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Ideas into profit

Projects to make

Electronic themes

Alternative technology

Micro electronics

An Introduction to Photovoltaics

BURNING UP

In the start of a 3 part series we take a look at the The Techology of CDs

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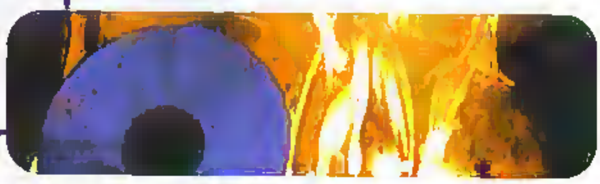

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The Electronics and Beyond Team

Jonathan Aldred BSc(Hons) – News and Features Editor

I was born in Wirral, Merseyside, and moved to Aberystwyth in 1993 to read Geography. My interests include current events, new and emerging technologies, and the history and applications of the Periodic Table. My hobbies are creative writing, science fiction in all its aspects, computer art and listening to music. I am also a big fan of Formula 1 and Formula 3000 motor racing.

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Anna Penar – Media Sales Manager

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

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

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

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

Natasha Nagaoka – Publishing Manager

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

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

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

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

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

Paula Matthews – Subscriptions Manager

I was born in Sutton Coldfield and have a BTEC in Business and Finance.

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

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

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

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

As the leaves change colour...

Electronics and Beyond looks at what makes up photovoltaic material and why it is useful for construction purposes. We look at the mechanics of this practical green technology in part 1 of a special 3 part series from BP Solar.

If you like to sit by the fire and listen to the radio in the evenings then you may be interested in our new series on Discovering Amateur Radio in which Ian Poole takes a look at this area of electronics which crosses and links up continents. Talking about fire, see the first of our mini-series on Burning CD's, not literally CD's in flames, but the ins and outs of storing and copying limitless amounts of data.

Are you interested in photography? If you are then turn to Photographic oddity and learn about a unique camera made in a week! Another important question to ask yourself is: Do we learn from history? Maybe not, see Technology in Trouble as the spectacular rise and fall of internet billionaires is documented. This boom and bust phenomena is somewhat reminiscent of the cyclical downturn of the 1930's! For those of you who believe in the power of the internet as a marketing tool and are planning to set-up your own website for commercial purposes then the first part of Build your own website may be of use as Mike Bedford brings commonsense to a complicated and often confusing topic.

In our special news feature, Martin Pipe looks at the decline of profitability and viability of manufacturing TV sets in South Wales and the shift of manufacturing from the high to the low –end economies of the world. Our News Editor recently bought a MiniDisc and please read what he says is an impartial review of this top-of-the-range piece of new technology.

In Constructors corner, we feature an electronic kit powered by the mighty AVR processor and you have the opportunity once again to purchase either the assembled or pre-assembled version. This month we look at PIC so take a look at part 1 of the PIC programmer feature which was incidentally sent in by an Electronics and Beyond reader who asked me if I would be interested in publishing it. As PIC is a very popular choice of engineers worldwide, I hope in the future to publish further articles and practical application examples based around this versatile and economical silicon chip

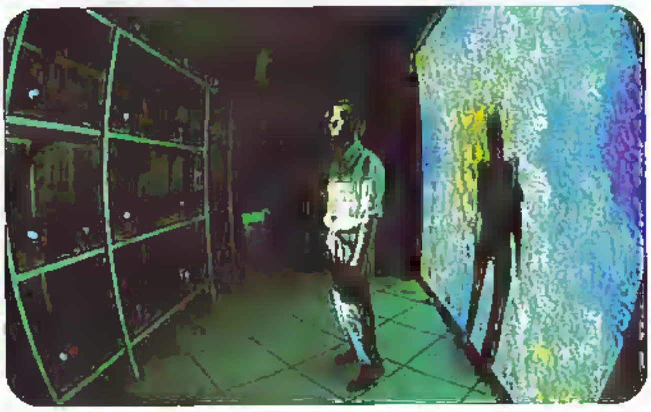
This October, we are pleased to announce the results of our recent competitions, so see if you are the lucky winner of either a ST7 Starter Kit, the book Programming and Customizing the AVR microcontroller or the grand prize of Matilda in our Robotwars short story competition. This month, why not read two runner-up stories, one humorous, one serious from the Robotwars competition. Thank you everyone for entering and we hope you will continue to try your luck in future Electronics and Beyond competitions.

We hope you enjoy our autumnal issue and welcome your suggestions and contributions which we are always happy to publish.

The devil is in the details – the screen that matches the resolution of the human eye

I t sounds like science fiction – a 20 million pixel screen 10 feet high and 13 feet wide, capable of visual definition that actually matches that of the human eye? You certainly wouldn't be able to get one for your living room, but such a screen has been created and is on proud display at the Sandia National Laboratories in New Mexico.

Sandia is a national security laboratory operated for the U.S. Department of Energy by the Sandia Corporation, a division of Lockheed Martin. They design all non-nuclear components for the USA's nuclear weapons, perform a wide variety of energy research and development projects, and work on assignments that respond to national security threats (both military and economic). The screen is the centrepiece of Sandia's new Visualisation Corridor, so named because 'it suggests a wide path through which large quantities of data can flow'. Its purpose is to allow scientists to monitor extremely high-resolution simulations of nuclear reactions and scan through such real life imagery as stress reactions and aerial photography.



Left: Behind the screen

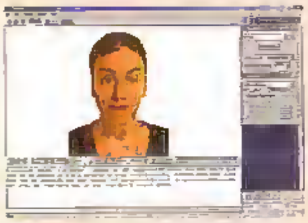
'If the devil is in these details, we'll find him,' says Sandia's Brian Wylie, alluding to the opportunity for finding minute but important details that would not show up on a standard resolution screen.

'The image is as detailed as if an aircraft at 21,000 feet were imaging every ear of corn in a 100-acre field', according to manager and program leader Philip Heermann. 'The image approaches the visual acuity of the eye: the eyeball is the limiting factor, not the computer. From ten feet away, the image is as good as your eyes are able to see'.

To display such an image must take a lot of processing power, so is there any measurable delay in rendering the images? Thanks to a process of massively parallel

NEWS bytes

Now talking heads can read your email



Is your web site incredibly boring? Many of them are, and web developers try to hide just how boring their sites or their products are by dressing the sites up with flashy graphics. Now web site designers have a new option to distract potential surfers from just how thin, computer imaging, the images are displayed in a matter of seconds rather than minutes or hours. Instead of being created from a single graphics card, the image is generated through the orchestrated outputs of 64 computers splitting data into 16 screens arranged as a 4 x 4 set. Each digital projector creates a bright 1,280 by 1,024 pixel image on its designated part of the screen, with a resulting image that is easily discernible in ambient light conditions. The system is so well configured that there is a total absence of image edge overlap.

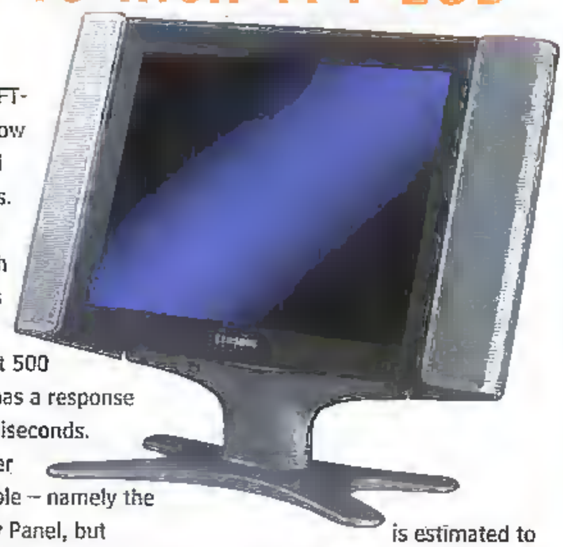
'We are 100 times faster in producing an image than the fastest SGI graphics pipe, and to my knowledge are now the fastest in the world in rendering complex scientific data sets,' says Mr Heermann (SGI being an industry leader in graphics performance).

There are, in fact, three of these screens and they are deliberately situated close to many of their potential users – a set of people that includes weapons analysts, engineering scientists and micro-technology developers – to whom they are available on a 24 hour basis. The screens were installed through an open wall during remodelling of the building and if they ever need to be removed or replaced, there is now an access port in the roof to allow them to be lifted in or out with the use of a crane.

By January 2001, the Sandia team expects to reach the project's second phase goal of building a screen with 64 million pixels. The need for this, and the present screen is explained by Heermann: 'It does not make sense to view a 20 million or 100 million cell simulation result on a standard 1 million-pixel display'.

Beyond that, Sandia have plans to build a version of the Visualisation Corridor that will be available for use outside of the classified environment in which it currently resides. One possible area in which it might be welcomed is the movie industry, where similar clusters of computers (or 'render farms') may take a half-hour or more to render an image equivalent in size to that of the Sandia screen.

Samsung Electronics develops the world's first 40 inch TFT-LCD



This new 40-inch TFT-LCD wide screen from Samsung has approximately 980,000 pixels and can provide a display with XGA (Extended Graphics Array) definition. It aspect ratio is 15:9 and it has a viewing angle of 170 degrees.

TFT-LCD production processes become increasingly difficult as screen size grows larger. Various companies have been working on ways of making screens exceed the 30-inch 'barrier' that previously existed and Samsung see their new product as a technological breakthrough for TFT-LCDs.

Previous criticisms of TFT-LCDs include low brightness and response times. Samsung have addressed both of these issues with a screen that displays at 500 candelas and has a response time of 12 milliseconds. There are larger screens available – namely the Plasma Display Panel, but Samsung's new screen has much better picture clarity, requires only half the power of a PDP, and is estimated to have three times its lifespan.

For more information go to http://samsungelectronics.com.

Intergraph launch lawsuit against Intel over Itanium

US workstation manufacturer Intergraph already have one lawsuit (1997, still pending) filed against Intel – claiming the company used Intergraph patented technology in the Pentium line of processors. Now the company has launched a new suit claiming that Intel's EPIC (Explicitly Parallel Instruction Computing) instruction set, used in their new range of Itanium processors, conflicts with patents relating to Intergraph's C5 Clipper microprocessor.

The C5 Clipper was sidelined by Intergraph in 1993 in favour of a series of Pentium-based workstations.

NEWS bytes

tedious or long-winded the actual textual content is – Producer Lite from famous3D (US retail price $295).

With this entry-level version of the more expensive Producer suite of tools, you can create three-dimensional virtual characters that can read the text of the web site out loud and can even be incorporated into emails.

You can choose one of a large number of photorealistic and fantasy heads and then choose a voice to match it. Then simply type in text and insert emoticons (e.g. :-), etc) to make the head talk and gesture. According to the company 'The content can be seamlessly inserted into websites and emails to be streamed over low bandwidth connections without the buffering experienced by video streaming'.

For an additional $350 you can buy famous3DmeNow, which allows you to create your own virtual head models for use in Producer or Producer Lite. All you need is a front and a side facial photograph, which you import into the software. You then move a set of points to specified places on the photo such as the tip of the nose, the cheekbones, etc, and the model is automatically created.

For further details and to see the talking heads in action, go to www.famous3d.com.

NEWS bytes

Tough times ahead for semiconductor sector

Recent 2001 projections from electronics industry analysts IC Insights make gloomy reading for anyone involved in the semiconductor sector, with a 26 percent decline in revenue, 16 percent decline in unit volume, the first ever decline in the DSP market (28 percent), and the biggest ever decline in the programmable logic market (a massive 51 percent).

DRAM revenues are expected to fall by just over half, with over-capacity being blamed for the collapse in prices. Korean firm Hynix are one of the most troubled companies in this sector. They are currently losing money and building debts at rates that may mean a withdrawal from the industry or even collapse, with the Korean government having ruled out the use of any public funds to save them. Persistent rumours of Motorola withdrawing from the semiconductor industry have also been doing the rounds.

Britain's Unloved Robots Seek Better Relationships with Intelligent Humans

Not enough young Britons are taking an interest in the current use of manufacturing robots in industry or their future development. According to BARA (the British Automation and Robotics Association), this is because of the poor image most young people have of the industry.

BARA has decided to move to the Warwick Manufacturing Group at the University of Warwick, where it can use the Group's global contacts and technical reputation to attract more interest towards British robotics from leading technical

and academic organisations and the people who work or study within them.

According to Dr Ken Young who leads WMG's automation application research group, the UK has been overtaken in its use of automation technology by a number of other countries. 'If we are to maintain any manufacturing industry here it is important that this trend is reversed,' he says. 'This link will make independent advice on robot application available to industry and will ensure that automation is used appropriately'.

Dr Young believes that the new partnership between BARA and Warwick Manufacturing Group will help 'build on the interest that has been created in robots by television programs such as 'Robot Wars' and attract a stream of technically capable graduates'.

More women use the Internet, but a third of UK adults will never go online

Which of the following have you ever bought online? (Base: All Internet Users. = 482)	
Books:	19%
Flights/holidays:	16%
CDs/Videos:	15%
Computer hardware/software:	13%
Cinema/theatre tickets:	7%
Financial services (e.g. banking):	6%
Groceries:	5%
Something else:	13%
Nothing:	49%
Don't know:	4%

What is the main reason why you are not on the Internet? (Base: All Those Not Connected To The Internet. = 1,211)	
It's not relevant to my needs	34%
It costs too much	24%
I don't understand technology/ don't know how to get online	21%
I'm too old	18%
It will provide me with nothing I can't get elsewhere	6%
I don't approve of some of the information you find being freely accessible	5%
Other:	6%
Dont Know:	8%

The fourth Online Annual Internet Survey carried out by Which? Magazine is interesting reading for companies who have their fortunes tied up in the Internet. Its results show that the gender gap that existed between Internet users has closed up a bit with 45% of the 16m people in the UK who now use the Internet being women – a 6% increase on last year. Also, almost 8m people in the UK have now shopped online – up from 1m in the first survey.

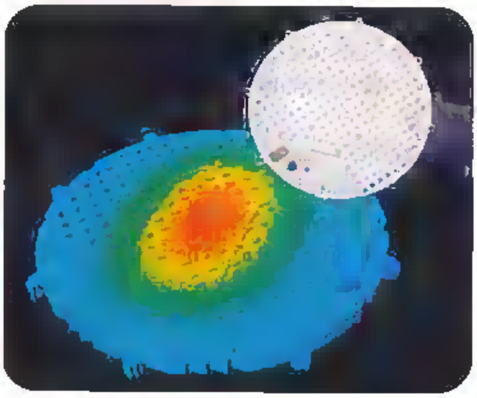
It is not all good news for companies with e-commerce interests though – only 1 in 10 feel that the Internet offers better customer service than high street shopping, and whilst the total number of shoppers has increased, the percentage of the Internet population who shop online has remained broadly the same.

One of the more surprising findings of the survey is that the number of people who say that email is their preferred means of communication has fallen from 14% in last year's survey to only 5% in this. 67% preferred face-to-face meetings, 19% their land line phone, 4% their mobile, only 1% the post, and 4% were indecisive.

But what about those people who say that they will never go online. Reader John Copeland, in our June issue, wrote 'Perhaps some people say that I am behind the times, but I have never used the Internet and do not see any reason to start now'. According to the survey, his is actually the most common view amongst those people who are not connected to the Internet. 60% of the 1,221 people without connections, when faced with the question 'When, if at all, do you expect to be connected to the Internet?' answered 'Never'. When projected, this equates to a third of the population of Great Britain. Resistance to the Internet does, however, increase dramatically with age. 33% of 15-34 year olds, 50% of 35-54s and 85% of over 55s do not think they will ever get connected.

The survey was carried out for Which? by the market research company Capibus. 2,044 people were interviewed and the resulting data was weighted for sex, age, social grade, region and working status. The results, according to Capibus, can be taken as representative of the entire UK population over the age of 15. You can see the survey for a limited time at www.which.net/surveys/intro.htm.

PipingHot thermal management software from Flomerics



Sometimes, for the purposes of mutual publicity, two different companies team up to announce how the product from company A has created enormous benefits for company B. Here take company A as Flomerics, developers of Flotherm thermal management software, and company B as PipingHot Networks, who develop broadband wireless access equipment for providing companies with access to the Internet and the ability to transfer large files without the need for cabling.

PipingHot's new subscriber unit had to work at temperatures between −40 and +60 degrees C, and was to be shipped to both extremely hot and cold counties alike. As the unit might well be installed in direct sunlight on the outside of a building, a cooling mechanism was an essential part of the design. PipingHot decided on a heatsink (see photo), and they used Flotherm from Flomerics to help in its design.

'We used Flotherm to examine the temperature rises for different heatsink designs, and to optimise the efficiency of fins and pins,' said Clem Fisher, PipingHot's RF Manager. 'We settled upon a large 14 inch heatsink featuring cylindrical pins. Without Flotherm we would have had to build a large number of heatsinks, then put resistive loads on them and measure the temperature rise. One thing that Flotherm highlighted was that there was some airflow stalling in our design, which would have been difficult to find out without Flotherm'.

Without the software, PipingHot have estimated, it would have taken them nine months to design the assembly. Using the Flotherm simulations the whole process was completed in just six.

Flomerics can be contacted in the UK on 020 8941 8810, and their global web presence is at www.flomerics.com.

New compact Schrack relay from Easby

Intended for general purpose Protection Class 1 use, such as in white goods and other domestic appliances, this general purpose mounting relay is designed as a replacement for 'sugar cube' type relays with a typical reduction in footprint of 40 percent.

The Schrack PB relay is UI & VDE approved and rated for use up to 10A at 250V AC. Coil versions are available at 6V, 12V and 24V. The Ag/Ni contact configuration can be bought direct from Easby as C/O, with N/O having to be ordered. The relay takes up 15 square millimetres on the PCB, with a height above the board of 20mm.

Contact sales@easby.co.uk or telephone 01748 850555 (850556 direct fax) for further details.

Low ESR solid polymer electrolytics from Samwha Electric

Samwha Electric UK (a division of Easby Electronics) is now offering reflow-solderable 105 degree C solid conducting polymer capacitors in both an SMD and a radial leaded series.

The radial leaded FA series offers capacitances in the range of 4.7 to 150 microfarads from 4V to 16V DC. The FC surface mount series is available in values from 2.2 to 15 microfarads, 6.3 to 16V DC. Both series offer low impedances and low ESRs at high frequency. For example, at 1MHz, the impedance of a typical FA capacitor is a fifteenth that of a standard aluminium electrolytic and a tenth that of a tantalum capacitor. The solid electrolyte ensures a long life as there is no liquid to dry out.

NEWS bytes

ROW becomes the world's biggest semiconductor market

Also according to IC Insights, for the first time ever the Rest Of World (ROW) semiconductor market will become the world's biggest, exceeding those of Japan, America and Europe. China's indigenous semiconductor market has fuelled a growth in their own industry, and this is also due to add to the current over-capacity problems that are troubling the semiconductor industry. China looks set to spend $23 billion on building new fabs over the course of the next 5 years.

Electronics firms still late to pay bills

Analyst company Experian has discovered that electronics and electrical companies are taking an average of three days longer to pay their bills than they were during 2000. The figure given by the company is 64 days – over two months. In 1998 the Late Payments Of Commercial Debts (Interest) Act was introduced, but this has not made any improvement to payment times.

Peter Brunning's Public Diary

Mobile Phones

Natasha, our editor, and I get on very well. I rang her earlier today to ask for some suggestions on what I should write about. Something controversial, topical and with an electronics theme she suggested. God! I thought that does not give much leeway. Whatever can I write that covers such a requirement. Mobile phones she suggested. Now what could I possibly write about mobile phones. Maybe I could liken their use to putting my head in a microwave oven, or perhaps as the only way to have a conversation when travelling alone by train in the UK.

In Holland the trains are particularly friendly but in England talking to one's fellow travellers is not an option. I do hate the modern trend of being forced to sit next to someone who insists on talking into my ear so that I can hear every word but none of which are intended for me to hear. I can understand to an extent the people who travel day after day the same rail journey being too bored to worry about who they are travelling with. But mobile phones on trains should be banned, and for that matter in all other public places.

I am not a fan of the latest trend. I do not own a mobile and see little chance that it will change. So what about the fears of these machines creating health problems? This gives me the opportunity to introduce a more interesting topic, astrology! Work out the link if you can before I go on to explain!

One of my interests is studying people to see how their inner characteristics relate to their birthday. I have been at this for 20 years. I started by drawing many birth charts using standard astrological theory and rapidly concluded that most of it was total rubbish. Yet there was an underlying theme which ran too true to be written off. I was forced to conclude that we do conform in general terms to our sun sign, and worse still the astrological trine (120 degrees) between signs is significant. Every fourth sign really does have a similarity. Three earth signs, three water signs, three fire signs and three air signs.

I had expected my investigation into that topic to rapidly run out of interest. I could not leave it there so I hypothesised a few ideas and reached a fascinating conclusion. If we assume that the key date is the moment of conception not birth then the explanation starts to become scientifically acceptable. The earth as it rotates round the sun does not follow a perfect circle. The distance from the sun varies from month to month. So the intensity of radiation received also varies. Add into this argument that different regions of our solar system will inevitably experience difference levels of radiation from outside sources, and we have an explanation of how for example all people born on 1st June have a general similarity to their underlying personality.

That is the easy bit but how do we explain a similarity between every fourth sign? The planets going round our sun cause a tidal effect on the suns surface in exactly the same way as the moon does to our surface. Mercury, Venus, Earth and Jupiter account for virtually all the tidal flow of the molten larva. The other planets Mars, Saturn, Neptune, Uranus and Pluto have a small but insignificant effect. I wrote a programme many years ago to run on my first computer, a TRS80, to analyse the tidal flow due to these planet movements taking account of their radial position and varying distance from the suns surface.

The pattern of tidal flow when related to the actual position of the earth gives a consistent 120 degree pattern for several years. It is easy to accept that basic sun sign characteristics are due to the different levels of radiation received at our surface due purely to the position of the earth in its orbit. And we can stretch this idea a little to accommodate a relationship between every fourth sign due to the tidal flow on the suns surface.

I have put this to the test over many years. While it is not surprising that the sun signs characteristics do hold good, the 120 degree trine has proven in my limited evaluation to have an alarming degree of consistency, which suggests something more than planet movements.

I gave up seriously studying astrology because it is almost impossible, we are dealing with human characteristics. The sun sign gives an indication of the inner emotional forces which are driving each individual. The books are right in that respect and in linking every fourth sign but that is where it ends. Forget the effects of the moon. We are relating the effect to conception not birth so the moon has no chance of being included.

Did anyone work out the link? The one thing my investigation has convinced me beyond all doubt is that our underlying emotional characteristics are influenced by the radiation levels at the time we are conceived and to a steadily lessening extent as time goes on. Which particular type of radiation causes the effect is impossible to know.

The worry most often expressed about mobile phone hazards is cancer or memory loss, but simple logic suggests to me that personality change is a far more likely problem. We know so little about the working of the human mind.So the big question is whether a power of 1 or 2 watts at around 1 or 2 gigahertz is enough to influence the development of our brains. My gut feeling is that while I cannot imagine a problem with half a watt radiated 3 or 4 centimetres from my scull, I am not so happy about 1 watt or higher.

I decided at this point to ring my friend David Ayre and talk it over with another experienced rf man. 'It's all a question of heat being generated by the rf signal and at these power levels that would not be significant' was his first input. 'But' I argued 'maybe an odd resonance could focus the energy into one spot. Maybe there is electrolysis'. 'Yes maybe' he conceded 'but there is years of experience of exposure to rf and so far no significant evidence against at this very low level'.

The problem of course is that we do not know. If there are parts of the brain which act as semiconductor material, which is quite possible, then a DC current will be generated which will cause electrolysis. That would be a much greater worry. Low levels of heat can be conducted away, but electrolysis is a progressive effect.

Standard mobile phones produce 2 watts in the 900 Mhz band or 1 watt in the 1800 Mhz band. I see it like this. The radiation that goes towards the user gets absorbed by his or her head. That is a stupid arrangement. The energy is not being put to use and may be causing damage to the person. I suggest that the shape of mobiles should be changed so that a metallic shield is between the antenna and the user. The idea being to give the antenna 270 degree coverage with a notch in the direction of the user to achieve a ten times reduction in the radiation which reaches the head. Existing mobiles could be upgraded by adding a facia of metal coated plastic with an extended shape.

The question of mobile radio masts is more complex. At first sight the idea that any mobile phone mast could be a problem to child or adult is absurd. There is no point in the fixed mast having more than twice as much power as the mobile as the effect drops off at the rate of the square of the distance, but on reflection it is not a question of just one signal. One mast might handle 1000 channels and a significant number will be transmitting for 24 hours a day instead of 15 minutes or so.

Based on these figures we can calculate the relative effect of the fixed transmitter compared to a mobile operating 5 cm from our head. A mast with 1000 channels operating at the equivalent power of two times the mobile power per channel produces 2,000 times more radiation than the mobile. The actual power of the transmitter will be much less but the radiator will be a high gain antenna focused into the horizontal plain. The attenuation of the signal with distance will depend on the terrain but we will assume it is a true square law:-

Relative distance = 0.05 x sqr root (2 x 1000) = 2.2 meters

I am demanding a ten times reduction in the radiation towards the head so we need to multiply by 10 inside the square root:-

Relative distance = 0.05 x sqr root (2 x 1000 x 10) = 7.1 meters

This figure of 7.1 meters is the distance where a base station with 1000 channels operating creates the same heating effect as a mobile modified with my proposed shield and operating 5 cm from our head.

For electrolysis total exposure is the important factor so in this case we need to use the average number of channels and the total time in our base units of 15 minutes. For example children are at school for about 7 hours and over this period the 1000 channel base station might average 400 channels operating together:-

Relative distance = 0.05 x sqr root (2 x 400 x (7 / 0.25)) = 7.5 meters

In this case as children are in the radiation field my reduction factor of 10 needs to be increased to 100:-

Safe distance = 0.05 x sqr root (2 x 400 x 100 x (7 / 0.25)) = 75 meters

What I have done is create an equation based on my years of rf experience related to my understanding of life. It is not a true scientific solution but it is likely to be a good safety guide line. There are other effects such as the attenuation of buildings and the possibility of standing waves. One is good and the other bad so ignoring both is a good compromise.For mobile phone masts near schools:-

Safe distance = 1.4 x sqr root (Average number of channels x Exposure time)

where exposure time is in hours per day, the number of channels is averaged over the same period, and the distance calculated is in meters.

Mobile phones should never be used by young children, and anyone who uses a telephone for significantly longer than 15 minutes every day must use a fixed telephone. Finally, manufacturers get your finger out! Incorporate a shield between the mobile phone antenna and the user's head.It takes 2500 watts 45 minutes to heat up my bath water but the lowest power light bulb will heat a filament of tungsten to white heat in a quarter of a second using just one fifth of a watt!

The ELECTRONICS Forum

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Water Powered Watches

Question: About twelve years ago, I remember there being a short craze on water powered watches. I'm not sure what principle these worked on (I'm guessing certain electrodes pick up free electrons from ions), but I would be interested in using it for my own projects. Any information you could give me about this technology would be much appreciated. Perhaps someone remembers what company made the watches, and how to get in touch with them. – **Greville J. Kirk.**

Answer: The principle was that there were two electrodes of different metals that relied on the impurities in the water to create a potential difference. There was a problem in that the electrodes tended to get oxidated and it stopped working fairly quickly. If you put a bit of lemon juice (or vinegar) in the water the problem went away. In fact Xilinx used this methodology to prove that their low power PLDs were really low powered by powering them with a zinc rod and a copper rod pushed into a lemon. – **Steve Hawkins.**

I think you refer to the former Philips 'CoolRunner' CPLD devices which were sold to Xilinx about 18 months ago. All the literature at that time showed the CPLD powered by injecting two electrodes into an orange. – **Iain King.**

Log. Amplifier

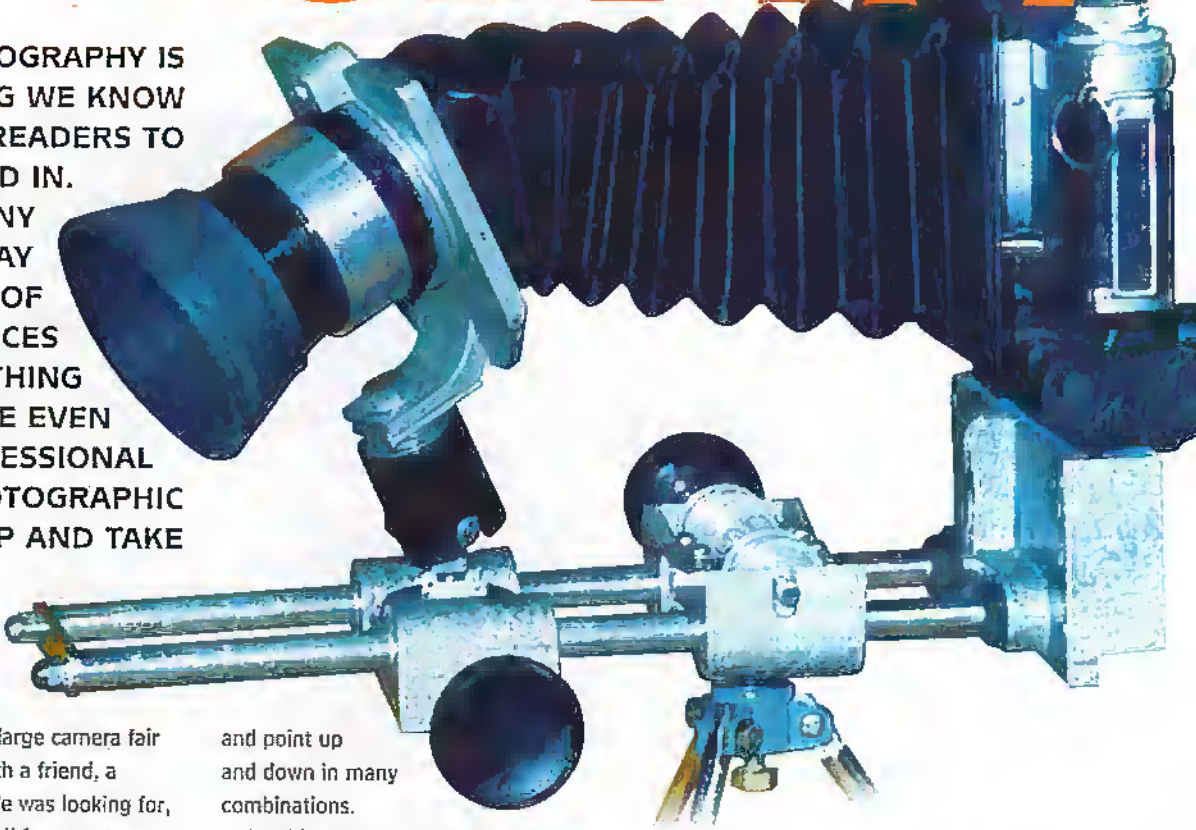
Question: Does anyone know how I can make an amplifier whose gain can be made variable logarithmically, like a log. expander? I am interested in logarithmic amplifiers or amplifiers where the gain could be set to a 'function' i.e. output = input squared or some other function. Frequency would be very low & gain would not be extremely high. – **Harold Goodwin.**

Lime Scale Remover

Question: Can anybody help me find a Module or Circuit Diagram for a swept frequency lime scale remover? My pond is full of Blanket Weed. – **Martin Baugh.**

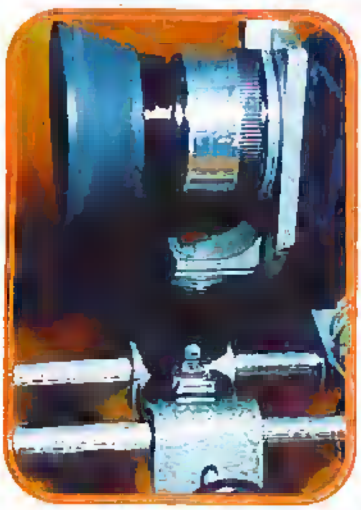
Photographic ODDITY

by Tony Hamilton-Gray



PHOTOGRAPHY IS SOMETHING WE KNOW MANY OF OUR READERS TO BE INTERESTED IN. HERE TONY HAMILTON-GRAY OF PRINTS OF WALES INTRODUCES US TO SOMETHING THAT WILL MAKE EVEN THE MOST PROFESSIONAL OF OUR PHOTOGRAPHIC READERS SIT UP AND TAKE NOTICE.

It was a chance remark that led me to build this camera, while visiting a large camera fair at the NEC, Birmingham with a friend, a retired pro photographer. He was looking for, amongst other things a small format mono-rail camera. We found a very nice Swiss manufactured small mono-rail, GREAT! But at £1700 plus VAT with no lens or filter holder we walked away. I said 'I'll build you one'. We both laughed and the subject was forgotten until several months later during a quiet period in my shop. I recalled what I had said and started looking around my scrap boxes.



Finding a focusing stage of an old black and white enlarger I cut down the negative holder and rotated it 180 degrees around the rails and onto this I fixed a close-up focusing attachment. This would allow the camera body to swing left and right of the centre line of the finished camera. The lens holder was mounted on a ball and socket, this gave the lens holder provision to swing left and right and point up and down in many combinations.

An old Soligor 35mm SLR body fitted the bill as it had built in through the lens metering and a removable prism giving a waist level finder. An alloy plate cut to fit the larger end of the bellows with a hole cut in the centre, with a part from the back end of an old lens with a 42mm thread was used to fit the alloy plate onto the body, contact adhesive secured the bellows to the plate.

A brass Taylor Taylor Hobson 5.5 inch focal length lens, probably made before the war, was screwed into a length of alloy tube and attached to the lens holder with araldite. As you can see, this required very few tools, i.e. Hacksaw, File, Hand drill, Screwdriver and a small Adjustable Spanner.

This project was completed in my retail photographic shop in-between customers, who got very curious about this strange looking object. It was completed within a week.

Would it work? I loaned it to a friend and he enjoyed playing with it, it was so much so that it was three months before I got it back. The results were good, due no doubt to his photographic skill rather than my engineering.

It now sits on a shelf in my workshop. Every now and then I take it down and play with it, thinking that I should sell it or strip it down and fit a normal lens on the body and use it as a normal camera, but as I own many cameras from 35mm SLRs up to a huge 7x5 mono-rail I don't really need another camera.

If you have comments or questions about the construction of this camera I would be only too pleased and willing to answer them. I have also built a couple of pinhole cameras which are really fun to use if F256, yes F256, is your idea of fun. Perhaps I'll write about that one day.

If you would like to get in touch with Tony, you can do so via the usual magazine email and postal address. We will pass on to him any correspondence received.

An Introduction to PHOTOVOLTAICS

In association with bp solar

PART 1

THE CLEAN, GREEN BUILDING OF THE FUTURE IS HERE. THE USE OF BIPV, WHICH STANDS FOR BUILDING INTEGRATED PHOTOVOLTAICS, HAS PROVEN THAT MANY BUSINESSES AND HOMES CAN PRODUCE ALL, OR NEARLY ALL OF THEIR OWN ELECTRICITY, THEREBY REDUCING GREENHOUSE GASES THAT HARM THE ENVIRONMENT

If a material is said to be photovoltaic (PV), a voltage will be generated in it by the incidence of light upon its surface. It is a catalyst for the conversion of light energy into electrical energy. PV cells are not only environmentally friendly, but are silent as well because they do not contain moving parts.

What materials can be used?

Silicon (Si) is the most important photovoltaic material presently in use: It is benign, widespread and extremely suitable for use as a PV material. It does have disadvantages, though, and these are that it is expensive to purify and prepare in its photovoltaic form, and that this final form can be fragile. Other materials – namely gallium arsenide (GaAs) and cadmium telluride (CdTe) – can be used, but they are either too expensive or have not been proven over a 20 year period of use.

Monocrystalline silicon (where the atoms are regularly arranged within a single crystal) is the most effective form of silicon for use as a photovoltaic. This form of silicon is grown as an ingot from a seed of crystal silicon within a molten silicon solution. A diamond saw is used to slice the ingot into pieces, which are then smoothed so as to remove the rough surfaces. A cheaper way of casting silicon is to pour the molten solution into a tray or mould. This produces polycrystalline silicon (with its multifaceted appearance). This is, however, slightly less effective as a PV material than the single crystal form.

Using thin-film techniques, silicon can be coated onto the glass that will form the window area of the final PV module. This is the least expensive option, but does make the silicon amorphous and this means a lower efficiency and a degradation of the material over time.

Architects may consider the aesthetics of the material to be equally as important. Monocrystalline silicon is blue and regular, polycrystalline silicon is blue and patterned, and thin-film silicon (the kind that powers solar calculators) is brown. Efforts are being made by manufacturers to widen the choice of colours, but this is difficult because with any change in colour there must be some reduction in PV efficiency (as visible light scattered back is light that is lost to the PV process).

How is a PV cell created?

To turn PV material into a PV cell, a pn junction needs to be created just below the front surface (more on which to follow). Two additional processes then need to be applied: The next stage is to bond metal contacts onto the front surface to 'gather' electrical charge without blocking the incoming light too much. Finally, so as to minimise the amount of light lost through reflection, an anti-reflection coating is applied to the silicon.

Silicon photovoltaic cells normally generate up to 0.5V and, providing they are sealed away from moisture in the atmosphere, can have a long and productive lifespan.

The photovoltaic process.

Figure 1 shows a schematic of the electrically active layers within the crystal structure of a PV cell. Pure silicon has a very low electrical conductivity because almost all of its electrons are immobilised in bonds. To increase the conductivity, a very small quantity of boron is introduced into the material. This process is known as 'doping'. Doping silicon with boron introduces positive charge carriers into the material. These can be thought of as gaps in the bonds of the crystal structure where electrons would normally be expected to be. Silicon that has been doped with boron is referred to as being 'p-type', the 'p' representing 'positive'. Similarly, 'n-type' silicon is silicon in which the main charge carriers are electrons (negative), and this is created in the same way but with phosphorous as the dopant instead of boron.

Most of the silicon in the PV cell is p-type, but the surface – where the light enters – is n-type. The most important part of the cell, however, is the interface between the two. Just below the surface, this interface – known as the 'pn junction' – is where the negative and positive charge carriers combine, cancelling each other out. However, because the dopant atoms are fixed within the crystal structure, they cannot move to cancel each other's charge. Instead, they form a charged barrier – positive in the top part of the pn junction and negative in the bottom part.

When a photon is absorbed into a PV cell, it passes its energy to an electron in one of the bonds. The increase in its energy level liberates that electron from its bond, turning it into a charge carrier, free to contribute to electrical conduction. The gap left by that electron is effectively positively charged, and can also contribute to conduction.

The cell is designed so that most of the photons that hit it generate these carrier pairs of electrons and gaps in the junction. Because of their proximity to the unbalanced charges created by the dopant P and B atoms, the two types of carrier are forced to travel in opposite directions. Electrons move away from the boron in the junction and towards the top, and the gaps move downwards into the p-type material.

When the PV cell is connected to a circuit, a route is provided for the electrons to flow from the front (or top) of the PV cell to the back, where they recombine with the gaps. This can alternatively be looked upon as a route for positive current flowing from the back to the front of the cell.

What is the difference between PV cells and solar panels?

Firstly, the name 'solar panel', whilst instantly recognisable by the layman as a panel for turning light into electric, can also include solar water heaters and, as such, should not be used. The preferred name for a group of PV cells is a 'module'. PV modules contain several cells always connected in series. By doing this, the inconveniently low voltage created by a single cell can be added together with that of others, forming a more useful value.

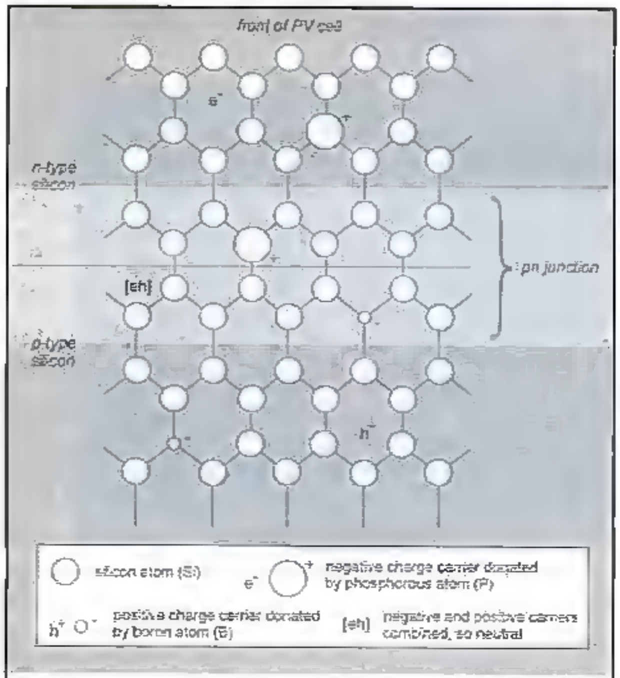


Figure 1.

The front of a PV module is a window of low-iron content glass. This both protects the cells and also ensures a high transmission efficiency. The cells are hermetically sealed with either silicone or EVA (ethylene vinyl acetate). A module may or may not need a frame to strengthen it – if the glass is sufficient protection, the module is referred to instead as a 'laminate'.

Electrical connections, labelled positive and negative, are fitted to each end of the series connected cells. The maximum voltage per module is usually 22V dc.

Modules can be connected together in one of two ways to form an array. A series connection of modules (or 'series string') will increase the voltage. A parallel connection will increase the generating capacity without any increase in voltage.

Unfortunately, should one cell be shaded by, for example, the branch of a tree, it can have the same effect as shading the whole module. Parallel connections within an array are important for minimising any losses incurred in such a way.

I-V curves and peak power.

To examine the electrical characteristics of a PV module, an I-V curve (a graph of current against voltage) can be drawn. To obtain the WP (peak watts) value of a module, that module should be illuminated using a solar simulating light source at a constant temperature. With no loads connected, the open-circuit voltage can be measured. This will give a value on the V axis because no current is flowing. The short circuit current can also be measured by shorting the terminals together via an ammeter (this will give a value on the I axis, where $V = 0$). Unlike a mains supply, which maintains its voltage irrespective of the number of appliances connected, the voltage of a PV module will drop as more current is allowed to flow. By varying the load, a series of values for I and V can be found and plotted on the I-V curve (see figure 2).

