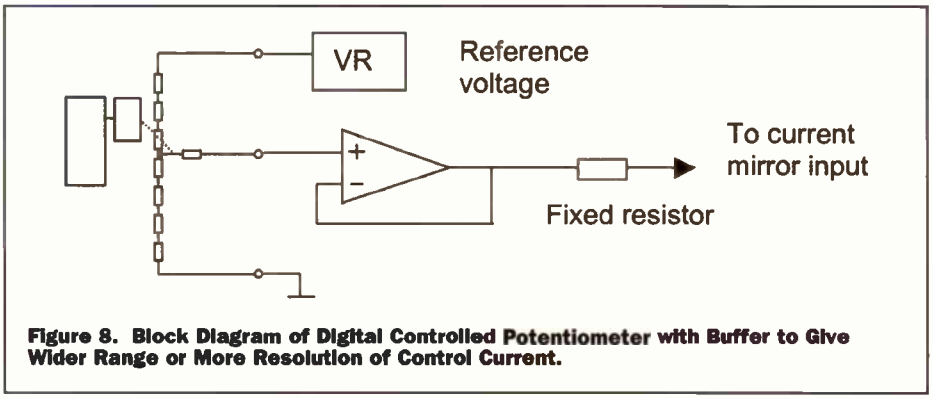


Figure 8. Block Diagram of Digital Controlled Potentiometer with Buffer to Give Wider Range or More Resolution of Control Current.

The explosive growth of the fiber optic communications market has created a fast growing market for Xicor's family of X9520 devices. The X9520 is targeted at controlling the laser diodes in fiber optic modules for Fibre Channel and Gigabit Ethernet. The X9520 integrates 3 digital potentiometers, 2k bit memory, and 3 voltages monitors that combine Xicor's EEPROM technology with mixed signal functions.

Faster Than c-Light PROPAGATION

by Reg Miles

At the NEC Research Institute in Princeton, USA, scientists have made a light pulse traverse a chamber in less time than it takes light to travel the same distance at its normal velocity in a vacuum (c). However, this apparent contradiction of relativity is not quite what it seems to be. The researchers, Lijun Wang, Alexander Kuzmich, and Arthur Dogariu, have been at pains to point out that the experimental study was performed with great care and repeated numerous times; that the results are consistent with what their theoretical model predicted; that the theoretical model is entirely based on existing physics theories of electromagnetism and quantum mechanics; and thus it does not contradict relativity.

The early press reports of their having measured a light pulse that was travelling at over 300 times c-light velocity are therefore erroneous. But still, in the experiment, the light pulse did emerge on the far side of the chamber sooner than if it had travelled through the same thickness in a vacuum - by a time difference that was measured at 310 times that of the vacuum transit time (this being the time that it takes light to traverse a distance in a vacuum). So it is certainly open to misinterpretation.

The experiment consisted of making a smooth light pulse of about 3 microsecond duration propagate through an atomic chamber of 6cm in length that had been filled with caesium atomic gas. It takes 0.2 nanosecond for a light pulse to traverse a 6cm length in a vacuum. In this case the light pulse emerged from the chamber 62 nanoseconds sooner than if it had propagated through the same thickness in a vacuum. As the researchers put it, 'The net effect can be viewed as follows: the time it takes a light pulse to traverse through the specially prepared atomic medium is a negative one. This negative delay, or a pulse advance, is 310 times the vacuum transit time.' (310 x 0.2 = 62 nanoseconds).

'The experiment can be well explained using existing physics theories that are consistent with relativity. In fact, the experiment was designed based on calculations using existing physics theories. However, our experiment does show that the generally held misconception "nothing can move faster than the speed of light" is wrong. The statement only applies to objects with a rest mass. Light can be viewed as waves and has no mass. Therefore, it is not limited by its speed inside a vacuum. Information coded using a light pulse cannot be transmitted faster than c using this effect. Hence, it is still true to say that "Information carried by a light pulse cannot be transmitted faster than c." The detailed reasons are very complex and are still under debate.'

It is one of those superluminal effects that can occur in an anomalous dispersion material - which is what the specially prepared Caesium was. The figure shows a greatly exaggerated version of what must be happening in the experiment. In Region 1, in air, the three waves begin in phase, then go out of phase (the experiment did not use just three wavelengths, it is a reduction for the sake of clarity). In the anomalous dispersion Region 2, inside the Caesium chamber, the wavelengths change - the short gets longer and the long gets shorter - modifying their phase relationship again. When the waves emerge from the chambers' exit surface their normal wavelengths are restored. Then, due to the phase modulation that occurred as they passed through the anomalous dispersion region they rephase in Region 3, in air, to replicate the exact form of the original pulse at that farther point.

Such a phenomenon could not happen in any material with normal dispersion properties - a light pulse cannot rephase to appear at a farther point along its propagation direction, it would travel normally and arrive at that farther point at a later time. The observed results were due entirely to the unusual properties of the anomalous dispersion material, that caused the rephasing, that made the light pulse behave as if it had jumped between the two points and thus taken a negative time to traverse the distance.

The researchers achieved this anomalous dispersion by preparing the Caesium in a form that is not naturally occurring. Using the technique of optical pumping the Caesium atoms were driven almost entirely to just one of Caesium's 16 possible quantum states, corresponding to a temperature of almost zero Kelvin. Apparently, the properties of this medium are closely related to those of the lasers used for the optical pumping.

The researchers conclude with the hope that their work 'Can find its usefulness in peaceful applications that benefit humanity.' They speculate that, by using this effect, it might be possible to increase information transfer speed up to c. They also mentioned the Internet and inside a computer as examples of present day technology where information is transmitted at speeds far slower than c and these would benefit from a good boot of superluminal motion.

For additional information contact: Aston Bridgman, Corporate Communications Division, NEC Corporation, 7-1 Shiba 5-chome, Minato-ku, Tokyo 108-8001 Japan. E-mail: a-bridgman@ak.jp.nec.com

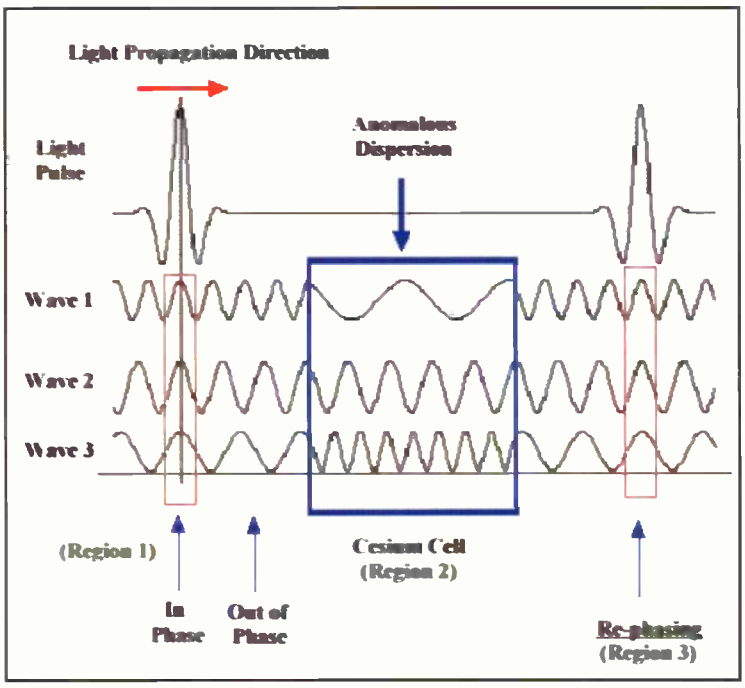


Figure 1. A "snapshot" of a propagating light pulse. A light pulse is made of many component waves (waves 1 through 3). Inside an anomalous dispersion region (region-2), the waves propagate in an unusual way. The result is that the waves are "rephased' again at a distant place along its propagation direction to produce the incoming pulse. The effect is greatly exaggerated here for the purpose of illustration.

Triac Principles AND CIRCUITS

PART 2

Ray Marston concludes his description of triac principles and circuits in this second episode of this 2-part mini-series.

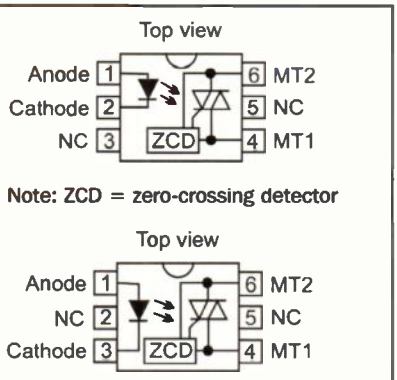


Figure 1. Typical optocoupled synchronous 'zero-voltage' triac outlines and pin notations.

Last month's opening episode of this 2-part feature explained triac basics, looked at various practical triac power switching circuits, introduced optocoupled triacs, and explained basic synchronous 'zero-voltage' power switching principles. That episode concluded by pointing out that the simplest way of making a really efficient synchronous 'zero-voltage' triac-driving circuit is with the aid of a special-purpose IC that functions as an optocoupled low-power synchronous 'zero-voltage' triac that can easily be used as a slave for synchronously driving a normal high-power triac. This month's concluding episode gives practical details of such circuits, together with other triac-related circuits and information.

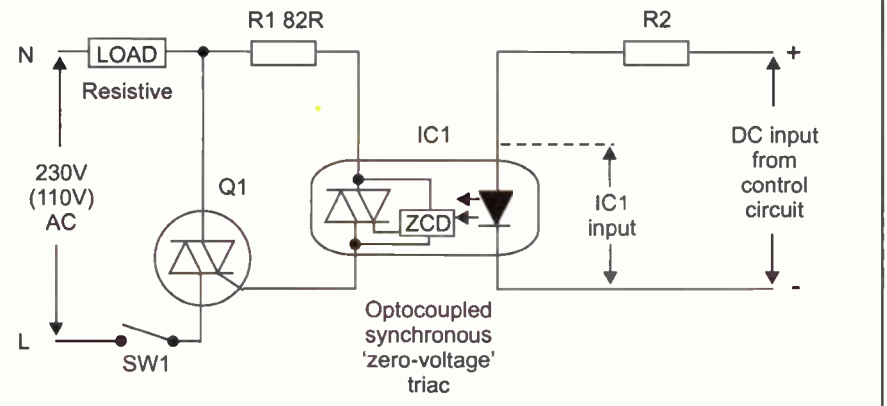


Figure 2. Basic power switching circuit using an optocoupled synchronous 'zero-voltage' triac.

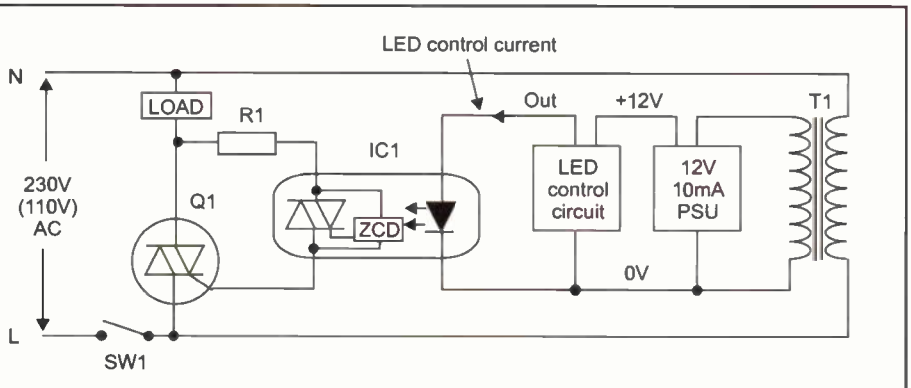


Figure 3. Basic power switching system using an optocoupled synchronous 'zero-voltage' triac.

Optocoupled synchronous power switching

Synchronous 'zero-voltage' triac-driving circuits are widely used in modern electric heating and filament-lamp lighting control systems. Until fairly recently, several companies produced special synchronous 'zero-voltage' triac-gating ICs for use in such applications; the best known of these ICs were the CA3059 (from RCA) and the TDA1024 (from Signetics), which each had built-in AC-derived DC power supply circuitry, a zero-crossing detector, triac gate drive circuitry, and a high-gain differential amplifier/gating network. In the mid-1990s, however, all of these ICs were made obsolete by the introduction of a new and modestly priced type of IC that functions as an optocoupled low-power synchronous 'zero-voltage' triac that can easily be used as a slave for synchronously driving normal high-power triacs.

Several companies (including Isocom, Motorola, Sharp, Siemens, and Toshiba) manufacture optocoupled synchronous zero-voltage triacs. Most of these devices take the form of a six-pin DIL IC, as shown in Figure 1, and house a simulated triac that has its gate drive controlled via an integral photosensitive zero-crossing detector (ZCD), which can be remotely energized via an integral LED. Typically, this type of optocoupled triac has maximum AC ratings of 400V peak and 100mA r.m.s. (with a surge rating of 1.2A for 10µs), will only trigger when the instantaneous AC voltage is below a fixed zero-cross inhibit voltage (V_{IH}) value of ±15V nominal (±25V maximum), has a maximum LED forward current rating of 60mA, has a typical input current trigger sensitivity of 8mA or less, and the entire package has an isolating voltage rating of several kV.

Optocoupled synchronous zero-voltage triacs are easy to use and provide excellent electrical isolation between input and output. The input is used like a normal LED, and the output like a low-powered triac. In most practical applications, the optocoupled triac is used to activate the gate of a 'slave' triac, thereby driving a resistive AC load of any desired power rating. Figure 2 shows a practical circuit of this type, which can be manually or automatically switched on or off via a DC input current.

Note in Figure 2 that R1 is used to limit the peak switch-on current of the optocoupled triac (and thus the peak gate current of Q1) at IC1's absolute maximum V_{IH} value minus 2V, i.e., typically at 23V; with the R1 value shown, the peak switch-on current is limited to 280mA. R2 is used to limit the LED input current of IC1 to a sensible working value.

Figure 3 shows one way of incorporating the above circuit in a complete electric power switching system. Here, when SW1 is closed, the AC power line is connected to both the load/Q1 circuitry and to the primary of low-power transformer T1, which has its output converted into a 12V DC supply that powers IC1's LED control circuit, which is electrically fully isolated from the AC supply. The LED control circuit can take any of a variety of forms; some simple examples are shown in Figures 4 to 7.

The simplest LED control circuit that can be used in the Figure 3 system consists of an on/off

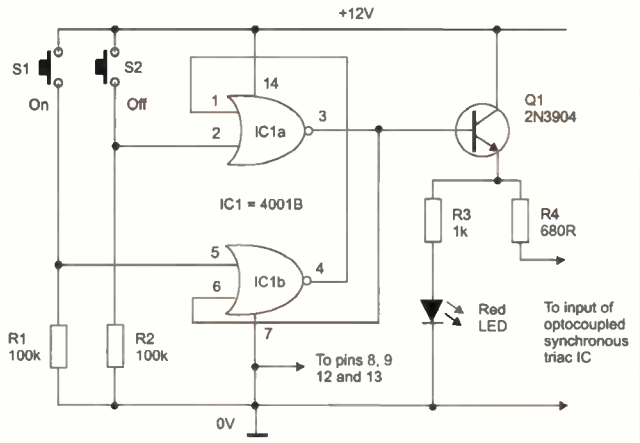


Figure 4. Dual push-button LED control circuit for use in the Figure 3 system.

toggle switch that - when closed - connects the IC1 LED to the 12V DC supply via a 680R resistor that limits the LED 'on' current to about 15mA, thereby switching the electric load fully on.

Figure 4 shows a dual push-button LED control system, in which the LED and load turn on when S1 is briefly closed, and off when S2 is briefly closed. Here, CMOS NOR gates IC1a-IC1b are wired as a manually triggered bistable multivibrator that has its output buffered by emitter follower Q1 and latches into the 'output high' state when S1 is briefly closed, thereby energising the circuit's red LED via R3 and feeding a 15mA control current to the LED input of the optocoupled triac. The bistable latches into the 'output low' state when S2 is briefly closed, thereby killing the DC power feeds to the red LED and the triac.

The Figure 4 circuit gives purely manual on/off LED control of an electrical power load such as a heater. Figure 5 shows a simple circuit that also provides the option of automatic control via an adjustable thermostat switch that is normally closed but opens when its temperature exceeds a selected value. Here, the red LED and the electric heater are off when SW1 is in the 'off' position or in the 'auto' position when the thermostat is open, but are on when SW1 is in the 'on' position or in the 'auto' position when the thermostat is closed.

Figures 6 and 7 show high-precision versions of the basic Figure 5 circuit, with the thermostat replaced by a temperature-sensitive electronic switching circuit. The Figure 6 circuit uses an ordinary silicon diode (D1) as a thermal sensing element. Here, zener diode ZD1 is wired in series with R1 so that a constant 5.6V is developed across the two potential dividers formed by R2-R3-RV1-RV2 and R4-D1, and a near-constant current thus flows through each of these dividers. A constant reference voltage is thus developed (via RV1) between the R1-ZD1 junction and pin-2 of the 741 op-amp, and a temperature-dependent voltage with a coefficient of -2mV/°C is developed between the R1-ZD1 junction and pin-3 of the op-amp. Thus, a differential voltage with a coefficient of -2mV/OC appears between pin-2 and pin-3 of the op-amp, which is wired as a high-gain (open loop) voltage comparator with slight hysteresis applied via R6.

In Figure 6, RV1 is a linear rotary pot that is used to manually adjust the heater system's operating temperature over a ±10°C (nominal) range, and RV2 is a multiturn preset that is used to set the circuit's nominal (with RV1 at mid-scale setting) trip temperature. To initially set up the circuit, set RV1 to mid-scale, adjust the temperature of D1 to the desired mid-scale trip value, then trim RV2 so that the red LED is on but goes off again if the D1 temperature is increased slightly (by briefly applying finger heat to D1). In practice, the circuit has a typical switching sensitivity of about 0.5°C.

The Figure 7 circuit uses an inexpensive NTC (negative temperature coefficient) bead or disc thermistor, with a nominal resistance of 4k7 at 25°C, as its thermal-sensing element. Here, potential divider RV1-TH1 applies a temperature-sensitive voltage to pin-3 of the 741 op-amp, and potential divider R1-R2-RV2-R3 applies a preset reference voltage to pin-2 of the op-amp. The two potential dividers are actually wired in the form of a Wheatstone bridge, and the op-amp is used as a high-gain bridge balance detector; the bridge balance point is unaffected by variations on supply voltage. Capacitors C1 and C2 help to ensure circuit stability.

The action of the Figure 7 circuit is such that (when SW1 is in the Auto position) the output of SW1 is normally low but switches high and activates the red LED and the external triac when the TH1 temperature is below a value pre-set via RV1 and RV2. RV2 is a linear rotary pot that is used to manually adjust the heater system's operating temperature over a limited range, and RV1 is a multiturn preset that is used to set the circuit's nominal (with RV2 at mid-scale setting) trip temperature. To initially set up the circuit, set RV2 to mid-scale, raise the temperature of TH1 to the desired mid-scale trip value, and then trim RV1 so that the red LED is on but goes off if the TH1 temperature is increased slightly.

Note that the Figure 7 circuit has a typical switching sensitivity similar to that of the Figure 6 design (about 0.5°C), but that its thermistor has a far longer thermal time constant than the sensing diode of the Figure 6 circuit; the Figure 7 circuit is thus slower-acting than the Figure 6 circuit. Also note (in Figure 7) that the thermal 'span' range of RV2 can be increased (or reduced) by increasing (or reducing) the value of resistor R2.

Finally, note that - in all cases where an 'automatic' heater-control circuit is used to regulate the temperature of a room - the actual thermal sensor device (thermostat, thermistor or sensing diode) must be sited roughly 1 metre above floor level, in a position where it can directly and safely sense the temperature of normally-circulating air; this position must be free of draughts or direct radiation from the heater, and must not be obstructed by furniture, etc.

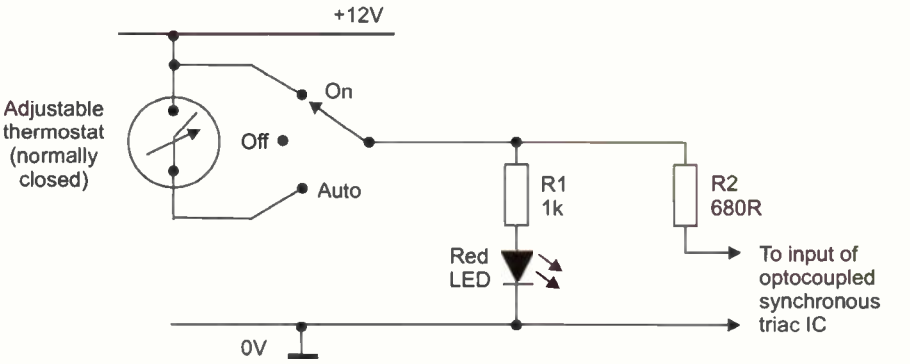


Figure 5. 'Thermostat' LED control circuit for use in the Figure 3 system.