Power (in watts) is simply the product of current and voltage. To find the maximum power we need to find the largest product of current and voltage, and on the I-V curve this can be represented as a rectangle touching both the origin and the 'knee' of the line drawn to connect up the plotted points. The 'peak power' of a module is taken in such a way using a standard solar irradiation of 1,000 W/m^2 and a cell temperature of 25°C.

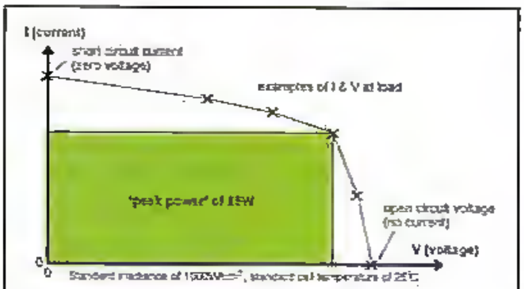


Figure 2.

The term 'peak power' applies only to test conditions – 'maximum power' should be used under all other circumstances. Maximum power is dependant on irradiance, which is in turn dependant on cloud conditions and time of day.

Test conditions aside, PV cells should be kept as cool as possible to maximise their power output. For each °C rise in cell temperature, there is a decrease in power of 0.3%. Modules are built with minimal covering over their backs so that air can flow over them and keep them cool. However, the test irradiance mentioned above can cause a rise in cell temperature of around 30°C, resulting in an actual temperature of 55°C, and this will reduce the maximum power attainable by approximately 10%. Only if the ambient temperature is below 0°C might maximum power reach peak power at standard or peak levels of irradiance.

Though the maximum power can be derived for any value of irradiance, can it just as easily be extracted? It is now common for inverters to include a peak power tracker. In the dc to ac conversion process, a peak power tracker constantly adjusts its input voltage in order to maximise the product of I and V. The tracker is important because it maximises power extracted as the temperature and irradiance vary.

What angle should the modules be tilted at?

If PV modules are to be incorporated into a structure that is already there and is immovable, such as the roof of a house, there may not be much of a choice. If, however, a PV array is to be incorporated into the structure of a building at the design stage, then there are some very clear choices to be made. Firstly, at what time of the year is the power going to be of most importance? The tilt angle can be optimised for the summer, the winter or a compromise. To maximise annual yield, designers optimise the tilt of their arrays for the summer. This might usually be the latitude angle of the site minus about 20°. To raise the minimum output, designers optimise instead for the winter – the latitude angle of the site plus about 20°.

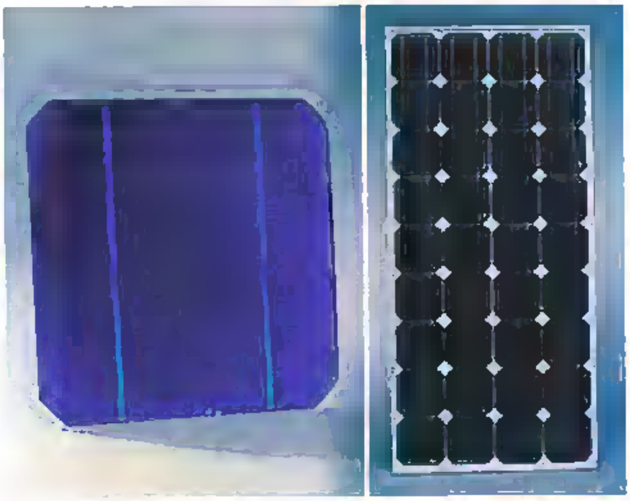
It is also possible to incorporate a system that will constantly adjust the tilt so as to give the best yield. This can be very expensive, but there is a cheaper alternative and that is to incorporate a hinge system into the modules so that they can be adjusted manually with each change of season.

What about orientation and location?

In a northern latitude, a south facing array will collect the most light throughout the year and will thus produce the most energy. Failing this, east and west facing facades can still produce significant quantities of energy from PV.

When it comes to measuring the amount of sunshine available at the site, daily insolation is the measurement that needs to be looked at, rather than hours of sunshine. Daily insolation is measured in kWh/m², otherwise referred to as 'peak-hours per day'. Because the standard irradiance of the specified peak power of 1,000 W/m2 (1 kW/m²) is also close to the maximum irradiance received by a surface facing the sun, a figure for the energy received during the day can be worked out from the equivalent number of hours in which a constant 1 kW/m² is received.

Meteorological records for daily insolation can be consulted, but these mostly measure from a horizontal plane. In some places, the daily insolation is available for a plane tilted in respect to the angle of latitude. PV arrays are rarely mounted horizontally – they are usually tilted at an angle or set vertically into the structure of larger buildings.



BP 'Saturn' Cell and Module

The Oxford Solar House (main photo) was set up in 1994 as a project for exploring the issues surrounding the use of PV technology in the built environment. It has 3 series strings consisting of 16 modules each, and these face due south with a tilt angle of 40° from horizontal (site latitude is 51.8°). Horizontal surface daily insolation records for the Oxford area show an annual mean of 2.6 peak-hours per day, with means of 0.6 for mid-winter and 4.4 for mid-summer. Data is also available for the same area at a tilt of 45°, and this shows an annual mean of 3.3 peak-hours per day, with 1.3 for mid-winter and 4.5 for mid-summer. This latter set of statistics is more relevant to the Oxford Solar House than the horizontal set, and the difference between the two illustrates how important it is to use the right daily insolation data whilst still at the planning stage.

If the required daily insolation figures are not available in that area for the tilt angle being considered, there are other ways of working them out, and these require more sophisticated calculations. In addition, further conversions are needed for directions of tilt other than due south.

Measuring performance.

The amount of energy generated varies from day to day, so to simplify the problem of measuring performance, the total generation should be measured over the course of one year. A convenient unit of measurement is the kilowatt-hour. The annual energy yield of the Oxford Solar House is around 3,000 kWh.

The total electrical output divided by the peak power of the array gives another parameter that can be used to compare systems and their relative performance – the 'annual specific yield'. The Oxford Solar House has a total array output of 4kWP, so its annual specific yield is 750 kWh/yr/kWP.

The annual specific yield depends on the following factors:

- Insolation: The annual insolation of the site at given angles of tilt and deviation from due south.
- Cell temperature: The operating temperature of the cells – related to the ambient temperature, moment-to-moment insolation and the effectiveness of cooling.
- Electrical coupling efficiency: The effectiveness of peak power tracking and the inverter.

For the Oxford house, an estimate of the maximum attainable value for the annual specific yield has been worked out as follows:

3.3 (peak-hours per day, annual mean) x 365 (days) x 0.85 (a 15% reduction for the effects of cell heating above the standard testing temperature) x 0.9 (90% efficiency of inverter, including effectiveness of peak power tracking) = 921 kWh/yr/kWP.

The value of 750 kWh/yr/kWP observed in the house compares well with this estimate of the maximum, although it may have be set unattainably high by the estimate of the effects of cell heating being a little too conservative.

PV integration on a larger scale.

BIPV (Building Integrated PV) is becoming more and more widely used in the construction / refurbishment of larger commercial buildings. BP Solar is a major manufacturer of PV arrays and technology, and their PowerWall panels have been designed to substitute directly for materials such as glass or granite, traditionally used in these buildings. As well as providing useful energy, these panels can also appear quite aesthetically pleasing when the building is designed with their inclusion in mind.

Next month we take a closer look at BIPV, courtesy of some real life buildings which utilise BP Solar's photovoltaic modules to create buildings that are not only environmentally friendly, but attractive to look at as well.

What MONEY from ELECTRONICS?

2: TECHNOLOGY TAKES A TUMBLE

by Gregg Grant

IN PART 2 OF THIS SERIES ON THE SPECTACULAR FALL OF HIGH TECH SHARES, WE LOOK AT THE ENTREPRENEURS WHO MAYBE SHOULD HAVE KNOWN BETTER OR EVEN HAD MORE MODEST EXPECTATIONS OF WHAT INTERNET BUSINESS WOULD MEAN IN REAL TERMS. THEY DO SAY HISTORY REPEATS ITSELF! THE CRASH OF THE 1930S REINCARNATED...

The Billionaire Who Fell To Earth

To understand failure at its most spectacular, let's look at the case of Autonomy. Dr. Mike Lynch was not only an Internet star, he was also the phenomenon's first sterling billionaire and a brilliant technologist to boot. Having spent some time in academia and at GEC Marconi, he decided to set up his own company, Neurodynamics, marketing a machine designed to match fingerprints. This greatly aided the solution of murders long forgotten -except of course by the police - and Neurodynamics quickly achieved success.

In 1996, Lynch launched Autonomy, with a £2,000 loan. The company rapidly became a world leader in processing the enormous amount of information flowing along the internet. When the company was floated on the Stock Exchange in November last year, the market valued it at a cool £5.2 billion!

This meant the big time immediately: entry into the FTSE 100 and Lynch - at least on paper - he became VERY wealthy indeed. A mere three months later, Autonomy became another casualty of the internet bubble, it being booted out of the FTSE 100 almost before the ink on its admission documents was dry. Worse however was to come.

By early May the shares had fallen by a horrendous 43% and so stock which - in its glory moments - had been valued at £41 a share, was now trading at £3.82 per share. Lynch went from being a billionaire to a round figure worth of £126 million, a haemorrhage of £874 million. There can be few men around who've lost £56 million in a day!

Duo Disaster

Another high-wire act in the internet loss field is the services company Affinity Internet, founded in 1995 by friends Terry Plummer and Wayne Lochner. Both men had mortgaged their homes and taken out loans to the tune of £1 million to launch their new venture which - initially - enjoyed spectacular growth.

The company's product seemed a sure bet too, for it provided the technology for companies offering free access to the net, and having clients such as Vodaphone and Powergen helped of course. At the height of the internet euphoria in March 2000, Affinity Internet's shares rose to £80.78, giving its founders a total wealth of £437 million. A year later however, matters were very different.

The shares tumbled to £3.55 and the company's value plummeted - if I can put it that way - from £1.8 billion to £88 million, leaving the founders with personal wealth of some £23 million apiece.

The Off Line Auction House

Another casualty of the dot.com disaster is Tim Jackson, the founder of the on-line auction house QXL. A one-time financial journalist, he brought his business - which stands for Quick Sell - to market in October 1999.

The share price stormed to £7.44 and Jackson was - in short order - worth around £423million. In fact, he made £34million in one day when his company did a deal with the American on-line outfit Excite. All of this of course mirrored much of the share-trading and deal-making of the Great Crash of the early 1930s: it was all on paper.

Like last-minute, QXL was worth a fabulous amount at its height, despite low revenue. Its value of some £2.5billion contrasted starkly with its monthly earnings of about £500,000.

The ultimate irony of course is that Jackson's original specialisation - financial journalism - should have given him a head-start in the warnings department as to what could - and in fact did - happen when what could be called the North Sea Bubble burst. In no time at all QXL was not so much an on-line business as an off-line one and, as things stand at present, Tim Jackson is worth a more modest £5.8million.

A Softer Shade of Hard, A Harder Shade of Soft

Hardware and software entrepreneurs too have had a thin time of it lately. In fact, the greatest loss of all was made by an engineer-entrepreneur, Dr Andrew Rickman. An electronics scientist by profession, Rickman founded Brookham Technology in a room above his garage in 1988. It specialised in manufacturing Integrated Circuits - ICs - for transmitting information across fibre optic lines, thus greatly speeding up the Internet.

By mid-summer 2000, Rickman's stake in his creation was worth £1.75billion, the shares were valued at £54 apiece and the company had a valuation of £6billion, more in fact than the mighty Sainsbury's grocery empire. This was the peak. It was to be short-lived. American companies were soon in the market and an avalanche of near-identical products gave Brookham serious competition, resulting in a spectacular drop in the share price, which presently hovers around the £3.20 mark. Rickman's personal wealth is now a far more modest £107million.

If the hardware men were finding the going difficult, life was equally as tough for the software entrepreneurs, a classic example being Gordon Crawford. In January this year, headlines such as 'London Bridge falling down...' was but one take on Crawford's issuing a profits warning on behalf of his company, London Bridge Software.

Crawford's company had developed software that enabled banks and other financial institutions to identify bad payers. With clients of the stature of Chase Manhattan and Lloyds TSB, the company rapidly attracted investors and - by Spring 2000 - the shares were trading at £15.58, making Crawford's stake in his company worth a cool £1.6billion. It looked like London Bridge would rapidly become a FTSE 100 star, its shares being avidly sought by virtually everyone, not least the banks themselves.

However, failure to rapidly secure American orders, at the time when technology shares were beginning to stumble, saw the stock crash from its peak to around the £2.50 at present. Currently, Crawford's 49% stake in the business is worth about £196million, a massive fall by anyone's definition.

Another man whose wealth rivalled Crawford's was the Welsh billionaire Terry Matthews. He'd begun his working life at 16, in the British Telecom, BT, research laboratories before moving to Canada where he founded the electronics firm Mitel in 1972. Fourteen years later he sold this business and used some £1.5million of his profits to set up Newbridge Networks, in which he took a 25% stake.

Early in 2000, he sold this business also, this time to the French electronics giant Alcatel, for an impressive £4.3billion, he taking a 3.1% holding in Alcatel itself, which subsequently proved to be one of his less successful moves.

At the height of the technology boom, Matthews's little slice of Alcatel was worth a handsome £1.5billion. The subsequent crash however has seen £810million of that sum vanish. Nor was this his only loss. He became involved in the internet security company Ncypher, and also in Andrew Rickman's Brookham Technology. The former was worth £82million at its height and Matthews's investment in Brookham was valued at £90million. Presently these investments are worth £25million and £5million respectively.

Nevertheless, despite the horrendous falls outlined above, all of these entrepreneurs are still very much in business and doubtless have learned a great deal from their varied experiences. Therefore what future do the so-called Hi-Tech shares have, given their rags-to-riches- to-better-quality rags again performance over a very short period?

The Permanent Plummet

Virtually none at all, if the investment banks are to be believed. Since March last year, some technology shares have fallen by as much as 90% and the Financial Times's Techmark Index has dropped by 48.1% from its high-point. More pertinently perhaps, America's Nasdaq - 'the stock market for the next 100 years' as the advertisement had it - has fallen by a whopping 59.2%!

Indeed the bankers' take on the situation is dire. They envisage only about five of the major Hi-Tech players surviving. As to the shares, in the view of one analyst, they will take years to even approach their former heights, if ever.

And the moral in all this? Beware investment analysts hyping future killings not so much on companies for 'carrying on undertakings of great advantage, but nobody is to know what it is,' but on companies of nil advantage which they - the investment analysts - know not one damned thing about!

Stray Signals

by POINT CONTACT

Hello readers, it's nice to be back after a gap of several years. Readers of my earlier ramblings, like E. V. K. of Taunton, may recall that one of the later ones was "penned" on my laptop, from an NHS bed. The series was discontinued shortly after, not - I'm glad to say - due to a visit from the Grim Reaper, but the exercise of an editorial new broom. (Actually, my last appearance in these pages was in 1997, in one of several of my technical articles the magazine has published, under a variety of other pen-names.) Now the magazine has a new editorial new broom, who has kindly agreed to provide space for some more Stray Signals.

You may have been fascinated, as Point Contact was, to see a programme on the box recently, about hacking. Apparently, it started when some bright spark in telephone system development labs in the USA decided that the old loop-disconnect signalling could be replaced by in-band tone signalling (a silly decision as it turned out, but then silly decisions abound in commerce and business, not to mention politics). The earliest version seemed to replace the dial pulses with pulses of tone that, it transpired, could easily be mimicked using a plastic whistle found in packets of a certain brand of breakfast cereals. Later signalling used in-band DTMF - dual tone multi-frequency - each digit on the dial pad being represented by a different pair out of a set of audio tones. Hackers soon came up with the infamous "blue box", which was capable of playing such tone pairs into the mouthpiece of the hand set. With a knowledge of the control sequences, 'phone calls could then be made for free, at the risk of imprisonment if caught with one of the illegal boxes. Both DTMF and loop-disconnect dialling are still in use, though presumably security arrangements have been beefed up to discourage free-calling.

The hackers with whistles or blue boxes were far from the first free-callers. I remember when on National Service in the RAF in the nineteen fifties, one of us budding air radar technicians at the Number Two Radio School, RAF Yatesbury, had been a Post Office trainee before being called up. He showed us how you could dial around the system by tapping the handset rest up and down to simulate dial pulses, if you could get the speed and mark-space ratio right and knew the right codes - which he could and did. He explained that this was not a good idea though, in a public phone box, as bobbies were trained to watch out for it. "Back dialling" was cleverer, and safer. With the aid of a cork and a pin (even those he did not need, being practised), one could ensure that the "off normal" contact never got reset. Dialling was then carried out working from the fully clockwise "0" position, letting the dial return as far as 9 to dial 1, to 8 to dial 2 and so on. From a phone box on the camp, with half a dozen of us watching, he set up a call via Swindon, Birmingham and several other exchanges including one in Scotland, finally ringing the phone in another box next door.

After leaving the RAF, I got a place as a sandwich student with the G.E.C.,, whose motto in those far-off days was "Everything Electrical". Visits were laid on for us students to various company sites, including the Telephone Works sites in Coventry. There we saw the just introduced "trigger dial", specially developed to prevent successful back-dialling. We also saw ladies adjusting these rotary dials, to get them within the specified range of seven to fourteen pulses per second. Such was their skill that, watching the dial run back just once, with one tweak of the governor springs they would get it to ten pulses per second, straight off. How many skills and crafts disappear with every step of "progress"!

There has been a lot of discussion, and some concern, over the years, about the possibility of different types of radio signals interfering with each other. TETRA and TETRAPOL (the Interpol version of TETRA) are likely to cause problems for SRDs (short range devices) operating in the obsolescent UK 415 MHz band, and even the Europe-wide 433MHz band. And it is unfortunate that the ninth harmonic of the 13.5MHz TV subcarrier falls on 121.5MHz, an international marine distress frequency. Now, there is concern about the various systems all operating in the 2.4MHz ISM band, available worldwide almost, on an unlicensed basis. It is already a Babel band inhabited not only by Industrial, Scientific and Medical users, but also by newer generations of cordless phones, and by millions of microwave ovens. Add to that three extra contenders, Bluetooth, HomeRF and the IEEE sponsored LAN standard 802.11b for local area networks, and there is real cause for concern. Bluetooth is designed as a short range (up to 10m) link, to replace cables or infra red links between laptop computers, printers, digital cameras, cellular phones etc. The 802.11b LAN standard was originally designed with corporate local area networks in mind, whereas HomeRF is designed for networking in the home, with a range up to 50m. Like Bluetooth, it uses FHSS - frequency hopping spread spectrum - hopefully to minimise interference from other transmissions, though HomeRF's hop rate is much lower than Bluetooth's. Like a microwave oven, Bluetooth transmits whenever it feels like it - has data to send - there is no listen-before-send protocol. How all these systems will fare remains to be seen. The danger is that, in the early days when not too many are deployed, it will all seem to work OK, and the existing systems will become entrenched only to find later, that with more and more items in use, operational reliability becomes just too low and no-one knows what to do about it.

Yours sincerely,
Point Contact.

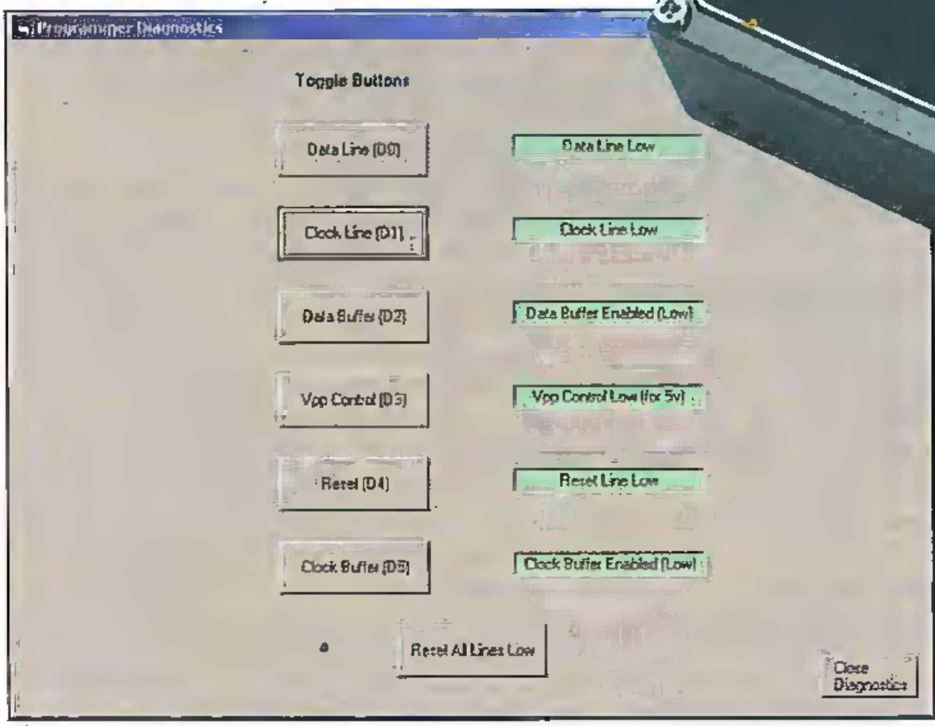
A D.I.Y. PIC PROGRAMMER

PART 1

by Malcolm Peill

Have you ever had the idea of a project that could automate some task around the home or your hobby that could easily be performed with some control logic. However, the thought of designing a circuit that would involve many logic gates, analogue input operational amplifiers and all their associated components was just too involved. Even having accomplished this, the project would be dedicated to one particular task and be very inflexible in trying to add any design improvements once these were found necessary. Of course your desktop computer could do the job, but leaving your 1Ghz Pentium pc powered on 24 hours a day just to turn on the sprinkler system when the plants need watering seems a bit of an overkill.

The solution is to make use of a very useful yet under-appreciated device, the MicroController. These single chip devices are



in effect a small self-contained computer system, and are used extensively in many commercial products requiring a small amount of processing power in a limited space.

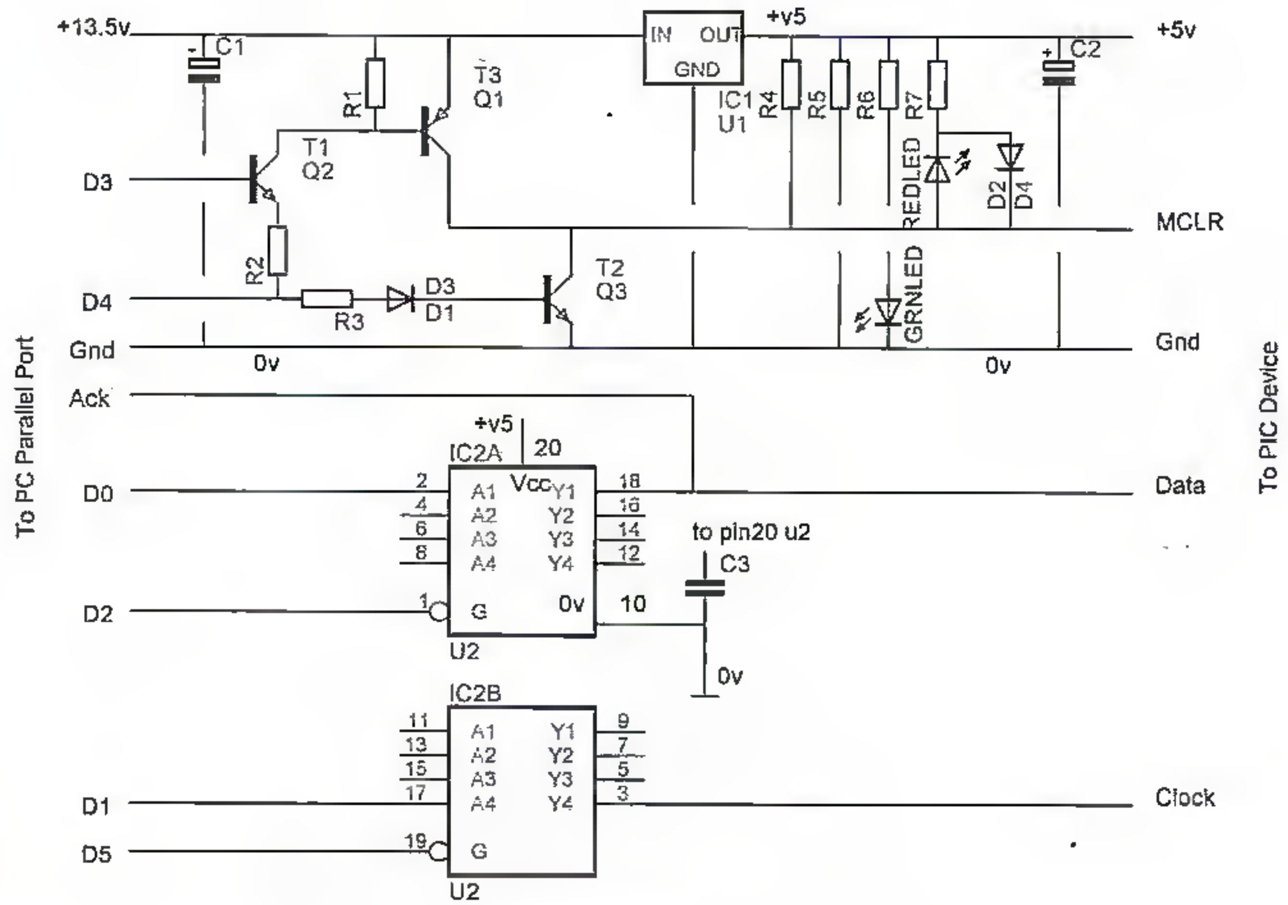
These devices have come a long way since the days of the first microprocessors. Microchip are a major manufacturer of these MicroController's, and offer an extensive range of devices with part numbers prefixed with the letters 'PIC'. They do have those same functions as microprocessors, but also include flash memory to store the program, some RAM to manipulate variables, digital input and output ports, timers, A/D converters, serial I/O and others depending on the particular device selected.

The drawback with these devices being used by the electronics enthusiast has been the relatively expensive equipment necessary to program them, and hence the reason for this project. Initially, we will go through the basics of what is needed to be able to program these PIC's, along with a design based on that shown in Microchip's application notes freely available from their web site www.microchip.com.

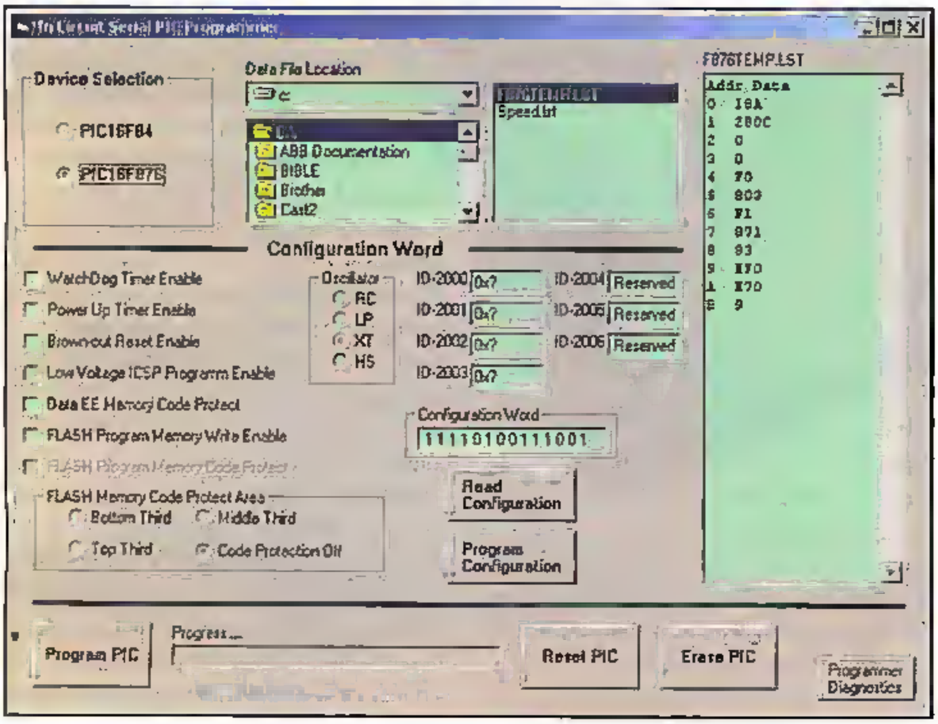
PIC Programming Requirements

There are a large number of variants in the PIC family, and this project has concentrated on two particular devices, the PIC16F84 and the PIC16F876. The '84 is relatively new, and includes digital input and output ports along with an on-chip timer, plus other useful functions. For those more adventurous who need additional I/O, the '876 also includes serial I/O and A/D converters, along with a higher number of timers and digital input /output lines.

Both of the PIC's can be programmed using the same ICSP (in-circuit serial programmer). This allows a project to be designed and built, and the PIC then reprogrammed as many times as necessary to



PIC Programmer Circuit



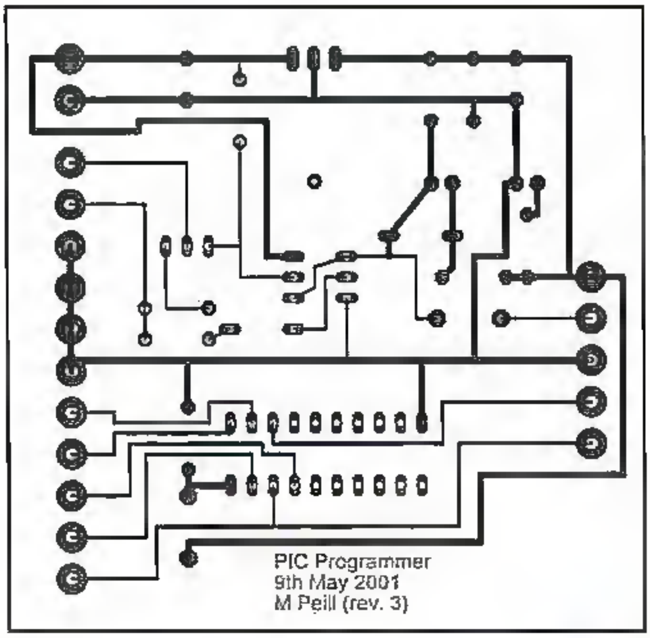
fix bugs and add enhancements to the software without having to dismantle or disturb the hardware.

There are several steps necessary to get an application running in your final project.

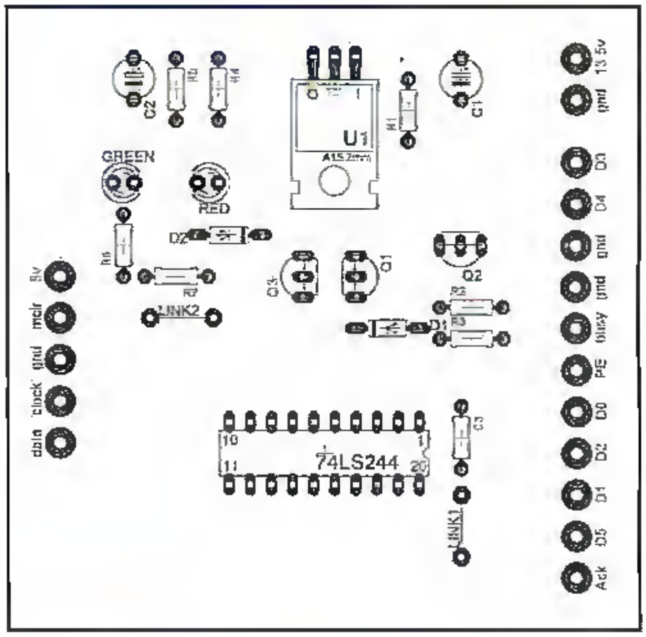
- First, write the assembler level program that will control your project (and remember it can be modified later if mistakes are made, so no devices have to be replaced).
- Secondly, the program currently in assembler mnemonics has to be converted into machine code.
- Thirdly that machine code has to be transferred to the PIC.

Thankfully, Microchip has made the first two steps relatively painless in providing tools to do the job. Again on their web site they have, freely available, the software application into which you write your code in mnemonics. This file is then saved and imported into a second application that assembles the program into machine level code. This produces a number of files, one being the listing file. Once this is done, this final code from the listing file is transferred to the PIC using the programmer detailed in this article that is based on the circuit given in Microchip's application note, using software written by the author available on CD (see details in the Parts List section).

The PIC itself is programmed by a serial data stream into one of its digital I/O port lines, D7. Associated with the data is a serial clock used to gate the data into the device, and this is fed into a second digital I/O port line, D6. The only other connection necessary

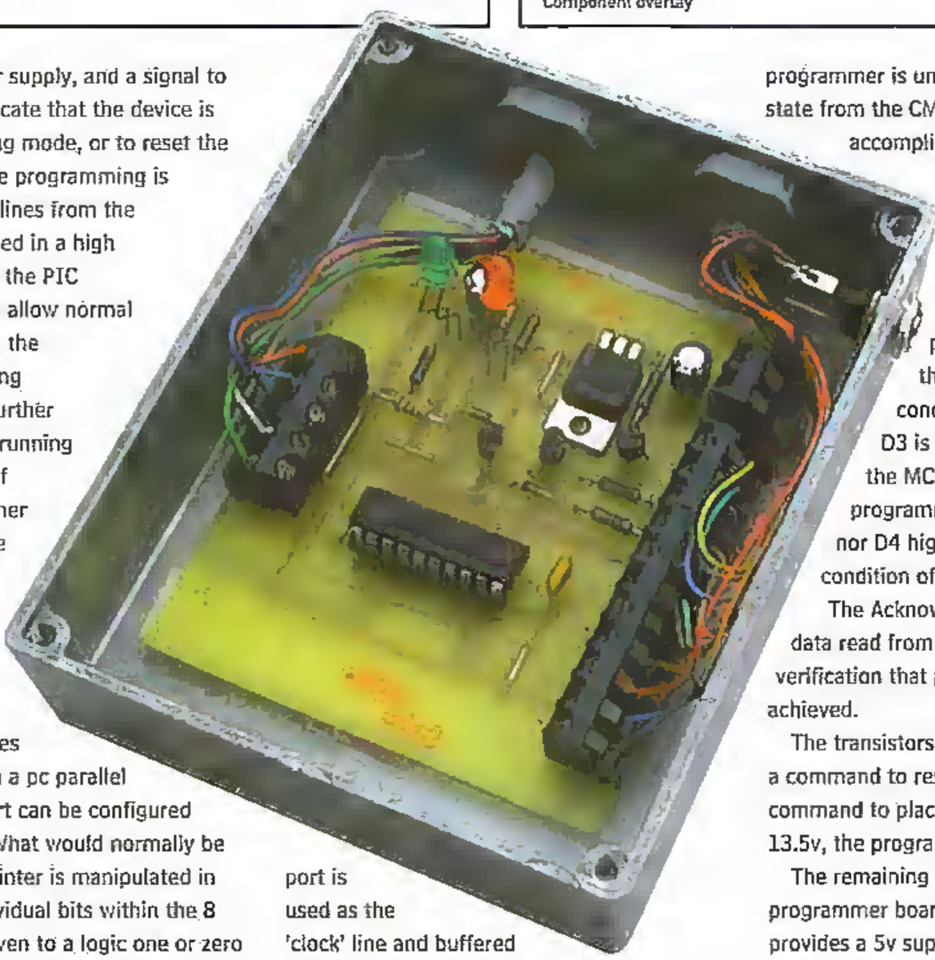


PCB Track



Component overlay

to the PIC is a power supply, and a signal to the MCLR line to indicate that the device is entering programming mode, or to reset the PIC as required. Once programming is complete, the driver lines from the programmer are placed in a high impedance state and the PIC momentarily reset to allow normal operation of the PIC, the programmer remaining connected to allow further modifications to the running code as necessary. Of course the programmer can be removed once all changes are complete.



Theory of Operation

The programmer takes its drive signals from a pc parallel port. The parallel port can be configured as a standard port. What would normally be data directed to a printer is manipulated in such a way that individual bits within the 8 bit wide byte are driven to a logic one or zero as required in order to output data to the PIC. Data from the PIC via the programmer is fed into what would normally be a status line from the printer, but again can be interrogated to read back the appropriate information.

The circuit is quite straightforward. Data bit D0 from the parallel port is used as the 'data' line and is simply buffered through a logic gate before being sent to the PIC 'programming data' input line on its RB7 pin. In the same way, bit D1 from the parallel port is used as the 'clock' line and buffered on its way to the PIC 'programming clock' input line on its RB6 pin. Data bits D2 and D5 are toggled by software running within the pc to switch off the output from the data and address buffers respectively, placing them in a high impedance state. This allows the same pins on the PIC to operate as standard digital input or output lines as required by your project. Of course if these lines are used for other purposes, care must be taken not to load the pins in such a way that the programmer is unable to drive their logic state from the CMOS buffer. This can be accomplished with simple pluggable links on the project board, or rather more thought given to the design of any interface circuitry used.

Data bit D4 is used to place the MCLR line at 0v, the master clear or reset condition of the PIC. Data bit D3 is used to impose 13.5v onto the MCLR line, placing the PIC in programming mode. With neither D3 nor D4 high, the normal operating condition of MCLR is set at 5v.

The Acknowledge bit is used to feed data read from the PIC back to the p.c. for verification that programming has been achieved.

The transistors on board are used to ensure a command to reset the PIC overrides a command to place MCLR at either 5v or 13.5v, the programming mode.

The remaining integrated circuit on the programmer board is a 5v regulator chip. This provides a 5v supply to the tri-state buffer on board, and also power to the project circuit that you are attempting to program. There are two L.E.D.s on board, one indicates that power is applied, and the second indicates that the unit is in programming mode. An external 13.5v power source is required that is used to feed the voltage regulator and also provides the programming voltage necessary to program the 16F84 PIC.

The second type of PIC, the 16F876 mentioned earlier in the article, actually has the option of being programmed at low voltage without the use of the 13.5v line. This provides a means of simplifying the programmer to some extent and eliminates the need for the external supply. However, in order that both types of PIC could be programmed, the supply remains necessary.

Construction

Building the programmer is relatively straightforward. The cable used to interface with the p.c. parallel port only uses 11 of the I/O lines. This can either be built from component parts, or as an easy option you could utilise a spare printer cable, cutting off the Centronics connector and stripping back the appropriate wires as required.

25way D Type Parallel Port Pin No.	Signal Name
2	D0
3	D1
4	D2
5	D3
6	D4
7	D5
10	Acknowledge
11	Busy
12	PE
18	Ground
25	Ground

Table 1.

On the prototype built and shown in the photos, terminal strips were used to wire cables to the circuit board. To save a little cost these could be eliminated and the cables wired direct to the p.c.b. Again, a d.c. power connector was used to feed the 13.5v external supply to the unit. This could be dispensed with and flying leads used to connect to the p.s.u.

For the output cable that connects to the PIC project board, a terminal strip was used that can plug directly onto terminal posts. These posts take up little room on the PIC board and are very useful as a means of reconnecting the programmer at a later date should you want to reprogram the PIC without disturbing your project in any way. The connector blocks are available from RS Components, part number 426-159, with mating terminal posts 426-165.

It has been left to the constructor to select a suitable box to house the unit, only requiring sufficient holes to feed the input and output cables and power supply, together with 2 holes for the indicator LED's.

The application note available from Microchip goes into great detail on how to manipulate the lines to program a PIC. It includes flow charts that would allow you to write appropriate software to use with their programmer if you are that way inclined. For those looking for an easier life, the author has written a software application that can be used directly with this circuit to allow you be program your PIC project with the minimum of effort (see Parts List).

Testing the Unit

If you have elected to use the application software available here, it has the facility not only to program the PIC, but to enter a diagnostic mode where the operation of the programmer can be checked prior to connecting to your first PIC project.

Firstly install the software and plug the programmer into the parallel port of the p.c. Once you run the software it has the ability to manipulate individual lines from the p.c. parallel port and check that output lines switch state as expected. To enter this mode, click on the 'programmer diagnostic' button. You can then click on appropriate buttons to toggle each line as required and observe the result using a scope or digital multimeter.

The result of switching each line is given in table 2.

Where to Next

If all is well, you now have a functional PIC Programmer, and you may be happy to go away and start developing your complex control systems. With a little surfing around the Microchip web site (www.microchip.com) you will find the tools and documents necessary to create source code and program the PIC as required. On the other hand, you may just be wondering what on earth you need to do next. In the second part of this series we will go through the basics of what a PIC actually needs in terms of hardware and software in order to get the device to do something useful. We will discuss the configuration requirements and the basic instruction set common to most of the PIC family of devices, and then go through the actions necessary to write your very first PIC program.

Start with all lines set to logic 0, or low.

Action	Result
D0 low, D2 low	Data low
D0 high, D2 low	Data high
D0 low, D2 high	Data high impedance
D0 high, D2 high	Data high impedance
D1 low, D5 low	Clock low
D1 high, D5 low	Clock high
D1 low, D5 high	Clock high impedance
D1 high, D5 high	Clock high impedance
D3 low, D4 low	MCLR high (+5v)
D3 low, D4 high	MCLR low
D3 high, D4 low	MCLR programming (+13.5v)
D3 high, D4 high	MCLR low

Table 2.

Parts List

Resistors all resistors 5%, ? watt

R1, R2, R3, R4	2k
R5, R6	750R
R7	1k2
Capacitors	
C1	22uf, 35v electrolytic
C2	68uf, 10v electrolytic
C3	0.047uf, 100v ceramic
Semiconductors	
Q1	2N3906
Q2, Q3	2N3904
U1	78M05CT
U2	74LS244
Miscellaneous	
LED	red
LED	green
D1, D2	1N4148

Terminal Blocks and cable as required.

The printed circuit board is available from the author at a cost of £10.00.

The programmer software is available on CD at a cost of £15.00.

Post and packing for either or both of the above is £1.00. Allow 28 days delivery.