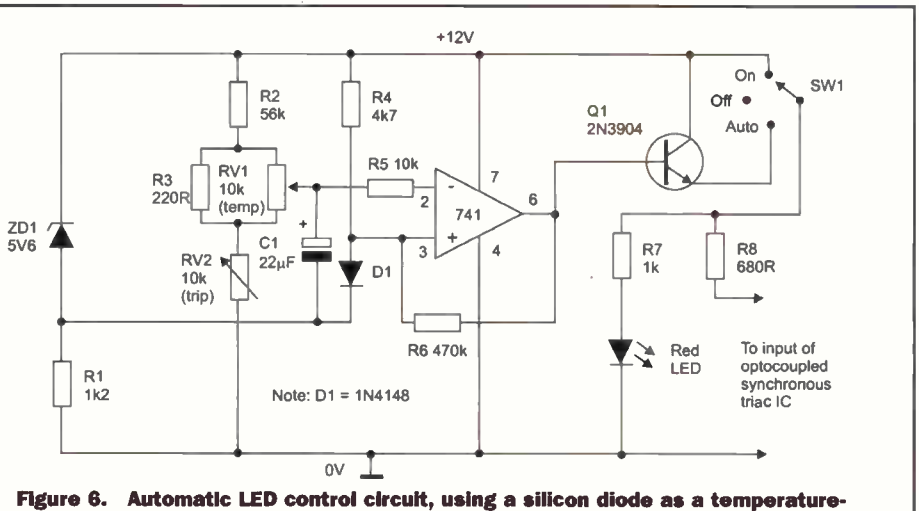


Figure 6. Automatic LED control circuit, using a silicon diode as a temperature-sensing element,

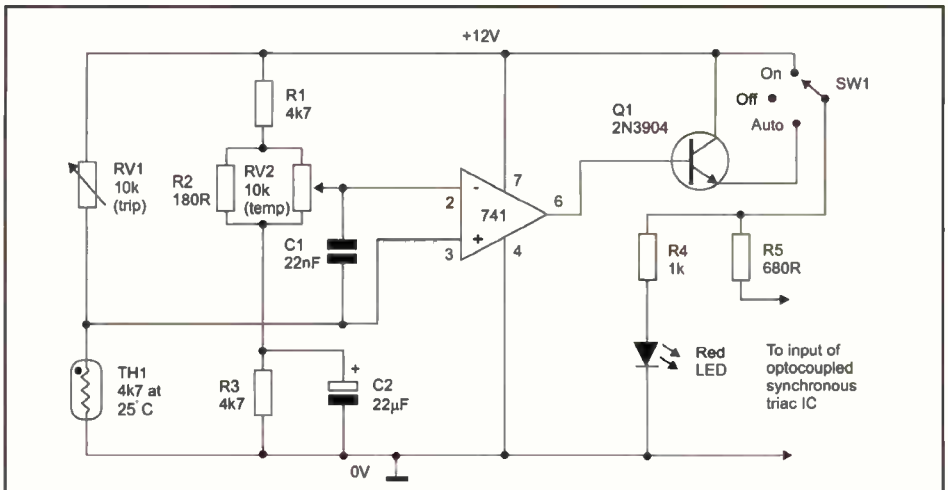


Figure 7. Automatic LED control circuit, using a NTC thermistor as a temperature-sensing element, for use in the Figure 3 system.

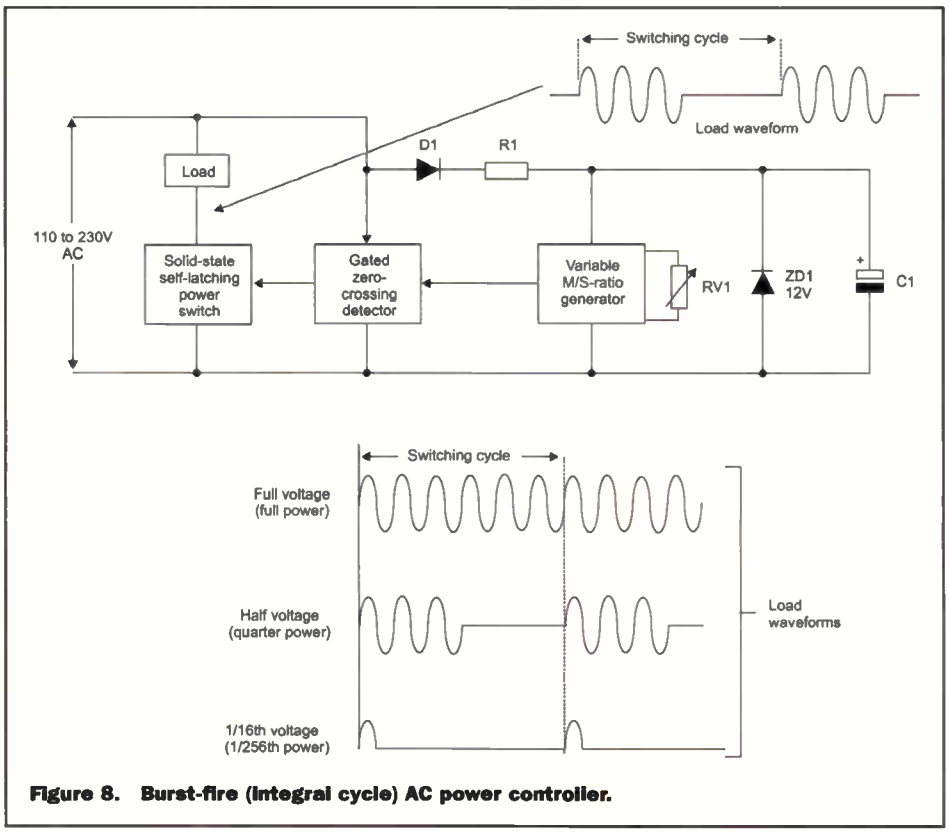


Figure 8. Burst-fire (integral cycle) AC power controller.

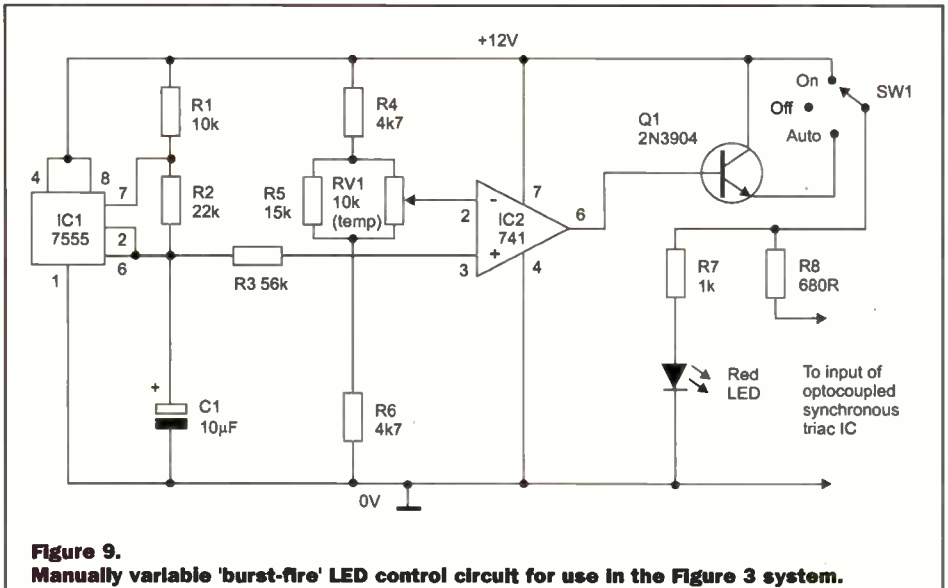


Figure 9.
Manually variable 'burst-fire' LED control circuit for use in the Figure 3 system.

'Burst fire' AC power control principles

There are three basic ways of controlling the AC power feed to resistive loads such as filament lamps or electric heaters via a triac. One of these is the variable phase-delay-switching system, which gives fully-variable power control and is often used in lamp dimmers, but generates substantial RFI and is thus unsuitable for driving high-power (greater than about 200W) loads. The second is the synchronous zero-voltage power switching system (see last month's Figure 19), which generates minimal RFI but gives only a simple on/off - rather than fully-variable - type of power control.

The third method of AC power control is the burst-fire integral-cycle system shown in Figure 8, in which bursts of complete half-cycles are fed to the load at regular line-frequency-related intervals. Thus, if bursts are repeated at 8-cycle intervals, the mean load voltage equals the full supply line value if the bursts are of 8-cycle duration, or half voltage (equals quarter power) at 4-cycle duration, or one sixteenth voltage (equals 1/256th power) at one half-cycle duration, etc. The burst-fire system thus gives variable power control and generates minimal RFI, and is often used to control the thermal output of electric heaters.

Note that the burst-fire integral-cycle control system operates on the synchronous 'zero-voltage' triac switching principle, and practical circuits of this type can thus be made by using suitable control circuitry in conjunction with the basic power switching system of Figure 3. Two suitable circuits are shown in the next section of this article.

'Burst-fire' heater control circuits

The optocoupled synchronous circuits shown in Figures 2 to 7 all - when powering a heater load - give a simple form of control in which the heater is either fully off or is operating at maximum power. Figures 9 and 10 show circuits that drive the heater in the synchronous burst-fire mode, thus enabling the heater's thermal output to be varied over a wide range. The Figure 9 circuit enables the heater's thermal output to be varied manually, via RV1. The Figure 10 circuit varies the heater's output automatically, to maintain a room's temperature at a precise pre-set value.

The operation of the Figure 9 circuit is fairly simple. Here, IC1 (a CMOS version of the 555 'timer' IC) is wired in the astable mode and generates a repeating ramp waveform across C1. This waveform has a period of about 680ms (thus spanning roughly 68 half-cycles of a 50Hz power line waveform or 82 half-cycles of a 60Hz waveform during each period) and is centred on half-supply volts and swings symmetrically between 1/3rd and 2/3rds of supply voltage value. This waveform is fed to pin-3 of op-amp IC2 via R3, and linear rotary pot RV1 feeds a dc reference voltage that is variable from below 1/3rd to above 2/3rds of the supply voltage value to pin-2 of the op-amp, which is configured as a high-gain voltage comparator.

The net effect of the above circuitry is that IC2 converts the 680mS ramp waveform into a switched rectangular output waveform with a

mark/space (M/S) ratio that is fully variable from 0:1 (output low for the full 680ms period) to 1:0 (output high for the full 680ms period) via RV1. When SW1 is switched to the Man (manual) position, this output is fed to the input of the Figure 3 optocoupled synchronous electric heater control system, where it enables the mean power input to the heater to be varied (via RV1) from zero to maximum in 68 discrete 'half-cycle' steps in a 50Hz system or 82 steps in a 60Hz system.

Finally, to complete this look at burst-fire heater control circuits, Figure 10 shows a self-regulating synchronous burst-fire heater controller that automatically varies the heater's input power to maintain a room's temperature at a precise pre-set value. Here, the circuit to the right of R3 is almost the same as the Figure 7 thermistor-controlled automatic circuit, but the IC1 circuit to the left of R3 is taken directly from the Figure 9 circuit and superimposes a 680ms ramp waveform (with a peak-to-peak amplitude of about 40mV) on the RV1-TH1 junction and pin-3 of IC2.

The net effect of the above combination is that the external heater is turned fully on (via the optocoupled triac in the Figure 3 system) if the TH1 temperature is more that (say) 1°C below a pre-set value, or fully off if it is more that 1°C above the pre-set value, but is operated in the burst-fire mode - with its M/S ratio automatically adjusted via TH1 - when the TH1 temperature is within ±1°C of the pre-set value. The circuit thus automatically adjusts the heater's thermal output level to meet the room's heating needs; when the temperature reaches the precise pre-set value the heater does not switch fully off, but generates just enough output power to exactly match the thermal losses of the room.

To initially set up the Figure 10 circuit, set RV2 to mid-scale, raise the TH1 temperature to the desired mid-scale trip value, then trim RV1 so that the red LED flashes on and off (at roughly a 1.5Hz rate) but goes fully off if the TH1 temperature is increased slightly. When experimenting with this circuit, note that the thermal 'span' range of RV2 is determined by the R5 value and the burst-fire thermal operating span is determined by the R3 value.