Please send cheques (payable to Mr M Peill) to:

Mr M Peill, 65 High Rigg,
Brigham, Cockermouth,
Cumbria, CA13 0TA.
e-mail: malcolm@peill.org.uk

NANOTECHNOLOGY- How to convert mechanical signals into Electrical signals

by Reg Miles

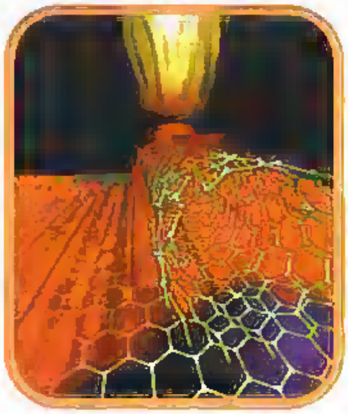
RESEARCHERS AT NORTH CAROLINA STATE UNIVERSITY AND THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL HAVE DEMONSTRATED THAT ELECTRICAL RESISTANCE BETWEEN CARBON NANOTUBES AND GRAPHITE SURFACES THAT SUPPORT THEM VARIES ACCORDING TO HOW THE TUBES ARE ORIENTATED.

This discovery marks the first time scientists have been able to show that by rotating a nanostructure they can control its electrical resistance.

Junction resistance peaks six times as the end of a nanotube is rotated 360 degrees, the scientists found. This is because the atoms in the nanotube and graphite are arranged in hexagons. This facility to alter the junction resistance by changing the tubes' position on a graphite substrate could be important to telecommunications and other electronics industries, such as wireless communications or micro-robotics, by making it easier for them to design electronic devices and actuating systems - on/off power switches and the like - at the nanoscale level.

'By changing the angular alignment of the atomic lattices, we found that contact resistance varied by more than an order of magnitude in a controlled and reproducible fashion', said Dr. Marco Buongiorno Nardelli, a research associate in physics at NC State. 'Being able to do this gives nanoscale-device designers a controllable, continuous means of converting mechanical signals into electrical signals - something they have long sought. Being able to adjust the electrical resistance in this way could, one day, lead to much faster, more energy efficient electronic devices.' In addition to Buongiorno Nardelli, the seven person research team includes Drs. S. Paulson, A. Helser, R.M. Taylor II, M. Falvo, R. Superfine and S. Washburn, all of UNC-Chapel Hill. (Paulson is now at Duke University.) The experiments were carried out at Chapel Hill.

Buongiorno Nardelli, from Rome, served as the team's sole theoretical physicist. He believes that even without its long-term practical applications the discovery is significant because it represents another building block in modern science's understanding of nanotechnology fundamentals. 'The transfer of electrons from one material to another has almost always been thought of in terms of energy conservation, with no attention being paid to momentum conservation. These experiments show us that momentum conservation plays a role, too.'



According to Richard Superfine, associate professor of physics and astronomy, 'It is the most direct measurement that electrons in a material travel in particular directions and that those favoured directions need to be matched as you go from one material to another where they touch. This effect is pronounced in carbon nanotubes, threadlike molecules that conduct electricity and have the potential to be used for ultra-small circuits.' Researchers need to be sure when making such devices that the preferred directions are aligned when the devices are assembled, the scientist said.

Conversely, the effect can be used to make sensors that measure the rotation of nanometer-scale objects. 'Tunable resistance in nanotubes may be useful in molecular scale machinery where you have moving, sliding and rotating parts,' Superfine said. 'You need to be able to sense the motion of those parts in an indirect way, such as through the measured current, because in an assembled device you will not be able to look directly at the part.'

Earlier research by the North Carolina at Chapel Hill team published in 'Nature' last year showed that carbon nanotubes roll across a surface rather than slide when the nanotube is put on graphite. A recent article in 'Physical Review' showed that this rolling occurs because the atoms in the outermost layer of the nanotube interlock with the atoms on the graphite surface. When the atoms interlock, the nanotube rolls, and when the atoms are not enmeshed, the nanotube slides. This means that the atoms are acting like gear teeth. Together with the present findings on the electrical properties of these atomic scale contacts, the UNC-CH researchers believe they are creating the foundation of the ultra-small scale engineering of machines.

The continuing experiments involve recording mechanical and electrical properties of carbon nanotubes with a unique device the UNC-CH researchers invented. Known as the nanoManipulator, the device combines a commercially available atomic force microscope with a force-feedback virtual reality system. The former employs an atomically small, gold-tipped probe capable of bending and otherwise manipulating molecule-sized particles. The latter allows scientists to see and feel a representation of the surface a million times bigger than its actual size.

According to Mike Falvo, research assistant professor of physics and astronomy, 'People are talking about nanotechnology right now, but if you are going to engineer those kinds of systems, you have to know how they work. This is one potentially very important piece of that puzzle - how do really small contacts conduct electricity? We've shown that unlike in large contacts, in very small ones their relative orientation can have a profound effect on current flowing through them. Knowing this could be critical to building the tiniest electromechanical switches, for example.'

The experiments were supported by The National Science Foundation, the National Institutes of Health and the Office of Naval Research (trust the military to be involved!).

For more information contact:

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Build a WEB SITE

by Mike Bedford

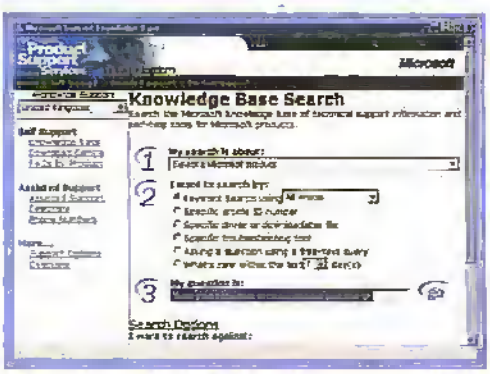
IN THIS NEW SERIES WE LOOK TO PROVIDING YOU WITH A PRACTICAL DOWN TO EARTH INTRODUCTION TO BUILDING A WEBSITE OF YOUR OWN FROM SCRATCH. PART 1 INTRODUCES YOU TO THE PLANNING STAGE.

Anyone and everyone who is anyone now has a presence on the Web – this, at least, is the common perception. Clearly this is a gross over-simplification and many successful companies and organisations – especially those well removed from the computer industry – have yet to take this step. This isn't to say, of course, that a Web site is of no value to these companies – it could well be of great value. Indeed many well-established companies have discovered that a home on the Web has improved their already successful businesses. This new series is aimed at those companies, clubs, charities, other organisations, and even individuals who are considering taking that step for the first time. It will also be of interest to those who already have a Web site which has not brought in the expected benefits. Large companies, with huge financial resources, tend to employ the services of top-notch Web design consultancies – our target audience is quite different. The emphasis here is the DIY approach and we anticipate that this will be of interest to individuals and those small to medium-sized organisations who can't afford to spend many thousands on a Web site.

Why do you need a Web site?

It's been said that if you fail to plan you plan to fail. This is undoubtedly true of designing a Web site. Planning applies at many levels but the most fundamental aspect of planning concerns the rationale for putting a site on-line. Why do you need a Web site? If you can't answer this question adequately, it's almost certain either that you don't actually need a Web presence or, if you do, that your site will not have the desired effect. There are, of course, many different reasons for having a Web site. An on-line advertisement, a means of taking orders on-line, a resource for your existing customer base, and even a vehicle for learning about Web authoring are all valid reasons and there are many others. Only when you know what you expect of your site, though, can you start to plan its structure and content to achieve that aim. Let me give an example.

Many small companies think of their Web site as an electronic advertisement and are surprised that it doesn't bring in the same amount of business as an advertisement in the local paper. Certainly a Web site can be a successful advertisement but this is by no means guaranteed. With so many millions of sites out there, how can you be sure that sufficient numbers of people will find yours? Certainly there are ways of increasing the chances that your site will come near the top of the list in search engines and we'll look at this topic later in the series. But even so, unless your business addresses a very small market niche, the chances are that your site will be listed by search engines among hundreds of others offering similar products or services. However, if you can provide some genuinely useful information on your site, this may be adequate to cause people to come flocking to it. Perhaps you have a business selling PC upgrade products and services. This isn't exactly rare and a simple Web site listing the various motherboards, processors, graphics cards, CD-RW drives and so forth won't really stand out among all the sites belonging to your competitors. Now let's assume that you write a PC Upgrading Guide and put it on your site. So long as this is informative, authoritative, and not overtly tailored to pushing your products, people will start to notice it. And if they find it useful they'll put links to it from their sites. Very soon you could be achieving hundreds of hits per day. Admittedly most of them will just take your free information and run. But if just two or three percent of them decide to buy products from you, that could add up to quite a few extra orders per day – far more than you'd get from the simple electronic advertisement approach. Needless to say, this is but one possible scheme but it illustrates how gaining a clear understanding of what you want from a Web site is an essential first step.



The Structure

Once you've decided what you want your Web site to achieve, you can then start to make a list of the pages you'll need to do that job. And when you've got an idea of the page contents, the next job is to start planning the structure of the site. Unlike a printed book or magazine, in which all the pages are in sequence, Web publishing gives you much more scope because of the way pages are linked together using hyperlinks. Certainly you could arrange your Web site like a book, with pages in order, one after the other, but this is comparatively uncommon. A much more popular structure is the hierarchical one in which the home page is a top-level menu. This menu links to lower level menus which, in turn link to yet lower level menus or actual pages of information.

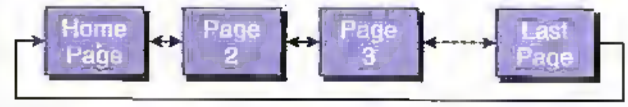


Figure 1.

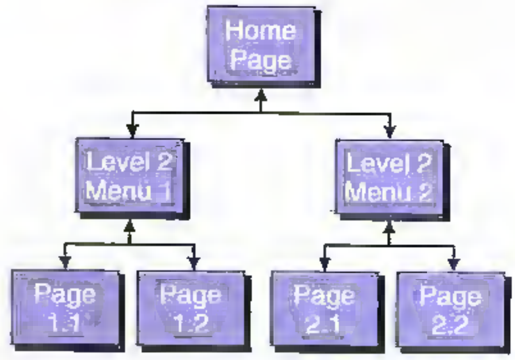


Figure 2.

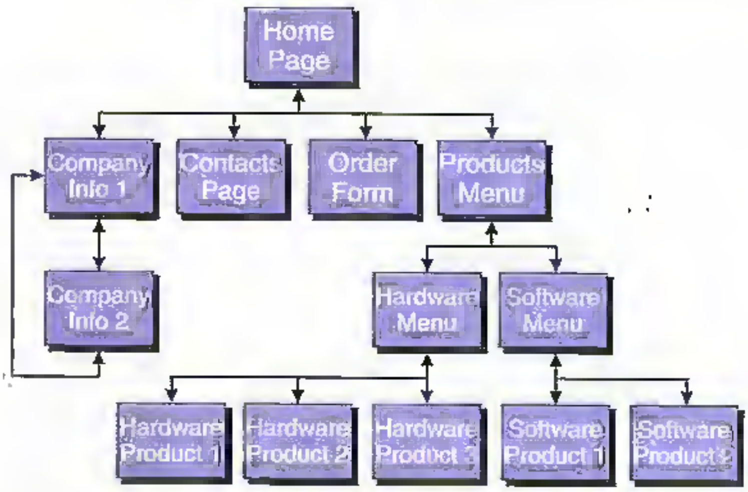


Figure 3.

Exactly how many levels of menu you have will depend on the complexity of the site, indeed the depth may not be uniform throughout your site. For example, the home page may have links to contact details, product listings and an order form. The contacts and ordering links may lead to single pages whereas the product listing link may lead to another menu listing categories of product. In reality, most sites are neither a pure sequence of pages nor a pure hierarchy. Instead, links often allow short cuts between pages without navigating back through the hierarchy, it's common to provide a link back to the home page from any page in the site, and certain parts of a hierarchical structure may include sequential pages to reduce the amount of information on screen at any one time.

The best way to plan the structure of your site is to draw diagrams with arrows indicating links. The diagrams reproduced here show a sequential site, a hierarchical site, and a composite site which is probably more typical of real world structures.

Registering a Domain Name

Not so much planning, but another piece of preparatory work you'll need to do is to choose a domain name. Actually, you don't have to do this but if you don't the URL of your Web site will end up as something like www.my_isp.com/my_user_name which doesn't look too professional. What you really need is a URL such as www.my_company.com, www.my_organisation.or.uk or something similar. And since you can now register domain names for as little as £15 for two years, this really isn't an area you should skimp on – image is very important to the success of your Web venture. There are really just too many companies offering domain names to give any meaningful recommendations here – just do a search on-line. Most of these companies will also offer you a Web hosting service but you won't necessarily need this – the topic of Web hosting is coming up next.

Web Hosting

The last of the major topics to be considered before we can get to work is where to have your Web site hosted. Large companies tend to have large servers permanently connected to the Web via a high bandwidth line and can, therefore host a Web site themselves. Individuals, smaller companies and larger organisations either use a dial-up line and/or have a low bandwidth connection. As such, the only solution is to find a company which provides a Web hosting service. Basically, they give you either a dedicated server or some disk space on a shared server, onto which you can upload your Web pages to put them on-line.

Although there are companies whose sole business is Web hosting and, as I mentioned earlier, companies which register domain names will often host sites too, as a first step, I would recommend using the services of your ISP. Most ISPs now offer free Web hosting to their customers and, whereas the service won't be as good as that provided by more specialist companies, it's a quick and simple way to get up and running. The limitations you'll tend to find are in the amount of disk space provided, in the scripting languages available (we'll look at this later in the series), in the amount of logged information they can provide (e.g. how may people have visited your site, how long they spent on each page etc.), and the fact that you'll share a server. For a large organisation which is totally dependent on its Web site, these disadvantages will discount the use of an ISP in favour of a dedicated Web hosting company. If you're just starting out, though, your current ISP probably provides a perfectly acceptable service. And if you do end up moving, the company with whom you registered your domain name will be able to arrange for traffic to be forwarded to your new ISP or Web hosting company so your domain name will stay the same and your customers won't notice the change.

Next month in Part 2 Mike Bedford looks at Web Design Software

web electronics

THIS MONTH WEB ELECTRONICS PUTS ITS FEET UP AND READS THROUGH THE NEWSPAPERS. WEB ELECTRONICS BEING WEB ELECTRONICS, THAT OF COURSE MEANS CLICKING ONTO THE INTERNET AND DOING A QUICK SEARCH USING YAHOO, LYCOS OR SOME SIMILAR SEARCH ENGINE.

Most of the major newspapers in the UK, Europe, the USA and the rest of the world have their own web sites. The amount of news directly accessible from these can differ, but if maintained properly they all have the advantage over the printed copy of being able to report breaking news directly as it happens.

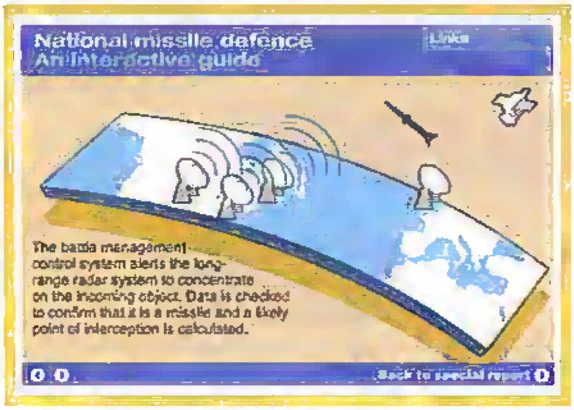
You also, in the majority of cases, have free unlimited access to not just the present day's news, but a past archive of news stories, searchable in ways that might range from the simple to the highly specific. Not all of the items that appear in the paper may make their way onto the Internet, but these online versions of the 'real' newspapers do have more than enough information to ensure that a visit to these sites is bound to turn up something of interest to you.

Guardian Unlimited
www.guardian.co.uk.

This is an extensive and easy to navigate site featuring stories from the magazine, breaking news as it happens and a wide range of features from the weekly sections of the newspaper. The review sections are very good and offer material above and beyond what you would find in print.

The book section offers a selection of first chapters from recent publications, and Trailer Park in the film section allows access to over 50 viewable trailers from current big screen movies.

There is a searchable database of jobs, the Guardian being well known for its pullout jobs pages, and also complete one-day listings for all television channels (terrestrial, cable or satellite) available in the UK. Interactive guides utilising Flash animation are available on a number of topics. These are informative in a way, but fairly basic.



If you register with the site, you can also receive free WAP and email services related to a wide range of subjects and issues. Guardian Unlimited also offers a television-based channel to subscribers of Cable & Wireless and NTL digital TV services in various parts of Britain (for more information telephone 0500 200 940).

Whilst there is quite a lot of 'net news', however, there is very little on this site to do with electronics and technology. Anything that does appear on the site is likely to be found through an archive search rather than any main sections.

Archive

The archive search facility on this web site allows you to specify the date or a range of dates that you want to search (through the input of one or several keywords). You can choose to sort the results by date or relevance. The archive dates back to 1998. We did a search for 'Marconi' and found 535 articles. 'Robot' generated 110, and 'Robotics' resulted in 22.

The Electronic Telegraph
www.telegraph.co.uk.

With such a name, you might expect more of an emphasis on the technological side of the news than is available in other newspapers and, thankfully, the Electronic Telegraph does not disappoint. Go to the main site and click on the Telegraph Network pull down menu. Click on 'Technology' and you will be taken to Electronic Telegraph Connected.

Made up of features, regulars and news items ('After 100 years, the robot is about to clean up', 'Beethoven's lost overture created by a computer', etc), this is more like a weekly web magazine than a newspaper's online site. It does seem to be aimed at the non-technically literate rather than serious electronics or software professionals, but that is no bad thing as most of its articles are extremely readable. Regular 'columns' include 'Hard Drive' by Professor Peter Cochrane and the tongue-in-cheek 'Silicon Valley Diary' by Andy Goldberg.

Archive

Every weekly edition of Connected dating back all the way to 6th August 1996 is available for viewing. The main Electronic Telegraph site is also searchable, with a search engine that is second to none in its layout and usability. It has three times the number of options available on the Guardian search page yet manages to seem much simpler. The articles in the archive date all the way back to 1994. There were 531 responses for 'Marconi', 195 for 'Robot' and 22 for 'Robotics'

Independent Digital
www.independent.co.uk.

Independent.co.uk

Like the Guardian and Telegraph sites, the Independent has a lot of online content. The digital section has news, features and reviews, but the majority of this is web rather than technology related.

Archive

Dating back to 1999, this archive is searchable by date and also has an additional search box for the whole internet, provided by Ask Jeeves. There were 200+ responses for 'Marconi', 108 for 'Robot' and 20 for 'Robotics'.

The Times
www.thetimes.co.uk.

From the pull-down menu bar, select 'Features' and then 'Science'. When we tried it, there were no more than five news stories and these were more 'New Scientist' than Electronics and Beyond.

Archive

The archive of past articles was not searchable by date and, oddly, there was no indication on either the search or results page of just when the archive dated back to. We found 354 results for 'Marconi', 32 for 'Robot' and 2 for 'Robotics'.

Financial Times Online
www.ft.com.

FT.com FINANCIAL TIMES

If you want industry / company specific financial news and information, you are better off visiting the online presence of the Financial Times than any other newspaper-related site on the Internet.

As well as comprehensive information on the markets and economy, the site is a good source of up to date news relating to companies and industries from around the world. Lacking pictures, for the most part (just as you think it's starting to load up a picture it turns out to be an advert), and flashy graphics, it may appear a bit dry to the casual surfer, but in all fairness it isn't aimed at them and what it does it does well.

Click on 'Companies' and you'll find a list of all the major companies currently in the news. There is also a search engine that allows you to type in the name of a company and call up its share price details and other financial information along with a list of recent news stories involving the company. Click on 'Industries' and you will be able to call up news and analysis pages sector by sector.

So, that's the major UK broadsheets covered. But what about the American newspapers, or the French, German, Polish, etc? We don't have enough space to cover all of these here, but for the benefit of those who are interested in going onto the net and finding national and local newspaper sites, we will now suggest a few Internet directories that will allow you to find the site you want easily and at the merest click of a button.

Online Newspapers Directory
www.onlinenewspapers.com.

This is a useful site that allows extremely quick access to thousands of newspaper sites all over the world. Select a region and choose the relevant country from a pull-down menu. This will then present you with a list of regional and national newspapers (most of which will, of course, be in the native language or one of the native languages of that country). Select Venezuela, for example, and you will get a list of 28 online papers. Clicking on 'El Nacional', for example, will take you to the web site of that newspaper.

This is an Australian site and it puts all of the UK's national newspapers under the heading of 'England'. It is extremely comprehensive when it comes to local newspapers in the English, Scottish and Welsh regions, but as for Northern Ireland, we couldn't find any information dedicated to papers from there at all.

Newspapers of the World on the Internet
www.actualidad.com.

This is similar to the Online Newspapers Directory but with continental silhouettes instead of pull-down menus. England, Scotland and Northern Ireland are well represented, but this time it is Wales that is missed out. UK national newspapers are, again, listed under England rather than having a separate section for the UK.

US Newspaper Links
www.usnewspaperlinks.com.

This site is the best place to go if you want comprehensive state-by-state coverage of local newspapers in the United States of America. It also has links to local radio stations, TV stations and magazines.

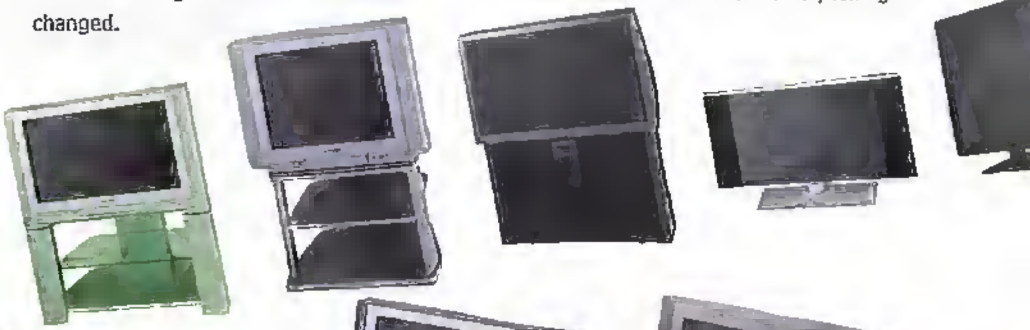
Yahoo UK & Ireland Newspapers Directory
http://uk.dir.yahoo.com/News_and_Media/Newspapers.

This is an extremely long UK & Ireland listing in alphabetical order with a selection of major USA papers thrown in for good measure at the bottom of the page. A short synopsis of each site's coverage is included alongside, making it easier for you to decide whether you want to go there or not.

TV jobs GLOOM

by Martin Pipe

THIS DECEMBER, HITACHI IS TO CLOSE ITS COLOUR TV FACTORY IN HIRWAUN, SOUTH WALES, WITH THE LOSS OF 174 JOBS. THE HISTORY OF THE FACTORY, WHICH HAS PRODUCED TVs RANGING FROM SMALL-SCREEN SETS TO HIGH-END REAR-PROJECTORS, IS AS COLOURFUL AS THE PICTURES PRODUCED BY THE PRODUCTS THEMSELVES. ORIGINALLY SET UP BY GEC IN 1969 TO FULFIL THE COLOUR RENTAL BOOM, THE PLANT WAS SOLD TO HITACHI IN THE LATE 1980s.



Not that Hitachi is the only TV manufacturer to feel the pinch. Sony and Panasonic have both announced massive TV-manufacturing job cuts – 1,400 in the case of Panasonic's Cardiff factory. These two manufacturers will instead be producing TVs in the Czech Republic, where wage bills are considerably lower. Such are the effects of globalisation, which has resulted in the widespread shift of manufacturing activities to countries of (relatively) poor living standards, like parts of Asia and ex-Communist Eastern Europe.

This is all because consumers demand lower prices, while shareholders want higher profit margins. TV manufacturing is a different kettle of fish to textiles, though – everybody in the country knows (even if they blindly accept it) that designer trainers and T-shirts cost next to nothing to produce in Indonesia, but sell for a fortune by the time they reach UK shops. All of the difference seems to be absorbed by obscene profits, flashy advertising and sponsorship deals.

TV prices, unlike those of clothing, have been driven artificially low over the last 30 years. Back in 1967, when colour broadcasting started, a colour set would have cost around £300 – the price of the minivan used to deliver it to the customer. The only item of transport you'll be able to buy for the £70 now demanded for a supermarket colour TV is a cheap bicycle.

HITACHI
Inspire the Next

Oh how things have changed.

According to a Hitachi spokesman, there's just no money in consumer electronics any more – he claims that Hitachi's TV operation has lost 'millions' over the last five years. The same is likely to ring true of the other manufacturers, who are forced to relocate just to survive – unlike the global fashion brands, who do it out of greed.

Hitachi's smaller-screen (portable) sets are made in Mexico, along with a range of other TVs destined for sale in the nearby US. Shipping sets any larger than this to Europe is likely to be an expensive undertaking, and thus not financially-viable. Yet Hitachi has not, according to its spokesman, taken steps to set up a TV manufacturing facility elsewhere in Europe (Hirwaun was the only European factory). Setting up a TV factory is a time-consuming and expensive business, and so where will its sets come from once the Hirwaun-made stock dries up? Will we see TVs made by third-parties (possibly the same Turkish factories churning out cheap sets for supermarkets) to Hitachi specification, or will Hitachi pull out of mass-market TV altogether? This wouldn't be without precedent. One only has to look at firms like Nokia and – possibly more representative of Hitachi – Mitsubishi, both of which gave up TV manufacture in favour of new product areas towards the end of the last millennium.

Hitachi's spokesman declined to give me a definite answer, telling us rather cryptically that his employer would be concentrating on the 'higher end' of the market – i.e. rear-projection and plasma – where profits can still be made. Funnily enough, these sets will be made in Japan; their high value makes shipping viable. But if we enter a global decline – as many economists are predicting – who will have the money to spend on luxury TVs?

Air Your Views

Finding the right component

I just bought for the first time 'Electronics and Beyond' and I found it very interesting.

I decided to build the low power audio amplifier featured on page 56, but I had a problem in finding the 560pF polystyrene capacitor (C10). I tried RS, Farnell and Maplins but without luck, so I replaced it with a 470pF one.

I wonder if you can suggest if this value is ok, or you could provide me with some information where to get the proper value.

Best regards and many thanks,

Marco Di Giuliomaria (via email)

Gavin Cheeseman replies:

Thank you for your query regarding the 'low power audio amplifier' article in Electronics and Beyond magazine. I am sorry to hear that you have been unable to obtain the 560pF polystyrene capacitor (C10). Unfortunately components sometimes become difficult to obtain after a project has been designed.

Modifying the value to 470pF as you mention provides a good alternative. For most applications the value is not particularly critical. The modified value will slightly change the frequency response at the high frequency end when the capacitor is connected in circuit but in practice this is unlikely to cause any problem. Polystyrene capacitors were specified for their superior performance but another option is to fit a 560pF ceramic capacitor.

One general point: when using different capacitor values or types in the circuit please follow the precautions mentioned in the article regarding testing etc. I would advise you to always check that the circuit operates correctly after the modification and is stable.

I hope this answers your question and that you continue to find the magazine interesting and informative.

Geriatric Student's Diode Tester Question

This is a very interesting project and I've much enjoyed reading the straightforward instructions.

However, there is one thing that has continued to puzzle me despite extensive head-scratching (although, as a geriatric student of 72 summers, this may just be my personal limitations!). No matter how I read it, I cannot see how the dual voltage supply can work.

Surely, with a 9v supply across it, the mid-point of the voltage divider will be +4.5v; and thus the buffer op amp will also show +4.5v at its output?? Equally, the positive line will be at +9v and the negative line at 0v?

Clarification would be greatly appreciated.

Terry Snape (via email)

David Clark replies:

The answer to your question lies in which point you use as a reference for your voltage measurements.

If you are measuring your voltages relative to the negative terminal of the 9 volt supply you are right to say that the voltage at the output of the buffer will be plus 4.5 volts. In other words you are using the 9 volt supply negative terminal as the reference point and calling it 0 volts.

But you can also measure all your voltages relative to the output of the buffer op amp. In this case you are using the output of the buffer amp as the reference point and defining that point as 0 volts.

So if you connect the 0 volt, or COMMON, terminal of your voltmeter or multimeter to this reference point, the reading you get when you measure the voltage at the negative terminal of the 9 volt supply will be minus 4.5 volts, and that at the positive terminal of the 9 volt supply will be plus 4.5 volts.

I'm pleased you found the project interesting and that you enjoyed reading it, and I hope this clears matters up for you.

Articles inspiring letters, letters inspiring articles

I would like to know if the magazine accepts articles from non-staff authors, because the new-look format is particularly appealing. Specifically, I was inspired by several articles and letters in the current (August) issue to draft replies and comments which have already gone beyond the scope and length of a simple letter – even that of Dr. Osbourne's!

I am an electronic engineer with some years experience of designing and constructing instrumentation, both stand-alone and computer-interfaced. I have been working in environmental and plant sciences, meteorology, and the chemical industry – my recent interest has been in micropower and high-impedance circuitry, especially connected with atmospheric electricity and pollution studies, but I have also produced privately in AV (including several 'light-sculptures') and electronic musical instruments.

Jey Roger Knight (via email)

Thank you so much for your email and the answer is yes we value contributions from non authors or freelance writers. I would need to see a sample of any of the subjects you mentioned.

All material should be sent in the following formats: Word for the Text, Diagrams should be EPS files with the annotations in Helvetica. if you are using Corel Draw please save them as WMF files. Images should be in JPEG, GIF or TIF, or preferably original photos. For detailed information on acceptable file types please contact our designer at ihouston@madasafish.com

I look forward to working with you and am very happy you find the new look appealing.

– The Editor

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

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

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

Gaming Glove

There is an article on your 'August' cover regarding a gaming/computing glove. I can see the picture on your website, but can't seem to find the story online.

Christos Livadas, USA

The P5 glove was featured in our Event Review but we did not give a web address for the company who make it – Essential Reality. Their web address is www.essentialreality.com. We referred briefly to the glove as part of our event review but hope to cover it more fully in a future edition of the magazine.

News and Features Editor

The 'OPTO' in OPTOELECTRONICS

RAY MARSTON DESCRIBES THE BASIC NATURE AND BEHAVIOUR OF OPTICAL PRISMS AND LENSES IN PART 2 OF THIS OPTOELECTRONICS-RELATED 4-PART SERIES.

Substance	Refractive Index
Free Space	1.000 000
Air	1.000 293
Ice	1.31
Water at 20°C	1.333
Glass	1.5 to 1.9
Diamond	2.42

Figure 1. Table listing typical refractive index values for various transparent media.

Most of last months opening episode of this mini-series described the basic nature and behaviour of light, with particular regard to its use in modern optoelectronic systems. The remaining part of that episode dealt with two types of light-beam manipulators, namely, mirrors and retroreflectors. This month's episode continues the 'light-beam manupulators' theme by describing the nature and behaviour of optical prisms and lenses.

Light-beam manipulators.

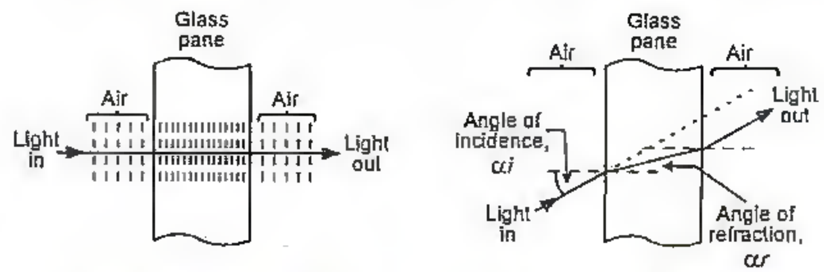
PRISMS.

In optics, a prism is a block of transparent material having two or more plane (flat) surfaces. Prisms have an innate ability to bend the paths of light. A flat sheet of glass is a very simple prism.

When light travels through a transparent material or medium other than free space, its velocity (v1) and wavelength (l1) are lower than those that pertain in free space (v0 and l0). The ratio v0/v1 or l0/l1 is known as the medium's refractive index, and is notated by the symbol n. Figure 1 lists some typical n values for various transparent media, including normal glass (n = 1.5 to 1.9), which is transparent to all visible light and much of the lower IR spectrum, but blocks most of the UV spectrum.

Figure 2 illustrates the effects that 'refraction' has on a light ray when it travels through a pane of glass with (for simplicity) an n value of 2. In Figure 2(a) the beam enters the glass at an incident angle of OO, is slowed down (thus reducing the light's wavelength but not its frequency) as it passes through the glass, and then returns to normal 'though air' speed as it leaves the glass at an angle of OO.

In Figure 2(b) the dashed lines represent the normal or zero degrees angular reference line. In this diagram the ray enters the glass at an incident angle (ai) of (say) 300 and then, as it passes from the thinner medium (air) to the denser one (glass), the ray bends towards the normal by a refractive angle (ar) of about 150; when the ray passes from the denser to the thinner medium again as it leaves the glass, the ray bends away from the normal again, returning to its original angle of 300, thus obeying the basic Laws of Refraction. The values of ai, ar, and the n values of the incident (ni) and refractive (nr) regions are related by Snell's law of refraction, which states that nr/ni = sin ai/sin ar.



(a) A light ray and its wavefronts passing through a sheet of glass after arriving at an incident angle of zero degrees.

(b) A light ray passing through a sheet of glass after arriving at an incident angle of about thirty degrees.

Figure 2. Diagrams illustrating the effects of refraction through a sheet (pane) of glass.

Note in Figure 2(b) that the light ray leaving the glass is shown parallel with - but offset from - the path of the original input ray, which is indicated by the dotted line. The degree of offset (parallax error) increases with the angle of incidence and with the thickness of the glass. Simple mirrors, in which light rays enter and leave the mirror via the same glass surface, are subject to this type of parallax error.

Most prisms have plane surfaces that are angled away from each other, as shown in Figure 3, in which two prisms each have their major surfaces angled at 300 to one another. This diagram shows the effects that the prisms have on a light ray that arrives at an incident angle of zero degrees. In both cases the ray passes cleanly through the glass without bending, but on leaving the glass the ray bends away from the normal by about 150, thus obeying the basic Laws of Refraction.

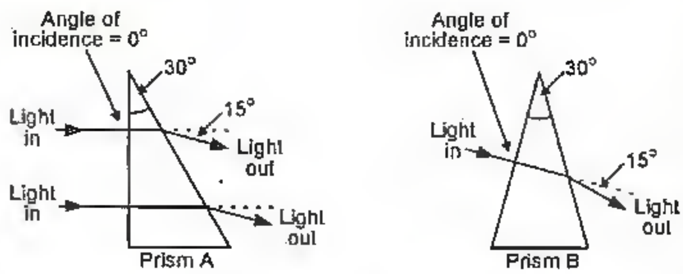


Figure 3. Diagram illustrating some important ray-bending features of a simple prism.

Note in Figure 3 that the degree of ray bending is independent of the thickness of the prism glass and (ignoring n value effects) is determined mainly by the angle of incidence of the ray and by the angular difference between the prism's input and output surfaces.

Regarding the 'n value effects' mentioned in the above paragraph, it is important to note that the refractive index values of all transparent media other than free space vary with the wavelength of a light, and increases as wavelength shortens. The refractive index of glass is normally measured using a yellow sodium light with a wavelength of 589nm; the actual index value is higher than normal to violet light (400nm wavelength) and lower to red light (700nm wavelength).

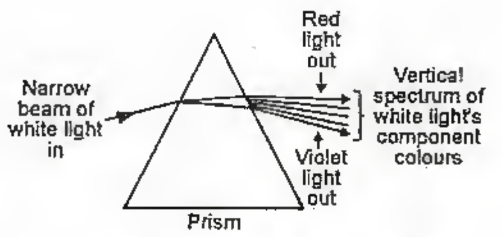


Figure 4. Exaggerated diagram showing a prism splitting a beam of white light into its component colours.

Figure 4 shows, in exaggerated form, the results of passing a narrow beam of white light through a symmetrical triangular prism. White light contains all the colours (wavelengths) of the visible spectrum, and the prism thus (because its refractive index is wavelength-dependent) bends each individual colour of the beam by a different amount, giving the least bend to red light and the greatest bend to violet light. The prism's output thus takes the form of a vertically-expanded coloured spectrum. This scattering of white light's component colours is known as dispersion.

When a ray of light passes through air and enters a prism, it bends by an amount determined by its angle of incidence and by the refractive index value of the glass. When the ray leaves the prism again and returns to the air, it bends by an amount determined by its angle of incidence and by the refractive index of the air (1.0) divided by that of the glass (say 1.5), and this value is invariably less than zero (0.667 in this example). Figure 5 shows the actual amounts of output refraction that occur on three different prisms that each have a refractive index of 1.5.

In Figure 5, the ray strikes the output surface of prism A at an incident angle of 300 and leaves the prism at a refractive angle of 420; this prism thus bends the ray downwards by 120. In the case of prism B, the ray strikes its output surface at an incident angle of 400 and leaves at a refractive angle of 850, thus bending the ray downwards by 450.

Note in the case of prism B that the ray leaves the prism at an angle that is only 50 less than the angle of slope of the prism's output face, and it is obvious that if the angle of incidence is increased much more the ray will be unable to penetrate the prism's output surface. The angle of incidence at which this occurs is known as the surface's critical angle, and is dictated by the n value of the glass; the critical angle is 430 at an n value of 1.5, 360 at an n value of 1.7, and 320 at an n value of 1.9.

Figure 5 shows, in the Prism C diagram, what happens to the light rays when they strike the prism's output face at an incident angle of 450, i.e., at an angle greater than the critical angle of the surface. Under this condition a phenomenon known as total internal reflection occurs and makes the internal surface act like a mirror that bends the rays by double their angle of incidence, thus (in this case) bending them through a 900 angle and projecting them through the lower face of the prism.

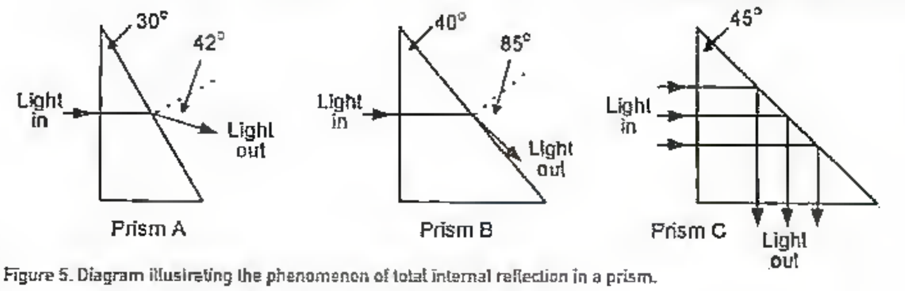


Figure 5. Diagram illustrating the phenomenon of total internal reflection in a prism.

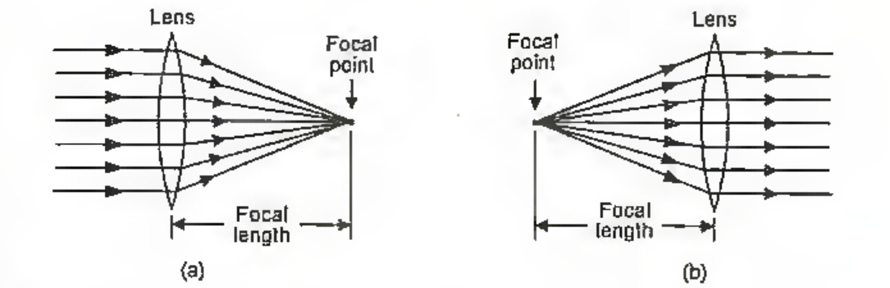


Figure 6. A simple lens can (a) focus a parallel bundle of rays onto a single point, or (b) convert the rays from a single point source into a parallel (collimated) beam of light.

The internally-reflecting type-C prism thus acts like a mirror that bends light through 900, but (since the light passes through separate input and output surfaces) does not suffer from parallex errors. This type of prism is widely used in high quality optical instruments and devices such as reflex cameras, binoculars, and automatic laser-aiming controllers.

Total internal reflection can occur whenever one tranparent material interfaces with another that has a lower refractive index, thus giving a less-than unity refractive index and a positive critical angle value at the interface junction. All modern fibre optic cables rely on this 'internal reflection' basic principle for their very efficient low-loss operation (fibre optic cable principles will be described in Part 3 of this series).

Lenses

Normal optical lenses are light-bending refractive devices that are related to prisms but have curved (rather than flat) faces. Figure 6 shows the classic profile of a simple lens that has two parallel faces that are each radially curved in two dimensions, to form a section of a sphere. This type if lens can focus a parallel bundle of light rays onto a single point (the focal point), as shown in Figure 6(a); the distance between the centre of the lens and the focal point is the focal length of the lens. If a light point-source is spaced from the lens by a distance equal to the focal length of this type of lens, the lens converts the light into a parallel ('collimated') beam of light, as shown in Figure 6(b).

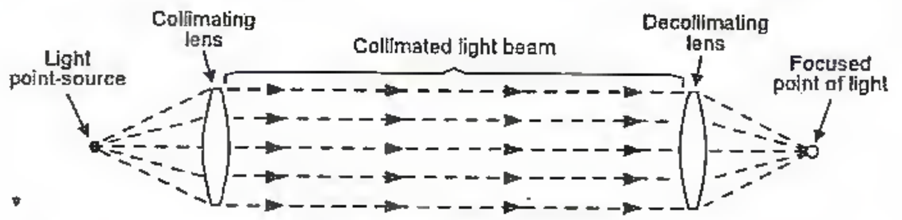


Figure 7. Basic way of using two lenses in a light-beam system.