Finally, note - when using burst-fire systems to control domestic electric heaters with built-in lamps - which the control system must be fed to the heater elements only, and must not be applied to the lamps.

AC lamp dimmer circuits

Triacs can be used to make very efficient lamp dimmers by using the 'phase-delayed switching' technique in which - in each power half-cycle - the triac is gated on at some controlled phase-delayed time after the start of each AC half-cycle, thus controlling the mean power fed to the lamp. All such circuits require the use of a simple L-C filter in the lamp feed line, to minimise RFI problems.

The two most popular ways of obtaining variable phase-delay triac triggering are to use either a diac plus C-R phase delay network, or to use a special-purpose IC as the triac trigger. Figure 11 shows a practical diac-triggered lamp dimmer, in which R1-RV1-C1 provide the variable phase-delay. This circuit is really a simple variant of the basic lamp dimmer circuit shown in last month's Figure 6, with the addition of the L1-C2 RFI suppressor and with RV1 and SW1 ganged together to easily enable the lamp to be turned fully off.

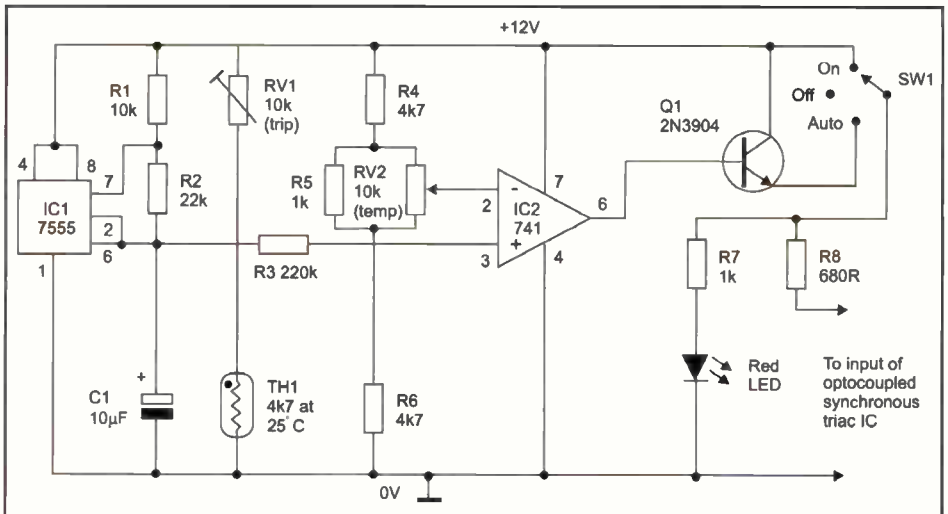


Figure 10. Fully automatic 'burst-fire' LED control circuit for use in the Figure 3 heater control system.

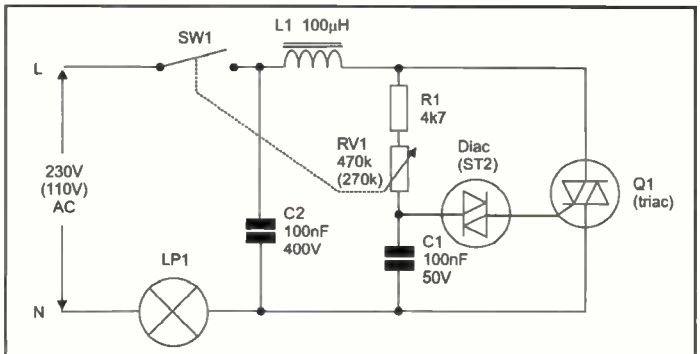


Figure 11. Practical circuit of a simple diac-type lamp dimmer with RFI suppression.

A weakness of the simple Figure 11 design is that it has considerable control hysteresis or backlash, e.g., if the lamp is dimmed off by increasing the RV1 value to (say) 470k, it will not go on again until RV1 is reduced to about 400k, and then burns at a fairly high brightness level. This backlash is caused by the diac partially discharging C1 each time the triac fires. Backlash can be greatly reduced by using the 'gate slaving' technique of Figure 12, in which the diac is triggered from C2, which 'follows' the C1 phase-delay voltage but protects C1 from discharging when the diac fires. If desired, the backlash can be reduced to virtually zero by wiring a current-limiting resistor in series with the diac, to reduce the magnitude of the C2 discharge voltage, as shown in Figure 13.

A 'smart' lamp dimmer IC

Many modern lamp dimmers have their triac driven via a dedicated 'smart' IC that can turn the lamp on or off or control its brilliance, the IC taking its action commands via a touch-sensitive pad or push-button input switch. For many years Siemens were the leading producer of this type of IC, first with the IC known as the S566B, and then (starting in 1990) with the SLB0586, which remained in full production until 1995 (but was still widely available in early 2000). Today (in year 2000), the most popular lamp dimmer IC is a low-cost Holtek product known as the HT7704B 'touch' dimmer.

The HT7704B is an 8-pin DIL IC with the outline and pin notations shown in Figure 14,

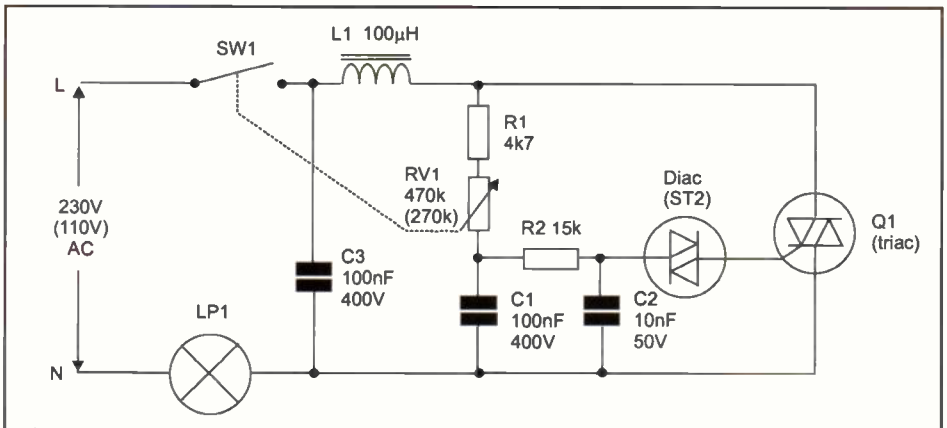


Figure 12. Improved diac-type lamp dimmer with gate slaving.

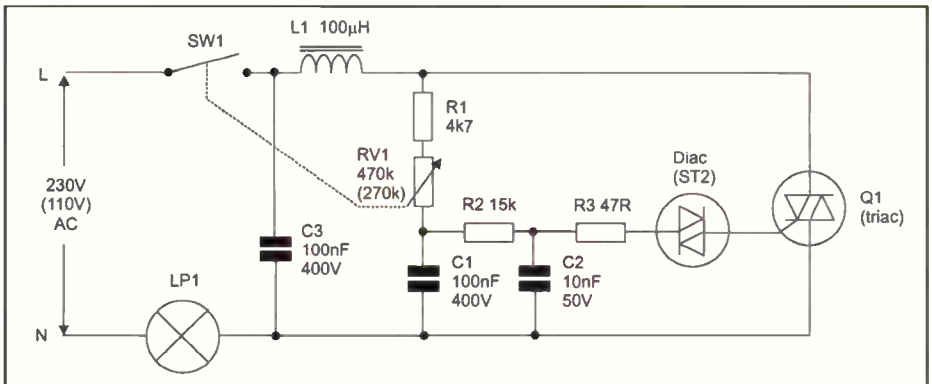


Figure 13. Minimum-backlash diac-type lamp dimmer.

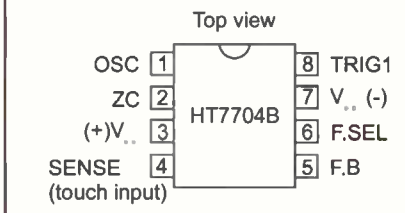


Figure 14. HT7704B outline and pin notations.

and provides four levels of brightness plus switch-off control, all sequentially selectable via a simple metal 'touch' pad or plate that is ac coupled to pin-4 of the IC. In use, the first 'touch' turns the lamp on at its lowest brightness level; the next three touches bring the brightness up to maximum level in successive stages; the fifth touch turns the lamp full off, and so on.

Figure 15 shows the basic application circuit of the HT7704B (without fused overload protection or RFI-suppression circuitry), with alternative component values and pin-connections shown for use with 50Hz or 60Hz AC supplies with nominal values of 110V or 220V. Note that R1 is a 2W type and needs a value of 22k on 110V AC supplies or 47k on 220V AC supplies, that pin-6 must be tied to pin-7 on 50Hz supplies or pin-3 on 60Hz supplies, and that the ratings of triac Q1 must be chosen to suit the lamp power and supply-voltage rating of the individual system.

Triac protection techniques

In use, triacs must always have an r.m.s. current rating greater than that of the load that they are driving and must always be protected against catastrophic damage from current surges or malfunctions in their loads. Adequate protection can usually be obtained via a suitably rated quick-blow fuse that is effectively connected (either directly or via a supply-connection plug) in series with the load and the triac's main terminals, but in a few special applications additional protection may also be needed. Note that the fuse value must always be chosen with great care, and should be of the minimum practicable rating; a fuse with too high a rating provides no useful protection.

When a triac is used in an electric-heater driving circuit, a quick-blow fuse with a current rating greater than that of the heater but less than the maximum current rating of the triac provides adequate protection. When a triac is used in an electric-motor driving circuit, a quick-blow fuse with a current rating greater than the stalled current rating of the motor but less than the maximum current rating of the triac should be used.

In most filament-lamp driving triac circuits, the triac needs a current rating at least three times greater than the normal running current of the lamp, and should be protected by a quick-blow fuse with a rating of 500mA (1A absolute maximum) per 100W of lamp rating in 240V AC system, or 1A (2A absolute maximum) per 100W of lamp rating in 120V AC systems; in some special filament-lamp driving circuits, however, additional protection may also be needed, as described later in this article. To understand the principles of triac protection in filament-lamp driving circuits it is necessary to understanding certain characteristics of fuses, filament lamps, and triacs, as follows.

Fuse Basics

An ordinary 'quick-blow' fuse consists of a short length of wire, which burns out ('blows') if the current passing through it exceeds a limit determined by the wire's diameter. Most quick-blow fuses use a copper wire, which has a melting temperature of 1083°C and a resistance that - when referenced to 20°C - increases by about 0.4% per °C increase in temperature. Thus, when the current passed through the fuse exceeds roughly 40% of its rating, its resistance and power dissipation and temperature all increase exponentially with further increases in current, until a point is reached where the ability of the fuse to dissipate power is exceeded by the prevailing input power level; under this condition the fuse eventually blows at its weakest point; when a fuse blows, its wire first melts at the failure point, which is then widened as current briefly arcs across the gap and vaporises the adjacent metal.

All fuses carry a 'rating' figure (such as 500mA, 1A, 2A, 5A, etc.), which indicates the maximum current that the fuse can safely carry without blowing or suffering a reduction in its working life. The fuse will only blow if its rating figure is exceeded ('overloaded') for a significant period of time; thus, a 2A quick-blow fuse may take absolute maximum times of several days to blow at 2.2A, 2.5 hours at 3A, 1 second at 4A, 40ms at 6A, 8ms at 10A, 2ms at 20A, 500µs at 40A, and so on. All quick-blow fuses can thus safely handle large-amplitude current transients or surges, provided that they do not exceed a certain critical duration.

Filament Lamp Basics

An ordinary filament lamp consists of a tightly coiled tungsten wire filament that is supported on insulated struts, has its two ends made externally available, and is enclosed in a sealed glass envelope or bulb. In use, an electric current passed through the resistive filament raises its temperature to a white heat, causing it to emit white light; the glass bulb that encloses it is normally filled by a non-reactive gas such as argon, to stop the filament burning up under this condition.

The tungsten filament's wire has a melting temperature of 3370°C and a resistance that - when referenced to 20°C - increases by about 0.45% per °C increase in temperature, making the resistance value rise sharply with filament temperature. The resistance of a 240V 100W lamp is typically 40R at 20°C but is 576R under normal 'white heat' running conditions (the lamp thus shows about a 14:1 resistance

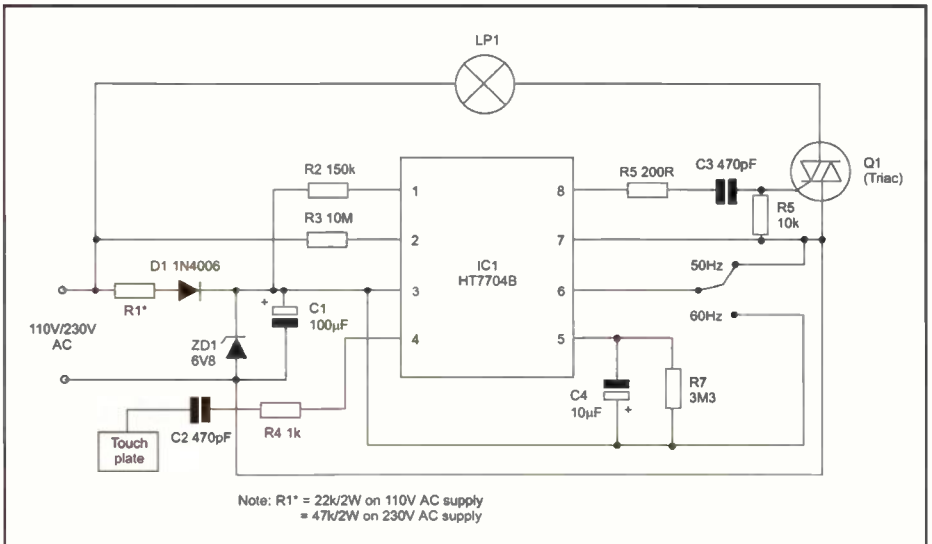


Figure 15. Basic HT7704B lamp dimmer application circuit.

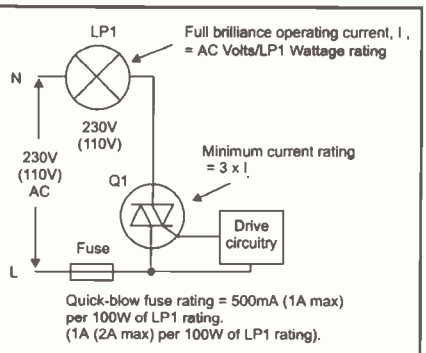


Figure 16. Basic triac and fuse selection data for use in simple on/off lamp switching and lamp dimmer types of application.

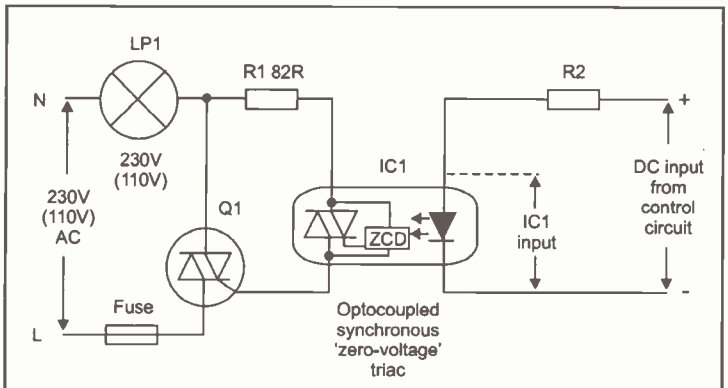


Figure 17. Ideally, all on/off-type lamp switching circuits should be gated via an optocoupled synchronous 'zero-voltage' triac, to eliminate all switch-on surge current problems.

variation over its full usage range). Note from this data that this 100W lamp consumes a normal r.m.s. running current of 417mA from the 240V AC supply but - if it is initially switched on at a moment when the AC voltage happens to be at the peak point in a half-cycle - may pass an initial switch-on surge current of up to 8.46A, thus generating a 2030W switch-on power surge in the lamp. By comparison, a 120V 100W lamp consumes a normal r.m.s. running current of 833mA and may pass an absolute peak switch-on surge current of 16.5A.

In practice, the lamp's initial switch-on power surge makes its filament resistance rise very rapidly (in a few milliseconds) to a value reasonable near to the filament's normal operating value; the lamp-driving triac (and its protective fuse) must be able to handle this surge current without suffering damage.

Tungsten filament lamps have a typical operating life of about 2000 hours. The outer surfaces of the coiled tungsten filament slowly 'boil off' with continued use, until the weakened filament eventually blows at its most vulnerable (thinnest) point, in the same basic manner as in a fuse, i.e., the failure point first melts and is then partly vaporised by arcing; usually, the vaporised metal blackens part of the glass bulb's inside surface. Filament lamp failures occur in three basic types, which can be classified as 'simple', 'recursive', or 'catastrophic'; these failure types have the following characteristics.

Most lamp failures are of the 'simple' type, in which the filament simply burns through and then arcs at its weakest point, vaporising the local metal; the lamp emits an audible 'ting' as the two halves of the ruined filament spring apart; usually, the arcing debris blackens only the end of the bulb. This type of failure often occurs at the moment of initial switch-on and is usually harmless to triac drivers.

The 'recursive' type of lamp failure can be regarded as a small number of 'simple' failures occurring in quick succession. At the end of the first failure, the broken but still hot and vibrating ends of the filament briefly make contact and weld together, passing a surge of current through the remaining (but shortened) length of filament, which quickly suffers another failure at another weak point, and so on. In this type of failure, the lamp usually flickers on and off a few times before finally dying; the inside of the bulb normally becomes widely blackened as a result of the multiple arcing that occurs in this process.

This type of failure may be accompanied by very heavy current surging, which may damage a driving triac that is not adequately rated or fuse-protected.

The 'catastrophic' type of lamp failure is a rare and very savage type of recursive failure, in which the internal arcing is so severe that the entire inner surface of the lamp and the filament's supports becomes coated in conductive vaporised metal, thus shorting out much of the filament and causing a very low resistance to appear across the lamp's terminals. This type of failure sometimes occurs in crude flashing-lamp disco displays in which the triac-driven lamps are switched on and off in response to the filtered amplitudes of the music, often going through thousands of on/off switching sequences (and their associated heavy surge currents) per hour; triacs need special protection in this type of application. In extreme cases of this type of failure, the triac may develop an internal short-circuit, and the fuse may then blow as the lamp filament self-destructs, thus destroying all three components during the 'failure' process.

Triac Basics

From the 'current overload protection' point of view, the two most important parameters of a triac are its basic 'r.m.s. on-state current rating', IT (RMS), and its non-repetitive peak surge on-state current rating over a period of one full cycle duration, ITSM. Typically, ITSM is ten times greater than IT (RMS) in 60Hz systems, and eight times greater than IT (RMS) in 50Hz systems. Thus, a 4A triac can typically handle ITSM surge current of up 32A in a 50Hz system, or 40A in a 60Hz system.

Triac Protection Circuits

When all of the above data is put together, it transpires that the simplest on/off-switching or 'dimmer' type of lamp-driving triac circuit should take the basic form shown in Figure 16. The lamp's normal 'fully on' running current, I_L, equals the AC supply voltage divided by the lamp's power rating, the triac needs a minimum current rating of 3 x I_L, and the fuse must be a quick-blow type with a current rating of 500mA (1A absolute maximum) per 100W of lamp rating in 240V AC system, or 1A (2A maximum) per 100W of lamp rating in 120V AC systems.

Ideally, all modern lamp-driving 'on-off' types of triac circuit (including those used in flashing-lamp disco displays) should take the basic form shown Figure 17, in which the main triac is gated via an optocoupled synchronous 'zero-voltage' triac (as described earlier in this article), thus completely eliminating all switch-on surge current problems.

In very extreme cases, particularly in flashing-lamp disco displays, the above circuit can be modified to give the main triac additional protection against damage from the 'catastrophic' type of lamp failure by wiring a ballast resistor is series with the load, as shown in Figure 18; this resistor must be a wire-wound type with a resistance equal to at least 5% of the lamp's hot resistance and with a power rating equal to at least the same percentage of the lamp's power rating. If the lamp suffers a near short circuit during a catastrophic failure, this ballast resistor limits the surge current to a value that blows the fuse but does not damage the triac; the ballast resistor gives a slight reduction in lamp brilliance under normal running conditions.

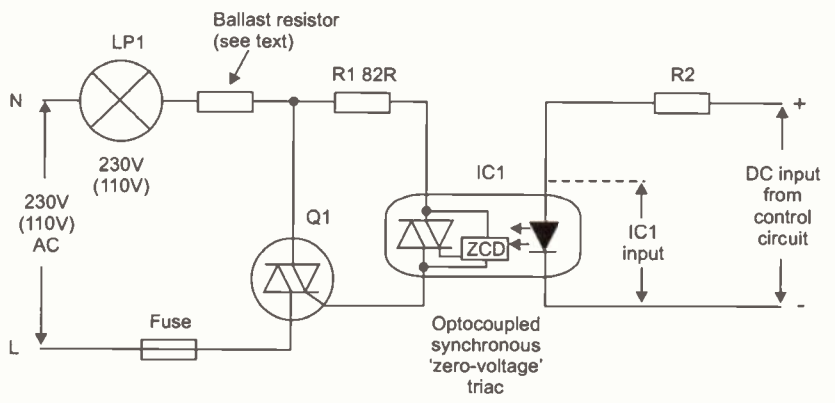


Figure 18. In extreme cases, such as in flashing-lamp disco displays, the main triac (Q1) can be protected against damage from a 'catastrophic' lamp failure by a ballast resistor, wired as shown.

COMMENT

by Keith Brindley

The next generation of the world's easiest to use computer operating sysatem - the Apple Macintosh's Mac OS - has entered its first Public Beta stage. Interested Mac users can get the software directly from Apple's Apple Store (go to: (http://www.apple/com) and follow the links). Macs officially supported by the beta include basically anything that under about three years old - physical hardware requirements include a minimum of a PowerPC G3 processor, and 128Mb of RAM.