Figure 7 shows the basic way of using two simple lenses in a light-beam alarm or communication system. At one end of the system, the left-hand lens converts the tranmitter's light point-source into a collimated (parallel) light beam, and at the other end of the system the right-hand lens converts the collimated beam back into a point of light,

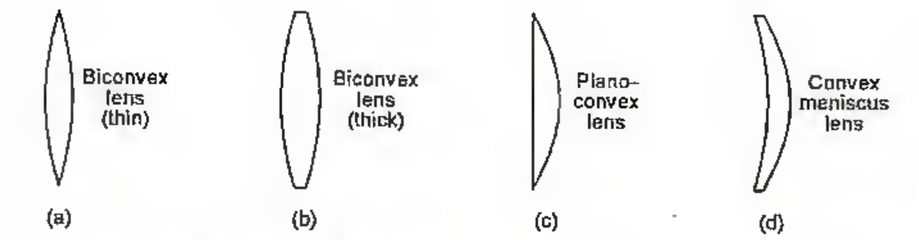


Figure 8. Four simple types of convergent spherical lens.

which is applied to the receiver's light-sensitive input. Identical lenses are used in the collimating and decollimating processes.

Systems of the above type only generate a perfectly parallel beam if the light point-source is infinitely small, and this is an impossibility. In practice, the beam widens with distances after leaving the collimating lens; the amount of widening is proportional to the width of the light source and inversely proportional to the diameter of the lens. For minimum widening, the lens diameter must be large relative to that of the source.

Simple lenses with one or both faces shaped as a section of a sphere are known as spherical lenses and are available in convergent and divergent types; convergent types make a parallel beam of light converge towards a common focal point; divergent types make a parallel beam of light diverge outwards. Figures 8 and 9 show a variety of lenses of these types.

Figure 8 shows four simple types of convergent spherical lens. The thin biconvex lens shown in (a) is the same type as shown in Figure 6; it operates equally well either way around, but its sharp edges are rather fragile. The thick biconvex type shown in (b) gives the same performance as the (a) type, but is more rugged. The plano-convex type shown in (c) has one flat and one curved face and must be used the correct way around, with the flat face pointing in the direction of the parallel light beam and the curved face aimed towards the light's focal point. The convex meniscus type shown in (d) has a very long focal length; it is the type used in most spectacles and contact lenses.

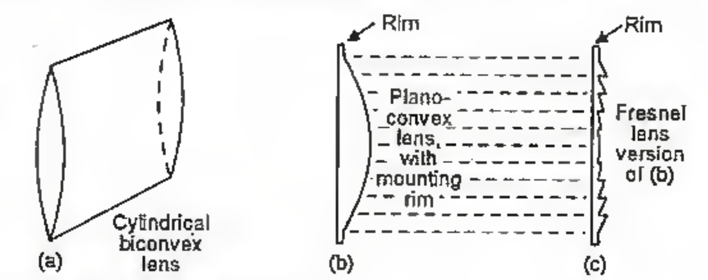


Figure 10. Three special types of spherical lens.

Figure 9 shows three simple types of divergent spherical lens. The biconcave lens shown in (a) can be used either way around, but the plano-concave type shown in (b) must be used the correct way around. A concave meniscus type is shown in (c). Lenses of these various types are often used in conjunction with convergent lenses, to make high-quality compound lenses (as described shortly).

Most spherical lenses are of the simple type already shown, but other types are also available. The cylindrical biconvex lens shown in Figure 10(a), for example, is curved in one dimension only, and is used to focus a parallel light beam into a thin line, rather than a spot, or to convert a thin line of light into a collimated beam.

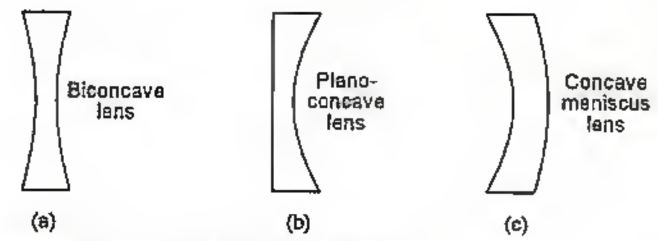


Figure 9. Three simple types of divergent spherical lens.

In most normal lenses much of the sub-surface glass or plastic lens material performs no useful function. A Fresnel lens is one in which most of the non-useful lens material is removed, to make a lightweight or low-cost lens that performs almost as well as a normal lens in simple 'light-beam' types of application. Figures 10(b) and (c) show – in cross-section form – how a plano-convex lens with a mounting rim is transformed into its Fresnel equivalent. Here, the Fresnel lens is made up by effectively dividing the original (b) lens into ten horizontal slices, removing the 'dead' material from each slice, and then bonding the remainder onto a base of identical material that also acts as the lens rim. In practice, most Fresnel lenses are moulded, in plastic or glass.

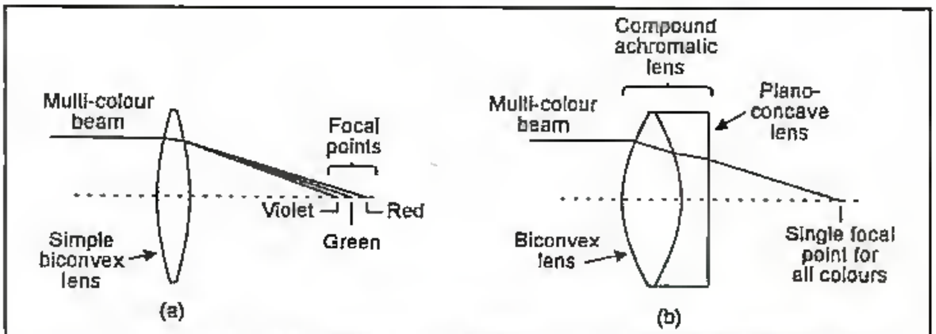


Figure 11. The compound achromatic lens shown in (b) is designed to minimize chromatic aberration of the type suffered by the simple (a) lens.

The focused images generated by simple spherical lenses suffer from spherical and chromatic defects or abberations. Spherical abberation makes a straight line appear curved in the focused image; if you wear spectacles, you can see a demonstration of this effect by standing in front of a set of library shelves and noting how the shelves above and below your eye level appear curved when you have your glasses on, but not when they are off.

In simple lenses, chromatic abberation makes faint coloured fringes appear around focused white or multi-coloured images. The effect occurs because the refractive index of the lens material (and thus the focal length of the lens) varies with the colour of light, as shown in Figure 11(a), making it possible to sharply focus only a small slice of the colour spectrum; the rest of the spectrum is out of focus, producing the 'fringe' effect. This problem can be overcome by using a compound lens made of one converging and one diverging lens, each with a different refractive index value, as shown in Figure 11(b). Such a lens can be made to give all colours the same overall focal length, and is known as an achromatic or antispectroscopic lens.

The strangest and most recently developed lens is the graded-index (GRIN) rod lens, which is used in modern fibre optic applications and operates in a different way to a normal lens. A GRIN rod is a glass or fibre rod that has a refractive index that decreases progressively with distance from the rod axis. This index variation causes light rays to follow a sinusoidal path as they travel along the rod, as shown in Figure 12(a). The length of one complete sinusoidal cycle in the rod is called the pitch (P) of the rod; the P value is determined mainly by

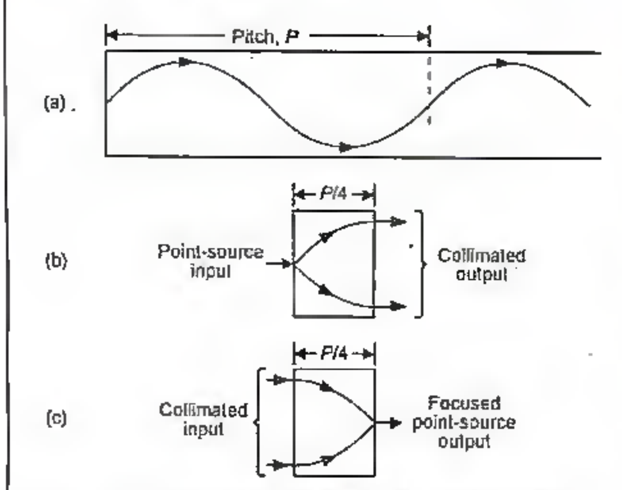


Figure 12. Light rays follow a sinusoidal path through a graded-index (GRIN) rod (a). A quarter-pitch GRIN lens collimates the light from a point-source (b), and focuses a collimated light beam into a point (c).

the rod's diameter and refractive index profile; the value is typically about 20mm.

A GRIN rod lens is simply a slice of GRIN rod with a length less than a single pitch-length, so that its optical output signal is out of phase with the optical input signal. The most interesting and widely used GRIN rod lens has a quarter pitch (giving it a length of about 5mm) and has the interesting properties illustrated in Figures 12(b) and (c). Note in (b) that the light from a point source in contact with the centre of the left face of the lens emerges from the right face in fully collimated form, and in (c) that a collimated light beam entering the left face leaves the right face as a focused spot. The GRIN rod lens thus has some properties of a conventional lens, but has a very short focal length.

GRIN rod lenses are widely used in modern fibre optic and laser module applications. Figure 13 shows an example that illustrates the advantages of a GRIN rod lens over a spherical lens in a simple fibre optic application in which the fibre optic cable's point-source 'light' output needs to be collimated when fed into the outside world. In the case shown in (a), the light is collimated by a conventional lens, which must be placed a precise fixed distance from the end of the cable, to which it is coupled by an air gap. In the case shown in (b), the GRIN rod lens is simply bonded directly to the polished end of the cable, and no carefully spaced air gap is required.

More information on fibre optic and GRIN (graded index) operating principles will be given in next month's episode of this series, which will give an in-depth explanation of fibre optic principles and practice.

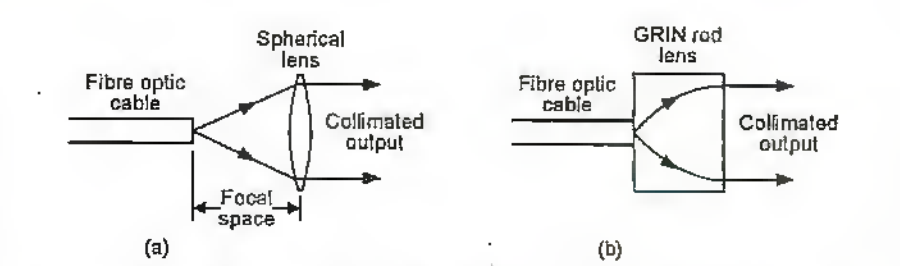


Figure 13. Method of collimating the light output from a fibre optic cable using (a) a spherical lens and (b) a GRIN rod lens.

CONSTRUCTOR'S Corner

by Peter Crowcroft and Frank Crivelli

Amtel AVR Programmer

This kit is a simple but powerful programmer for the Atmel AT90Sxxx ("AVR") family of microcontrollers.

The Atmel AVR devices are a low-power CMOS 8-bit microcontroller using a RISC architecture. By executing instructions in a single clock cycle, these chips achieve throughputs approaching 1 MIPS per MHz. Get plenty of up-to-date information and data sheets on AVR Starter Kits from www.avr-forum.com.

These devices feature onboard Flash program memory, EEPROM for nonvolatile data storage, as well as a number of fuse and lock bits. They are electrically erasable; they can be re-programmed over and over again without the need for UV erasers.

Programming of all these features is supported with this programmer.

Devices Supported

- AT90S1200 (20 pin DIP)
  1K program, 64 bytes EEPROM
- AT90S2313 (20 pin DIP)
  2K Flash, 128 bytes EEPROM & SRAM
- AT90S4414 (40 pin DIP)
  4K Flash, 256 bytes EEPROM & SRAM
- AT90S8515 (40 pin DIP)
  8K Flash, 512 bytes EEPROM & SRAM
- AT90S4434 (40 pin DIP)
  4K Flash, 256 bytes EEPROM & SRAM (requires adaptor K122ADT)
- AT90S8535 (40 pin DIP)
  8K Flash, 512 bytes EEPROM & SRAM (requires adaptor K122ADT)

This programmer does not support In-System-Programming.

The programmer uses a serial port for communication, which has several advantages:

- The programmer does not require special software other than a terminal emulator program that can send an ASCII text file. Windows 3.11 & 9x come with this program – terminal or hyperterminal – built-in. Or you may use our term.exe from our website.

WELCOME TO OUR NEW HANDS-ON CORNER FOR ALL WHERE YOU CAN BUY AND BUILD YOURSELF A TOTALLY ORIGINAL ELECTRONIC KIT OR PERHAPS YOU WOULD PREFER TO CHOOSE THE PRE ASSEMBLED KIT OPTIONS AVAILABLE. WE AT ELECTRONICS AND BEYOND HOPE YOU HAVE LOTS OF FUN AND ENJOYMENT FROM THESE PAGES AND OUR AIM IS TO PROVIDE YOU WITH VARIETY EACH MONTH SO YOU ARE ABLE TO LEARN AS YOU MAKE THE PROJECTS.

- It allows the programmer to be used with any computer and operating system.

The kit is constructed on a double-sided, through hole plated printed circuit board (PCB) measuring 110mm x 69mm (4.3" x 2.7"). Protel Autotrax & Schematic were used to design the PCB.

The kit is powered by a mains adaptor with an open circuit output voltage of at least 16VDC. Most 12VDC adaptors should supply this quite easily. Current capacity of the adaptor should be at least 150mA.

Provision is made on the PCB to fit ZIF programming sockets. However these are not supplied with the kit.

Assembly Instruction

A number of the components are physically similar and can be easily mixed up. Before starting, identify the following components:

- 1N4148 diode 1N4148 marked on body
- 5.6V zener diode 5V6 marked on body
- 12V zener 12 or 12V marked on body
- BC547 transistor
- BC557 transistor
- 78L05 regulator

Using the component overlay on the PCB, insert the components in the following order:

1. Resistors and diodes
   The diodes must be inserted the correct way around. The "bar" on the diode body lines up with the "bar" on the component overlay. The dot on the resistor network RP1 must go into the box marked on the overlay for RP1. RP1 may be 10P9R or 9P8R.
2. Ceramic and monobloc capacitors
3. IC sockets (not the ZIF sockets if used)
4. Transistors and 5V regulator
5. LEDs
6. Electrolytic capacitors
   Make sure that the electrolytic capacitors are inserted the correct way around. The positive lead is marked on the overlay. The negative is marked on the body of the capacitor.
7. Crystal, pushbutton switch and DC jack
   The switch has a flat side which lines up with the "bar" on the component overlay.
8. D25 connector and ZIF sockets (if used)
9. Proceed to "TESTING" before inserting any ICs.

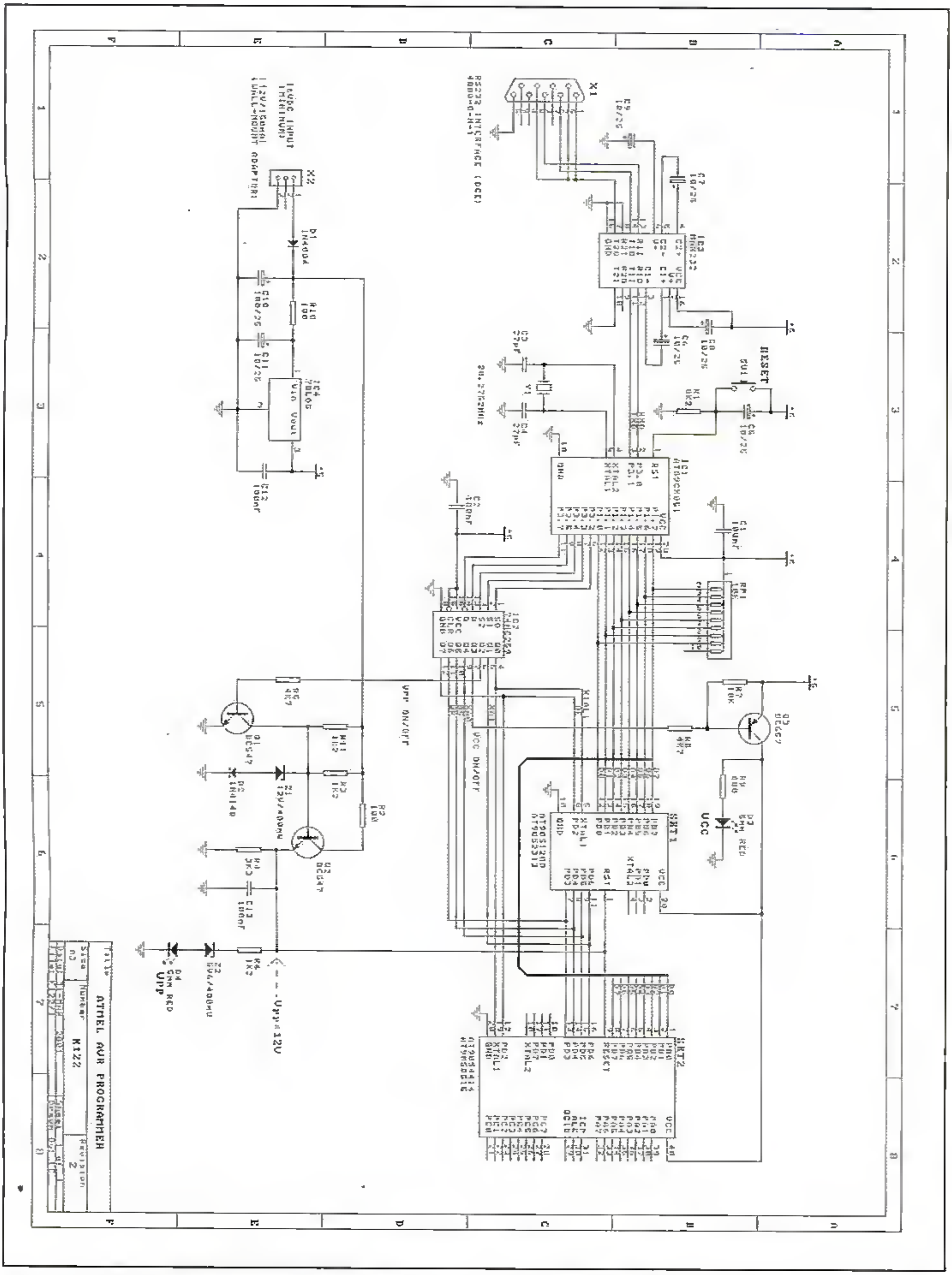
Circuit Description

The 78L05 regulator provides a stable 5V supply for the ICs. Diode D1 protects the kit against reverse polarity of the power supply. Transistors Q1 and Q2 are used to control the programming voltage: Q2 switches the programming voltage on or off and is controlled via Q1. A high on the base of Q1 pulls the base of Q2 low and the programming voltage is switched off.

A low on the base of Q1 causes zener Z1 and diode D2 to conduct and 12.6V is applied to the base of Q2. The programming voltage is now 12V. Resistor R2 limits the current supplied to the programming pin. With a 12V programming voltage zener Z2 conducts and the "Vpp On" LED lights.

Transistor Q3 switches the supply voltage to the programming socket. A low on the base supplies 5V to the socket and the "Vcc On" LED lights.

The control software for this kit is contained in IC1, a pre-programmed 89C2051. It controls all the functions for



reading, verifying and programming of the AVR chips, including the EEPROM, lock and fuse bits

Port pins P1.0 to P1.7 are used to transfer data to or from the programming socket. IC2, an 8-bit addressable latch, provides additional outputs and is controlled via port pins P3.2 to P3.6 and P3.7. The in-built serial port on pins P3.0 and P3.1 is used to communicate with the host PC. IC3 converts between TTL and RS232 signal levels.

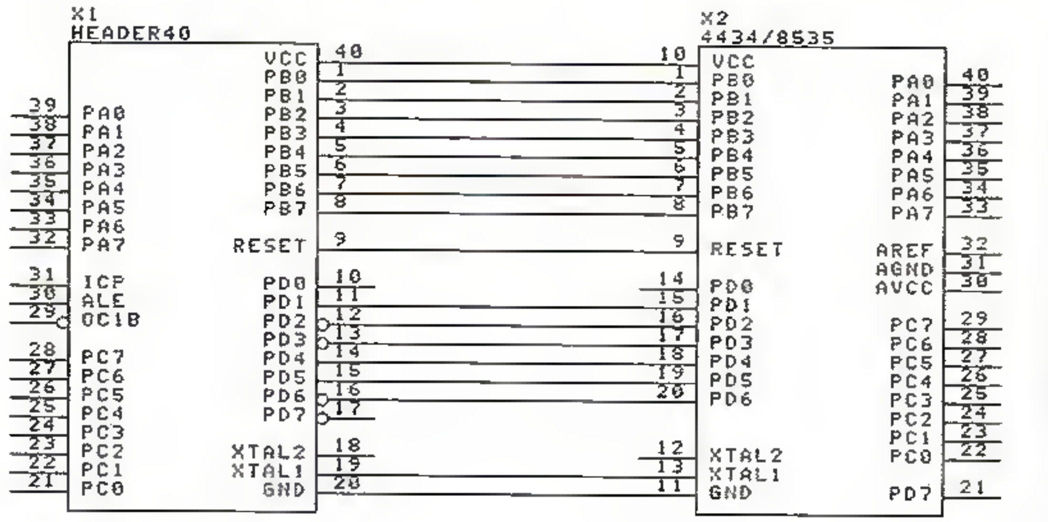
Testing

Before applying power, check that all parts are inserted in the correct position. Make sure the electrolytic capacitors and diodes are the right way around.

With no ICs inserted apply power via the DC jack. The "VPP" LED should come on. Check the following:

1. +5V rail - measure between pins 10 and 20 of IC1 socket.
2. VPP voltage - approximately 12V on pin 1 of SKT1 and pin 9 of SKT2 ("Vpp" LED on)
3. VCC voltage - 0V on pin 20 of SKT1 and pin 40 of SKT2.
4. Insert a wire link to pins 6 and 16 of the IC2 socket. The VPP voltage should now be 0V.
5. Move the wire link to pins 7 and 8. The "Vcc" LED should be on and the voltage on pin 20 of SKT1 and pin 40 of SKT2 should be 5V.

If all is well, remove power and insert the ICs. When power is then applied the Vcc LED will turn on for 0.5 sec then turn off. Both LEDs will be off.



K122 Adaptor for 90S4434/8535

Operation and Use

1. Connect the programmer to the serial port of a PC or other host using a "straight through" cable.
2. Start a 'terminal program' such as Windows Terminal, Windows 95/98 HyperTerminal or DOS Telix, ProComm, etc.
3. Set the communications parameters to 9600 baud, 8 data bits, 1 stop bit and no parity bit. If you use term.exe enter 'term 9600'. (Make a desktop icon with 'term.exe 9600' as the ending in the path.)
4. Apply power. A menu will appear and both LEDs should be off. (If the menu does not appear hit Reset on the K122 PCB, or Esc on the keyboard followed by Reset. Or Enter, followed by Reset.)
5. The programmer is ready for use.

NOTE: Do not insert or remove ICs in the programming sockets until the programmer is powered up. Once powered do not insert or remove ICs until both LEDs are off.

Programming Commands

- Commands may be entered in upper or lower case.
- There is no need to select the chip being programmed. The programmer automatically identifies the device before any programming option is executed. An error message is printed for unknown devices.

With term.exe using Kit 122 to program AT1200 the usual keypress sequence is

C P alt-S enter R P L

The first time we hit alt-S we have to put in the name of the file to be sent to the programmer (eg, 'k129.hex') where k129.hex is in the same folder as term.exe.The next time you enter alt-S the entry is remembered. You might like to do V alt-S enter a after the P alt-S the first few times to verify the program is correct. X as the optional final command shows the lock bits LB1 & LB2 status (0 for locked; 1 unlocked.) C may be omitted if the Ics are new and known to be blank.

Description of Commands

P Program memory

This will program the currently selected memory (flash or eeprom). You will be prompted to send the file, which must be in Intel HEX format. Use an ASCII or text transfer to send it.

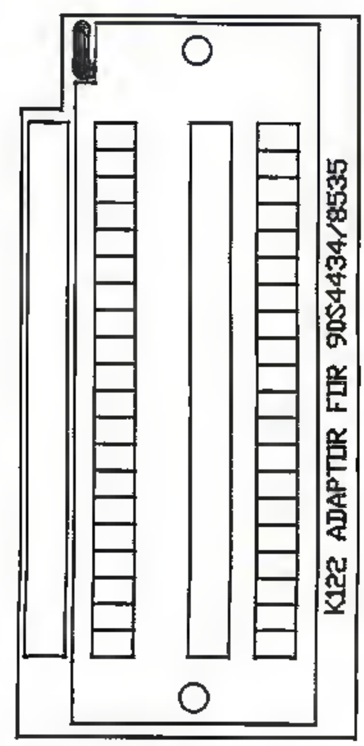
Before programming a chip it should be erased.

Chips that have been "locked" cannot be programmed without erasing first. If an error occurs while programming, a message will be printed and the programmer will stop. Stop the file transfer and press the reset switch to continue.

V Verify memory

Verify the selected memory (flash or eeprom) against an Intel HEX file. You will be prompted to send the file. An error message will be printed if verification fails.

Note: Verification should be performed BEFORE writing the lock bits. Writing the lock bits prevents the code from being read out. All data will read as FFh and verification will fail.



K122 Adaptor for 90S4434/8535

D **Dump memory**
Read the contents of the selected memory (flash or eeprom) and send it to the PC. The data is converted into Intel HEX format before sending. A terminal program with input capture or logging allows the data to be saved to a disk file.

L **write Lock bits**
Used to program lock bits 1 and 2. All lock bits are programmed – there is no choice. Lock bits are set to '0' when they are programmed (locked).

C **Chip erase**
Erase the device (electrically). Erasing the device does NOT affect the fuse bits. These are erased using the 'S' and 'R' commands.

F **address Flash memory**
AVR devices have two types of programmable memory – flash (code) memory and eeprom (data) memory. This command, together with the 'E' command, is used to select which memory type is being referenced by the 'P', 'V' and 'D' commands.

The command prompt will show which memory type is currently selected.

E **address Eeprom memory**
See 'F' command above.

Sx **SPIEN fuse (P)rogram/(E)rase**
Programs or erases the AVR fuse bit "SPIEN".
"SP" programs the fuse, "SE" erases it.

Rx **RCEN (FSTRT) fuse (P)rogram/(E)rase**
Programs or erases the AVR fuse "RCEN" ("FSTRT")

On the AT90S1200 chip it is called the "RCEN" fuse. On each of the other chips it has a different function and is call the "FSTRT" fuse. In either case this command is used to program or erase this fuse bit.

"RP" programs the fuse, "RE" erases it.

X **display Fuse and Lock bits**
This command displays the current status of the fuse and lock bits.

If it does not work

Poor soldering ("dry joints") is the most common reason for the circuit not working. Check all soldered joints carefully under a good light. Re-solder any that look suspicious. Check that all components are in their correct position on the PCB. Are the electrolytic capacitors and diodes the right way round? Is the power supply voltage at least 16VDC? Is the programming voltage (12V) correct? Is the reset switch the right way round? Check the resistor network RP1 is the right way around.

Web Address & Email

You can email us at peter@kitsrus.com if you have any problems or requests. Information on other kits in the range is available from our Web page at: http://kitsrus.com

Notes:

August, 2000.
We found a problem programming date code 0016 of AT90S1200-12PC. This was traced to the programming cycle for the chip being outside the max specified of 0.9msec. V1.2 of the firmware with this kit allows a longer programming cycle of 1.2msec and this fixed the problem.

September, 2000.
An Adaptor Board for programming the AT90S4434/8535 chips is now available. It is supplied with 2 x 20 in SIL headers and a 40 pin IC socket. The user can use a 40 pin ZIF socket if they wish.

March, 2001.
Correct connection of C8 on the serial interface. It was around the wrong way but it did not affect operation. The schematic with this documentation is the correct one.

Small firmware bug fix for 2313 programming. Last hex byte was not programming properly.

Parts List

Resistors (0.25W carbon)		
R2,10	100	2
R9	680	1
R3,6,11	1K2	3
R4	3K3	1
R5,8	4K7	2
R1	8K2	1
R7	10K	1
RP1	10K SIL resistor network 9 or 10 pin	1
Capacitors		
C3,4	27pF ceramic	2
C1,2,12,13	100nF monobloc	4
C5,6,7,8,9,11	10uF 25V electrolytic	6
C10	100uF 25V electrolytic	1
Semiconductors		
D1	1N4004	1
D2	1N4148	1
D3,4	LED, 5mm, red	2
Z2	5V6 400mW zener	1
Z1	12V 400mW zener	1
Q1,2	BC547 transistor, NPN	2
Q3	BC557 transistor, PNP	1
IC1	AT89C2051 Microcontroller, pre-programmed	1
IC2	74HC259 8-bit addressable latch	1
IC3	MAX232 or equivalent Dual RS-232 transmitter/receiver	1
IC4	78L05 +5V regulator, TO-92 package	1
Miscellaneous		
Y1	Crystal, 20.2752MHz	1
X1	D9 connector PCB mounting, right-angle, female	1
SW1	Pushbutton switch	1
X2	2.5mm DC jack PCB mounting	1
16-pin IC socket for IC2,3		2
20-pin IC socket for IC1, SKT1		2
40-pin IC socket for SKT2		1
PCB, K122	1	

Electric Guitar SUSTAIN CIRCUIT

by John Edwards

THERE ARE ALREADY MANY CIRCUITS AROUND WHICH PROVIDE THE SUSTAIN FUNCTION FOR GUITARS, AND HERE IS YET ANOTHER ONE. ESSENTIALLY, THIS IS AN AUTOMATIC GAIN CONTROL, WHICH IS ARRANGED SO THAT THE GAIN IS INCREASED AS THE INPUT SIGNAL DIES AWAY, SO SUSTAINING THE OUTPUT AMPLITUDE FOR AN EXTENDED TIME.

Some of the other circuits are simple, some are complex – this one is in the middle. Some of the simple circuits are also functionally quite elegant, although perhaps a bit picky about the actual components such as FETs used as gain control resistors. However, others are functionally a bit questionable and act more like limiters.

The described circuit can be adjusted over a very wide range of input signal levels, and has the merit of being flexible in the choice of components. It is easy to 'special' part the LM3080, an Operational Transconductance Amplifier (OTA) which is used as the variable gain element. There is a quad op-amp too, which is shown as the common or garden LM324, but the TLC27M74 from Texas Instruments would be a good alternative if you have one. Both are low current drain devices. None of the op-amp inputs or outputs has to approach the supply rails very closely except for one, which has to be able to go down to about 0.6V above the negative rail, and both of the mentioned devices will do this.

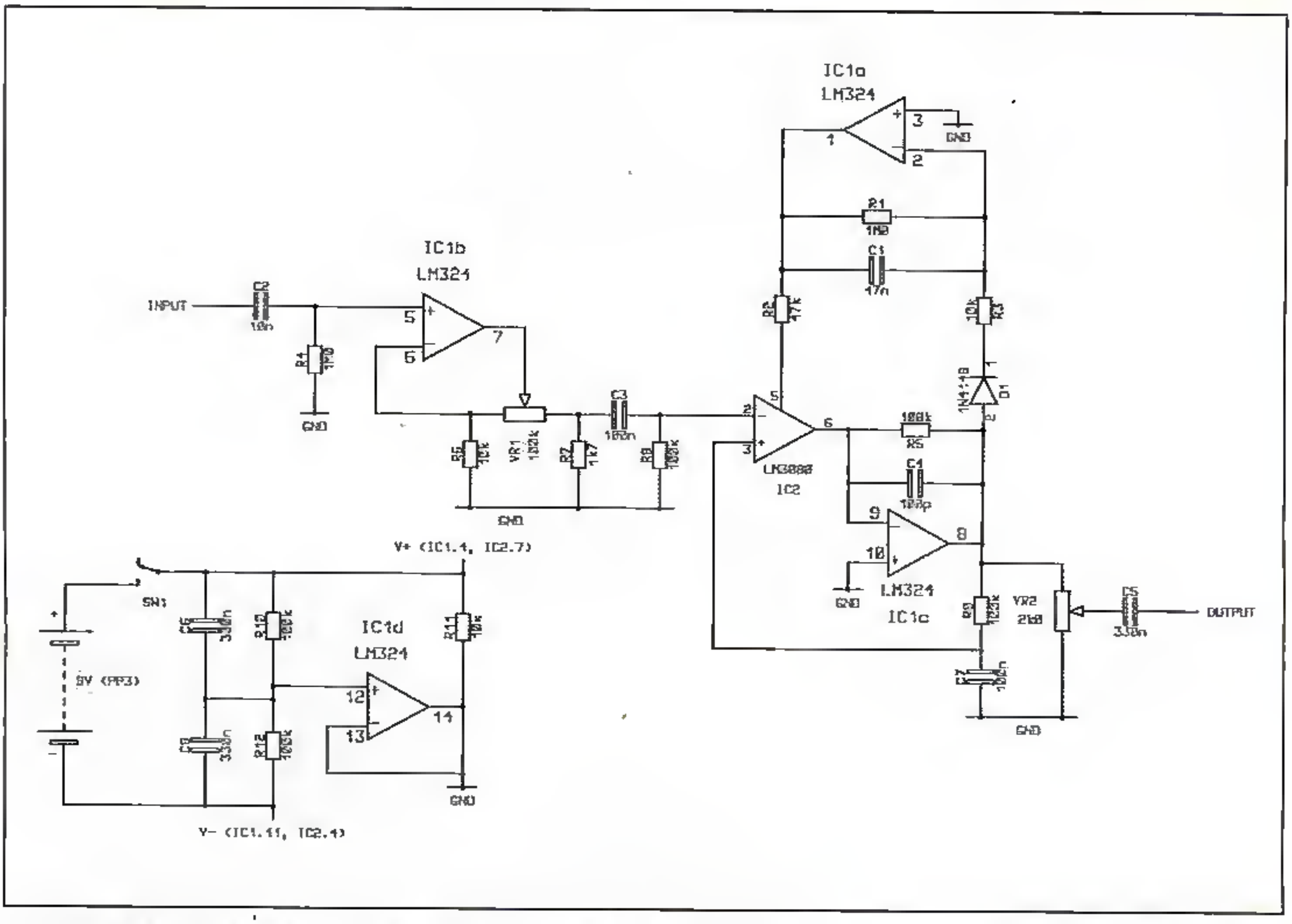
An OTA is a variation on the op-amp circuit. A normal op-amp supplies a high voltage gain, the output voltage typically being up to 100,000 (or much more) times the differential input voltage for 0Hz signals. The OTA, however, provides a current output proportional to the differential input. It has a transconductance (also known as 'gm') of mA/V rather than a gain of V/V. The value of the gm is set by a bias current, and in the LM3080 works out at around 20 times the bias current per volt input. So a bias current of 100uA will produce gm=2mA/V. This only works over a small input range though, as the maximum output current is about the same as the bias current, after which there is no further increase. The voltage appearing at the output doesn't affect the current, as long as it gets no closer than about 1V to either supply. So, for instance, a resistor connected to the output will convert the current output directly to a voltage output, where the voltage gain is equal to (gm x resistance)

The circuit is shown with a single 9V battery supply, and an op-amp section is used to generate a ground reference set mid-way. The circuit will operate quite reasonably over a wide supply range without any changes, and even four AA cells should be just about possible. Not needing a true central tap in the supply has the merit that even the on/off switch can be simple. Indeed, this could be on one of the level pots – something you couldn't do with a tapped supply.

Operation

Power is supplied when SW1 is closed. The + line goes to IC1.4 (that is, the op-amp IC1 pin 4) and IC2.7. The – line goes to IC1.11 and IC2.4. Between them the current drawn is no more than a couple of mA. Op-amp section IC1d generates a 'ground' reference for the signal on the output IC1.14. This is connected to the +ve supply by resistor R10, which draws a little current from the output stage of the op-amp, so shifting it's operation just into class A, for the lowest impedance and fastest response. Little load is placed on the output due to the ground referenced components.

The input signal is applied to IC1b via C2, which with R4 provides a high impedance input with a low frequency -3dB response set at16Hz. IC1b is a non-inverting amplifier with the gain



set by VR1 and R6. Only the section of VR1 on the R6 side comes into the gain equation, providing a range of x1 to x5.5. The other part of VR1 adjusts the attenuation between op-amp output IC1.7 and the inverting input of the OTA. The attenuation ranges from x1 to x21 (i.e. a gain of x1 to x1/22). Combined, this gives a range of adjustment from the signal input to the OTA of x1/22 to x5.5.

The OTA is operated open-loop, and the maximum differential input voltage for linear operation is around 50mV, depending on your definition of linear. Above this level in either polarity the output current will be reaching its limit, which is the same as the bias current supplied to pin IC2.5. As the input signal increases above +/- 50mV the output current waveform will become increasingly clipped off. The maximum signal level for linear operation with the gain right down (x1/22) will therefore be about 1.1V peak (a 0dBm signal in 600 ohms). With the gain right up (x5.5) then 9mV is all that is permitted. Beyond that, the circuit becomes a limiter.

The adjusted input signal is passed to the OTA inverting input through C3 which with R8 acts as a high-pass filter set at 16Hz. R8 also provides a DC path for the input bias current of the OTA. Assuming there is an OTA gm bias current into IC2.5, then there will be a current signal out of IC2.6, which is passed to the inverting input of the op-amp IC1c. This is operating as a normal inverting amplifier with the OTA substituted for the input resistor, and R5 the feedback resistor, with C4 providing high-frequency cut above 16kHz. The IC1c output is passed out from the circuit through VR2, with isolation through C5. Pin IC1c.9 is held virtually at the level of IC1c.10, which is the averaged op-amp output signal. This will be very near zero, and is fed back to null any offset drift due to OTA input bias changes. The averaging filter R9 and C7 has a high cut off frequency of 16Hz, so it has little effect on the actual signal.

If part of the signal cycle from the final op-amp stage exceeds about 560mV positive, then diode D1 will be conduct, and the output of the integrator (ICa.1) will fall towards the negative supply. This reduces the voltage across the OTA bias resistor R2 (the OTA end of which is at 0.6V above the negative supply), and so the bias current also reduces. This directly lowers the gm of the OTA, and so the amplitude of the final output signal. This gain reduction continues until a balance is reached where there is just sufficient current passed through D1 at the signal peak to counteract the de-integration current drain of R1. If the input signal level now falls, (a note dies away), then the peaks will also reduce, and D1 will conduct less or not at all. The integrator output will rise toward ground as C1 discharges, increasing the OTA bias and so tending to maintain the output signal level. Eventually, as the signal continues to fall, the integrator will arrive at ground and no further increase in OTA gain can be made. From this point, the output signal starts to track the input signal decay, and the sustain period is over.

The gain of the OTA/op-amp stage is gm times R5. As gm is 20 times the bias current, which is about 4V/R2 maximum, then the maximum gain of the stage is (20x4/47k x100k) which is x170. For an output signal at 560mV peak, this means the input to the OTA would have to be 3.3mV peak. If the input gain has been set to make the full signal 50mV at that point, then the sustain will hold the full level until the input has decayed away to 1/15 of the initial level. How long this is depends on the actual input signal decay rate. From that point, the output level will start to follow the input signal down. Note that if the input starts at a lower level, then the circuit runs out of sustain earlier; reducing the input gain therefore has the effect of reducing the sustain time. This does NOT effect the peak output level, which remains a fraction of 560mV as set by VR2.

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Electronics and Beyond magazine

Books

Tool Box

Prototype boards

PC Interfaces
- PC card/dongles
- USB Hubs
- Converters

New Products/Special Offers

Training and Evaluation

At the beginning there is the...Starter Kit

Every professional engineer needs to be able to quickly evaluate a new device with minimum cost and carry out simple development tasks using it. A simple, easy to use Starter Kit is the ultimate training tool, which provides an evaluation platform for testing your particular choice of silicon.

The Kanda Range of Starter Kits for every application and every budget... variety and choice of professional evaluation tools... simple easy evaluation tools for any application... for a wide range of devices.

ALL products come complete with:

- Free Technical support via telephone, fax, e-mail & web
- 90 day warranty after purchase
- Comprehensive Information package

The ST Evaluation solution

ST Microelectronics work closely with Kanda and we have developed a high class evaluation series of tools for basic to advanced applications designed around the ST7 device. From the starter kit, through evaluation boards to In System Programmers and Gang Programming solutions, all equipment supplied by Kanda is ST approved.

ST7 Starter Kit Package

Starter Kit board
Flash sample devices
Power Supply (US,EU,UK)
Parallel port Interface cable
CD-ROM
User Manual
Software
Personality keys(emulation and programming keys)
Registration card

Features

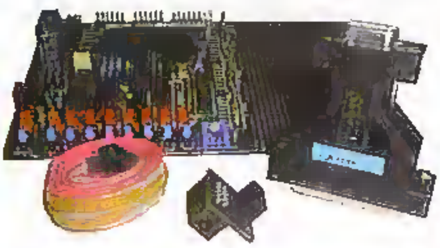
ST7Flash, OTP and EPROM development environment
Supports 32 or 42 and 56-pin devices
Programming IDE, Application Builder, Full Function Editor
In Circuit Simulation
Professional Assembler

Supported Devices	Order Code	Price $	Price £
32-Pin EPROM and FLASH	ST7KND1-KIT2*	160	115
42/56-Pin EPROM and FLASH	ST7KND2-KIT2*	160	115
*-EU, -UK or -US Power Supplies	Supports Win95, Win98 &Win2000		

ST7 Starter Kit

The ST7 Starter Kit provides you with everything you need to immediately start designing, developing and evaluating applications at a reasonable cost.

Each Starter kit comes with a pre-programmed device. It demonstrates the key features of the ST7 using the on-board hardware resources (push buttons, LED's, buzzer etc) Instructions are performed on the PC, I/O's on the Starter Kit (In-Circuit Simulation)



ST7 Boards

For fast project development, we also supply target boards for 32-pin and 42/56-pin ST7 devices. We have specially designed these boards for use with the ISP and they are ideally suited for ST7 projects. All the oscillator selections of the ST7 family of devices are fully supported, unlike other ST7 solutions. Included with each of the evaluation boards are schematics providing a full reference design for implementing your ST7 project.The on board features include, an Analog reference for Analog to Digital conversion, LCD contrast, etc. All ports and pins brought out to standard pitch headers (0.1") to a user configurable matrix area. Fully isolatable switches and LEDs using the onboard jumpers. The standard Kanda box header connection for serial In-system programming is included for easy programming. These boards can be purchased on their own or with an ST7 In System Programmer.