Known correctly as Mac OS X (pronounced mack oh ess ten), the software is a usable release, but if you decide to give it a whirl you should remember that it is still a beta release. You can expect some bugs with it, although these aren't too severe and certainly haven't caused any serious problems on my own test system. Also, because it's a beta, there's not too much native third-party software around for it yet - only about 110 applications, utilities and tools at the time of writing. More third-party programs are appearing daily however, and it's likely that the vast majority of current programs will have been updated to work natively on Mac OS X long before its release in final form next year.

To say that Mac OS X is different from earlier generations of Mac OS is quite an understatement. The software has been changed from the bottom up. Where before, the Mac OS was always its own proprietary system, Mac OS X is based upon the industry standard UNIX system, with all the power that UNIX confers. At its heart is the Mach 3.0 kernel, which incorporates several features, notably:

- protected memory - applications are allocated their own memory space, so if and when an application goes bad, other applications remain unaffected. The computer itself remains running, as do all other applications
- preemptive multitasking - a very effective method of allowing multiple jobs to be carried out apparently at the same time. Mac OS X allocates processor time according to job importance, so that the overall 'feel' of the computer remains responsive to the user even when processor-intensive tasks are being carried out in the background
- symmetric multiprocessing - the new OS is built to take full advantage of more than one processor in a computer. The result of this is that application developers don't need to adapt their programs, Mac OS X does all the work for them
- advanced virtual memory - automatic and efficient control over the amount of memory applications require
- new graphics abilities - the Mac platform has always (since its inception in 1984) been the leading computer for personal computer graphics ability. New components in Mac OS X take this even further, with integral support for the standard portable document format (PDF) in the Quartz graphics system. As Quartz is a system component, any application running natively on Mac OS X can take advantage of PDF, reading or creating PDF files for anyone else to share.

Mac OS X Public Beta is supplied with several native applications built-in, including Apple's new email program Mail, and Microsoft's Internet Explorer Web browser. So a couple of minutes after install you can be mailing and browsing the Internet with all the typical ease that the Mac OS has always given.

Native Mac OS X applications fall into two categories. First, those programs that have simply been re-jigged to ensure that they make no operating system calls apart from those supported directly by Mac OS X. These are known as Carbonized programs, and they run well, although not taking advantage of Mac OS X's full power. In the short term, most applications will simply be Carbonized by developers, and in this way most older applications will be re-cycled to run in the new operating system. In the longer term, though, programs will be re-written to take full advantage of Mac OS X - these are known as Cocoa programs.

But Apple hasn't forgotten users with applications that pre-date Mac OS X. Built-in to Mac OS X is the Classic environment - to all intents an application that runs the previous generation of Mac OS (OS 9) in its own window. An application that is not Mac OS X native simply launches into the Classic environment. This gives full backwards compatibility with users' older programs while they are in the process of being updated to Mac OS X native classification. Even in the Public Beta release of Mac OS X, this means that all programs can be used straight out of the box.

Performance of Mac OS X Public Beta is pretty good. It's not noticeably any slower than its older counterpart OS 9 runs on my test setup (which incidentally is the oldest Mac that Apple supports with this release), and in certain features is actually faster. This bodes well for the final version of Mac OS X, as it has yet to be optimised to take full advantage of its potential.

One of Apple's intentions in releasing Mac OS X Public Beta is to gauge users' reactions to the operating system. Apple wants to hear from users, with bug reports, feature requests, and general comments. As it stands Mac OS X is significantly different not only in power, but in hands-on use too. The graphical environment in Mac OS X is controlled through what's known as Aqua. In effect, this is the Mac graphical user interface as Mac users have always known it, but with many new twists and grinds. Several long-time features of the traditional Mac OS have so far been left out of Mac OS X (the Apple Menu, for example), and several new ones have appeared (the Dock is the most obvious). Needless to say, Aqua is creating quite a storm among long-time Mac users, some of whom are for it, some of whom are against. Despite the storm, however, Aqua promises to be the most powerful personal computing environment of all time when its released into general use soon. It's ironic really, just as Microsoft Windows almost catches up with the old Mac OS environment in the form of its Windows ME operating system, Apple simply moves the goalposts yet again.

Also new to Mac users is the UNIX-based command line interface ability of Mac OS X. Effectively, on the surface Mac OS X is a new yet traditional graphical user interfaced Mac, but you can opt to tweak it in old yet brand-new non-Mac ways. Judging by the reaction from the UNIX community, I suspect that Mac OS X is going to be very popular for a much wider marketplace than it ever was before. UNIX power and Mac GUI makes for a very powerful computer

A screenshot of Mac OS X Public Beta - the Dock at the screen bottom displays favourite and running applications, together with files and folders on the computer, all available with single-click access. The Dock is set for mid-sized icons, with magnification as you drag over them. Running applications have an identifying pointer triangle under their Dock icon. Also shown top-left is the System Preference utility, and two Finder windows (one running a movie, the other displaying network and hard disk). In the background is the Classic environment with Microsoft Word running on it.

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TECHNOLOGY WATCH

With Martin Pipe

Visitors to the Live 2000 event at Earls Court could see, hear, play with and buy the latest consumer-electronics gizmos. Among the most impressive collections of gear as that of Sharp, a Japanese company that's starting to win back a reputation for innovation. One of the most impressive products on show anywhere at Live was the company's gigantic LC-R60D rear-projection monitor, which is equipped with a 60in. 16:9 screen. Yes - we did say 'monitor'! No TV tuner is included, and so you'll have to rely on the one fitted to your VCR! The set employs three 2.6in. CGS (Continuous Grain Silicon) TFT display panels - one for each primary colour. Each of these panels has a resolution of 1280 x 1024 pixels. The R60D is compatible with HDTV signals, and these formed the basis of the Live 2000 demonstration. Resolution is simply unbelievable, with much fine detail visible - notably in the audience shots of the basketball game. Colour was vibrant, and dynamic range (the range of whites and blacks that can be handled) of a commensurate standard. Our only complaint was that of occasional artifacting, but this can probably be attributed to the programme source, which was presumably MPEG2-encoded.

The R60D, which is a mere 60cm deep, features a multi-standard colour decoder for analogue sources, and component video inputs compatible the latest high-end DVD players. The lenticular screen is designed, say Sharp, to give wide viewing angle with no loss of picture quality. We can confirm that the R60D did offer a pretty wide viewing angle - normally a problem with rear-projection TVs. Although the type of user likely to opt for one of these monsters is likely to invest in an expensive ancillary sound system, the R60D does include a stereo amplifier and speakers. But then again, with its stratospheric price of around £50,000 only Bill Gates is going to be able to afford that and the sound system in one go! But then again, Gates might not want one. For some reason, there's no VGA input for computer display compatibility. Ridiculous, bearing in mind its high-end-status. Despite its PC unfriendliness and the second-mortgage price, Sharp reckon that four have already been sold in the UK - at Harrods, naturally...

Still on the vision front, Sharp presented an unusual video recorder. As one might guess from its name - the DV-RW10 - this unit employs DVD media, rather than tape. The Pioneer-developed DVD-Rewritable (DVD-RW) media, to be precise - as opposed to the competing DVD-RAM and DVD+RW technologies from Hitachi and Philips/Sony respectively has a 12cm disc that will store 4.7GB of data. The compression rate is adjustable, giving a trade-off between recording time and picture quality. In its highest-quality mode, the data rate is 10.8Mbps - which equates to around 1 hour of recording time. At the other end of the scale, the 1.7Mbps data rate will offer around 6 hours of VHS-quality recording. Minidisc-style editing is envisaged, while a thumbnail image-based navigation systen will allow the contents of a previously-recorded disc to be quickly ascertained. The unit, which will also play pre-recorded DVD movies, sells for the equivalent of 'around £2000' in Japan, where it has just been released.

Sharp LC-R60D HDTV rear-projector. Yours for £50,000 - if you're prepared to overlook the VGA input... Photo courtesy of Adrian Caspersz.

A UK standard model is expected by June 2001, but no further details - such as an estimated price - were available. Expect to see a UK-standard Nicam TV tuner, and - hopefully - i-link terminals for end-to-end digital recording from DV and Digital8

The manufacturers of in-car entertainment spared no expense when it came to promoting their products. Employees of Alpine must have fought over who drove the company car to the exhibition! Photo courtesy of Adrian Caspersz.

camcorders. Note that i-link doesn't feature on the Japanese-market model, though.The RW10 may be able to play standard DVDs, but compatibility doesn't currently go the other way! In time, though, we'll begin to see DVD players able to play DVD-RW discs recorded on machines like the RW10. Other manufacturers, including Philips and Hitachi, have demonstrated hardware based around their rewritable DVD technologies, and have come up against the same problem. Hitachi reckons that its next generation of DVD players will be DVD-RAM compatible - and thus able to play discs recorded on its unique DVD-RAM camcorder. As for DVD+RW, who knows? This standard has not, to the best of my knowledge, been approved by the DVD Forum. Both of the others have. DVD was well-represented at the show, with players on show from all of the Japanese majors present. The popularity of the format is rising, the UK DVD Committee claiming that over 56,000 players were sold in June alone. Audiophile-grade DVD players were demonstrated by TAG McLaren, Arcam and Sonneteer, amongst others.

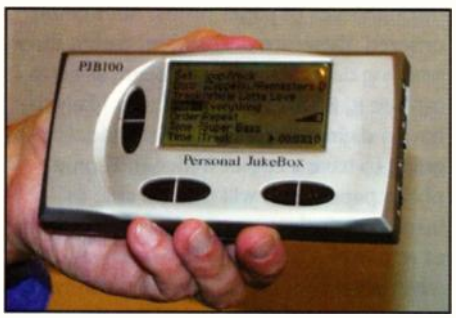
In a radical departure from its normal product line-up, Sharp is the first major Japanese corporation to launch a commercial digital amplifier. A rather smaller organisation, TacT from Denmark, made it to market first however. TacT's stylish Millenium, which made it into the Guinness Book of Records following its 1998 launch, is rather pricey at £7000. It's still available, and could be seen - and heard - at the Lenbrook stand. Sharp's model is just under half the price at £3,300 - but that's still quite an outlay! The stylish and massively-built SM-SX1 amplifier, which is rated at 50W RMS per channel, was developed in conjunction with Professor Yoshio Yamasaki of Japan's Waseda University. Most amplifiers designed for digital sources employ a digital-to-analogue converter, followed by a conventional analogue amplifier to drive the speakers. Not so a digital amplifier, which uses pulse-width modulation (PWM) techniques to amplify a (digitally-filtered) S/PDIF digital signal from a CD player, Minidisc recorder or DAT machine.

The PWM-amplified signal is then subjected to low-pass filtering, yielding an analogue signal that can drive the speakers. The main advantage is, sound quality apart, an efficiency that approaches 100%. The Sharp unit does, however, feature three analogue stereo inputs, one of which is a balanced (XLR). A specially-developed delta-sigma analogue-to-digital converter transforms those analogue voltages into the bitstream needed by the amplifier. The TacT Millenium, conversely, will only cater for analogue sources if an optional converter unit is added. The SM-SX1 also features a special dedicated bitstream input for Sharp's SACD player. Designed to match the amplifier, the DX-SX1 will itself set you back a cool £2,700! Unfortunately, we weren't able to assess the sound quality of either item, since the demo area was closed off at the time of our visit. Sharp won't have it all their own way, though. Small Surrey-based audiophile manufacturer Sonneteer plans to launch its own 'Bronte' digital amplifier soon - this will offer a 150W RMS per-channel output and an efficiency of 96%. Digital amplifiers from other manufacturers will, no doubt, follow in time..

Visitors to Live 2000 could experience various forms of entertainment, such as this live 'scratch' DJ. Photo courtesy of Adrian Caspersz.

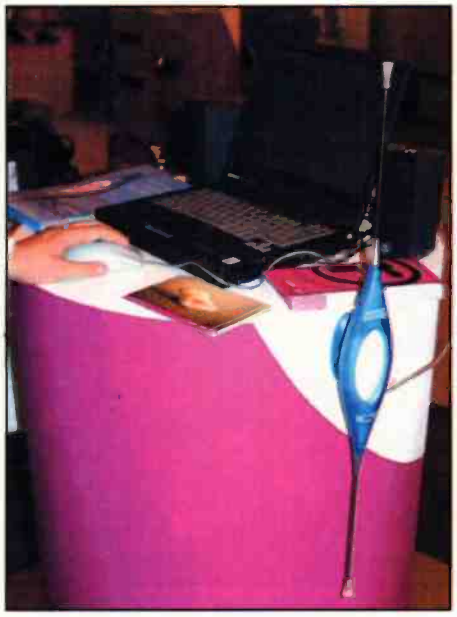
Moving from digital amplification to digital broadcasting, there been some movement on the DAB ('digital radio') front. For a start, DAB coverage is now reckoned to be 73% of the UK. UK is perhaps not the best term - although most of England can now receive DAB, availability is currently poor in much of Wales and Scotland. English readers, then, will appreciate that receiver prices are, at last, starting to fall. At the show, commercial DAB operator Digital One was promoting affordable Grundig in-car systems. One could choose from a version with cassette deck for £300, or a CD version for £50 more. These prices included the head unit, DAB receiver and aerial, but not fitting. Still, 'Electronics' readers could install the equipment themselves! The most interesting DAB developments were, however, related to reception of DAB at home.

The Infomedia offshoot of PDA manufacturer Psion brought us Wavefinder - a PC-based DAB receiver that is similar in concept to the long-awaited Radioscape product discussed in Technology Watch over two years ago! Indeed, much of the technology was bought in from Radioscape. The Wavefinder consists of an attractive (it's illuminated!) dipole aerial that includes the RF circuitry, and the front-end/decoding Windows software. Basically, the aerial sends raw DAB streams corresponding to a single multiplex to the PC via USB. The desired one is selected by the user, and its MPEG 1 Layer 2 stream is decoded by the software and played back via the PC's soundcard. There's also a recording option that allows



This is the Hango Personal Jukebox. At £650, it's rather expensive for an item of personal audio - no matter how comprehensive its info screen! Creative Labs now sell something very similar at less than half the price. Photo courtesy of Adrian Caspersz

A side view of the Hango Personal Jukebox, showing the USB interface - across which MP3 tracks are transferred from a PC - and power/headphone sockets. No S/PDIF output for your hi-fi, though... Photo courtesy of Adrian Caspersz.



This is the Psion Wavefinder - a DAB receiver for PCs. Unfortunately for Psion, the same £300 will buy you VideoLogic's self-contained tuner, which was also launched at Live. Both units make provision for PAD, although the Psion's is the most visible. Photo courtesy of Adrian Caspersz.

you to record radio programmes to your hard disk as MP3 files. The Wavefinder soiftware also supports the decoding abd display of PAD (Programme Associated Data), which could include text, Web links, photos or graphics. Unfortunately, the price of the Wavefinder is £300 - which is rather more than Radioscape's original projected pricing of £100.

Also making its first appearance at Live 2000 was the DRX-601, a conventional DAB tuner for hi-fi systems. It's made by VideoLogic, a company more famous for its PC speaker systems and graphics cards. VideoLogic does have a considerable amount of expertise in the DSP field, some of which was presumably employed in the design of this DAB tuner. What makes the DRX-601 special is its price - which, like that of the Psion, is £300. As a result, it's now the most affordable hi-fi DAB tuner now available. Its nearest rival is a £500 Technics model with built-in FM/AM analogue tuner - but what if you've already got the latter? Features of the DRX-601 include remote control, low-noise power supply with toroidal transformer, 24-bit digital-to-analogue converter, 9 station presets, loop-through for analogue tuner and coaxial/optical digital outputs. The DRX-601 also sports a RDI optical output port for future expansion. A VideoLogic spokesman reckons that the latter could be used to interface the tuner to a PC, so that PAD information could be decoded by a PC. In that case, surely a standard RS-232 or USB port would be a more sensible fixture? We hope to bring you in-depth reviews of the VideoLogic and/or Psion receivers in a future issue of 'Electronics'.

Since the last Live exhibition in 1998, the

If you've got money to burn, the Imerge Soundserver will allow an independent choice of MP3s and WAV files to be enjoyed in two or more rooms around the mansion. Photo courtesy of Adrian Caspersz

Internet has taken stage, and to this end a number of Web start-ups made an appearance at this year's event. One of the more interesting on show was eBaraza <www.ebaraza.co.uk>, which derives its name from the Swahili for 'meeting' or 'community'. Well, it sure beats paying ridiculous sums to those greedy domain-name carpetbaggers! Despite its 'co.uk' address, eBaraza is based in Switzerland. Launched in February, it's billed as a 'pan-European Internet photo-sharing community' - or, to quote from its slogan, 'your life in pictures'. Users upload their photographs onto the site, where they can store, view and share their images for free. Photographs are organised into 'albums', which can be organised from anywhere.

Send your relatives your username (e-mail address) and password, and they'll be able to view your holiday snaps or wedding photos from any Internet-connected PC, wherever it happens to be. Another benefit is a free Windows 95/8 or NT/2000 program - the eBaraza Viewer - which allows many tasks to be conducted off-line. It features an image browser, basic manipulation tools and quick batch upload. eBaraza plans to fund its site - and presumably make a profit - through sales of paper prints. After being ordered, these are despatched within three working days. Ebaraza's problem, as far as I can see it, is that the type of user likely to have a digital camera and/or scanner is also going to have a colour inkjet and some photo paper - and will thus be able to instantaneously print out downloaded pics as required. That said, eBaraza runs advertising banners - there must surely be more sites than advertisers these days! - and could sell other photography-related items on-line. We wish it well. Who knows? Perhaps the next David Bailey will be discovered through eBaraza!

Another web site, which appears to be

There were some seriously wacky in-car setups on show!
Photo courtesy of Adrian Caspersz.

targeted at those of student age, is cycosmos. This site <www.cycosmos.co.uk>, promoted at Live 2000 with a large stand built around what can only be described as a padded cell, is a virtual community. Define your avatar - or 'cytizen' - and interact with others who happen to be online at the same time. A bit like a chatroom, I suppose, but with a few other bits and pieces tagged on. The site's slogan is 'make it real', which is ironic seeing that there's nothing to stop you from going on-line with a persona (and even sex) that bears no resemblance to reality whatsoever! Other features include e-mail and something called 'socialbrain'. The latter is an on-line extension of a feature at the German Expo 2000 exhibition, and seeks to define peoples' attitudes towards the future. Cycosmos, which caters for German and English users, appears to be funded through advertising banners and shopping ('buy fresh flowers for next-day delivery to your door'. Your door? Surely somebody else's door would be more fitting?). Unfortunately, the site employs so much cutting-edge technology (well, Java) under the bonnet that it occasionally caused

Cellphones equipped with WAP microbrowsers are proving popular, despite the inconsistency of the services that can be accessed. Here's the latest CMD-J5 model from Sony. This WAP-compatible handset features a voice recorder (as its LCD screen demonstrates), compatibility with HTML (yes, really!) and a thumbwheel for site navigation.

my browser (the latest Microsoft Explorer) to crash! What's the name of the infamous clothing e-retailer that was too cutting-edge for its own good? As I recall, that crashed rather spectacularly itself...

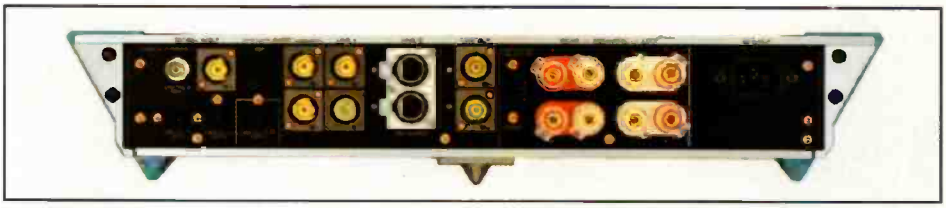
MP3 is, of course, the other significant development since 1998. Just about everybody seems to be selling MP3 players these days! At Live 2000, you could see - courtesy of the What Mobile stand - a plug-in module that adds MP3 playback to certain Ericsson GSM handsets, including the T28. And let us not forget the Siemens SL45, which has the player already built in. Both are designed to play MP3 files transferred from a PC. When GPRS (or, better still, 3G) comes along, then you'll also have the option of downloading MP3 files from the Internet itself. By then, of course, MP3 may well have been replaced by something else. The SDMI is pushing for compressed audio formats to include some kind of security measure, so that piracy can - at the very least - be tracked. At the Sony stand, you could see one of the first SDMI-compliant players - the NW-E3 Network Walkman which, at 33g, is billed as 'the lightest Walkman ever'. Like competing players (such as Diamond's Rio 500), the Network Walkman is equipped with 64MB of RAM. Unlike competing players, though, it won't play MP3 files. Instead, they - along with tracks 'ripped' from CDs - have to be converted into Sony's proprietary ATRAC compression format using the supplied OpenMG Jukebox software.

Personally, I can't believe that recompressing audio does anything for sound quality - even if the original was MP3! The Network Walkman employs version 3 of ATRAC, which was originally introduced for Sony's Minidisc format. Unlike Minidisc's original incarnation, though, the compression rate can be varied. Use the highest quality, which results in a data rate of 132Kbps (compare this with the most commonly-encountered MP3 rate of 128Kbps), and you'll be able to transfer an hour of music to your Network Walkman via its USB interface. There are also 105 and 66Kbps modes, which increase compression (and thus playback time) at the expense of sound quality. Unfortunately, the system is SDMI-compliant - well, Sony is a major record label, and has vested interests here. As a result, CD rips can only be transferred (or 'checked out', in Sony parlance) to the device three times. On the fourth occasion, the original CD is required. The same would presumably be true of SDMI-compliant Internet music downloads (the MP3-like .WMA format supports SDMI).