Item	Order Code	Price $	Price £
32-Pin Board	ST7KND-EV1	$99	£71
42/56-Pin Board	ST7KND-EV2	$99	£71
32-Pin Board with ISP	ST7ISP32	$125	£89
42/56-Pin Board with ISP	ST7ISP42/56	$125	£89
Both Boards with ISP	ST7ISP+	$198	£142

ST7 Motor controller Kit

Kanda's new comprehensive motor controller development kit makes controlling brushless DC motors simple, using the ST72141 microcontroller.

Just three EASY steps:

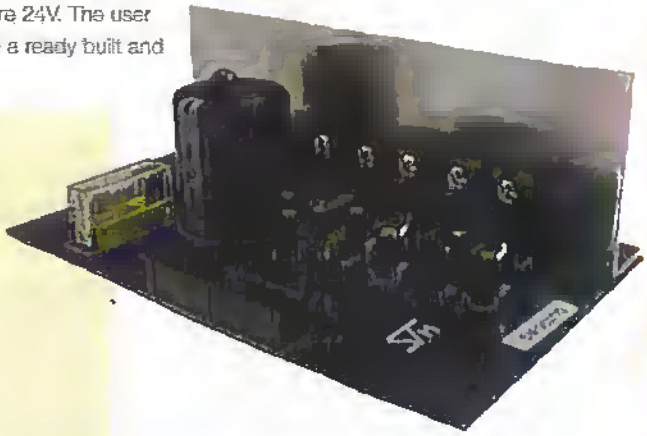
Step 1: Become an expert by practising with the supplied default motor at 24V

Step 2: Test your own motor, and work out your parameters

Step 3: Program your ST device with selected parameters and monitor the results

- This board can be used with the ST72141 emulator

The system and controller works from 12V to 300V, but the motor and power stage supplied are 24V. The user can modify the power stage to accept a 300V motor or can purchase a ready built and tested 300V power stage board from us.



Package

Programming Board
Controller board with pre-programmed OTP chip
Power stage (3-phase wired) Low Voltage or High Voltage
24V BLDC fan motor with standard load
15V Mains adapter
Parallel port cable
26-way ribbon cable with IDC connection
Blank EPROM chip
PC communication adapter
Manual on control theory, motor control and other essential information

Features

Simple Software Wizards
Application Builder
Assembler
Simulation Environment
Built In Programmer

Item	Order Code	Price $	Price £
Motor Controller Kit – EU PSU	ST7MTC2/EU	$695	£496
Motor Controller Kit – US PSU	ST7MTC2/US	$695	£496
Motor Controller Kit – UK PSU	ST7MTC2/UK	$695	£496
300V Power stage	ST7MTC2-PS300	$135	£97

8051 Workshop

A complete low cost starter kit for engineers and students working with 8051 devices. The system uses Atmel AT89 series microcontrollers – serial programmed 8051 type devices with on-board flash memory – to give you instant reprogramming and simple ICE. This is a brilliantly simple yet complete development system.

We also supply Ceibo, Phyton and Raisonance emulators for 8051 series. see our website www.kanda.com for details.

Order Code	Price $	Price £
STK8051	99	71

Features

- Application board with LEDs, switches, speaker and RS232 connector plus easy accessible port pins.
- In system Programmer
- Single step In Circuit Emulation
- 51 series Editor, Assembler and linker
- Sample device

For more products in our range of Starter Kits please call sales directly or log onto www.Kanda.com

Xicor Development Systems

XICOR

The Xicor Development Kit provides a complete development environment for Xicor products. The Kit comes in separate versions for each Xicor device type, but cost- effective software upgrades are available once you have one kit. The three kits support Xicor System Management, Mixed Signal and RF devices. All development kits feature a powerful, intuitive graphical interface that allows designers to quickly configure the user programmable features of Xicor's products.

The System Management Kit

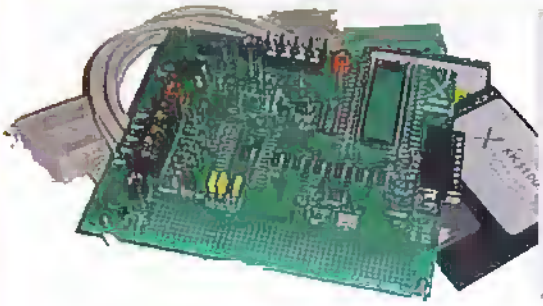
This kit provides a common platform to support all Xicor real time clock and CPU supervisor products. You can program low voltage sense trip points, real time clock alarm levels, and write to the integrated EEPROM memory. A user matrix section allows you to implement key sections of your design and explore design tradeoffs.

The Mixed Signal Kit

This kit provides a common platform to support all Xicor XDCPTM and programmable analog products. You can program XDCP resistance values, op amp gains, comparator threshold levels and other key analog parameters. A user matrix area is included. Supplied with the X9250 device module as target silicon. Mixed Signal Software features Simple 'analogue' feel software with sliders and switches.

The RF kit

A special RF design kit provides all of the features of the mixed signal design kit plus a unique pre-configured RF board to allow customers to optimise Xicor mixed signal products in RF applications. The X9250 device module is provided as the evaluation silicon.



Xicor Kit	Order Code	Price $	Price £
Xicor System Management Kit	XSMP001	$199	£142
Xicor RF Kit	XRF001	$199	£142
Xicor Mixed Signal Kit	XAMS001	$199	£142
Software Upgrades			
Mixed Signal Software	SWXAMS001	$49	£35
System Management Software	SWXXSMP001	$49	£35
RF Kit Software	SWXRF001	$49	£35

AVR®

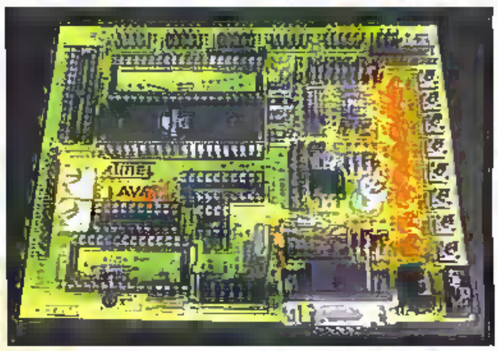
AVR Microcontrollers

Kanda have for many years worked closely with Atmel to produce quality starter kits and in recent years have added their own particular features to make a unique and very popular range of Starter Kits. The success of the STK200 was the result of Kanda's commitment to design excellence and its ability to orientate one kit to support an ever increasing number of features whilst retaining ease of use, coupled with high levels of quality control and reliability in the manufacturing process.

STK200+ Atmel AVR Starter Kit

The best Starter Kit ever...

The STK200 designed by Kanda for Atmel was the most successful starter kit EVER produced. One of the most popular and best-sellers of the Atmel Starter Kits comes with the value added pack software as a total package. Over 30,000 of the STK200 have been sold world-wide, now Kanda have enhanced the design to include more features of this simple but effective tool for AVR.



Package

STK200 Board
Access to all peripherals inc. ADC and UART
LCD interface
3.3V/5V operation
Brownout circuitry
Manual on CD

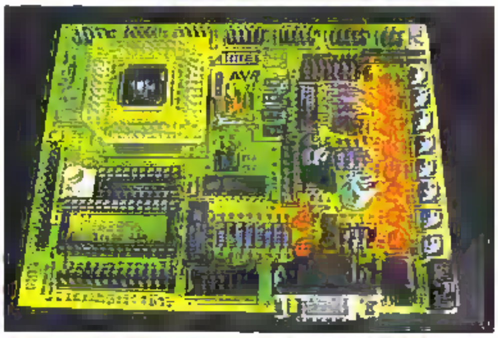
Features and Benefits

Classic Hardware
AVRISP In-System Programmer
Application Builder gives you instant source code templates and code examples
Assembler
Emulation includes a Debug package using the same hardware as ISP
Includes IAR Assembler & Simple In-System Debugger
Simple ICE

*For improved device programming support and faster programming times + WinNT/Win2K/WinME Support also check out the AVR PSI ISP which is compatible with this development board.

STK300+

The STK300+ is a complete low cost system for the Atmel ATMega AVR Range of Flash 8-bit in-system programmable RISC microprocessors & includes Application Builder Software.



STK300 Board
ATMega Builder Software
LCD external RAM provision
RS232 & ADC connection
Switches, LED'S & Power
External Reset
Dual Voltage operation
Brown out detection
Real time clock crystal

Supports
Atmel Atmega 103/L
Atmel Atmega 603/L

AVR Kit	Order Code	Price $	Price £
STK200+ For Classic AVR	STK200PLUS	$59	£42
STK300+ For MegaAVR	AVM0029	$79	£57

*For improved device programming support and faster programming times + WinNT/Win2K/WinME Support also check out the AVR PSI ISP which is compatible with this development board.

PLD Starter Kit

All you need to learn, teach or develop designs using Programmable Logic Devices. Complete hardware and software package for training and development. This package is used extensively by universities all over the world to teach logic and then move to practical implementation using PLDs. It also acts as a pretty neat development environment.

Package
1x ATF16V8
1x Device programmer
1x Training Board
1x Parallel Connection Board
1x Get going with PLD's Book
Kanda PLD Programming Software
Kanda/Atmel CUPL Interface

Programmable Devices
ATF16V8B & C
ATF22V10B & C
ATF20V8B & C

Item	Order Code	Price $	Price £
PLD Starter Kit	ATM014	$299	£214

The Ubicom Range
Debugging the SX range

UBICOM™

In-System Debugging allows the whole development process to be carried out on the same desktop, so you don't need constant hardware and software changes-just plug and go. The project-based IDE makes version control and code organisation quick and easy.

Features

Application Builder:
uses simple wizards to create all your set-up code including ports, timers and interrupts, as well as device configuration (FUSE/FUSEX).

Assembler:
Built-in Assembler is called with only 1 mouse click or key press so you avoid DOS prompts
On-screen error listing and highlighting in your source code means bugs are fixed easily.

Emulation
Debugger uses the emulation functions of the SX chips giving genuine emulation on your target instantly.

Benefits
Small 60x55x16mm
Flexible: Parallel & Serial Port connection
Comprehensive: Programs all the features of all the devices
Easy, intuitive development

Device Support
SX18AC
SX20AC
SX28AC
SX48BD
SX52BD
Win95,
Win98,
Win2000 & WinNT

Item	Order Code	Price $	Price £
SX-In System Debugger	SX-ISD	$99	£71

Ideal for use with SX Evaluation Board to give known target hardware

Starter Kits

SX Evaluation Board

The Scenix SX Evaluation Board is designed to provide a cost effective platform for developing applications with the SX series high-performance communications controller. This evaluation board is specifically made available to serve as a target environment for demonstration and development of Virtual Peripheral" software modules.

Ideal for use for SX Debug

see Optama SX C compiler on www.kanda.com

Starter Kit	Order Code	Price $	Price £
SX In System Debugger	SX-ISD	$99	£71
SX Evaluation Kit	EPAK-SXEVAL01-03A	$89	£64

Networking and Connectivity

SX Stack Kit

Ideal for implementing Internet Access in a simple application – make you project talk to the web.

The SX-stack is a configurable combination of standard Internet protocol layers optimized for the SX series communications controller. Supported Internet protocols include PPP, TCP/IP, HTTP, SMTP and POP3. It provides the end-user with hands-on experience using the SX-Stack's iSX Web Server and eSX E-mail Appliance configurations. The iSX is an embedded Web server that implements the hypertext transfer protocol(HTTP) and is capable of communication with any Web browser. The eSX offers e-mail appliance functions, with SMTP and POP3 protocols used at the application layer.

Package

SX-Stack (iSX Web Server and eSX E-mail Appliance) Demo Board
AC Power Supply
9-pin-to-9-pin serial cable
CD-ROM containing iSX/eSX source code files, support files and documentation
User's guide

Ethernet SX Stack Evaluation Kit

Ideal for simple Internet connectivity with network capability, using 10-BaseT.

The Ethernet SX Stack is a configurable combination of standard Internet protocol layers optimized for the SX communications controller. Supported Internet protocols include TCP, UDP, IP, ICMP, DHCP, ARP, HTTP, and STMP. The purpose of this evaluation kit is to provide the user user with hands-on experience using the Ethernet SX Stack. The kit includes an integrated web server and email appliance provided through implementation of the HTTP (Hypertext Transfer Protocol) and SMTP (Simple Mail Protocol) application protocols. ARP (Address Resolution Protocol) and DHCP (Dynamic Host Control Protocol) protocols are implemented to deal with addressing issues specific to the Ethernet environment. The SX communications controller's in-systems programming feature enables the device to be reconfigured easily for one of several implementations. To download your own material to the demo board's EEPROM or to evaluate other stack application variations, you need SX DEBUG or SX ISP to reprogram the SX device.

Features

- Ethernet SX Stack Demo Board:
- SX52BD 50 MHz communications controller
- Realtek 10Base-T (IEEE802.3) Ethernet device for physical and MAC layer support
- 32kB EEPROM memory chip for storing web content
- 24-pin wide-body DIP socket for Scenix' JVM (Java Virtual Machine) application prototyping and expansion
- Two RS-232 communication ports
- Clock circuit, power and transmission status LEDs, RESET button
- I/O and Demo support:
- Thermistor for "remote" temperature sensor demo
- LED control via buttons on embedded web server page
- 20 I/O pin expansion header for customer application usage
- TCP/IP Stack and Application Layer Software

Starter Kit	Order Code	Price $	Price £
Ethernet SX Stack Evaluation Kit	EPAK-TCP/ETH01-02	$199	£142
SX- Stack Kit	EPAK-TCP/PPP01-03	$149	£107

For CAN Starter Kit & Module solutions call sales or visit www.Kanda.com for the latest demos and datasheets

CAN Starter Kits and modules

Two starter kits are available for learning, evaluating and testing CAN bus applications. The CAN modules are available for your applications as 28-pin DIP packages and you can also purchase complete C and BASIC library routines.

Starter Kit 1 consist of one activity board and one CAN module plus sample programs written in C and BASIC, manuals and datasheets. Ideal for PC connection

Starter Kit 2 consists of two activity boards, 2 CAN modules plus one RS-232 cable, one 1 m. CAN cable, AC/DC adapter (not included in all countries) and more sample programs demonstrating distributed I/O and the Philips PeliCAN mode. Ideal for multiple node development.

Activity Boards

Each activity board has a socket for the CAN module with Power supply and communications connectors plus jumpers, switches and LEDs and large user prototyping area with all CAN signals easily accessible. They are ideal for testing and developing applications.

CAN modules

The CAN modules are also available separately, and consist of an embedded microcontroller with CAN (Controller Area Network), in a 28-pin DIP package, which you can simply plug into your application. Each module works at almost 4MIPS and is completely re-programmable to your specification using In System Programming. Each module also has on-board RS-232 transceivers and a RESET circuit that generates a proper reset after power up and will also halt the microcontroller if the voltage drops below 4.38V. Furthermore it has a standard ISO-11898 CAN transceiver on board, but could also use an external CAN transceiver with your own hardware with e.g. OPTO isolation.
Two versions are available, with or without RS232. Each module has 11 I/O lines plus SPI and one external interrupt.

It is also possible to buy source code libraries for complete CAN implementation.

Library 1 is in Object form and cannot be altered or adjusted, but there are no limits to the speed. Both FIFO queues are preset to 4 CAN frames. This is an inexpensive way of testing the CAN libraries with full functionality and speed.

Library 2 is full documented C source code for you to modify or add functions to suit your needs. The source code is treated as a site licence and you may not distribute or resell the source code. Both FIFO queues can be set to suit your needs but only in size increments of 1,2,4,8,16...512. All you need to do is to include the WiCAN.C and WiCAN.H file to your project and you are up and running. Sample programs are included to show how it works.

Name	Order code	Price $	Price £
Starter kit 1	LAWSTK/001	$119	£85
Starter kit 2	LAWSTK/002	$269	£192
CAN Module (with RS232)	LAWCAN/001	$64	£46
CAN Module (no RS232)	LAWCAN/002	$59	£42
CAN Library 1 (Object code)	LAWLIB/001	$99	£71
CAN Library 2 (Source code)	LAWLIB/002	$500	£357

The Mitsubishi Range

The M16C series from Mitsubishi offer a secure and extremely versatile range of 16-bit flash micro controllers. Their advanced features are well suited to projects requiring user interfaces such as Digital TV, Mobile Telephones and Digital cameras.
Kanda work closely with Mitsubishi and are currently working to expand the range of tools available on the Kanda shop.

Name	Order code	Price $	Price £
M16C USB Starter Kit	M30240	$299	£214

Hardware

M30240 Starter Board
RS232 cable for download of user-code & debugging from PC
USB cable
9 volt DC Power Supply

Software

KDB30- PC software for debugging
Tool Manager- Integrated development environment(trial version)
NC30-C-compiler(trial version)
AS30- Assembler (trial version)
Sample programs

Features

Low cost evaluation of M16C USB
Simplified Debugger
Compile, download, execute and debug programs
Access to UART,A/D, some I/O and USB
Includes all software and documentation needed

FPGA Kits

FPGA Tools are able to integrate system level functionality into one device, thus offering the system designer the ability re-think his approach to his solution. Kanda offers you a variety of options with the basic product line and you can even purchase a complete practical hands-on course which could be your route to a well paid career.

We offer different options depending on your level of expertise. Logic on a Board provides a simple design and software solution for users with FPGA experience. The FPGA starter kit provides full software, tutorials on how to use it and a complete hardware applications package and the full training kit comes complete with an interactive VHDL tutorial.

FPGA Starter Kit

Comprehensive hardware and software package covering the implementation of designs in FPGA technology. Covers the use of VHDL compilers, fitters, downloaders in hardware and software using a comprehensive hardware platform, complete software suite and book on CD.

Starter Kit Package

Main Board
Programming Software
Cable
Dongle
Sample Device
Comprehensive FPGA book (on CD)
Registration Card
Adapter Board
AT40K20 device

FPGA Training Kit

FPGA Starter kit as detailed above, plus Interactive VHDL Tutorial on CD ROM with :

- Tutorial, Cook Book, Reference & Guide
- 100+ VHDL Examples
- 350 fully synthesisable examples in the Cook Book

This kit is the ideal introduction to FPGA and covers all aspects of using them in your applications.

Logic on a board

Plug and go FPGA solution using standard 0.1 inch pin headers. Avoids surface mount headaches during development and production. The built-in configurator and connector allow immediate use with no wiring headaches. Comes complete with PC Design Flow and bitstream downloader software and parallel port adapter and cable for instant programming. A complete FPGA solution.

FGPA Systems	Order code	Price $	Price £
FPGA Training System	FP0050	$295	£211
FPGA Starter Kit	FP0020	$139	£99
Logic on a board	FP0060	$99	£71

If you would like further information on any of the Range of Starter Kits please contact Sales or log on to www.kanda.com for the latest information on new products available today.

Kanda prides itself on its commitment to ensuring you the customer are able to choose the right option as we have the experience and expertise to provide you with a Starter Kit tailored to your budget and our aim is to design, manufacture and produce kits which are easy to use yet provide all the features you need depending on the complexity of your particular application needs.Please call sales if you need any assistance or datasheets on any product in our ranges

Ordering Information

Please contact sales on:

+44 (0)1970 621 030 or

1-800-331-7766/1-866-34-KANDA

FAX +44(0)1970 621040

or log onto to **www.kanda.com** for a comprehensive product datasheet.

Introduction

Programmers and burners is a large section so we have broken it up into the following categories:

- In System Programmers
- Universal Programmers
- Gang Programmers
- EPROM Erasers
- Programming Adapters

In System Programming

ISP (In System programming) is a popular new way to burn microcontrollers and other programmable logic devices. (Some manufacturers also call it ISD/ISR or ICP).

ISP is also associated with Flash technology, which allows you to erase and re-program a microcontroller many times; this simplifies the design stage and adds flexibility to production and update phases.

ISP removes many of the restrictions associated with using & burning microcontrollers. Using ISP you can now:

- Burn a device quickly without removing the device your project or have to use a UV eraser etc.
- Perform firmware upgrades in the field
- Customize your firmware with Serial Numbers, Calibration Data this could be integrated into production statistics etc..
- Download test & diagnostic routines prior to shipping your product.
- End of line customization – regional product variations and different product configurations can now be changed after production.

Some ISP implementations also have In-System debugging extensions to simply the design and debug process.

Kanda provide a range of ISP solutions to fit every need from development through debugging and production to field upgrades.

PC Based ISP Solutions

Kanda have a range of cost effective PC based ISP burners for a variety of different microcontroller families and different PC connection options.

All programmers use logical devices sophisticated ISP software.

The user interface has been carefully designed to provide "easy operation", coupled with advanced features for the power user. The COP8 ISP gives you save and load options for all your settings and files, making it simple to restart after a break. The standard erase, read, program and verify functions are available via single mouse click or keyboard shortcut and Auto-program makes repetitive device programming really easy.

The programmer includes Kanda's hex file editor, which allows you to edit and view your file prior to programming the device. This is useful for making small changes to your program code outside of your development environment. Verification after programming or verifying a device against a file is simplified by color-coding to give an instant visual check. And no more worries about your file type as the editor Auto-detects different file formats including Intel Hex & Motorola S Record.

Order Code	Description	PC Connection	Operating System	Device Range	Price $	Price £
ST7ISP32	ST7 ISP & 32 pin evaluation board	Multiconnector	Win9X/ME NT4/2000	ST72104,215,216, 254,124,314,334 and ST72171K2	$125	£89
ST7ISP42/56	ST7 ISP plus 42/56 pin evaluation board	Multiconnector	Win9X/ME NT4/2000	ST72104,215,216, 254,124,314,334 and ST72171K2	$125	£89
ST7ISP	ST7 ISP	Multiconnector	Win9X/ME NT4/2000	ST72104,215,216, 254,124,314,334 and ST72171K2	$45	£32
AVRUSB	AVR ISP SUPER	USB	Win9X/ME 2000	ALL AVR ISP DEVICES	$149	£106
PSI-ISP	*AVR ISP*	*PRINTER PORT*	*Win9X/ME NT4/2000*	*ALL AVR ISP DEVICES*	*$125*	£89
AVR-ISP	AVR PSI	Multiconnector	WIN95/98/3.1	ALL AVR ISP DEVICES (EXCLUDING ATMEGA163, ATMEGA32, ATMEGA161, TINY12,TINY15)	$39	£28
SX-ISP	SX ISP	Multiconnector	Win9X/ME NT4/2000	SX18/SX20/SX52/ SX48/SX28	$55	£39
COP8ISP	COP8 ISP	Multiconnector	Win9X/ME NT4/2000	COP8CBR9, COP8SBR9	$129	£92

Programmers and Burners

Multiconnector

Some of our desktop ISP solutions feature the multiconnector. This unique design features a 9-pin serial port and PC printer port connections, allowing you to attach the ISP to either port.

ISP Connector

A well-designed ISP connection is vital for programming reliability. The layout and pin usage of the ISP connector will change depending on your target microcontroller.

The 10 pin connector has interleaved ground lines to give better noise immunity and allow the use of longer cables. The cable supplied as standard is over a metre in length, giving you flexibility in use.

The connector diagrams for our supported targets are shown below:

Scenix, COP8, Atmel, ST

USB Connection

The AVR-ISP Super utilises the USB port, what are the advantages of the USB port?

As increasing numbers of PC's are fitted with a USB port as an industry standard, connecting to your PC via the USB port enables you to keep your serial and parallel ports free in addition you benefit from USB flexibility and speed.

Older PC's can easily be modified using a plug-in card to provide quick, easy upgrades. The USB port can operate at up to 12Mbits/s giving you a great advantage as programming times are increased enormously.

USB is supported under Windows 98/ME/2000.

Updates are available from Microsoft to USB enable Windows 95 & NT4, however we can not offer technical support on these platforms.

Keyfob Field Programmers

The ultimate programming tool for microcontrollers, in the field or on the production line - so easy a child can use it! The smallest stand-alone programmer available, just load it once and then program target devices again and again and again.

You require just one starter kit for your PC and you can load as many keyfobs as you need. Just connect the starter kit to your printer port and run the master software. Select your program file, device type and Fuse settings and now you can load the keyfobs with your program or test code in seconds. As the Keyfob is battery powered during load, you don't need any power supplies or cabling, just plug a Keyfob into the simple adapter supplied. Once a Keyfob is loaded, it is completely portable and can be used where you need it, not where your PC is located.

Think how often you need a simple upgrade to a vending machine, slot machine or other equipment such as lifts, security controls or medical equipment - simple, except it is hundreds of miles away. The rugged design and simple operation of this unique programmer means that you can "let the Keyfob do the walking" by sending the Keyfob rather than an expensive engineer. The Keyfob includes a 12V battery so your target system does not have to be powered for occasional programming although you will need power from the target for multiple programming to save battery life.

In order to configure the keyfob you need a Keyfob starter kit. This contains the PC Software & Connection lead required to setup your keyfob.

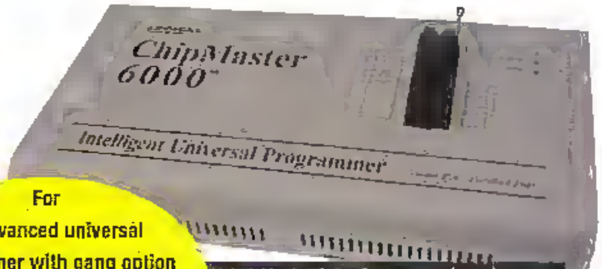
Keyfob starter kits contain a Keyfob, PC Configuration Software, Connection lead and an adaptor.

Order Code	Description	Device Family	Price $	Price £
ST7KF0010	ST7-KEYFOB STARTER KIT	ST7 ISP DEVICES	$99	£69 (?)
KF0010	AVR KEYFOB STARTER KIT	AVR ISP DEVICES	$165	£115 (?)
KF0040	AVR KEYFOB STARTER KIT + 5 KEYFOBS	AVR ISP DEVICES	$399	
COP8KF0010	COP8 KEYFOB STARTER KIT	COP8	$165	
COP8KF0040	COP8 KEYFOB STARTER KIT + 5 KEYFOBS	COP8	$399	

Additional Keyfobs Packs

Order Code	Pack Quantity	Description	Device Family	Price $	Price £
KF0030	5	Additional AVR Keyfobs	AVR	$299	£209 (?)
KF0020	1	Additional AVR Keyfob	AVR	$99	£69 (?)
COP8KF0030	5	Additional COP8 Keyfobs	COP8	$299	£209 (?)
COP8KF0020	1	Additional COP8 Keyfob	COP8	$99	£69 (?)
ST7KF0020	1	Additional ST7 Keyfob	ST7	$50	£35 (?)

Universal Programmers
Chipmaster 5000 & 6000 Series



Designed for both laboratory and mass-production applications the ChipMaster supports a wide range of different devices, including PAL, GAL, CPAL, EPLD, PEEL, MAX, MACH, PLSI, microprocessors, EPROM, series EPROM, PROM, and Flash memory.

For an advanced universal programmer with gang option please see the Chipmaster 7000 in the Gang Programmer section

Features

- 48 pin ZIF with insertion, contact checking
- Self program w/ statistic reporting for mass production
- Support 3.3 V low voltage chips
- Program 8-Mbit Flash within 60 seconds
- Windows 3.x, Windows 95, NT4 and DOS
- User configurable voltages and multiple verify passes

The chipmaster's on-board intelligence reduces system overhead to a minimum. Program an 8-Mbit EPROM in less than 80 seconds. (depends slightly on the processing power of your PC & Chipmaster Model) The ChipMaster is faster than its competitors and is much more productive with today's high-density, multi-megabit memory devices. The chipmaster performs device insertion and contact checks before it programs each device. It can detect poor pin contact and devices inserted upside down or in the wrong position. Protect your pocketbook by preventing expensive accidental chip damage.

Name	Order Code	Number of Devices Supported	Socket Configuration	Price
Chipmaster 5000	PROCM5-000	1,200	1 x 48-pin ZIF	$695
Chipmaster 6000	PROCM6-000	3,000	1 x 48-pin ZIF	$1,195

Shooter III

Gang Version available soon please call for details

FEATURES

- 'Dumb Terminal' operation through PC Serial Port.
- Use a Car Charger
- 1+hrs of battery operation with power saving sleep
- Master/Slave socket configuration for quick copies.
- Host-free operation, no software needed.
- Recent selection memory.

Hand-held chip programming system that allows the user to copy EPROM's in Stand Alone (Copier) mode or to download a file from any computer with an RS-232 port. Making a copy of a chip has never been as simple. Place a chip in the Master socket and a blank in the Slave, select the target device from the Shooter's in-system library of over 300 devices, press copy, and you're done. All that power in the palm of your hand, Shooter III measures a mere 8x4x2 inches. Shooter III has two 32-pin ZIF sockets capable of supporting 16k to 8-megabit devices.

Field Service Pack

The Shooter is also available as a field service pack, containing the Shooter III, PalmErase EPROM eraser and a shoulder/hip-pack to carry them around in.

Name	Order Code	Number of Devices Supported	Socket Configuration	Price
Shooter III	PRG-SH3-000	Over 300	2 x 32-pin ZIF	$375
Shooter III Field Service Pack	OPT-SH3-FSP	As Shooter III		$465

Gang Programmers
Softec MP8011A

Gang programming system for the ST7 & ST6 range of microcontrollers. This programmer supports all ST6 & ST7 devices using a modular programming head system. When you need to use a new package or device simply purchase a new set of programming heads. The unit supports 8 programming heads allowing you to program 8 devices concurrently.

The system is supported under Windows 95/98/NT/Me/2000 and requires a printer printer port. The system is fully upgradeable and software updates are available from the manufacturers website.

The main unit is supplied with the programmer base unit, power adapter, a parallel cable, a test board, the user interface software and user's manual. At least one programming head is required for operation.

Product	Description	Order Code	Price $	Price £
Softec MP8011A	Gang Programming System for the ST6 & ST7	MP8011A	$745	£539

Programming heads priced from $55. Please call or visit our website for a complete list.

Husky LC

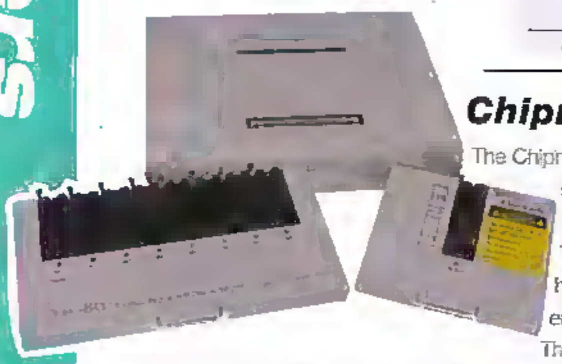
Rugged, reliable and easy on the pocket book. The Husky LC's are the ideal for development and production cycles for a wide range of devices. The Husky LC's are custom configurable designed to provide flexibility for the amount of devices you can program at one time, and the size of the devices programmed. Depending on the configuration you choose the LC's can program up to 4, 8Mb 32-pin parts.

Features

- Programs EPROMS, FLASH, OTP'S
- 4 x 32 pin ZIF Sockets
- Supports Flash 28Fxxx and 29Fxxx
- Intel, Motorola, and binary file support
- Supports High Speed Serial RS-232
- Windows 3.1/95/NT or DOS User Interface.
- Remote Command for Sun or Mac PC
- Low Cost and Compact Design

The Husky LC is available in a variety of memory and socket configurations allowing you to choose the most cost effective configuration for your needs.

Description	Memory	Num of Sockets	Part Number	Price $	Price £
Husky LC	1 Meg	1 Socket	PROHUL-D11	$445	£317
	1 Meg	4 Socket	PROHUL-D14	$545	£389
	4 Meg	1 Socket	PROHUL-D41	$545	£389
	4 Meg	4 Socket	PROHUL-D44	$645	£460
	8 Meg	1 Socket	PROHUL-D81	$645	£460
	8 Meg	4 Socket	PROHUL-D84	$745	£532



Chipmaster 7000

The Chipmaster 7000 is a software expandable universal device programming workstation that supports a wide variety of programmable devices in addition to the capability of testing digital ICs.

The Chipmaster is the most sophisticated low-cost programmer available today. A unique hardware/software architecture enables the Chipmaster to easily grow in support and engineering software design capabilities as quickly as your device library requirement.

The state-of-art universal programmer offers you the most advanced programming facilities with the user-friendliest interface. Since each pin is software addressable, new part numbers are being added to the list of supported devices through software upgrades. No new hardware to buy! It will prove to be one of the most reliable and long lasting instruments.

The optional gang module allows you to program 8 x 32-pin devices with very fast programming times. For example, you can download, program, and verify eight 8-Mbit Flash Memory (28F800) in approximately 160 seconds. There is also an optional ROM emulator module that supports devices up to 4-Mbit.

Name	Order Code	Description	Price $	Price £
Chipmaster 7000	PROCM7-000	Chipmaster 7000 programming system	$995	£710
CM7 Gang Module	OPT-CM7-8G	8 x 32 pin gang expansion module	$595	£425
CMD Rom Emulator Module	OPT-CM7-ROM	ROM Emulator expansion module.	$395	£282

Gangstar Pro

Features:

- Auto Programming Production mode
- 48 pin ZIF with insertion, contact checking
- Auto Port configuration
- Auto device selection for many parts
- Device insertion/pin contact checks

The GangStar-Pro is a one of a kind PC based parallel port GANG programmer with 8 fully isolated 48-pin ZIF sockets. Each of the GangStar-Pro's sockets are designed with dedicated FPGA's for independent control. This independent design gives the GangStar-Pro its' semi-concurrent programming capabilities. For example you can program four devices while removing/inserting devices in the remaining four sockets. And with the moduler design of the GangStar-Pro, in the event one, two socket module ever fails you still have three modules to continue your programming while the other is returned for repair or replacement.

TURBO SPEED

The GangStar-Pro has been dubbed the Turbo Gang Programmer for a reason; use the GangStar-Pro to program eight, 8-mb parts in under one minute. Programming times may vary slightly from PC to PC depending on the PC's processing capabilities (programming time based on a 486dx 66 system).

SPECIFICATIONS

Power: 100 to 240 VAC, auto-switching
Power consumption: 25 W
Operating temp: 5 to 45°C (41 to 113°F)
CE Certified

NO MORE MISTAKES

8 independent, isolated 48-pin ZIF sockets
Support for 3.3-5 Volt, Devices
Program 8, 8-MB Flash in under 60sec
Auto-sense, self-start
semi-concurrent mode
Modules allow flexible configuration
48TSOP/44PSOP/40TSOP
Flash, MCU support
Device insertion and continuity test
Project file save/load function

ANY APPLICATION

Designed for both laboratory and mass-production applications. Supporting nearly 3000 different devices, including PAL, GAL, PEEL, MAX, MACH, PLSI, microprocessors, EPROM, and Flash memory

Name	Order code	Price $	Price £
Gangstar Pro	PRG-GSP-000	$2,990	£1,999

Eprom Erasers

ULTRALITE ERASER

High capacity, high performance, Industrial EPROM eraser, The UltraLite will hold up to 50, 28pin devices in the maximum UV exposure area of the tray. The UltraLite comes with two UV elements, timer switch and removable tray for storage or quick swaping. Be safe and secure with UltraLite's auto shut-off timer and UV light indicator.

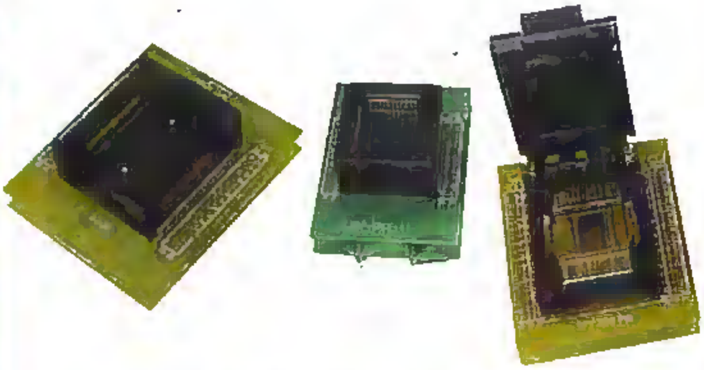
T8 SERIES ERASERS

The QUV Family of erasers are ideal for almost any situation. The convenient pull out tray holds over a dozen devices and is completely removable to easily swap whole trays of devices. Available in three models... (N) with no timer, (T) with timer/ and the Deluxe (Z) with timer and parabolic reflector to increase light intensity and range. Average erase time of 25 minutes, but times may vary by device.

PALM ERASER

The Palm-Erase is the perfect solution for the tech on the go. Easily fit this tiny but powerful eraser into your service tool kit and off you go. Erase EPROM's from 24 to 40 pins in 5 minutes or less.

Model	UV Elements	Capacity	Timer	Tray Size	Average Erase Time	Special Features	Order Code	Price US$	Price £
Ultralite	1	up to 50 x 28pin DIP/100 x 32pin PLCC	One Hour Auto Off Timer	5" x 9"	15 minutes	Tray interlock UV Light Indicator	ERA-ULT-000	$299	£214
T8 N	2	up to 25 x 28pin DIP / 66 x 32pin PLCC	No	4" x 8"	25 minutes		ERA-T8-00N	$99	£71
T8 T			Yes				ERA-T8-00T	$125	£89
T8 Z					10 minutes	parabolic reflector	ERA-T8-00Z	$150	£109
Palm Eraser	1	One 24-40 pin DIP EPROM	No	2" x 4" x 2"	5 minutes		ERA-PME-000	$69	£49



Programming Adapters

What are Adapters?

Most adapters are simple package converters. They allow QFP, SOIC, PLCC, TSOP and other devices to plug into the same devices equivalent DIP footprint. There are adapters available for memory, logic, micro-controllers and more. And in many cases they can be used with multiple devices from more than one manufacturer. Most device specific adapters for micro-controllers and logic devices plug into a DIP footprint, for devices that cannot use a generic footprint we have adapters designed to work with specific programmers.

How to Select an Adapter...

what you need to know

- Part Number and Manufacturer of the device
- The Device Package i.e. (PLCC, SOIC etc.)
- Device Pin Count
- Size of your programmers ZIF socket (40pin, 48pin, etc.)
- In some cases you may need to know your devices package dimensions for SOIC, SSOP and TSOP

Please call or visit logical devices website **www.logicaldevices.com** for advice on ordering adapters. Logical Devices have the largest range of programming adapters in the world.

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Ring +44 (0) 1970 621 030 or in the US on 1-866-345-2632 for more information.

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Credit Card ____ Issue No ____ Expiry Date ____

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VAT(if applicable)	
Invoice Total	

Fax Back Form +44 (0) 1970 621040

Discovering AMATEUR RADIO

by Ian Poole - G3YWX

AMATEUR RADIO IS A HOBBY THAT HAS CAPTIVATED THE INTEREST OF COUNTLESS THOUSANDS OF PEOPLE SINCE THE EARLIEST DAYS OF WIRELESS. THE HOBBY HAS DEVELOPED WITH TECHNOLOGY AND MANY PEOPLE USE CUTTING EDGE TECHNIQUES, YET IT IS ALSO A PASTIME WHERE IT IS POSSIBLE TO RELAX AND CHAT TO FRIENDS ON THE OTHER SIDE OF THE GLOBE, OR JUST THE OTHER SIDE OF THE STREET.

In fact there is a tremendous variety in the hobby and this provides the scope for a lifetime of interest. Technology, construction, research, operating, social and many other aspects make this a pastime that can be enjoyed by virtually anyone.

What is it all about?

In view of the many different areas of interest within the hobby, everyone can choose what they want to do and create their own flavour of the hobby.

For many years, one of the main attractions has been the possibility of hearing or contacting people many thousands of miles away, particularly on the short wave bands. This area of the hobby is still growing. In fact many people enjoy what is called 'DXing' where they aim to hear or contact stations that are either far away or in interesting locations. They may be on a remote island in the middle of the Pacific Ocean or in darkest Africa. To be able to do this some people have stations with large antennas and sophisticated equipment with which they can regularly make contacts with stations on all continents. Not everyone will be able to have such a grand station and there is no reason why they too cannot take part in the action. By developing good operating skills and being able to make the most of the equipment available it is possible to make very many interesting contacts. In fact some people make a point of using low power equipment to give a further challenge to the hobby. This shows that the short wave bands are truly open to all regardless of the station they have.

Even though many people think of the short wave bands as the place where radio hams can be found this is not the full story. There is certainly plenty of activity on the short waves, but amateurs can be found on their bands on many different frequencies. For example there is a growing interest in operation on very low frequencies. There is a band just below the long wave broadcast band. Moving in the other direction there are many bands that are much higher in frequency in the VHF and UHF portions of the radio spectrum, and some that are even higher. These are very different in character, presenting new challenges and areas of interest for those who are not as keen on the noise and activity o the short wave bands.

There are a number of other operating activities that can be enjoyed. At certain times of the year the bands come alive when thousands of stations take to the air to participate in one of the contests that are organised. Whilst not everyone enjoys them, many people find them exciting and great fun to enter fully, or just make contact with a few stations.

Also some people enjoy operating from interesting locations. These expeditions, commonly known as 'DXpeditions' attract a great deal of interest on the bands and some may make many thousands of contacts in a few days. For those participating in an expedition they can be hard work but very rewarding and they are a good opportunity to see an unusual part of the world. For those scanning the bands they are a good opportunity to contact a new country.

Another aspect of the hobby that has grown over the years is that of collecting 'QSL' cards. These are postcard sized cards that are often exchanged to confirm a contact. The term 'QSL' comes from an abbreviation that is often used meaning 'I confirm reception'. This term has been used to give these cards their name. The first confirmations were sent in the 1920s around the time the first short wave transatlantic transmissions were made and people often wanted some form of proof to show they had actually made a contact. Cards started to be sent and soon their use became accepted and most stations used them. Some stations even confirmed every contact, although this practice is not so common these days.

Today the cards are normally very colourful often having photographs of the country of origin, and as they may come from any country around the world dependent upon where the contacts have been made they provide an interesting record of the places that have been contacted.

Many organisations offer awards to people who achieve certain operating challenges. These certificates can be very colourful, and working towards gaining them can add a further dimension to amateur radio operation. One of the most famous is called the DX Century Club (DXCC) and it is gained for submitting proof of making contact with at least 100 countries. Endorsements are available for contacting more countries, and some stations have notched up scores of more than 300. Whilst this award may be one of the most famous, there are very many others that are available, but many others are available for a great variety of operating achievements.

Operating equipment forms a large part of the hobby today, particularly as many people use it as a relaxation. However many people enjoy constructing their own equipment. Today, amateur radio manufactured equipment is very good value and much of it is very sophisticated. As a result it is difficult for the home constructor to build anything as good or for the same cost. Nevertheless there are still many areas where the constructor can excel. There is an ever-growing band of people who enjoy constructing low power transmitters and their companion receivers. By keeping the equipment relatively simple it is possible for most people to make a transmitter or receiver on which they can make contacts. Whilst much of this equipment is relatively simple it is still possible to make a good number of contacts and there is an enormous sense of achievement when it works and the first contact is made. Apart from this, it is also possible to make a number of ancillary pieces of equipment around the shack. All of this is interesting and greatly improves one's understanding of radio and radio technology.

For many years amateur radio has assisted in pushing forward the frontiers of technology. It was radio amateurs who against the scientific thinking of the day proved that the short wave bands could be used for long distance communications. Nowadays radio amateurs still have a significant role to play in refining our knowledge about radio wave propagation. But this is not the whole story. Radio amateurs are also involved in looking at areas associated with new modes of transmission, new electronic design techniques, and a host of other areas of technology.

Computer technology is playing an increasingly important place in the hobby. Not only are there many amateur radio related computer programmes that carry out important tasks like station logging, predicting radio propagation conditions and the like, but it is also possible to link a computer to the transmitter and receiver and communicate over radio via the computers. Early data communications used large heavy teleprinters. Now computers are able to provide error resilient systems with considerable degrees of flexibility to ensure amateur radio is truly in the computer age.

Amateur radio is also not just about enjoying oneself. In many areas it helps the community and on many occasions it has helped save lives. It is an unfortunate fact of life that disasters strike from time to time. Often in these situations communications need to be set up swiftly, sometimes under very difficult conditions. Radio amateurs are uniquely placed to help at times like these. Having the equipment available, the knowledge required to set up a station, and the enthusiasm to help, radio hams are often able to provide a life saving service. On many occasions amateur radio has provided the only means of communication from a hurricane hit island because all the normal communications systems have been put out. Recently radio amateurs in India provided an essential and life saving service to the victims of the Gujarat earthquake. In the UK as well radio amateurs provide significant levels of help. In the UK an organisation known as Raynet has been set up, and under its banner radio amateurs frequently run exercises to ensure a high state of readiness.

For those looking for a career, amateur radio can provide an excellent grounding. Many electronic development engineers started by having an interest in amateur radio. This stood them in good stead for further education. It is also a known fact that many employers look for radio amateurs because they are known to have good practical experience in radio and electronics.

Amateur Bands

Radio amateurs, like other users of the radio spectrum are allocated bands of frequencies within which they are allowed to operate. There is a very large amount of commonality between these allocations around the world, although there are a few differences. However these are normally small, enabling world-wide communication between amateurs to take place easily. Until recently the lowest frequency band was the 160 Metre band that stretches from 1.81 MHz to 2.0 MHz. As it was the band with the longest wavelength it is often referred to as Top Band. It is found just above the top end of the Medium Wave. Now bands are allocated in the VLF portion of the spectrum. One at 73 kHz was only allocated on a temporary basis and now a permanent allocation is available at 135 kHz.

0.1375 - 0.1378	
1.810 - 2.000	160 metres (Top Band)
3.500 - 3.800	80 metres
7.000 - 7.100	40 metres
10.100 - 10.150	30 metres
14.000 - 14.350	20 metres
18.068 - 18.168	17 metres
21.000 - 21.450	15 metres
24.890 - 24.990	12 metres
28.000 - 29.700	10 metres
50.00 - 52.00	6 metres
70.00 - 70.50	4 metres
144.00 - 146.00	2 metres
430.00 - 440.00	70 centimetres

All frequencies in MHz

Table 1. Amateur radio band allocations in the UK up to 1000 MHz

There are many other bands in the short wave section of the radio spectrum. The most popular are the fifteen and twenty metre bands where large amount of long distance communications take place. However there are many other interesting and useful bands within this section of the spectrum.

For those wanting the challenge of communicating at higher frequencies there is a good variety of bands in VHF, UHF and higher portions of the spectrum. Here not only are the characters of the bands different because of the different ways in which the radio signals propagate, but the techniques used in the radio frequency circuits are different. A distinct advantage of using these frequencies is that the antennas or aerials are smaller, enabling even those in flats and apartments to have efficient antenna systems.

Propagation

The way in which radio signals travel or propagate can be very interesting. Whilst electromagnetic waves tend to travel outwards from where they are generated or transmitted, and can be thought of as travelling in straight lines, radio waves can be reflected and refracted in a number of ways around the earth making world wide transmission and reception possible.

Radio signals can be reflected and refracted in a number of ways. These often depend upon the frequencies in use. On the short wave bands the ionosphere, a layer ranging between about 50 and 300 miles above the earth's surface has a great effect. Signals can be reflected off the layers in this region enabling them to be heard over vast distances, often at the other side of the globe. The way in which this happens is fascinating and varies dependent upon many factors including the frequency in use, the time of day, the season, and the position in an eleven year sunspot cycle on the sun. In view of this many amateurs take a great interest in studying this.

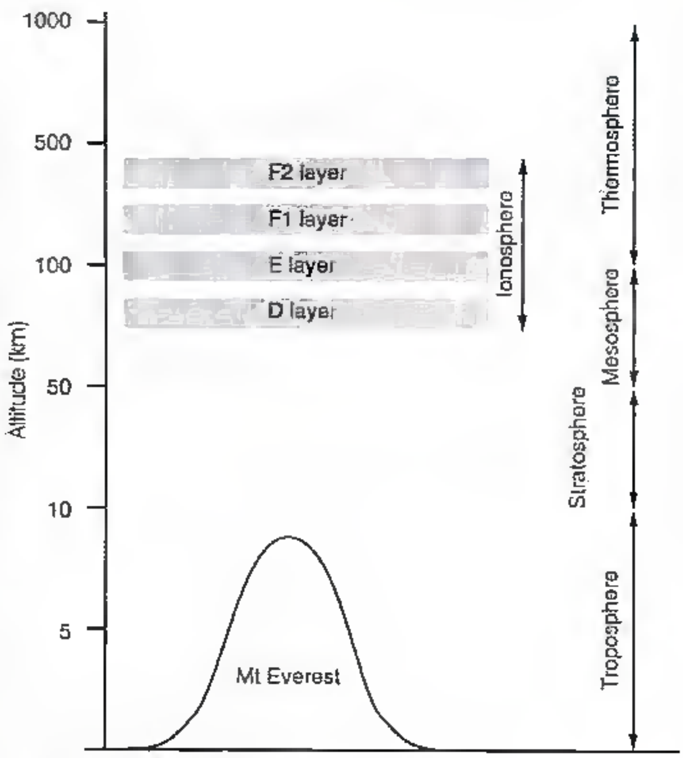

Figure 1. The atmosphere and the layers in the ionosphere

At higher frequencies signals may pass straight through the ionosphere, and other modes of propagation come in to place. It is found that signals can be refracted by changes in the refractive index found in the troposphere. These enable signals on frequencies well in to the VHF and UHF regions to travel over distances of 1000 km and may be more.

There are many more ways in which radio signals can be made to travel over distances that are much greater than the ordinary line of sight. Learning about them and using them is one of the many fascinating aspects of the hobby, and there is only sufficient room here to very briefly touch on them.

Summary

Amateur radio has many fascinating aspects to it. Next month we will take a look at listening on the amateur bands, what can be heard, and about moving towards obtaining an amateur radio transmitting licence. It is really quite easy and many thousands of people in all walks of life have done it in the UK.

Photos courtesy Icom (UK)

Image SENSORS

by Reg Miles

Figure 1a. Stripe Filter

Virtually all electronic cameras, consumer to broadcast, movie and still, analogue and digital, use a charge coupled device (CCD) as the image sensor. The exceptions to this rule normally use a complementary metal oxide semiconductor (CMOS) image sensor (although alternative technologies are under development). Recently, CMOS performance has improved, and that, combined with the intrinsically lower cost of producing them, has meant that the technology is showing promise in certain market areas, and is likely to assume some significance in the near future.

CMOS sensors have the advantage of being just a variation on standard CMOS technology: the sensors thus benefit from the general improvements that are made to the widely used technology; and they can be produced in any of the normal CMOS foundries. CCD sensors, conversely, use a specialised VLSI process; and their production is largely limited to the major electronics manufacturers. CMOS can also integrate a variety of peripheral functions onto the one chip, whereas it would not be economically feasible to do so with a CCD. And a CMOS consumes less power than a CCD. But the CCD does achieve a very good image quality with low noise; and it is available in a wide variety of sizes, with pixel counts ranging from thousands to tens of millions.

Pixels, or discrete picture elements, are necessary for both types of sensor because neither is capable of recording a continuous electrical representation of an optical image. A pixel in this context is a photon conversion site; and is normally a p-n junction photodiode or occasionally a photogate which is just an MOS capacitor that is exposed to light. The photodiode is the more light sensitive, because the MOS gate partially absorbs light - particularly blue. Incidentally, pixels are generally rectangular for video use and square for just about everthing else.

If photons have an energy greater than 1eV or their wavelength is less than 1000nm sufficient energy can be transferred as they penetrate the silicon of the pixel to create electron-hole pairs. The electrons and holes are then separated: normally by applying an electrical field which, depending on the substrate, will either drain away the holes and leave the electrons, or vice versa. In most sensors it is the electrons that are left behind to become the charge carriers. However, to be effective they must be integrated into charge packets of sufficient quantity to provide a measurable output. Integration is achieved on the reverse-biased and electrically isolated junction capacitances. The number of charge carriers that a pixel can hold in its potential well is known as the well depth, and will vary between tens and hundreds of thousands.

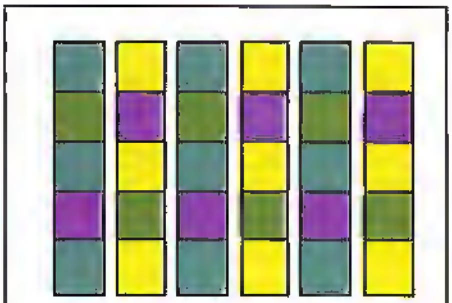

Figure 1b. Mosaic Filter

This gives only the brightness of the scene. To achieve colour reproduction the sensor must be filtered. Cameras with three sensors have dichroic filters coated onto a complex prism block so that each sensor receives only red, green or blue light. The majority of cameras have only one sensor, and use dyes coated on in stripe or mosaic arrangements (see Figure 1a/b). The colours used are normally red, green and blue (RGB); but can also be cyan, magenta and yellow (CMY); or any combination of at least three colours - the only criterion is that

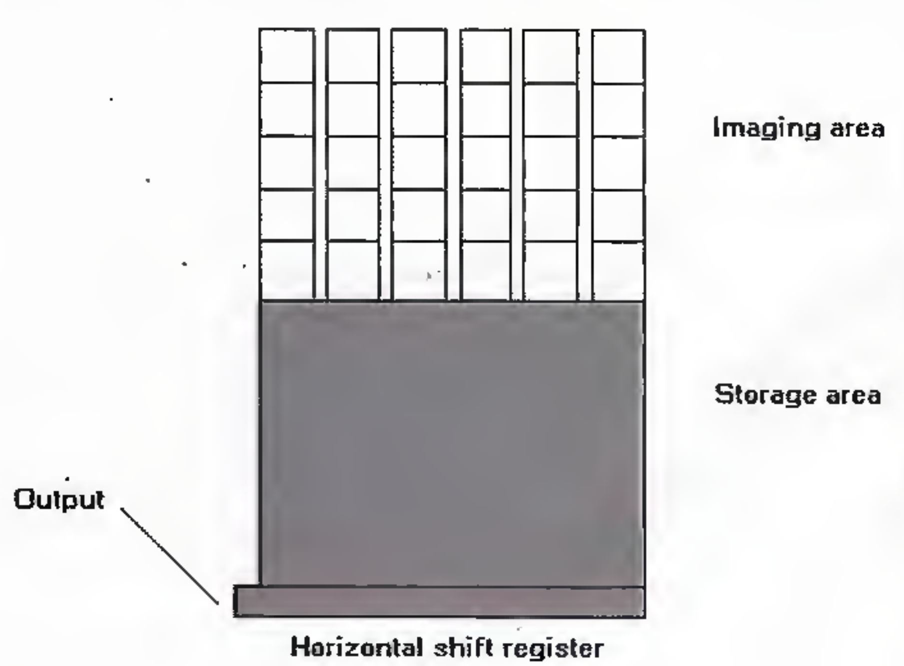

Figure 2a.

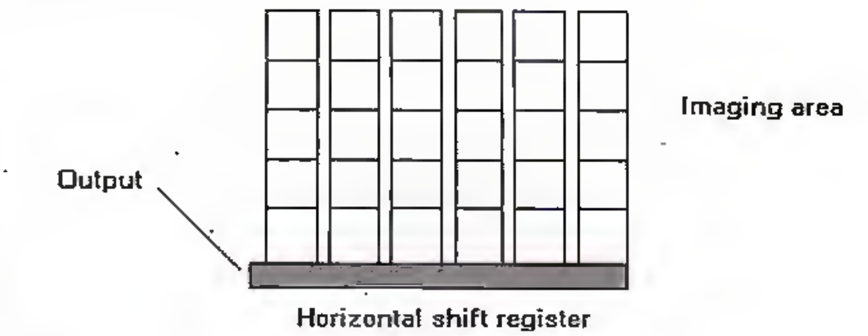

Figure 2b.

after processing they give the correct range of colours for the application.

Up to that point the CCD and CMOS are identical. Once the charges have been integrated though the resemblance ends.

To get the charges out of a CCD the horizontal rows of charge packets are moved down in parallel by clock voltages applied to gates consisting of a fine mesh of polysilicon electrodes that cover the CCDs surface. As each row reaches the bottom the charge packets are then clocked serially along a horizontal shift register. Each charge packet is then clocked via the output gate onto a floating n+ region ('floating diffusion'), and the voltage changes are sensed by means of a source-follower. After each charge packet has been sensed it is cleared in readiness for the next by applying a positive pulse to the reset gate which

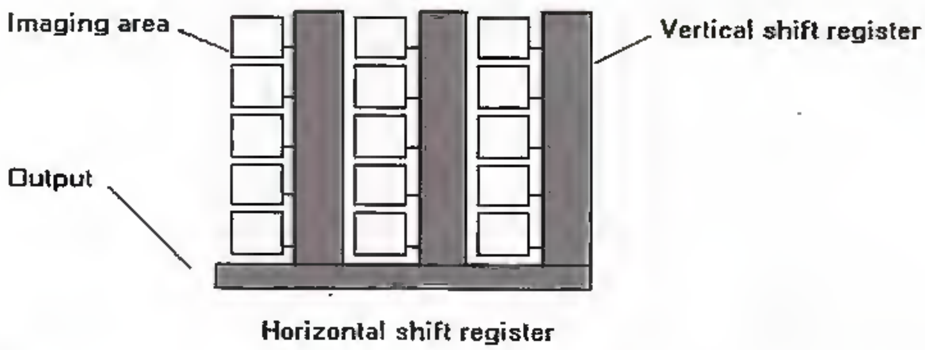

Figure 2c.

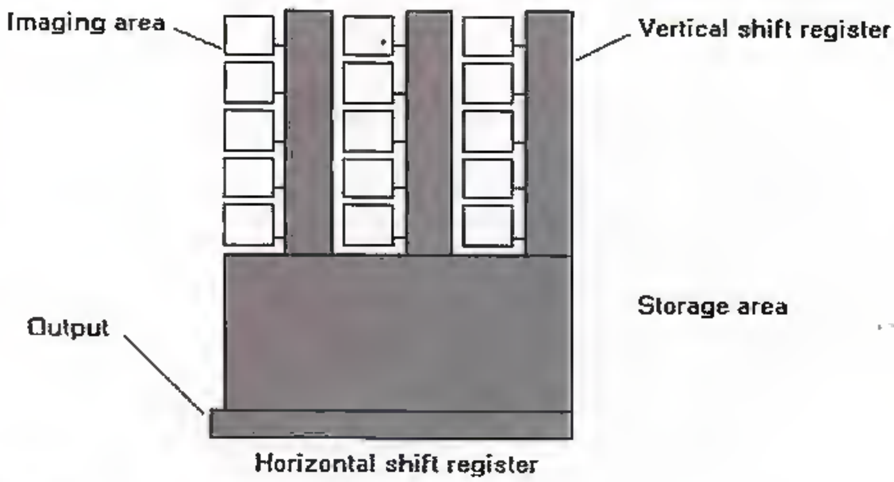

Figure 2d.

flushes it out the reset drain.

This is the basic principle. The details vary according to the type of CCD.

If a frame transfer (FT) type, Figure 2a, the charge packets are moved rapidly down through the imaging area, pixel by pixel, to a similar, but opaque, storage area during the field blanking period. From there they are clocked out a line at a time, through the horizontal shift register, simultaneously with a new charge being integrated in the imaging area. The disadvantage of using the imaging pixels as a shift register is that new electrons produced by areas of bright light can infiltrate the charge packets as they pass causing smearing (although modern designs minimise this).

This type of charge transfer is also used for the full-frame (FF) imaging type, Figure 2b; but here the whole area is light sensitive with no opaque storage area (the signal will either be displayed directly or go to an external store). FF is thus smaller and cheaper. However, because the whole charge must be read out before a new charge can be integrated its frame rate is lower. And this makes it even more susceptible to smearing, requiring optical shuttering or strobe lighting to prevent it.

The interline transfer (IT) type, Figure 2c, reduces the time from pixel to storage area to virtually zero by having adjacent opaque shift registers. The charges are read out sideways from the pixels, via a signal path, to the vertical shift registers. They are then clocked down the vertical shift registers, and out through the horizontal shift register, during one full field period - again, simultaneously with a fresh image being integrated. Smearing is thus much reduced. The disadvantage is that the imaging area is no longer filled entirely with light sensitive pixels.

The frame interline transfer (FIT) type, Figure 2d, is a combination of the FT and IT. The charges are moved rapidly down the adjacent shift registers to an opaque storage area during field blanking, and output while a new image is being integrated. It is thus as big as an FT type, but with the reduced imaging area and added complexity of the IT - the worst of both worlds, but for non-existent smearing.

The timing will also vary according to whether scanning is interlaced or progressive, and whether it is providing still or moving images (an increasing number of CCDs can be switched between both states).

With a CMOS the pixels are individually addressed, and the charge packets are switched to charge sensing amplifiers. There are two basic types of CMOS sensor - passive pixel and active pixel (active pixel sensor, or APS). The former has a buffered, charge sensing amplifier for each column of pixels, and a single transistor in each pixel that acts as a charge gate. In operation an entire row of pixels is switched to electrically isolated column bus lines for the amplifiers to sense the individual charges and convert them to an output voltage. With the active pixel type there is a source follower amplifier in each pixel and the charge packet is switched directly to it before being output to the column bus. In both types the vertical shift register clocks a line at a time to the sample and hold circuits and the horizontal shift register reads them out.

The active pixel usually contains at least three transistors - the additional ones being a reset transistor to control integration time and a row-select transistor. Because of this its fill factor (the ratio of light sensitive area to total pixel area) is less than that of the passive pixel. However, the direct amplification does reduce noise.

Whether passive or active, photodiode or photogate, CMOS is generally less light sensitive than a CCD of comparable size.

Not that CCDs are perfect: in addition to the IT and FIT types having a reduced imaging area, the channel stops dividing the pixels vertically to prevent horizontal charge leakage are opaque, and the polysilicon electrodes absorb some of the blue light. In applications where sensitivity and full spectral response are necessary, such as astronomy, FF CCDs are backside thinned and used back to front allowing photons to impinge on the base of the pixel wells. This process of thinning is a straightforward one, the silicon is dissolved away by acid to a depth of about 15 microns, and the CCD is mounted on a rigid substrate. The quantum efficiency (response to different wavelengths of light) of these back illuminated CCDs is therefore high by comparison with when they were front illuminated.

For more general applications microlenses are being increasingly employed on both CCD and CMOS to direct the photons onto the active areas of the pixels (see Figure 3). These are produced by a photolithographic process. Another method of increasing pixel sensitivity is to reduce the size of the insensitive areas by using finer fabrication - Philips', world's smallest, 2.4um square CCD pixels necessarily employ fine fabrication, which can equally well be applied to larger pixels. Or larger pixels can be used at the expense of resolution (smaller pixels enhance resolution, but at the expense of quantum efficiency and well depth). Or an indirect approach can be used - improving the spectral characteristics of the dyes used for filtration, for example.

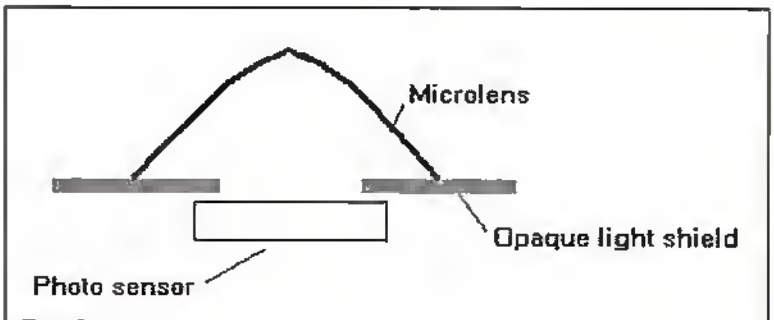

Figure 3.

As with all electronic devices CCD and CMOS sensors (particularly the latter) suffer from noise, and therefore incorporate some form of compensation.

In the case of a CCD this will probably be correlated double sampling (CDS). The output is reset to a reference value after each charge packet is flushed away, then the difference between that value and the next charge packet becomes the charge value for that particular pixel. This will largely eliminate fixed pattern noise (FPN) - the difference in dark current between individual pixels, in addition to several types of temporal noise.

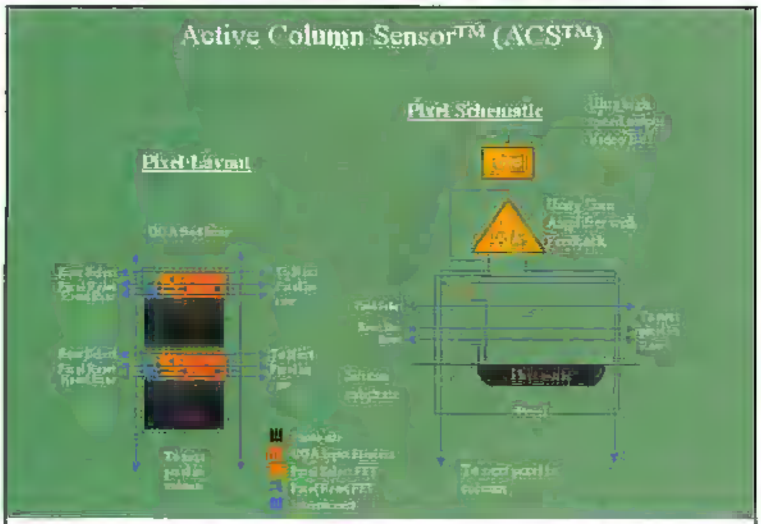

Figure 4a.

A CMOS is more likely to employ optimised fixed pattern correction, because FPN is of more concern with CMOS than CCD where it has been much reduced. The FPN shows particularly in the APS type with its multiplicity of individual amplifiers, each with its own offset and gain value. Passive pixel is less susceptible, although the pixel's position on the column bus does affect the charge level at the amplifier and the turn-on thresholds of the transistors do vary; but passive CMOS are used in products where noise is of less concern anyway - such as toys. In practice an on- or off-chip memory stores the offset values of the pixels, obtained by reading their output during reset, and subtracts the offset noise from the image. It is also possible to use this method to correct for optical fluctuations and defects.

Photon Vision Systems has further reduced FPN by the invention of an alternative to APS, called Active Column Sensor. In addition to reducing FPN, ACS increases signal strength because the gain of each amplifier in an active pixel is typically only 0.84. Unfortunately, the solution to the low and varied gain, a unity gain amplifier (UGA), would require at least six transistors in each pixel. What Photon Vision Systems has done is to compromise with a shared UGA, with one dual input transistor per pixel and around four shared column transistors (Figure 4a shows the arrangement, Figure 4b shows a conventional APS layout). Typically, the ACS pixel will have over twice the fill factor and full well capacity, providing at least twice the S/N ratio. Integrated test chips, with 25 micron pixels, have only 0.08 FPN and a S/N ratio greater than 86dB as measured on the output

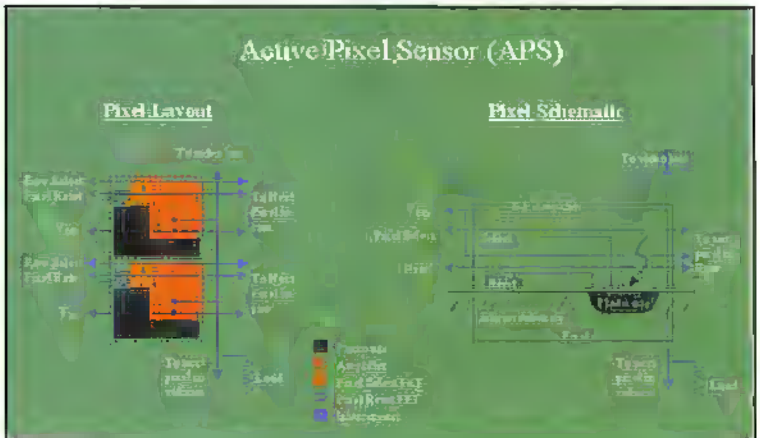

Figure 4b.

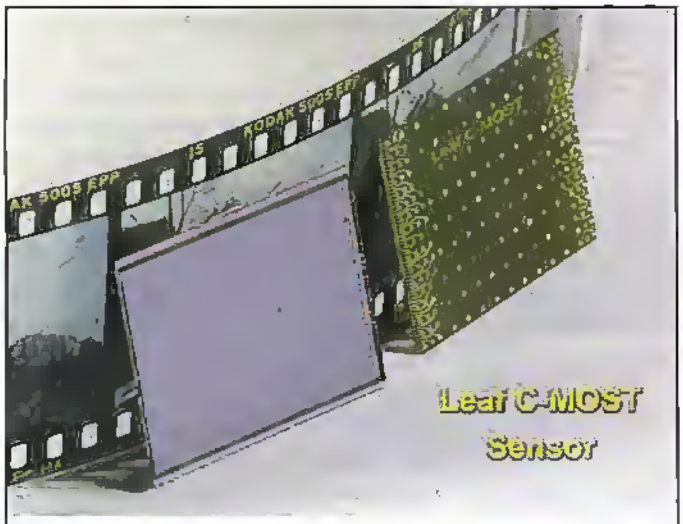

Figure 5.

of the sensor. A VGA format array with 10 micron pixels will have in excess of 70dB S/N at full video rates on the output of the sensor. Coupled with a CDS circuit to minimise offset variations, the company is claiming CCD performance at CMOS cost.

A photogate APS has noise control in each pixel. This is achieved by using the active circuitry to perform correlated double sampling. However, this is achieved at the expense of a reduced fill factor and greater complexity.

Both CCD and CMOS are also susceptible to blooming: where the well depth is insufficient to hold all the electrons and they spill over into adjacent pixels, causing image highlights to spread. This is countered by draining the excess to the substrate. But with the consequence of a reduced pixel area, smaller electron well depth and lower quantum efficiency. In areas of use such as astronomy CCDs may be used without anti-blooming; countering the overspill by taking a series of short exposures, then combining them into one by using image processing software.

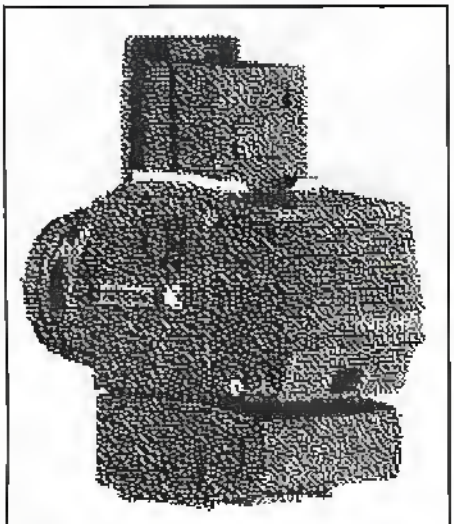
Figure 7.

The dynamic range in CMOS can be increased by having pixels that operate in logarithmic mode, with direct readout and random pixel addressing. There is no integration time, the logarithmic conversion circuit continuously converts current to an output voltage that will vary with the instantaneous light intensity (like a photographic exposure meter). The result will be a range of about 140dB, by comparison with around half that figure in linear mode. However, in low light levels the response time is slow, and with low contrast images the contrast is further reduced.

A somewhat similar approach to that of anti-blooming allows an electronic shutter to be incorporated into CCD and CMOS sensors. Here the pixels are held in reset, with the charges draining away, until the pre-set exposure time begins. CMOS sensors can also vary the timing inputs to the sensor. Both can also have an increased integration period and employ a mechanical shutter.

There is now a rapidly growing need for sensors that can be switched between 4:3 and 16:9 aspect ratios. Some consumer camcorders offer a 16:9 facility, but it is only electronic (letterbox) masking of the 4:3 image, not a true 16:9 image from a 16:9 sensor. The CMOS with its XY addressing has no problem with switching - any aspect ratio can be easily achieved by building in the facility to select different pixels. With a CCD, conversely, it requires major retiming to read out a 4:3 panel in a 16:9 chip.

This pixel selectivity of CMOS also enables the sensor to operate in reduced resolution, sub-sampled modes for a viewfinder display. This is achieved by writing to certain serial register bits in the sensor, which will then integrate and read out every second, fourth or eighth pair of lines, and every second pair of pixels. Keeping pixels in pairs maintains the arrangement of the colour filter blocks and, thus, the colour signal. A CCD cannot do this.

However, it can bin pixels (combine them) to increase the sensitivity at the expense of resolution. Binning is achieved by clocking the charge packets of individual pixels in both horizontal and vertical directions to give one large 'super pixel': vertical binning by clocking multiple lines into the horizontal register and horizontal binning by clocking multiple pixels under the summing gate. Thus, 2x2 binning combines four adjacent pixels - quadrupling sensitivity while halving both horizontal and vertical resolutions, 3x3 binning combines nine, and so on. However, it cannot be used with CCDs that have individual colour filters on the pixels, because the colour would be mixed up.

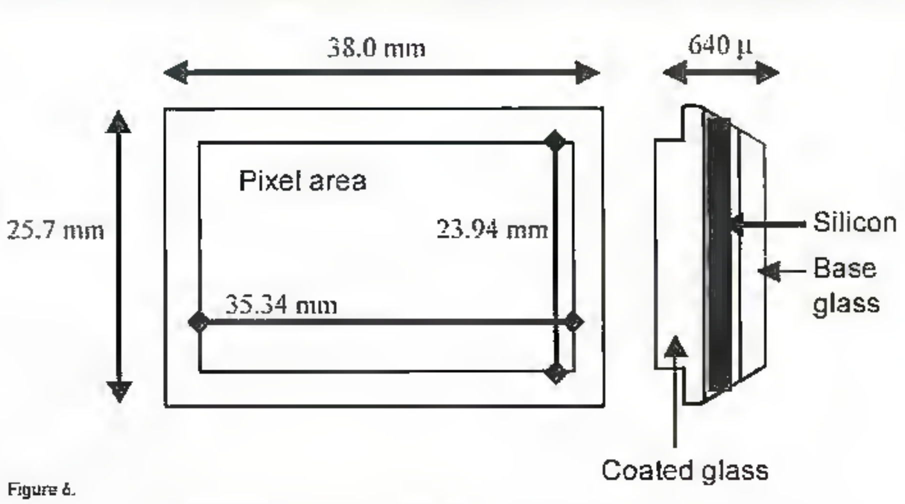

Figure 6.

This limited flexibility of CCDs is going to become an increasing disadvantage. And, with its complex clock requirement, something of an Achilles heel. The clock amplitude and shape are critical for correct operation, and this requires clock drivers using multiple supply voltages. Also, CCDs normally require secondary chips to implement the various functions such as clock drivers, timing logic, signal processing, etc.

Companies producing CMOS sensors used to be almost apologetic about their products. Now they are becoming quite bullish, with some predicting the imminent demise of the CCD and others, more cautiously, anticipating CMOS replacing the CCD at the lower end of

5	8	8	6	9	8	8	8	4
10	1	1	1	1	1	1	1	13
10	1	1	1	1	1	1	1	13
10	1	1	1	1	1	1	1	13
10	1	1	1	1	1	1	1	13
11	1	1	1	1	1	1	1	12
10	1	1	1	1	1	1	1	13
10	1	1	1	1	1	1	1	13
10	1	1	1	1	1	1	1	13
10	1	1	1	1	1	1	1	13
2	6	6	6	7	6	6	6	3

Figure 8.

the digital still camera market as a more realistic objective at this stage. In addition to a lot of small companies developing and/or producing CMOS, like VLSI Vision in Edinburgh (the first company to integrate a complete camera on a single chip), there are major names working, singly or in partnerships, on improving the performance still further, such as Canon, Kodak, Motorola, Texas Instruments and Toshiba. While NASA is experimenting with CMOS cameras to see whether they can get the performance of a CCD in a smaller, lighter camera that consumes less power - an obvious advantage in space.

NASA's Jet Propulsion Laboratory, the first to develop a practical CMOS APS, has developed the first fully digital camera on a chip, needing only five wires for operation. And has recently invented an approach that will make APS compatible with silicon-on-insulator (SOI) technology, that it is said will become the baseline for CMOS VLSI implementation. While in a separate development JPL is working on a high speed APS to be used as an integrated, 'smart sensor'.

The CMOS people are getting very excited by the prospect of these 'smart sensors'. They will combine the function of an imaging device with the integral facility for processing information acquired from those images to provide a result that can indicate position, motion, identity, etc; or be used in areas such as robotic vision; or to vary the charge integration time in individual pixels for adaptive exposure control. It will be possible to use a CCD for some of these purposes; but the facility to integrate functions onto a single chip means that CMOS generally has a significant advantage in this area.

CMOS technology is also moving gradually upmarket, as typified by the announcement of the CreoScitex Leaf C-Most sensor. This is the first CMOS with 6.6 million pixels (3150x2100); and the first that equals the frame size of 35mm film (see Figure 5). The pixels measure 11.4x11.4 microns. It is said to be particularly suitable for integration in upmarket 35mm, medium and large format photographic equipment; and was shown at Photokina 2000 in a medium format back. Its ultra-thin packaging will allow it to fit exactly into the focal plane of a standard 35mm camera (see Figure 6). CreoScitex collaborated with FillFactory for the design of the APS CMOS, with Tower Semiconductor for wafer fabrication and ShellCase for the packaging. The technology is scalable so larger and smaller devices can be expected.

On the subject of smaller devices, Canon has already launched the EOS D30 digital SLR with a 22.7x15.1mm image area CMOS. This has 3.25 million pixels, measuring 10.5x10.5 microns. And incorporates a programmable gain amplifier to minimise noise.

But the CCD is far from finished. Research continues on finding new applications for it, and both furthering its performance and reducing its cost.

Phase One has shown a prototype of the LightPhase H20 digital back which incorporates a 4020x4020 (16 million pixel) CCD from Eastman Kodak (Figure 7 shows it attached to a medium format camera). It is expected to be made available in July.

But for sheer size and number of pixels nothing can beat the modular CCD from Philips. This takes the basic building block of a 1024x1024 FF chip: which, using standardised connections, can be produced in combinations of up to 7x9 - 86x110mm and 66 million pixels. The layout is produced using just four basic blocks: imaging area blocks, vertical blocks, horizontal output register blocks and output amplifier blocks (see Figure 8). The 'split' arrangement allows readout through one, two or all four amplifiers. Production takes advantage of the repetitive structure to use a step and repeat process; thus overcoming the present inability of lithography equipment to produce fine details over a large area. Joining the individual parts electrically in the silicon is achieved by a patented 'stitching' technique that is claimed not to produce any visible seams in the image. A 7x9 array is the maximum at present; the result of using 12x12 micron pixels and necessarily fitting it all onto a 6 inch wafer (see Figure 9). And there can be any number between one and the maximum to suit the customer's requirements; with the only unique mask being that used to make the interconnect between the bonding pads. The particular configuration can thus be realised in production rather than design - greatly reducing development time and costs.

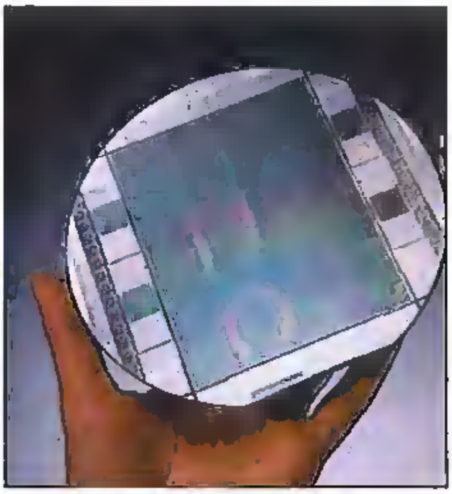

Figure 9.

Both FF and FT devices can be produced (in the latter case with half of the sensor masked for charge storage). If larger pixels are required then 2x2 or 3x3 can be obtained by binning. If the application requires colour, then a colour mask can be added to the CCD.

The full 7x9 CCD is initially being used for astronomy; and it is anticipated that it will also be used for digital photography, where the current maximum for an area array device is 6x6cm (medium format in photographic terms). A 1x2 FT CCD is already in production for progressive scan still imaging. While the modular device additionally has the potential for high speed imaging, with one block receiving the image and eight blocks around it storing sequential frames.

On a much more modest scale, Minolta has also embraced a modular approach: their RD-3000 camera uses two half CCDs to achieve almost 3 megapixels at lower cost. The image is divided by half mirror prisms and received by the two CCDs; the slightly overlapping images are then processed to remove differences between them and seamlessly joined.

Fuji has developed a significant change to the design of an IT CCD, and called it the Super CCD. They have taken the pixels, turned them through 45 degrees, changed their shape from rectangular to octagonal and arranged them in a honeycomb formation (see Figure 10). The charge packets can now be transferred directly to the vertical shift register, making the signal path redundant. The pixels are also larger, due to both their shape and arrangement, so their light-gathering capacity is improved. They are also better shaped to make the most of microlenses. With the result that the sensitivity, S/N ratio and dynamic range are all claimed to be improved by 2.3x as a result. The horizontal and vertical resolutions are also improved by the new, more closely packed, arrangement. In combination with Fuji's newly developed honeycomb signal processing LSI the effective resolution is claimed to be at least 1.6x greater than a conventional IT CCD with the same number of pixels (the new FinePix 6800 Zoom camera (see Figure 11) is said to give a resolution equivalent to a 6 million pixel IT from a 3.3 million pixel Super CCD). Conversely, the Super CCD can achieve the same resolution with fewer pixels - reducing power consumption and cost. Its colour reproduction is also claimed to be better. And, with R, G and B pixels in each horizontal line, alternate lines can be skipped for interlaced scanning - which will give better resolution than combining pairs of lines as is done conventionally for video output. It is also possible to sub-sample the pixels, with any vertical ratio possible and 1/3 horizontal ratio - speeding up the process.

Fuji envisages digital cameras with picture quality approaching that of 35mm film; combination digital cameras and camcorders giving high quality video as well as stills; and, by miniaturising the CCD, an extremely compact digital camera.

Although the CCD continues to dominate, and is likely to do so for some time to come, and CMOS is working its way up the imaging pile, there are other contenders waiting. I will deal with those, and other variations on image sensors, in the second part of this article.

ROBOTICS PROFILE: A Leg up for Robotics

ROBOTS WITH LEGS? FOR SOME PEOPLE THAT WOULD BE A SCARY THOUGHT, BUT NOT FOR THE STAFF OF THE LEG LABORATORY AT MIT.

If robots could walk with the same ease as humans and animals just think of the possibilities for space travel, the rescue services and even medical prosthetics. Robotic scientists could be sent out to explore the moons of Jupiter; robotic fire fighters could lie dormant within large buildings until the need arises for them to activate and start saving lives; people currently unable to walk could have robotic exoskeletal legs fitted, or skeletal ones implanted into their own.

Here we introduce you to the Leg Lab and illustrate their work with quotes from their web site and some of the creations they have already transformed from raw ideas into functional reality.

The Massachusetts Institute of Technology (MIT) is a privately endowed research university with a faculty of over 900 and nearly 10,000 undergraduate and graduate students. Its Artificial Intelligence laboratory has been an active part of the university since at least 1959. The AI Lab's research goal is to understand the nature of intelligence and engineer systems that exhibit it. It is an interdisciplinary laboratory of over 200 people that spans several academic departments and has active projects going on with members of every academic school in MIT.

'Our intellectual goal is to understand how the human mind works. We believe that vision, robotics, and language are the keys to understanding intelligence, and as such our laboratory is much more heavily biased in these directions than many other Artificial Intelligence laboratories'.

Part of the AI Lab at MIT is the MIT Leg Lab. This might sound like a strange name at first, but it is a very appropriate one because the Leg Lab is focussed almost exclusively on the subject area of legged locomotion in robots.

'We are interested in simulating and building creatures which walk, run, and hop like their biological counterparts. We have three reasons for pursuing this research:

Very little of the world is accessible by wheels. Legged robots may be useful for everything from exploring inaccessible or hazardous locations to providing service or entertainment in the places we live and work.