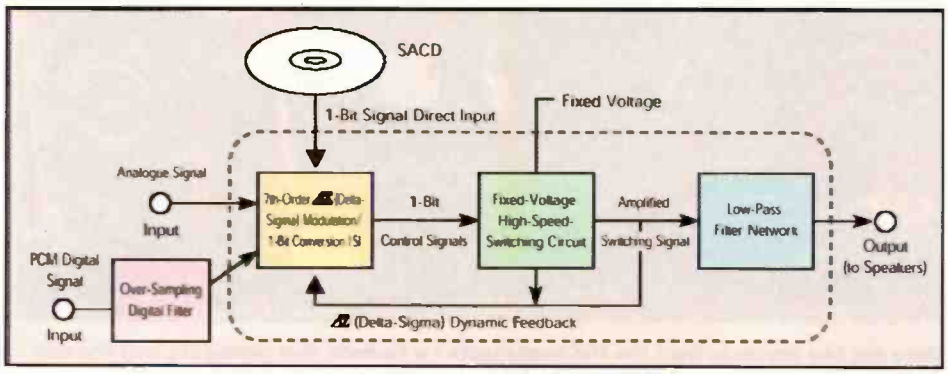
On the subject of Minidisc, there have been some interesting developments. The midi-sized Sony MDS-PC3 is equipped, like the Network Walkman, with a USB link for the transfer of music from a PC. It also supports the new 2x and 4x 'long-play' modes for up to 320 minutes of stereo music - presumably, the Network Walkman's ATRAC3 variable-compression is involved. The MDS-PC3 is supplied with 'PC-Link' software, which converts computer formats (eg., WAV, MP3) to ATRAC. We're pleased to report that there's no mention of SDMI, but then again there's no mention of any ability to transfer songs from MD to PC! Sony's LISSA MD deck (MDS-LSA1), meanwhile, forms part of the first audio system to be linked together via a different high-speed serial interface - I-link. LISSA represents the first consumer application of I-link outside digital video!

'True' MP3 players were in abundance elsewhere at Live. One of the most interesting was the Smart MP3 Disc Player, imported into the UK by Euro-Asia

Here are Sharp's matching digital amplifier (SM-SX1) and SACD player (DX-SX1). If you want both, be prepared to shell out £6000! There are now around 200 SACD titles on offer, with more to come. Sony also showed an unusual SACD player - the DVP-S9000ES. This will also play back DVD-Video titles, although DVD Audio discs isn't catered for. A political decision, rather than a technical one, methinks...



Round the back of the Sharp SM-SX1 digital amplifier, showing all the various analogue and digital connections.



Block diagram, showing one channel of the Sharp SM-SX1 digital amplifier.

One of the most interesting digital stills cameras on view was the Sony MVC-CD1000., which dispenses with traditional flash memory or floppy discs. Instead, images are stored on a special 8cm CD-R that has a capacity of 156MB capacity. Once the disc has been burnt, it can be read by a PC. We applaud Sony's efforts, but surely CD-RW would have been a more logical storage medium? Other features include a 10x optical zoom and a 2.1 megapixel resolution.

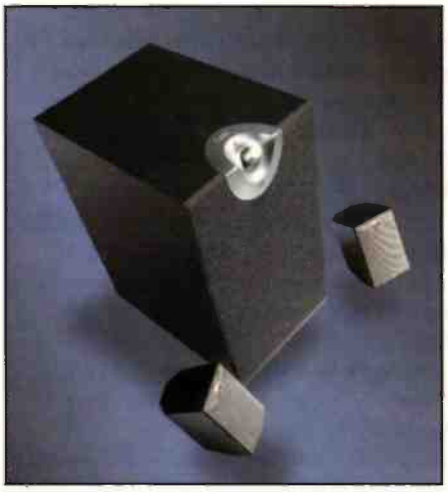
Technologies <www.smartproducts.co.uk>. This device, which resembles a personal CD player, will handle both audio CDs and CD-ROMs containing MP3 files. It sells for only £100, and your roving reporter was successfully tempted into buying one! I found it to work well, a more than acceptable sound quality being experienced after feeding its line output to a hi-fi system. But it's not all good news. The device won't handle MP2 files, or MP3s with a bit-rate exceeding 192Kbps. Its low price means that build quality and appearance are hardly of Sony standard! What's more, my photographer bought one - and his didn't work properly! Euro-Asia Technologies were quite happy to refund his money, though. Expect an in-depth review of the Smart MP3 Disc Player in a future edition of 'Electronics'.

Another MP3 player worth mentioning is the HanGo Personal Music Player, which was demonstrated on the UAS Enterprises stand. This palm-sized device, which is also made in the Far East, includes a 6GB 2.5in. IDE hard disk for storing music, an informative LCD information screen, and a USB interface for transferring MP3 files from a PC. Unfortunately, its £650 pricetag is far too high, seeing that Creative Labs have just introduced something very similar - the DAP Jukebox - for less than £300. If you want a home player, and have at least three grand to spend, you could have invested in the Imerge SoundServer. This PC-based device isn't dissimilar to the DIY unit described previously in 'Electronics', although it's fancier and looks prettier. The SoundServer is designed for use in two 'zones' (rooms), each of which can be fed

Whatever the future of video recording, it's unlikely to be tape (sorry, JVC). The problem is that there are at least three competing disc systems on the market. Here's the Sharp DV-RW10, which is compatible with DVD-RW media. The unit is currently available in Japan for around £2000, but a UK-compatible version could reach these shores by next summer.

with different music (presumably, two soundcards are plugged into its motherboard.). Other features include the ability to handle both uncompressed (WAV) and MP3 files, a TV screen user interface, Ethernet and infra-red remote control. Versions with eight independent analogue outputs are available for those with £10,000 to spend. Another interesting stand was the 'virtual music store' (VMS), at which custom CDs could be purchased. Users could choose tracks from a screen, using an arcade game-like control panel. Customers can, thanks to a headset, listen to songs before adding them to their selections (or p(ersonal)-mixes). A few minutes later, their selection - complete with attractive case artwork - is ready for collection. Of course CD-R is the recording format, and a look behind the scenes revealed a stack of Plextor eight-speed CD burners chugging away. VMS terminals are beginning to appear in record stores, notably HMV in Oxford Street - others will follow if the trial is successful. The music is stored on hard disks built into a 'virtual

Here are two products from the McLaren stable - a Formula One racing car, and the new Formula One AvantGarde speakers. The latter look ready for the fast lane too! Photo courtesy of Adrian Caspersz.



Dramatic developments in the sound quality of personal audio, computers and games consoles has led to a demand for better 'multimedia' speakers. Here's the stunning Aego2 sub/sat system from respected speaker manufacturer Acoustic Energy. Like its competitor VideoLogic, AE hopes to offer a Dolby Digital decoder soon.

Live 2000 is also the venue for 'sound-off' competitions, and there were plenty of companies selling gear too. Installers go to great lengths to ensure that their work looks as good as it sounds. Even the car's engine compartment is subject to scrutiny, as this shot of a Renault Clio shows. Photo courtesy of Adrian Caspersz.

Sound-off checks underway! Photo courtesy of Adrian Caspersz.

pressing plant' (VPP). This device connects to the printer that creates the CD artwork, and a 'robot' that automatically loads CD-Rs into the burners. Each VMS location is kept up to date with the latest music via downloads (presumably encrypted and individually-addressable) from a transponder on board one of the Eutelsat satellites. The orbital position of the satellite involved was stated as 8°E - presumably VMS is referring to Eutelsat W3, which is actually found at 7°E.

But what if you would rather make your own music? The Yamaha stand featured two DJX all-in-one 'DJ machines'. These products, clearly aimed at teenagers, will allow users to create their own dance music. Both feature a mixer, equaliser, drum machine, BPM counter and effects unit (transpose, filter, etc.). The lower-priced unit (the £200 DJX-IIB) utilises a CD-like revolving scratch-pad as the primary user interface (scratch effects, drum-loop editing and so on). Its bigger brother, the £300 DJX-II, features a full keyboard. This will drive external devices via MIDI, or play the internal tone generators. DJX-II users can choose from a sampler (there are line inputs round the back) or a range of preset voices that include pianos, organs and analogue synths. Scratch-style effects, and pitch-bending, can be achieved using a ribbon controller just above the keyboard. I played around with both units, and will admit to being impressed. Ten years ago, you would have needed a roomful of expensive equipment to achieve the same ends! But then again, ten years ago much of the stuff on show at Live 2000 would have seemed like so much pie-in-the-sky...

Note:

Live returns to its original status as an annual event! Live 2001 takes place at Earls Court, between 27th and 30th September 2001. If you missed this year's exhibition, you may like to know that a 'virtual' version, <www.live2000.com>, will remain open until November 24th.

Martin Pipe welcomes comments and ideas. E-mail him at:

martin@webshop.demon.co.uk

Or look for him online! His ICQ ID is: 15482544.

On the Yamaha stand, you could play with the DJX range of musical instruments, which are aimed at teenagers wanting to create dance music close to what they hear in the charts and clubs. You don't need any real musical talent (as the charts prove) and you can have some great fun into the bargain! Photo courtesy of Adrian Caspersz.

Earls Court - the home of Live. Photo courtesy of Adrian Caspersz.

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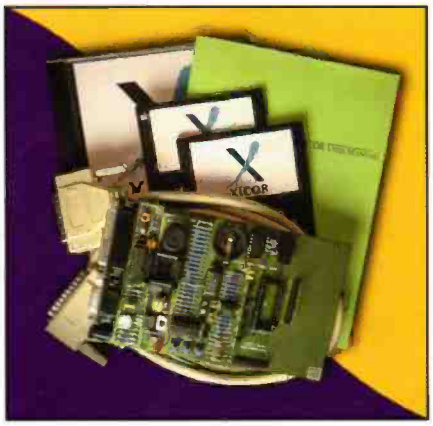

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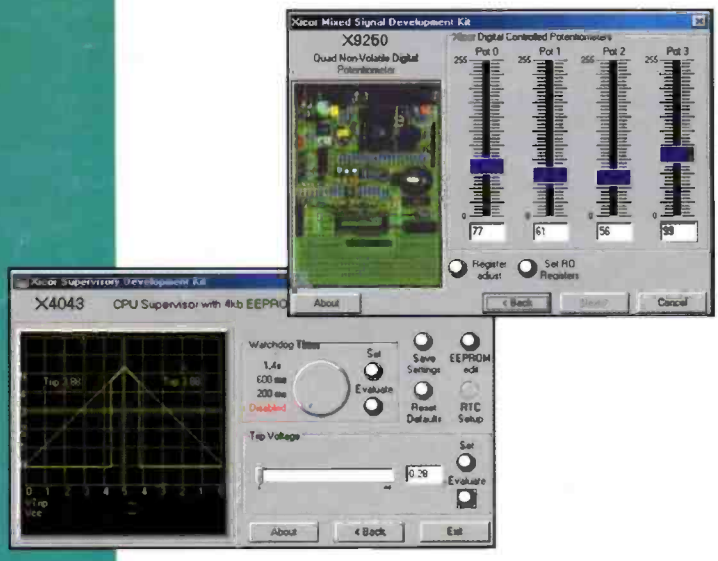

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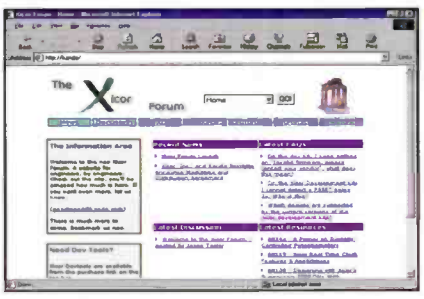

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