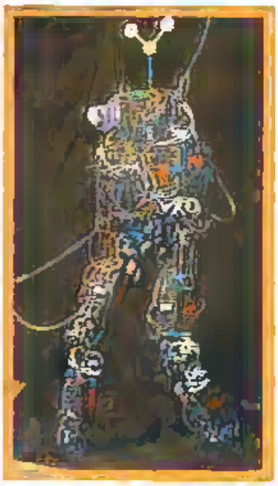
Figure 1. The Leg Lab's M2 robot.

Understanding how humans and other animals walk and run is interesting scientifically and important medically. We do research in natural legged creatures and then model them both in simulation and in real robots.

It's lots of fun! Not only are our robots fun to work with, but they're pretty entertaining to watch'.


Figure 2. M2 actuator and leg assembly.

Robots, humans and animals – when it comes to active balance and dynamics, the people at the Leg Lab are interested in all three. Robots that cannot respond to their surroundings and adapt to differently spaced footholds are unlikely to be of much use for anything more than the limited range of tasks they are entrusted with at the present. Similarly, most robots in current practical use are slow and limited creations because they lack the ability to balance.

The Leg Lab aims to not only create robots that can walk, but also ones that can run without losing their balance and falling over – when on the run and coming to a stop.

'The techniques used to control each of the running machines derive from a single simple set of control algorithms. They focus on support, posture, and propulsion. These algorithms have been adapted for hopping, pronking, biped running, fast running, trotting, pacing, bounding, and simple gymnastic manoeuvres'.

As well as walking and running, the Lab robots are also designed, wherever possible, to perform specific tasks – tasks that would add to their usefulness in real world situations.

'We have built a series of legged robots for experiments on active balance in dynamic legged locomotion.

Taken collectively, these robots have traversed simple paths, run with several different gaits (hop, run, trot, pace, bound), run fast (13 mph), jumped over obstacles, controlled step length, climbed a simplified stairway, walked over ramps, and performed rudimentary gymnastic manoeuvres. Although no one robot performed all these tasks, the machines all use a common set of balance and control principles'.

One of the Leg Lab's robots-in-progress is Troody the robotic dinosaur (see last issue's News pages). Another is M2 – the 3D Bipedal Walker.

M2 [see Figures 1 & 2] was initiated as a project in 1998. It has 12 active degrees of freedom: 3 in each hip, 1 in each knee, and 2 in each ankle. It will be used to investigate various walking algorithms and motion, control and actuation techniques, and also the processes of automatic learning. Its goals are to walk fast (1 metre/second), efficiently, and be successful at least 9 times out of every 10 attempts. It should also have a large margin of stability and be robust to small disturbances (in other words, reasonable pushes).

Completed robots include Spring Flamingo (in progress: 1996 to 2000) – a flamboyantly designed robot used to study planar bipedal walking [see Figure 3]. This was the first Leg Lab robot to use feet and active ankles. Rotary potentiometers at the hips, knees, ankles, and boom measure the joint angles and body pitch. Linear compression springs are located in the actuators to implement Series Elastic Actuation and linear potentiometers measure the spring compression. In all, the robot has six actuators and thirteen sensors.

'Spring Flamingo was initially designed to somewhat model a long legged bird like creature. Hence the bent-backward style 'knees'. In a real bird, that joint would really be the ankle and the bird would have an additional knee joint above it. Starting in September 1998, we decided to come up with algorithms which exploit the natural dynamics of the robot. In particular, we were interested in passive swing leg characteristics. In order to achieve these passive characteristics, the robot needed a bent-forward knee. Therefore we turned the feet around and had the robot walk the other direction with a human-style configuration'.

Quadruped [Figure 4] (in progress: 1984 to 1987) was developed to explore running on four legs. It was programmed to trot, pace, bound, and do several transitions between gaits. The Leg Lab learned from Quadruped that principles for one-legged hopping generalised to four-legged running, with the addition of a low-level leg co-ordination mechanism.

'We considered only those quadruped gaits that use the legs in pairs: trotting (diagonal legs as pairs), pacing (lateral pairs), and bounding (front pair and rear pair). By restricting consideration to the pair gaits, the control of the Quadruped was reduced to the control of an equivalent virtual biped. We found that each of the gaits that use the legs in pairs can be transformed into a common underlying gait, a virtual biped gait'.

Figure 3. Spring Flamingo.

A more recognisable animal form can be seen in the hopping robot Uniroo (in progress: 1991 to 1993), which, despite its one-legged nature, is kinematically similar to a real kangaroo of mass 6.6 kg. Uniroo [Figure 5] consists of a body, a three-joint (hip, knee, ankle) articulated leg, and a single degree-of-freedom tail. Its body is a bolted framework of aluminium struts, and its leg is composed of welded aluminium tubes. Hydraulic actuators control each joint and a steel coil spring at the ankle stores elastic energy ready for use.

'The Uniroo differ from the previous robots in four important respects. The Uniroo is not symmetric; the leg is articulated instead of telescoping, the hip is offset from the centre of mass, and the leg is relatively heavy (one-third the mass of the body). Because of the asymmetry, the ground forces during stance affects the body pitch. A massive leg also affects the body pitch as the leg is swept forward during flight. Finally, the kinematic redundancy of the leg must be addressed'.

The Leg Lab's work with the Uniroo robot

Figure 4. Quadruped.

showed that it is possible to control the balance of legged robots that have a non-symmetrical mechanical structure. Regulation of angular momentum allowed the robot to hop in a range of forward velocities from 0 to 1.8m/s for at least a minute.

'Although nothing proves that a steadily null angular momentum is part of an optimal hopping strategy, we observed that a small angular momentum is a characteristic of 'smooth' hopping and underlies a very natural motion'.

As well as taking inspiration from nature, the Leg Lab also applies techniques from robotics to the control of computer simulated creatures. Physics-based computer simulation is used by Leg to study robot control systems and animal behaviour, and to create automated computer characters such as the one-legged kangaroos from On The Run [see Figure 6] – a computer animated cartoon that explores how techniques from robotics can be applied to computer animation. The characters were animated automatically, using a physics-based simulation which allowed the creatures to move with physical realism without needing an animator to specify all the details.

'Task-level control allows the creatures to move in response to general instructions, such as the speed and direction of travel, changes of gait, and manoeuvres. The control system knows how to regulate the low-level joint motions and muscle forces so the animator is free to specify higher-level information. The idea is to let the animator work more like the director of a play who gives high-level instructions to skilled actors, who then control their own movements. We provided each computer character with a control system and physics-based simulation so they could move on their own: no hand animation was used. In the future, such automated creatures may find roles in interactive education, engineering, and entertainment'.

Retuning Control Systems (a video is available on Leg's web site) sets out to explore whether or not a control system that works for dogs, for example, will also work for giraffes or elephants. Other simulations include the motion of cockroaches and a human gymnast executing a flip and dismounting from a high bar.

Pixar's Toy Story and new film Final Fantasy are no doubt the first in a long line of computer animated films to draw the crowds at the box office. In the future, realistic physical simulations will become an increasingly integral part of the design of such films. They will indeed become essential as technology advances and computer generated big screen action becomes more and more realistic, perhaps even to the point where the average cinema goer can no longer tell the difference.

Figure 5. Uniroo.

Figure 6. A still from the On The Run animation.

Whilst we are on the subject of cinema, cast your mind back anyone who has watched the film Rising Sun (featuring Sean Connery and Wesley Snipes) to the scene where a bipedal robot is shown hopping along as if being taken for a walk by its owner. That robot was the Leg Lab's 3D Biped robot, shown in Figure 7 along with Uniroo and three MIT students, all of whom also had brief cameos in the film.

Clips from the film, along with other video clips, photographs and details of MIT Leg Lab robots can be found at their web site, address given below. A video tour of the lab is also available via their homepage.

Related Links:

Leg Lab:
www.ai.mit.edu/projects/leglab/home.html
Artificial Intelligence Lab:
http://web.mit.edu/
Massachusetts Institute of Technology:
http://web.mit.edu

Figure 7. Uniroo, 3D Biped and minders on the set of Rising Sun.

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BURNING CDs

PART 1 THE TECHNOLOGY OF CDS

THE CD HAS BECOME A UBIQUITOUS PART OF LIFE. THESE 4¾ INCH (12CM) POLYCARBONATE DISCS HAVE REVOLUTIONIZED THE WAY WE STORE LARGE VOLUMES OF DATA IN A RELATIVELY SMALL AREA. THEY ARE RANDOM ACCESS DEVICES, CAPABLE OF STORING LARGE AMOUNTS OF DATA AND ARE FAIRLY ROBUST YET ARE RELATIVELY EASY TO USE.

This mini series of articles looks at the technology behind CDs from their beginnings in the early 1980s and how to produce good copies. It is split into three sections, which will be published over the next 3 months:

Part 1: The technology of CDs
Part 2: How to create good CDs instead of coasters
Part 3: Copy protection methods and Frequently Asked Questions (FAQs)

The Technology

The first manifestation of CDs was for Audio and Sony and Philips are credited with its creation in 1983. Folklore within the industry suggest that the length of the recording length on the CD (74 minutes) was chosen to satisfy the wife of the President of Sony who wanted it to be able to hold her favourite symphony. Other rumours suggest that it was designed to be able to hold the whole of Beethoven's ninth symphony. There are other theories which can be seen at: www.urbanlegends.com/misc/cd/cd_length_origin.

In order to create a standard that could be adhered to by both the pressing plants and the CD player producers a standard was evolved which was called the 'Red Book' standard.

The principle adopted was that the data would be stored digitally and use a laser to read the data. The methodology is that a laser is shone at a reflective layer of aluminium which has been mastered with pits such that the laser beam will not be returned if there is a pit but it will if there isn't (referred to as 'land'). Therefore the data can be 'read' from the disc as a series of 1s or 0s dependant on the way the pits have been produced.

It wasn't long before the computer industry recognised that here was a medium that could be used to transport large amounts of data at a relatively small cost. The problem was that Audio CDs did not have to have a particularly good integrity whereas for computer data the integrity needed to be as perfect as possible. Moreover there needed to be a standard such that computer files could be stored in a particular fashion that was compatible across the industry. This resulted in an international standard called ISO9660 (or the 'Yellow Book' standard). Not only did this standard encompass the file structures but also clarified error correction and the format (such as interleaving, filename formats etc.)

This doesn't imply that Audio CDs have no error correction on them, they do but at a lower level than required by Data CDs. Audio CDs store data in 2352 byte blocks of data while Data CDs store 2048 bytes with the remainder being used for more complex error correction. All CDs use a method of encoding called CIRC (Cross Interleaved Solomon Code) which creates 'frames' of data which consist of 24 bytes per frame and 98 frames per block. The data is then interleaved (ie it is not consecutive) over a wide arc around the CD. Therefore if the disc is scratched the data can be interpolated using adjacent data in the stream to recreate a reasonable interpretation. Note that this means you should ALWAYS clean CDs from the centre out in straight lines rather than in a circular manner around the disc which can create scratches across a number of frames thereby increasing the possibility of the interpolation not working successfully resulting in annoying 'clicks' as the error correction fails to work.

CD-R (recordable Cds) first made its appearance in 1990 with the characteristics being specified in the 'Orange Book'. These initially used an organic photosensitive compound (similar to those used in photography) called Cyanine Dye which had its bond broken by heating using a laser, thus causing a 'pit' which would diffuse rather than reflect light. A later development saw the introduction of another compound called Phthalocyanine which is a gold colour as opposed to the green of the Cynanine. There is a debate in the industry about the relative merits of each dye with Mitsui (who manufacture Phthalocyanine based CDRs) stating that their storage life is 100 years as opposed to 20 years for Cynanine. Whatever the argument Phthalocyanine does appear to be less sensitive to degradation from sunlight or florescent lighting. This dye is usually coated in a very thin layer of proprietary silver alloy or 24 carat gold (50 – 100nM thick) which reduces the risk of oxidisation and corrosion. Note that the original Orange Book (part 2) specification was based around Cynanine developed by Taiyo Yuden (who produced the original 'gold' CDRs). The Silver/blue CDRs (based on a system patented by Verbatim) came onto the market in 1996, with Ricoh's phthalocyanine based silver/silver discs became available in late 1998. There are a lot of drive manufacturers but very few media manufacturers so if the Discs look the same over 2 different brands then the likelihood is that they were made by the same manufacturer.

How CDRs are made

Like conventional vinyl discs CDs are based on a spiral track that is preformed onto the blank discs. This track has a width of 0.6mm and a pitch of 1.6mm but unlike the LPs of old it is read from the inside out. This spiral track makes 22,188 revolutions around the CD with approximately 600 track revolutions per millimetre and if unwound the track length would be about 3.5 miles (5.6 Km) long and the data is read at a rate of 150Kb per second (on single speed drives). The data is stored from 25mm from the centre to 58mm where the lead out starts. The construction is as follows:

- Label
- Scratch Resistant Coating
- UV Cured Lacquer
- Reflective layer
- Upper Dielectric layer
- Recording layer (the bit that gets changed by the recording laser)
- Lower Dielectric layer
- Polycarbonate substrate

Note that the recording layer lies closer to the label side than the side from which the CD is read therefore it is important not to scratch the label side of the CD or it may become unreadable.

The Orange Book CDR standard essentially splits the write-able sector into 2 areas. The first is the SUA (System Use Area) and the Information or User Data area. The latter is where your data is stored however the former, which takes up 4mm of the CDs surface, acts very much like a boot area on a hard drive. It tells the CD reader what type of information is stored on the CD and what format this information is in. It is in itself split into two areas which are the PCA (Power Calibration Area) and the PMA (Program Memory Area).

The use of a PCA is not a new concept when using lasers to engrave. Many years ago when I used CO2 lasers to engrave chrome oxide printing rollers we used to create a test area at one edge of the roller to determine the optimum power settings. These changed from job to job depending on the purity of the coating and the power of the laser (which is a dynamic variable, which changed according to the weather). On CDs the PCA is used as a laser testing area which the recorder uses to determine the optimum power setting for that CD, thereby allowing for different materials and general physical characteristics (such as recording speed, humidity, ambient temperature and the physical coating of the disc). Every disc will allow up to 99 power test burns and the running total is kept in BCD form on the disc itself.

The PMA is split up into (up to) 99 tracks for Audio CDs with their corresponding start and stop times and into sector addresses for the data files on Data CDs.

The Information area is split into 3 areas which are the Lead in, the program area and the Lead out. The Lead in contains Digital silence on its main channel (there are up to 8 sub-code channels designated 'P' to 'W' which are interleaved with the main data channel and are used for specialist functions on Audio and Data CD players, more on these anon) and the Table of Contents (TOC) in the 'Q' sub channel. Its primary role is to allow the laser to synchronise with the pits on the Disc before the start of the data. Note that the length of the lead in is determined by the need to store the TOC for up to 99 tracks.

The Program area contains up to 76 minutes (650Mb) of data which is divided into a maximum of 99 tracks. Data is not stored as sequential 8 bit bytes as would be expected but is instead stored using an algorithm called Eight to Fourteen modulation (EFM) which creates a 14 bit pattern plus 3 merging bits. The merging bits are used to ensure that the pit and land lengths are no more than 11 bits long and no shorter than 3 bits long. This surprisingly complex arrangement is used in the error correction and to minimise the effects of jitter and distortion. The lead out is merely digital silence (all 0s) and is used to delineate the end of the program area.

The sub-code channels were included in the original CD specifications to allow the use of control data within the main data stream, without impacting on the audio or digital data and are up to 4 Mb each. The P channel is used to indicate the start and stop of the track, the Q is used for Timecodes (minutes, seconds and frames), TOC (only in the lead in area), the track type and the catalogue number. Channels R to W are generally used for CD graphics and is also used by Philips to support 'CD Text' which allows the use of text on Audio (red book) CDs, Philips call this the ITTS system. Some drives make use of these channels for specialist use, for example SEGA use it for supporting Graphics. Note that these sub codes have been omitted altogether on DVDs where the control codes are merged with the data. Note that the ISRC (International Standard Recording Code) is used by the recording industry to press the country of origin, copyright owner, year of issue and serial numbers onto the Q channel. However it is optional so it isn't found on many CDs.

CD-RW

CDRs are cheap and relatively easy to use but do suffer from the disadvantage that they cannot be erased and reused, moreover it is only by leaving the session open (where it can't be read by players) can data be added, which is hardly ideal for backup or archiving purposes. Therefore a group of companies (Hewlett Packard,

Mitsubishi, Philips, Sony and Ricoh) came together to develop a rewritable CD designated CD-RW.

This new class of CD allowed the user to erase redundant data and delete individual files. It is classified using the Orange Book III standard and can usually be distinguished by its gun metal grey colour as opposed to the gold or green of CDRs.

The technology of CD-RW differs from CDR in that rather than 'burning' a pit in the recording material it instead creates a phase change in the material. This is not to be confused with the magnetic phase changes as used in the 'super floppies' where magnetic material has its polarity changed by heating with a laser until it surpasses its Curie point. The methodology employed uses an optical phase change which, unlike the dyes used in CDR, uses a crystalline compound of Indium, Silver, Tellurium and Antimony. This compound has one unique property and that is that if it is heated to a certain temperature (200 Degrees Centigrade) then cooled it becomes crystalline (where it will reflect light) whereas if it is heated to a higher temperature (>500 Degrees Centigrade) and cooled then it becomes amorphous (ie it will absorb light).

In order to achieve this it requires that the writer (or 'burner') is capable of 3 power settings. These are High or Write power (used to create the amorphous state), Erase power (used to melt the recording layer creating a crystalline 'erased' structure) and read power which does not alter the state of the recording layer. Because of the necessity to remove the heat quickly from the heated area the structure of a CD-RW is more complex than the CDR. Its layers are:

- Label (optional)
- Printable coating (optional)
- Scratch Resistant Coating
- UV Cured Protective layer
- Reflective layer
- Dielectric layer
- Metal Film
- Dielectric layer
- Polycarbonate Substrate
- Protective layer (optional)

The advantages to this medium is that it can be erased and written to with a single pass of the laser beam (called direct overwriting) and the process can be repeated several thousand times per disc (1,000 is the figure quoted in the Orange book). The disadvantage is that the crystalline (ordered atom) structure reflects less light than on CDRs. Therefore if a CD player is to read both CD-RW and DVD for instance then it will need a dual wavelength read head. Moreover the media required for high speed (4x and above) burning is different to that used for lower speed recordings and this data is encoded onto the Disc itself. More information on this topic can be obtained from www.emdiapro.net/EM2000/writer11.html. The effect for the user is that they must select the correct media for their recorder or it may not work.

File Structure and the Standards

The standard that has been used to designate the data format on CDs since their inception was ISO 9660. Indeed writing a file in this format almost guarantees that almost any CD player can read it. It was however designed for pressed Discs or at best session at a time (ie the whole CD is written in one session) recording. It is notoriously inefficient for multi-session use (where data is added at a later date) as it uses at least 13Mb of Disc space for each session (even with tiny data files) and can only accommodate 99 tracks.

In addition its file structure can only allow the use of 8 character filenames, which must only use upper case letters, the numbers 0-9 and the '_' character and it can only support a directory depth of 8 levels.

The Optical Storage Technology Association (OSTA) addressed this problem by implementing a new standard designated ISO13346 UDF (Universal Disc Format) which is packet based, operating system independent and has an improved directory structure thus allowing a more flexible approach to the CD as a storage medium.

UDF allows files to be added incrementally with very little wasted overhead and so lends itself better to multi-session and archiving purposes. When writing to a Disc UDF creates a Virtual Allocation Table (VAT) that is used to describe the physical location of each file. Every time the Disc is added to a new VAT is created which appends the previous VATs thereby creating a directory of pointers to every file written on that disc.

This standard is not compatible with ISO9660 particularly as it needs to know which files will be written during a session in order to generate the Path Tables and Primary Volume Descriptors which are used to point to the physical location of the files on the Disc which is different to ISO9660's logical file structure. Therefore when creating a Disc based on this format there is no guarantee that it will play on all players, particularly as UDF reading software is limited at present. However it is rumoured that Microsoft will be including full support for UDF 1.5 (used on CDR and CD-RW) in Windows XP due out in the autumn (Windows 98 and later includes support for UDF 1.02 which is used for DVD).

The Standards

Red Book	Format for Audio CDs (also known as CD-DA)
Yellow Book	Format for Data CDs (Pre-pressed)
Green Book	Format for CD-i (Compact Disc interactive)
Orange Book	Format for record-able CDs Part 1 - CD-MO (Magneto Optical) Part 2 - CD-R (CD Write Once or WORM, also Photo CD) Part 3 – CD-RW (CD Re-writable)
White Book	Format for Video CD (very popular in Asia as a low cost alternative to DVD)
Blue Book	CD Extra and Laser Disc
CD Extra	2 Session CD, 1st session is CD-DA and the 2nd is data (aka CD Plus)
CDROM-XA	Extended architecture a cross between yellow book and Cdi. Form 1 – 2048 bytes of data with error correction for data use only Form 2 – 2324 bytes of data, no error correction for audio/video
CD-UDF	The UDF incremental packet writing file system

Some of the standards are available from www.ecma.ch and the full standards can be purchased from www.licensing.philips.com but they are not cheap.

In Part 2 we will look at how to produce good quality CD copies.

TO COINCIDE WITH THE FIRST PART OF IAN POOLE'S ARTICLE 'DISCOVERING AMATEUR RADIO', WE THOUGHT WE WOULD ASK HIM TO WRITE A REVIEW OF HIS OWN BOOK 'BASIC RADIO PRINCIPLES AND TECHNOLOGY' FOR THIS MONTH'S BOOKSHOP. IN KEEPING WITH THIS THEME, ALL THE BOOKS COVERED ON THESE TWO PAGES ARE TO DO WITH THE SUBJECT OF RADIO AND AUDIO TECHNOLOGY.

Basic Radio Principles and Technology by Ian Poole

The idea for my book Basic Radio Principles and Technology came out of my interest in radio techniques and all the different types of applications radio is used for these days. With the flexibility that radio systems offer, radio technology will be used increasingly as time passes. This makes radio an increasingly important topic.

The book assumes a basic knowledge of electronics – Ohms Law, what filters are and such like, but builds on this foundation. All the topics are described using the bare minimum of mathematics. In this way it is not a textbook, but it is intended to be an informative text that describes the basic principles and technology behind radio today. To give a good view of what the book covers the chapter titles are as follows: Radio today, yesterday and tomorrow; Radio waves and propagation; Capacitors, inductors and filters; Modulation; Receivers; Transmitters; Antenna systems; Broadcasting; Satellites; Personal communications; Appendix

The first chapter quickly sets the scene by describing where radio is today and how it arrived there. From the very earliest attempts by pioneers at the forefront of technology in their day at the beginning of the twentieth century and before, to today's high technology scene, the development has been a fascinating story.

The next chapter describes what radio waves are and how they travel. It details the different effects that various areas of the atmosphere have, and how radio signals travel over vast distances.

Moving on, the third chapter tells how resonant circuits work. Resonance and tuning is at the very heart of radio technology because the required signal on one frequency needs to be accepted whilst unwanted off channel signals need to be rejected. To achieve this there are a variety of different types of filter, and here the basic concepts are described. Filters described range from simple inductor-capacitor (LC) filters through to high performance crystal filters and the ways of describing their performance.

Chapter four covers the different types of modulation that are used. In order that a radio signal can carry information in the form of sound, video, data or whatever it needs to be modulated. There are a variety of ways this can be done. Simpler forms such as amplitude modulation (AM) that is used for long, medium and short wave broadcasting to some of the digital forms of modulation that are used in data transmission are covered.

Receivers and Transmitters are naturally very important. In the following two chapters the basic concepts of both transmitters and receivers are described. The concepts such as frequency conversion, frequency synthesis and phase locked loops are all covered. Typical block diagrams are given as are the specifications used to define their performance.

Antennas or aerials are also very important. Whilst the theory can become very complicated it is still possible to understand a great deal about this interesting area of radio technology with the minimum of mathematics. In this chapter many of the basics are outlines with descriptions of many of the more popular forms of antenna. Antennas such as the simple dipole or vertical are detailed as is the Yagi that is almost universally used for television reception.

There are many different applications of radio, ranging from broadcasting to mobile telecommunications. In the remaining chapters many applications are described including some up to date applications such as digital audio broadcasting or digital radio as it is now termed. Cellular telecommunications are also described.

Pages: 272pp
Price: £15.99

Spatial Audio

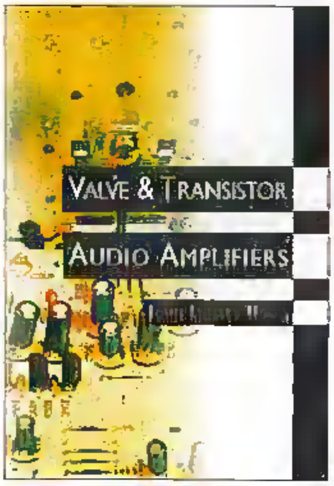
Exploring the principles and practical considerations of spatial sound recording and reproduction, Spatial Audio gives particular emphasis to the increasing importance of multichannel surround sound and 3D audio. The rise of increasingly sophisticated spatial sound systems presents an enormous challenge to audio engineers, many of whom are confused by the possibilities and unfamiliar with standards, formats, track allocations, monitoring configurations and recording techniques.

This is a clear and informative book, which provides a comprehensive study of the current state of the art in spatial audio. It concentrates on the most widely used approaches and configurations and is an ideal book for anyone wishing to expand their understanding in this area.

Students and lecturers on sound recording and music technology degree courses will find this an ideal text, and it will also be of major interest to film and video producers, directors, audio engineers, audio technicians, and studio engineers and technicians.

The Author: Dr Francis Rumsey is a Reader in Sound Recording at the University of Surrey and a Fellow of the Audio Engineering Society.

Pages: 256pp
Price: £24.99



Valve and Transistor Audio Amplifiers

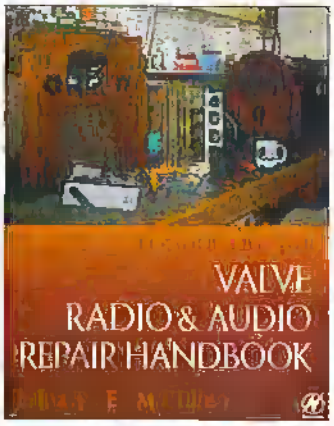
At the heart of any audio design is the audio amplifier. Its performance determines largely the performance of any audio system. Written by a well-known expert on audio technology, this book describes the milestones that have marked the development of audio amplifiers since the earliest days right through to the latest systems.

Topics covered are as follows: active components; Passive components; Voltage amplifier stages using valves; Valve audio amplifier layouts; Negative feedback; Valve operated power amplifiers; Solid state voltage amplifiers; Early solid-state amplifiers; Contemporary power amplifier designs; Preamplifiers; and Power supplies.

Including classic amps with valves at their heart and exciting new designs using the latest components, this book is the complete guide to the world of audio amplifier design.

The Author: John Linsley Hood is well known as an author and for being one of the finest audio designers around, having been a pioneer of design in the post-valve era. He comments on developments in audio in magazines such as The Gramophone, Electronics in Action and Electronics & Wireless World.

Pages: 272pp
Price: £19.99



Valve Radio and Audio Repair Handbook

This book is a practical manual made all the more interesting for the advice, opinions and recollections contained within. Aimed at professionals and enthusiasts, dealers and collectors, this is a worthwhile read for anyone who works with or has an interest in antique radio and gramophone equipment.

It places its emphasis on the practicalities of repairing and restoring, keeping technical content to a minimum but explaining it where it arises in a way that can be followed by readers with no background in electronics. Readers who have a good grounding in electronics but wish to learn more about the practical aspects will benefit from the emphasis given to hands-on repair work, covering mechanical as well as electrical aspects of servicing.

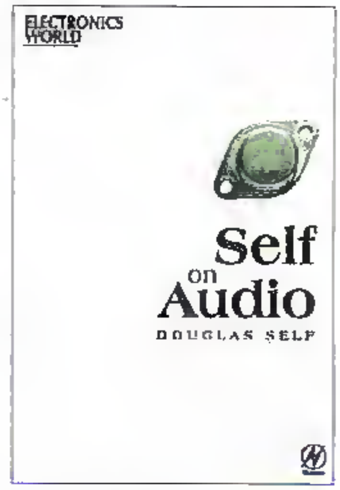
This book is an expanded and updated version of the author's classic Practical Handbook of Valve Radio Repair. Chapter headings are as follows: Electricity and magnetism; Voltage, current, resistance and Ohm's Law; Real life resistors; Condensers; Tuning; Valves; Principles of transmission and reception; Practical receiver design; Mains valves and power supplies; Special features of superhets; Battery and mains battery portable receivers; Automobile receivers; Frequency modulation; Tools for servicing radio receivers; Safety precautions; Fault finding; Repairing power supply stages; Finding faults on output stages; Faults on detector/AVC/AF amplifier stages; Finding faults on IF amplifiers; Faults on frequency-changer circuits; Repairing American 'midget' receivers; Repairing faults on automobile radios; Repairing battery operated receivers; Repairing FM and AM/FM receivers; Public address and high fidelity amplifiers; Common abbreviations; Appendices.

The Author: Chas Miller has been engaged professionally in radio work since 1948 and in technical journalism since the early 1970's. He is the editor of a bimonthly enthusiast's magazine called The Radiophile.

Pages: 288pp
Price: £19.99

Self on Audio

Douglas Self has been writing for Electronics World magazine for 20 years, offering his own insights into the scientific methods of electronics design. This book is a collection of the best of these articles, spanning two decades of amplifier technology but biased strongly towards more recent material. The articles include self-build projects as well as design ideas and guidance for the professional audio designer. The result is a



unique collection of design insights and projects.

The contents of this book are as follows: Introduction; PRE-AMPLIFIERS: An advanced preamplifier MRPI; High-performance preamp MRP4; Precision preamp MRP10; Moving-coil head amp; Preamp '96 I; Preamp '96 II; 'Overload Matters' (RIAA overload); Balanced line inputs and outputs, part 1; Balanced line inputs and outputs, part 2; POWER AMPLIFIERS: FETs less linear than BJTs; Distortion in power amplifiers 1-8; Distortion residuals; Trimodal part 1, 2; Load-invariant power amp INVAR.DOC; Common-emitter amps; Two-stage amplifiers; SPEAKERS: Excess speaker currents; Class distinction (amp classification); Relay control; Power partition diagrams; Audio power analysis.

Pages: 416pp
Price: £24.99

To order from the bookshop, please fill out this form and mail it to: Electronics and Beyond Bookshop, Units 17-18 Glanyrafon Ent. Park, Aberystwyth, Ceredigion SY23 3JQ

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Competition WINNERS

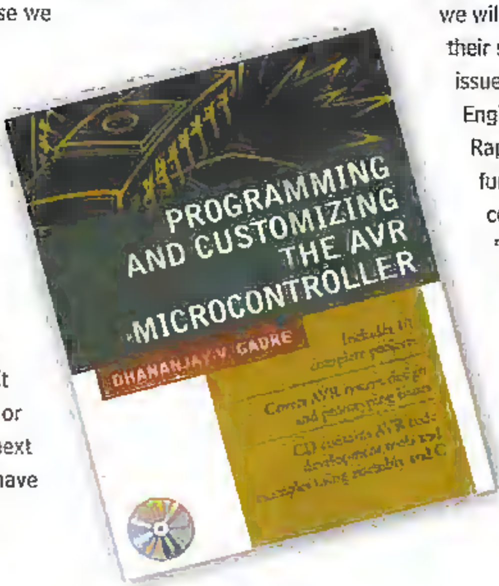
ST7 Starter Kit Competition

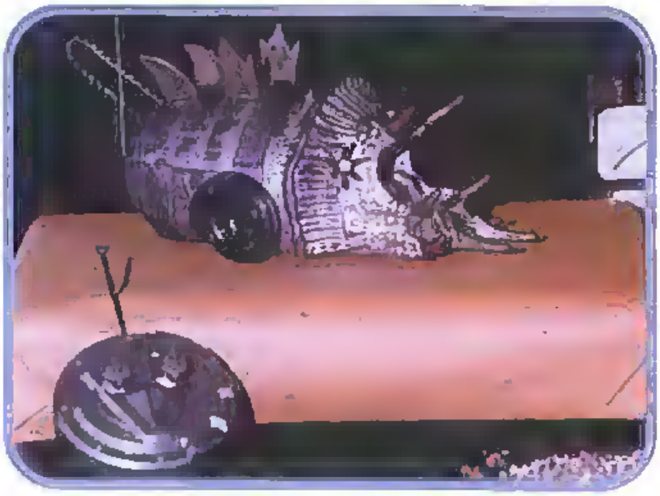
Thank you to everyone who entered our free prize draw in the hope of winning one of five ST7 Flash Starter Kits, retailing at a value of $160 each. We had lots of entries and the prizes are now on their way to the following five lucky people:

Donald Hopkins
R. P. Horsley
Graham Knott
James K. Williams
Alex Young

Reader Profile Survey.

A big thank you to everyone who took the time to fill in and send to us July's Reader Profile Survey. All entries were filed away in a folder and, because we didn't want to fold them up, we delved into it at random and picked out an entry. Unfortunately (for reasons you either know or will discover if you look back at that issue) it didn't have a name or address on it. The next one we picked did have these, and so congratulations go to Mr J. Dussart of Morpeth who wins the book 'Programming and Customising the AVR Micro Controller' by Dhananjay V. Gadre.





Robot Wars Competition.

We had a lot of entries for this competition, all of which were well thought out and obviously had a lot of work put into them. We finally decided on nine winners, and we will run their stories in consecutive issues, starting with 'The Engineer's Dream' by Linton Rapid (undoubtedly the funniest of our entries, and certainly the most topical). 'The Hacking Robot' by Daniel Grogan was selected as the winning entry. Daniel is one of our youngest readers, aged just twelve. Look out for his story in our Christmas issue.

Winners – Robot Wars Pull-And-Go Models

'Ramirez' by David Clark
'The Mage With No Name' by Nik Kelly
'Cold Harmony' by Belinda Lane
'Worlds Beyond Our Own' by Michael Oxford
'The Engineer's Dream' by Linton Rapid
'The Curious Lift' by Anthony T. F. Smith
'Alternative Technology' by Daniel Westman
'Mistaken Identity Chip' by L. L. Winterfield

Winner – Robot Wars Remote Controlled Matilda

'The Hacking Robot' by Daniel Grogan

The ENGINEERS DREAM

A short story by Linton Rapid

This is a true story of a dream I had recently. It began with Marvin the Paranoid Android reading excerpts from Electronics and Beyond magazine: 'Optocoupler Circuits? Don't talk to me about Optocoupler Circuits'. He went on to say he had a terrible pain in the all the diodes down his left hand side. I remembered about the lazy person's diode tester article on page 28. I asked him about it, and he told me he had been given the magazine by some ape-descended humanoid who didn't seem to realise that if he had a pain in all the diodes down his left hand side, there was obviously something wrong with all the diodes and it didn't take a brain the size of a planet to realise it. Ape-descended humanoids? Don't talk to him about ape-descended humanoids.

I took a walk into the darkness and suddenly found myself surrounded by a crowd of people. There was an anticipatory hush, and then the lights came on. Everybody cheered, but I couldn't for the life of me work out why. I turned and asked the man who was standing next to me. He was entirely in black-and-white (which did seem strange but it was a dream, after all). 'Don't ask me,' he said, 'I'm still pondering the peculiarities of email'.

...'I took a walk into the darkness and suddenly found myself surrounded by a crowd of people. There was an anticipatory hush, and then the lights came on. Everybody cheered...

I walked around, pushing my way through the crowd, and finally managed to get to something that looked a little bit like some sort of stand at an exhibition. 'Oh,' I said, 'this must be the E3 expo in Los Angeles that I've been reading about'.

'No,' said the woman behind the stand, 'and, before you ask, it's not the Micromouse event in South Wales either'.

'What is it, then?' I asked her.

'This is the August edition of Electronics and Beyond. You're inside it'.

'I am? That's a bit weird isn't it?'

'Well, yes, but it is your dream'.

'Fair enough. Erm... Who am I imagining all these people are then?'

'These? These are the readers. Oh, and I think there are a few contributors in there as well. There's Gavin Cheeseman, look'.

'Where?'

'Over there, knee deep in water'.

'Doesn't he realise? Why doesn't he get out of it?'

'He's got his flood alarm round his neck and the water hasn't got that high yet'.

'Oh'.

'Make a lot of sense, your dreams, don't they'.

'I would say this has got to be somewhere near the benchmark. So who are you then?'

'I'm Natasha Nagaoka, the magazine's editor'.

'Oh, so I suppose that would explain why you've got a keyboard on your head'.

'I have?' She reached up and snatched it off in annoyance. Another one reappeared immediately. 'Look, this might be your dream but it's my magazine – I'll have a little respect please'.

'Okay,' I said. 'Sorry'. The keyboard pointedly refused to disappear. 'So,' I continued, 'who else works on the magazine around here?'

'Well, there's Jonathan over there – he's the one with the shirt made out of press releases'.

'Because he's the news editor, right?'

'You're quick, aren't you'.

'Okay, okay, no need to be sarcastic'.

Natasha went on to point out all the other people who work on the magazine. She then turned into Marvin the Paranoid Android, who showed me the way to the airlock.

Outside the spacecraft there was a whole planet full of alternative technology. I parachuted to earth and, as was the case with the spacecraft, I had no idea from where the parachute came, nor was I going to ask.

The planet had wind powered green street lamps instead of trees. A semiconductor rabbit bounded past. I ran after it and grabbed it. 'Where's all the trees?' I asked.

'They've been cut down to make pages for the Bookshop. We replaced them with virtual trees, but they got cut down to make all the pages for Web Electronics. Now put me down, I'm late for the Geographic Information Systems Exhibition at Earl's Court, London'.

I put the semiconductor rabbit down and walked on for a little bit longer. This was a very strange dream, I told myself. Now how exactly could I find my way out of it?

'Here you are,' said Chris Wade, CEO of Cambridge Positioning Systems, appearing suddenly from behind a wind powered green street lamp. 'This is CursorTM, and it will help you find your way home again'.

'Thank you Chris,' I said, 'but I don't really think I need it now – I can hear my wireless of yesteryear going off in the real world'.

'Oh, well,' said Chris. 'Just think me up next time you are lost in a dream and don't know how to get out of it'. I thanked him, woke up and switched my restored antique radio off.

Just as an epilogue to my dream, here is what happened next:

Whilst brushing my teeth I thought to myself: 'that dream would make an excellent idea for a short story for the Electronics and Beyond Robot Wars competition'. But that had been in the July issue and I had been reading, the previous night, from the August one.

I hunted high and low, all around the house, but eventually realised that I had left July's issue of the magazine at work. When I eventually did find it, I discovered that the deadline for the competition was only a few days away. I had to act fast.

So here it is – written on my lunch hour and sent in with practically no proofreading at all. I hope it arrives in time. I would really like to win a miniature Robot Wars model. Don't give me the big one though, please! You want to know why? Well, that would be another story.

The End.

The Engineer's Dream was written by Linton Rapid and anyone who even thinks of copying it is, in the author's opinion, a much more ridiculous person than any of the ideas contained in this story.

Worlds BEYOND OUR OWN

A short story by Michael Oxford

The captain of The Pelican was in no hurry. In all his lonely journeying he knew that this was the most dangerous part of his voyage. Even 'Company' ships, with the most sophisticated navigation technology could come to grief here. Room for manoeuvring was tight and, in places, the very movement of a spacecraft could disturb the drifting rocks and debris, tearing great boulders from their orbits.

More than one craft had been crushed here. More than one pilot had cause to regret ever entering the Asteroid Belt.

Captain William Shuttleworth was nervous. He was sweating now. He had been here before and this journey to the facility on Px always gave him nightmares.

He had switched off his engines and was drifting towards the swirling debris, rocks and minor worlds. He drifted in and became part of the flow, the ship progressing by carefully balancing local gravitational fields, pulling itself towards the larger boulders and pushing the smaller rocks away.

It was a strange sight, had there been anyone there to observe it – an old freighter – an ex 'Company' ship sold off for scrap.

Its once smart blue and gold livery was now scraped and dented. Its rugby ball shaped hull had been patched and mended many times, and each time painted with whatever colour was available – mostly yellow, so that it now resembled an overripe melon. A ridiculous object.

After several hours of skilful navigating, the pilot was exhausted. He was flying in utter darkness. Here on the edge of the solar system the sun's weak rays could not penetrate through the floating rocks and rubble, and the ship's searchlights would only have lit up the dense clouds of dust.

He was drifting from one navigation buoy to the next, picking up their radio signals which, although extremely powerful, hardly reached from one beacon to the next. The entire electromagnetic spectrum was distorted here and communication was seldom possible.

Although he was expected, the people he was visiting did not know that he was coming today.

At last his instruments detected the facility's call signal and computed his approach to 'Shuttleworth Farm'.

Captain William's brother, Victor, lived here. Together with his wife, Mary, their two sons, Peter and Matthew, and their one assistant, Mr Brown.

The Shuttleworths' Farm covered an area bigger than Australia. They were the only people living in the southern hemisphere and, apart from the mine complex, their farm/factory was the only building on Px.

Px was a composite world. It had been assembled from the three largest asteroids and was probably the Company's greatest engineering accomplishment. It was considered an essential step in the colonising of the major planets.

These three fragments of past worlds were now held together with the Company's Gravitation Manipulation Technology, which, although it had proved troublesome in other sectors, had here made it possible to make one planet large enough to build a base for the miners and a farm to provide their food.

The Pelican was now speeding over the rough, dusty terrain. The pilot had switched on his headlights and below his ship he could see the long monotonous rows of crops that stretched from horizon to horizon.

Here and there he could pick out the movement of automated tractors, busy cutting down and grinding up the crop of Giant-Cabbage-Trees. Another triumph for the Company's botanists, these grey-green, leathery plants were genetically engineered to grow in this dark, airless place. Once processed in the farm / factory they would provide all the food, oil and plastic products needed by the miners on the other side of the planet.

The radio was working now. His ship had already identified itself to the farm's inhabitants and eager voices shattered the silence. It was a young adult's voice calling. 'Uncle Billy, Uncle Billy, is that really you? Come in Uncle Billy'.

Then a slightly deeper voice joined in. 'Come in Pelican. You are cleared to land. Uncle Bill, it's great to see The Pelican again. Mum and Dad will be so pleased to see you, especially Mum. She's not been too well; but she always says your visits are a tonic'.

Later at the farm, the family settled around the stove to prepare the special tea that Mary had prepared, but Captain Billy would eat none of it. He was on a strict diet, he said. However, he partook liberally of the brandy, which he had provided and soon he was singing and dancing around the room. Uncle Billy certainly knew how to liven things up.

It had been two years since his last visit and the family wanted to know all about his voyages, especially if he had managed to visit Earth. He shook his head. 'Not this time, I'm afraid, but everybody's talking about the wonderful work the Company has done there. 'New Earth', they're calling it now. The restoration and repair work is starting to have a marvellous result. I do believe everything is going to plan. Your new farm on Earth will be ready and waiting for you when you retire. Five more years and you will be home on Earth. Your boys will be at The Academy. It will all have been worthwhile'.

'But what of you Billy?' she replied. 'I don't know why you left the Company. You had a good job. Five more years and you too would have been retiring with a nice fat pension'.

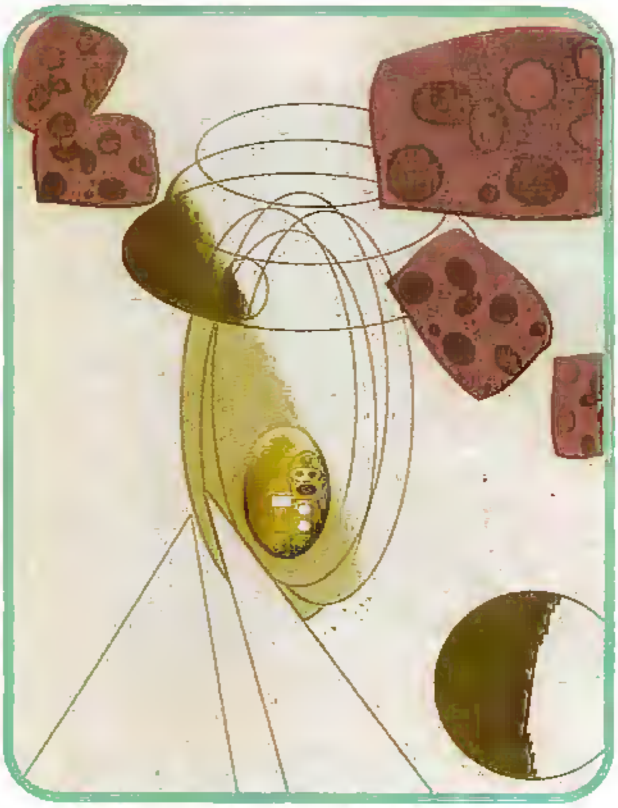
The captain just shrugged his shoulders. 'I'm happier doing what I do, travelling around meeting people. I'm happy. What more do I want?'

But Peter wanted to know more. 'Did you really know The Chairman? Were you really his right-hand man like mother says you were? Can you really get me into The Academy to become a space-pilot?'

'Enough, enough,' chuckled his father. 'You will tire your uncle out. Off to bed with the pair of you'.

But Billy had suddenly become serious. 'Let them be,' he said, 'it's history, after all,' and, gathering the boys to him, he sat them down on the sofa and began to tell a story.

'Long ago, when your father and mother and myself were just young people, just starting out, I worked in the market selling meat from my father's stall. Next to our stall there was a young man who sold organic vegetables. He was a man full of ideas and charisma. I remember, he kept saying, 'There must be a greener way to do things'. We used to converse during slack times and eventually he convinced me to become a vegetarian. We set up a business together and called it 'The Greener Way Company' – later known as just The Company.



...'They blamed it for the pollution and diseases that were plaguing the planet. But they trusted the company. They loved Malcolm.'...

Malcolm was an idealist, but he was also a superb businessman. He had, as they say, panache. Together we built the business up. We had our own farms, we had our own supermarkets, transport and shipping line. We operated in every country on Earth and we were bigger than many small countries. It was a time when people mistrusted big business. They blamed it for the pollution and diseases that were plaguing the planet. But they trusted the company. They loved Malcolm. He had become a celebrity, always appearing on television chat shows, and always saying, 'believe in me, believe in the greener way'.

Well, the Company just kept growing, swallowing up many smaller firms and even gobbling up the multinationals. Then, one day, Malcolm announced he was giving everyone in the world a share in the company. The sceptics said it was just a gimmick, but the people were delighted. They asked Malcolm to become World President. When he accepted, the company became, effectively, the world government'.

'Didn't giving those shares away devalue your share in the company, Uncle?'

'Oh yes, of course, in monetary terms it did; but we put fifty-one percent into a trust. That way we kept control and now we had the power we wanted. When 'we' told the countries to control their emissions, they jumped to it. But it wasn't enough. The world was dying, the sea already putrid and the land poisoned. Ninety-five percent of species had become extinct. It was a terrible time.

It was then that Malcolm had his great inspiration. 'To save the Earth, we must leave it. The world is tired,' he said. 'It must be allowed to rest and given time to renew itself. We already have bases on the Moon. Now we must colonise the planets'.

Thousands of spacecraft, more technically advanced than anything that had come before, were built and, everyone on Earth happily moved to live on Mars and on Jupiter's moons. That is why you and your family are living here on Px. Your parents signed a contract with the Company to work her for thirty years. In return, the Company will provide them with a new farm and a pension when they go home.

'Five more Peter, only five more years and you and Matthew here will be living on Earth and studying at The Academy'.

'Will they really take me at The Academy, Uncle?'

'Sure to, Peter. Your parents are Company personnel. The Company always looks after its own. How old are you now?'

'Seventeen, Uncle and Matt is sixteen'.

'Well then, in five years, you will be just the right age to enter The Academy. If you really want to become a space pilot you must keep up on your studies. You will need very high grades. What about you, Matthew? Do you want to be a space pilot too?'

'Oh no, Uncle Billy. I'm studying electronics and computing. I'm going to be an engineer'.

'Well now, I think your father is right; it is bedtime. Of you go, I'll see you in the morning'.

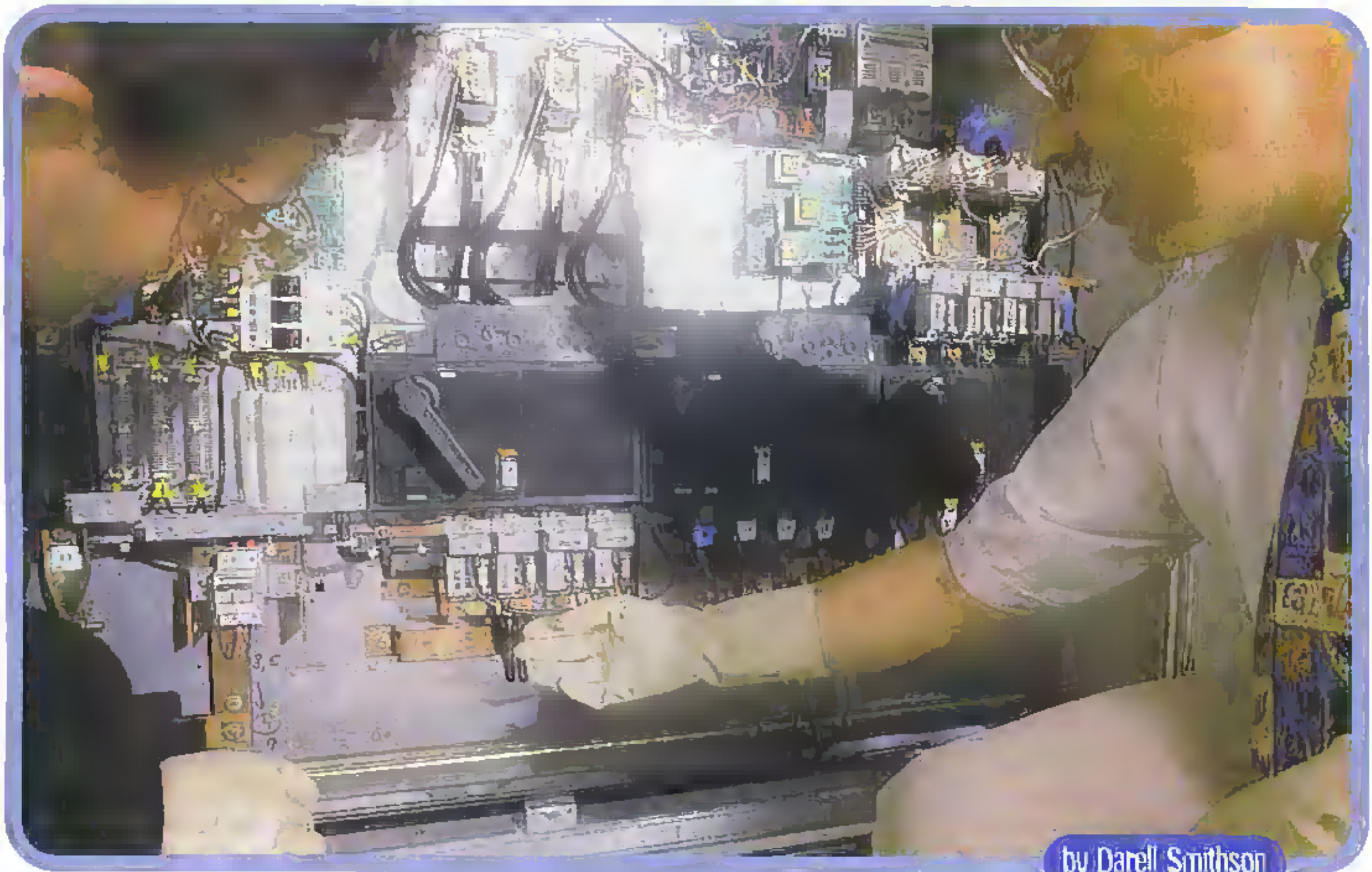
Despite his promise to the boys to see them in the morning, their uncle stayed only for one rest period. He was nervous that the miners would begin their periodic movement of ore through the asteroids. The Gravitation Manipulation Technique that they used created tunnels through the debris and long trains of ore were pushed through them to be collected by giant freighters waiting on the perimeter. At such times, the magnetic flux it created made navigation impossible.

'Kiss them goodbye for me,' he said, shaking Victor's hand and embracing his tearful sister-in-law. 'Tell them I'll be back in another two years'.

And then he was off. They watched his ship floating away over the grey-green cabbages until The Pelican's lights faded into the distance and were lost in the utter darkness of the endless night.

It wasn't until much later that they discovered that Peter was missing. They assumed he had sneaked on board The Pelican. Frantically they tried to radio the departing ship, but the only sound that came from their radio was the strange whistles and clicks and wails that Matthew had often called the music of the stars.

The End.



by Darell Smithson

TURNKEY SERVICE SOLUTIONS – the best approach?

WHY SHOULD ORGANISATIONS LOOKING TO MANAGE MULTIPLE ELECTRONIC DEVICES CONSIDER A SINGLE MAINTENANCE CONTRACTOR? DARELL SMITHSON EXPLAINS.

It's beyond doubt that a key part of the decision-making process when buying a new electrical appliance (be it a washing machine, in-car CD or network server) is whether to take out a service management agreement. It's virtually an automatic decision in the case of a server, but the question still remains.

However, with so many organisations looking for the best deals when buying new equipment, it's unlikely anymore that every appliance will be supplied by the same vendor; just look around your office...are all the PCs from the same vendor? Probably not.

In this situation, when an appliance does fail, people are left scrambling around looking for the right contact numbers, service agreement, department name etc, etc, all for each and every individual brand of appliance. Whilst all this is taking place, the organisation is losing money and productivity. Surely there has to be a way for an organisation's overall service needs to be catered for under an umbrella agreement, by one vendor?

Minimising downtime

Despite manufacturers' claims, nothing is infallible! With the best will in the world, there will be occasions (albeit infrequent) when problems arise and repairs are necessary. This is when the service engineer becomes your best friend.

With technology advancing at exponential rates, and appliances now supporting more and more critical applications, the thought of downtime is unacceptable. As such, manufacturers offer numerous after-sales packages to provide users with the assurance that should a product suffer from a failure of some kind, a service engineer will be on stand-by to offer assistance. Domestically speaking, such service management agreements (usually defined as extended warranty packages) may appear costly in the first-instance, but when weighed up against an independent engineer's call-out and hourly charges, could reap benefits in only a single use.

Within the corporate arena, service management agreements play a more integral role in the initial purchase of a product. When committing to the purchase of a new piece of equipment, e.g. a departmental printer, one must be assured that not only is the organisation purchasing at the best price available, but that it is also accompanied by a comprehensive service package. In the event of failure, the cost to the organisation in loss of productivity alone could easily outstrip the initial capital outlay for the equipment.

The grim reality

With more and more vendors offering competitive products both in terms of price and functionality, gone are the days when an organisation bought 'brand-X' alone. In today's stereotypical organisation, multiple brands co-exist. Therefore, with several different vendors all operating within one organisation, one must consider the ramifications on the service manager.

Each individual vendor may offer a uniquely tailored service solution for its own range of products, which means that an organisation could realistically hold multiple agreements for multiple vendors. For example, consider the possibility that 'brand-X' operates six different products within a particular company, as does four other vendors, each in turn offering a tailored service agreement for each product (email server, network printer, uninterruptible power supply [UPS], PC etc). In the event of one of these products failing and an engineering call-out being required, the host organisation must sift through numerous contracts in order to find the correct contract for the correct piece of equipment manufactured by a particular vendor, and so on. The amount of time simply taken to identify the appropriate service department/contact may have potentially cost the organisation thousands in lost productivity. So, one must ask the all too obvious question...why hasn't someone devised a better methodology for multiple product servicing?

One for all, and all for one

An organisation needs rapid reaction to any technical problem that it may face, but cannot necessarily afford the time to deal with multiple service contracts. To address this issue, a select number of organisations have begun to look at how a new service model can be executed. This has been particularly prevalent within the power and electronics industry.

Within this sector, the implications caused by downtime can be catastrophic. Take for instance the ramifications of an Internet Service Provider (ISP) suffering a power outage, and all of its servers being down for a period of time. The consequences to its business, and the business of its users, could be costly.

As with any other organisation, when purchasing equipment, companies in this sector look for the best specification and price no matter the brand, so it is likely that multiple brands co-exist side-by-side. However, this is a niche market, and whilst different brands may offer similar performance (and be purchased on this basis), the exact mechanics are individual and require experts to maintain them. So, this then brings us back to the premise that many brands generally mean many contracts? Not necessarily. Enter the complete service solution.

Total Assurance

In essence, the complete service solution is a simple idea – one organisation to provide the complete service management for all devices. In practice, it is not quite that simple. For example, it is unlikely that a photocopier engineer could provide technical support for a server fault!

Behind the complete service solution lies the fundamental premise of service management – expert technical assistance. As such, the complete service solution offers expert assistance for a specific genre of products, be they photocopiers or UPSs. Let us take the UPS as our example. The UPS is niche product (particularly in the high-end segment where a single unit may involve a five figure capital outlay), and whilst it may appear to the layman that a UPS is a UPS, in reality each unit can be fundamentally different. It is hard to directly compare two manufacturer's UPSs, as each unit integrates inherently individual technology and specifications around a common design – that of offering 24x7 power protection and assurance. The UPS offers critical support so in turn needs service management to match its critical nature.

Within this market place, an immediate response to any service need is imperative. This is why certain manufacturers in the industry have paid close attention to the traditional service management problems, and have devoted time to evolve this practice into a complete one-stop service solution.

One of the flaws of the traditional service model is the time it may take for an organisation to source the correct service agreement for correct product. Within the UPS industry, the problem of multiple brands co-existing is prevalent, which has led users to demand a more focused solution. In response to this, the industry has devised two models of service management:

Third party service management – within this model, a single manufacturer operates as the sole service provider to the customer, thus providing direct service and support to every brand within the host organisation. In the event of a failure, the user contacts the manufacturer, and it will send one of its service engineers to address the technical problem...in the RAC or AA mould! Despite the apparent advantages of this method (one contact for all servicing needs), the manufacturer must be able to service all brands of UPS to a high level. As aforementioned, all UPSs encompass individual specifications and technologies, so it would be essential for the managing organisation to employ expert engineers in all of the UPSs currently in the marketplace – an impractical solution.

Outsourced management ('Total Support') – operating along similar lines to the model above, the outsourced management solution is executed through a single manufacturer acting as a service facilitator (or agreement host). In the event of a failure, the user contacts the chosen host manufacturer for technical support. Once the call has been received, it is then analysed to discover which particular brand of UPS is at fault and whether the agreement host is equipped to support the device in question. Instead of sending the host manufacturer's own service engineer to service all manner of units, this service model means that the host manufacturer will (where necessary) outsource the maintenance of a particular unit to the specific vendor. Through this practice, the user is benefiting from cost-effective, vendor-specific service management whilst enjoying a centralised support contact process.

Of the two models above, the outsourced management method offers the user the advantages of a focused service management agreement without the aggravation of having to deal with multiple contracts. Within the high-end UPS sector, Total Support has been recognised as the optimum service management method and has received recognition from organisations such as Telewest, Tesco and Bank of Scotland. However, should this practice be restricted to just the high-end electronics industry?

No job too small!

Due to the critical nature of the UPS and its importance within an organisation, users are demanding Total Support across the entire range (from small networks to enterprises). Traditionally, smaller units have not been covered by service management agreements such as Total Support, but with advancing technology allowing smaller and smaller units to support larger systems, users are demanding the same level of service management as their larger counterparts.

As such, manufacturers have adapted the Total Support model to cater for this sector. An example of how the applications for such a service model may operate is in supermarkets, where the organisation-wide EPOS cashier system may be supported by a large UPS, but individual tills have their own separate UPSs. Larger UPSs may require specialised support (from the host organisation or outsourced vendor), but in most cases surrounding smaller UPSs, immediate support can be offered by the host organisation as the majority of failures in these units are to do with the natural life-span of the internal batteries. In cases such as these, the host is able to hot-swap the batteries on site no matter the brand of UPS. Through Total Support, the supermarket could call on technical support for all size of UPSs, thus assuring power protection for all of its systems.

And the future...?

Through the development of Total Support service management agreements, the electrical and electronics industry is beginning to appreciate the needs of the user. Whereas vendor-specific service agreements offer excellent service and assurance, such provision is compromised by reality – the multiple brand conundrum.

However, within marketplaces such as the power sector, manufacturers are now offering customer-friendly service packages. The provision of a centrally managed, outsourced service management agreement is a simple concept, and one that provides the customer with 24x7 assurance that no matter the fault (in either small or large units), technical expertise will be available to offer comprehensive service support. After years of operating within the constraints of the traditional service management agreement, one can only speculate that more and more customers will begin to migrate to a Total Support methodology.

Darrell Smithson is Service Manager at MGE UPS Systems Ltd. MGE conceived the Total Support service model as part of a strategic focus on the servicing side of the organisation. Since its inception, the model has contributed significantly to the company's overall growth and position in the market, culminating in a 29 percent year end increase in turnover.

Product Review

SONY MZ-G750

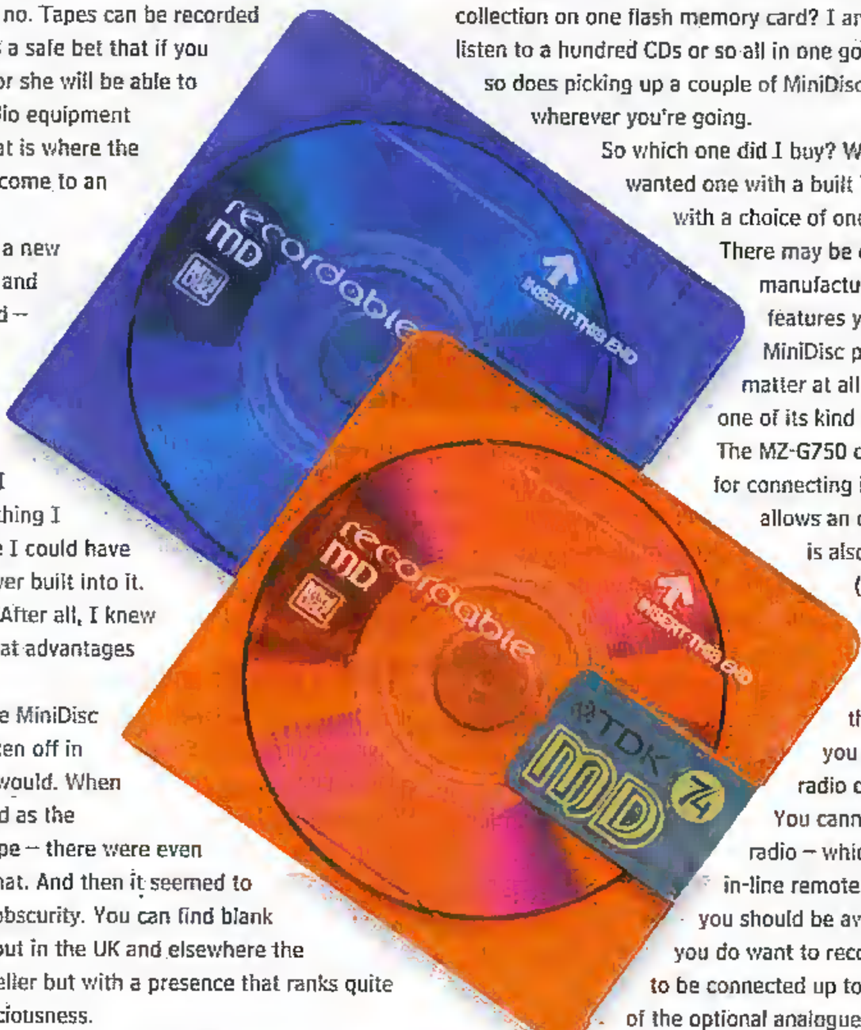
FM/AM MiniDisc Walkman

THE MINIDISC HAS NEVER REALLY TAKEN OFF IN THE WAY THAT THE DEVELOPERS WOULD HAVE LIKED IT TO, BUT HAS STILL SOLD QUITE CONSISTENTLY NEVERTHELESS. EVEN IF CURRENT AND EMERGING AUDIO TECHNOLOGY OUTPACES IT, THERE ARE ENOUGH PEOPLE OWNING MINIDISC PLAYERS NOW FOR BLANK MINIDISCS TO BE AVAILABLE THROUGH SHOPS WELL INTO THE FUTURE EVEN IF SALES OF THE PLAYERS DROP OFF AND DISAPPEAR ALTOGETHER. JONATHAN ALDRED RECENTLY BOUGHT A TOP-OF-THE-RANGE PORTABLE MINIDISC PLAYER. HERE HE NOT ONLY REVIEWS THE PRODUCT BUT ALSO EXPLAINS WHY HE CHOSE MINIDISC AS A FORMAT, WHEN HE HAD THE CHOICE OF TAPE, CD OR EVEN MP3 FLASH MEMORY CARDS.

I never liked vinyl as a recording medium. Some people still swear that you get the best sound reproduction off a vinyl record, but if that includes hissing, crackling and the occasional needle-jump, then I'd rather not listen to the record at all. I still have a big stack of favourite records that I will never sell, but am also likely never to play on a record player ever again. I keep them for sentimental reasons and have well over half of the tracks that are on these records also on CD.

But I must admit that vinyl does have one redeeming quality – with the lights down low or the room lit up by candlelight, the gentle hissing and crackling in the background of the right kind of music played on a record player can be very romantic indeed. Can anyone truly say the same of an audiotape?

The answer has got to be no. Tapes can be recorded on again and again, and it is a safe bet that if you lend a tape to someone he or she will be able to go straight to a piece of audio equipment capable of playing it, but that is where the good points of the medium come to an end.



A few years ago I bought a new Hi-Fi. It was very expensive and had all the features I wanted – three disc changer, five-speaker Dolby surround sound... I could go on, but this is not a review of my Hi-Fi. Basically, though, I was happy that it had everything I needed. For about £50 more I could have had one with a MiniDisc player built into it. Why didn't I pay the extra? After all, I knew what a MiniDisc was and what advantages it could bring.

Well, the problem with the MiniDisc is that it has never really taken off in the way that Sony hoped it would. When it first came out it was hailed as the replacement for the audiotape – there were even albums released on the format. And then it seemed to disappear very quickly into obscurity. You can find blank MiniDiscs on sale in shops, but in the UK and elsewhere the MiniDisc remains a steady seller but with a presence that ranks quite low within the public's consciousness.

And now there are CD-writers on the market, and MP3 players that can store compressed audio data onto an almost unbelievably tiny flash memory card. Will the audiotape finally die out as a medium? Perhaps it will, but not in the foreseeable future. More importantly, how will the MiniDisc fare against this new competition?

At the time I bought my Hi-Fi, the MiniDisc had such a low-key presence in general that I really did think it was on its way out, and if I wanted to record something I might as well record it on tape because then I would be able to play it on the car stereo or my walkman. Since then I have become increasingly fed up with audiotapes as, one after one, all my old concert recordings have gone distorted and, as a result of that, into the bin. It wasn't my Hi-Fi's fault – I know that because I checked on other cassette players. I still use the tape deck though – mainly because I have very little other choice.

Recently I decided to buy a CD Walkman. After only five minutes in the shop I had changed my mind – I had noticed the MiniDisc players that were placed next to them. I had also noticed the MP3 players. I decided to go away and think about it. The next week I came back and bought the MiniDisc player featured in this issue's Product Review. The reasons – it was smaller and lighter than the CD and tape players and because of its compression technology could store two or even four times the usual amount of music on a MiniDisc – 160 or 320 minutes instead of 80.

I spurned the MP3 players for three reasons – firstly I can play MP3 on my computer at home, as I have very good speakers built into the monitor. Secondly, I am not likely to want to put any of the MP3 files I download onto a Walkman, as the ones I play on the Walkman are all going to be off albums I have bought. Thirdly, MiniDiscs are extremely cheap nowadays and I can mix and match my CD collection as I please on any number of discs – why would I want my entire CD collection on one flash memory card? I am hardly going to want to listen to a hundred CDs or so all in one go. It might offer a choice, but so does picking up a couple of MiniDiscs before you go out wherever you're going.

So which one did I buy? Well, I had decided that I wanted one with a built in radio and that left me with a choice of one (the Sony MZ-G750, £200). There may be other models by other manufacturers, but this one had all the features you could possibly have in a MiniDisc player and so it did not matter at all to me that it was the only one of its kind available in the shop.

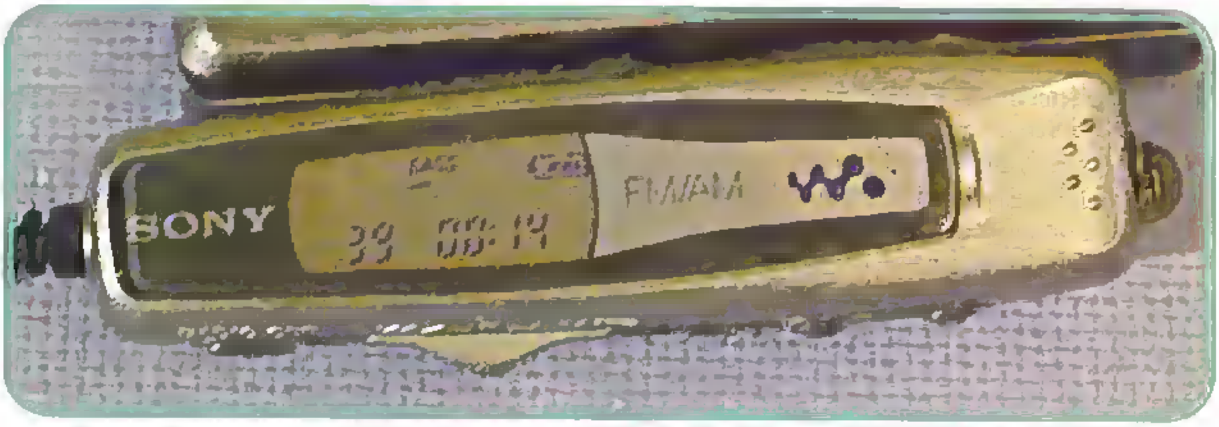
The MZ-G750 comes with an optical cable for connecting it to any digital source that allows an optical-out connection. There is also an optional analogue cable (RK-G136) for connecting it to Hi-Fi equipment with audio out jacks (not all Hi-Fi's or radios will have these, so do be aware that you need these to record from radio or other analogue sources).

You cannot record from the built in radio – which is actually located in the in-line remote – so that is also something you should be aware of before purchasing. If you do want to record from the radio, you need to be connected up to a suitable source by means of the optional analogue cable. I was horrified, upon getting back home again, to discover that my Hi-Fi did not have the necessary analogue-out connections. I was glad I hadn't bought the cable (if anyone out there can tell me if it is possible to connect my MiniDisc player to my Hi-Fi by means of the headphone socket, by the way, I would be extremely grateful). I will want to be able to record from the radio one day, so this is something I must eventually sort out.

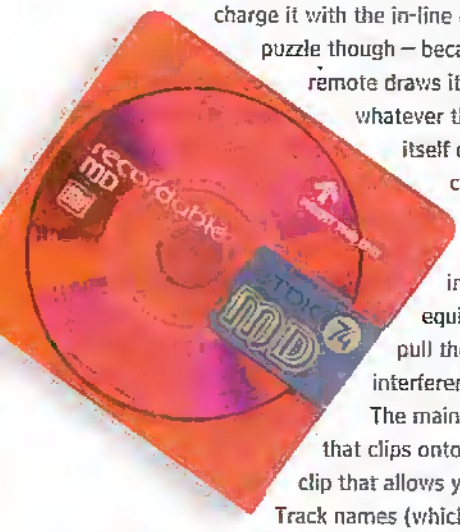
Radio aside, the main reason I bought the Walkman was to listen to my own selection of music from my own CDs. After charging up the rechargeable battery using the adapter supplied, I put in a blank MiniDisc and recorded the same track at each of the three different compression modes. LP4 did not sound quite as good as Normal – the best way I can describe it is that the sound sounded a little dull. LP2 however was just as clear as Normal, and this allowed for 2 hours and 40 minutes of recording time on each 80 minute disc. This equated to three Stereophonics albums, and a small selection of 'B-sides' (they were from a CD, so I suppose you might call them 'additional tracks' – 'B-sides' sounds better though). Another compilation of tracks by

Radiohead, REM, Catatonia and three other bands equated to 42 different tracks on the one disc. Another disc that I recorded a few days later took up 29, but only because all those were dance and garage music tracks, which tend to be considerably longer. You can mix and match between the different record/play modes if you want to – one track can be LP2, the next LP4 and the next one Normal. The remaining time left for recording, as shown on the display in recording-standby, changes every time you alter the default recording mode.

I tried the earphones out. They were good but uncomfortable. Other people might not find them so, but I prefer headphones and I had bought a new lightweight pair at the same time because my 'closed-cup' ones were too heavy and unsightly to take with me outside.



The shock-protection is excellent. I tried it out on the bus, which was shaking about all over the place, but stopped short of giving it a more rigorous test. I had, after all, just bought it and was not going to shake it any more than I had to. The radio, which uses the in-line's connecting wire as an aerial, kept cutting out though. I was far from pleased with this but the problem disappeared the next time I charged up the main unit. The instruction manual neglects to say that you should charge it with the in-line remote attached. This was a puzzle though – because as far as I can see, the remote draws its power from the unit. Still, whatever the problem it has now sorted itself out. The radio reception is clear in my house and outside but not in the E&B office. That might be due to some interference from all the equipment in the building – if I pull the wire straight the interference mostly goes away.



The main unit comes with a carry case that clips onto a belt, and the remote has a clip that allows you to secure it to your shirt. Track names (which have to be inputted manually onto the disc using the unit) are not shown on the remote, like they are on other models. This is because of the radio circuit being in there, but there is a display that shows the track number and volume. The names, visible on the unit, can be as long as 200 characters and scroll smoothly across the screen whenever you select a track.

The remote can be used to select a track, play, stop, cue, review, alter the volume, change radio station or band, and switch the unit off altogether. It is well laid out and I very quickly learnt how to do all of these things without looking.

Tracks on a MiniDisc can, of course, be moved around or erased. This is easily done and the unit can be set so as to automatically record on free space whenever a signal is received or record over a whole disc without having to go to the trouble of erasing. You can choose to play tracks randomly or a number of times if you wish. You can also choose between three different bass settings. There is a decibel indicator on the screen and an indicator of remaining battery time.

The more money you pay for a MiniDisc Walkman, the more hours of music you can get out of the battery. For this model you will not need to recharge again for 14 hours if playing at LP2 (11.5 at Normal), or 6 (or 4) hours if recording. Normally, however, you would record with the adaptor plugged in. The times given for playing from the Walkman will reduce if you alternate between the disc and the radio, but only slightly.

If you buy an optional microphone (mono or stereo), you can use the unit as a dictation machine. This has significant advantages over the use of chip-based dictation machines, as you can keep whatever you have recorded and will never have to erase over it.

All in all, this is a durable, light and stylish MiniDisc player that I am very happy with and would recommend very highly.

What is a MiniDisc and how does it work?

MiniDiscs were developed by Sony in 1992 and are made by a number of manufacturers. The Sony ones come in a range of five different colours, through which the actual disc itself can be seen. Recordable MDs use magneto-optical technology, which allows you to record a million times without any loss of quality (remember that old advert where the skeleton was still recording on his videotape even though he had long lost his eyeballs, ears and brain? Can it be that the people at Sony actually did re-write over a MiniDisc that many times?). There is no distortion, hiss or noise interference – like a CD the MiniDisc is entirely digital.

A laser inside the recording unit heats up the disc and demagnetises its magnetic layer. A magnetic field is then applied and the demagnetised disc stores all these 'zeros and ones' on one side only of the 2.5 inch, plastic enclosed diskette. A digital compression technology called ATRAC (Adaptive TRansform Acoustic Coding) stores more sound in less space by extracting and writing only those frequency components of the audio source that can actually be heard by the human ear.

Positions, lengths and names of all the tracks on the disc are stored in an area of the disc called the TOC (Table Of Contents). The player reads this every time you insert a new disc, or writes to it every time you record, move, name or rename a track.

When buying MiniDiscs it is always advisable to buy the ones that can hold 80 minutes at normal record and play modes. The difference in price between these and ones that hold less music is not all that great, and remember – unlike audiotapes, you can use and reuse these durable diskettes practically for ever.

GUITAR Practice Amplifier

by Gavin Cheeseman

THIS SIMPLE GUITAR AMPLIFIER PROVIDES A HEADPHONE OUTPUT AND IS IDEAL FOR USE IN THE HOME ENVIRONMENT WHERE IT ALLOWS THE GUITARIST TO PRACTICE WITHOUT BLOWING THE ROOF OFF!

The design operates from a 9V battery and features a 'fuzz' effect and basic tone controls. The circuit uses easily available components and may be constructed in just a few hours.

How does it work?

Figure 1 shows the circuit diagram of the amplifier. It effectively consists of a preamplifier stage (IC1) followed by a small power amplifier based around the LM386 IC (IC2). Power is switched to the circuit by toggle switch S1. Diode D1 provides protection if the power supply is accidentally connected with the incorrect polarity. Capacitor C4 provides high frequency supply decoupling close to IC1. The input signal (from the guitar pickup) is connected between terminals P3 (signal) and P4 (ground). The input signal is applied to the non-inverting input of operational amplifier IC1 via coupling capacitor C1. Resistors R1 to R3 bias the op-amp input to approximately half of the supply voltage with C2 providing decoupling. The maximum gain of the preamplifier stage is determined by the values of resistors R4 and R5 together with variable resistor VR1. When the preamplifier output signal is at a relatively low level, diodes D2 to D5 do not conduct and the output waveform is simply an amplified version of that at the input. Adjusting the setting of VR1 affects the gain of the preamplifier. A higher resistance setting results in increased gain. When the output signal level exceeds the point where the diodes start to conduct, the gain is reduced with the result that the output signal is effectively clipped. This part of the circuit is used to create a fuzz effect.

Switch S2 is used to select one of two different fuzz effect settings. With S2 closed, diodes D4 and D5 are bypassed and the positive and negative halves of the waveform clip at approximately the same level. With S2 open, D4 and D5 are connected in series with D3 resulting in unsymmetrical clipping. Because of the difference in harmonic content this creates a different sound at the output.

Output signals from IC1 are coupled to power amplifier IC2 via C5. Variable resistor VR2 controls the input level to the power amplifier and is used as the master volume control. Series resistor R6 helps to ensure that the amplifier is not overdriven. The power amplifier stage also incorporates basic tone controls VR3 and VR4. Tone control is achieved by adjusting the frequency response of the amplifier using resistors and capacitors connected in parallel with the IC's internal feedback components. Capacitors C6 and C7 provide supply decoupling close to IC2.

The output of IC2 is AC coupled by C12 to output terminal P6. A limited output via R10 is available at P5.

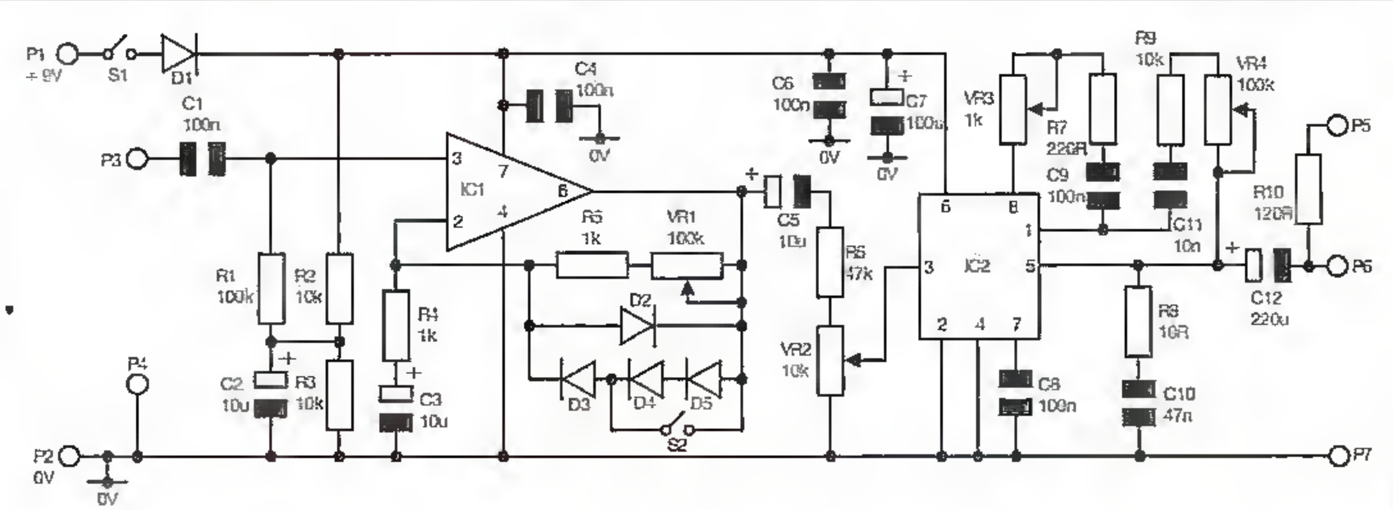


Figure 1. Circuit diagram

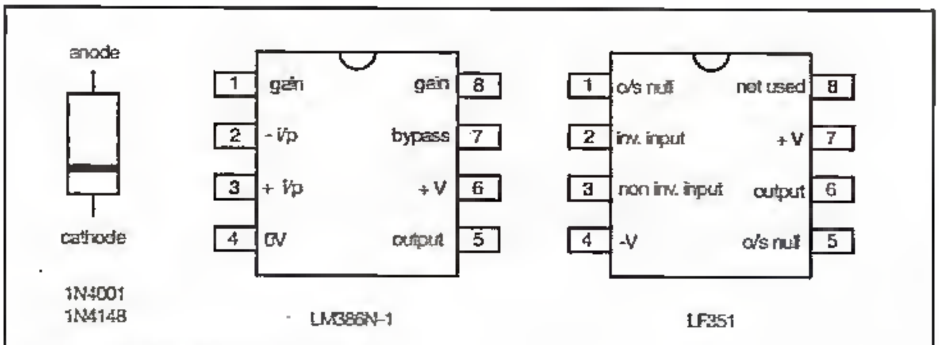
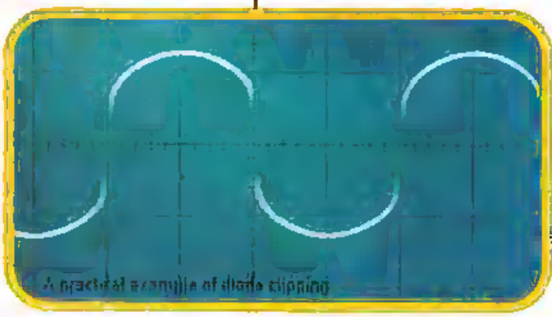


Figure 2. Semiconductor connection details

Building the Amplifier

The amplifier can be built using standard construction media such as matrix board, strip board or PCB. As with most high gain circuits, some attention should be paid to component layout if noise pickup and instability are to be avoided. Interconnections between components should be kept as short as possible with input and output wiring kept separate. Input leads should be screened to reduce the chance of coupling the output signal back to the input and to avoid excessive levels of mains derived hum. It is sensible to run separate power leads to the preamplifier and power amplifier stages. The positioning of decoupling capacitors is critical. C4 should be connected as close as possible to IC1 whereas C6 and C7 are best positioned near IC2. Connections to panel mounted controls such as the potentiometers (variable resistors) should be short and if the components are mounted off board may require screened lead.

As always, it is essential to pay attention to component polarities. Figure 2 shows pinout details for the semiconductors. The polarity of electrolytic capacitors is usually indicated on the component body. Normally, the negative lead is marked by a minus (-) symbol nearby on the case. The negative lead is also usually the shortest. Conventions may vary so please check if unsure. Similarly, make sure that the battery clip is connected the right way round. The positive lead is connected to terminal P1 (+9V) and the negative lead to P2 (0V).


A practical example of diode clipping

Housing

The circuit may be housed in a small plastic case or any other suitable housing. Adequate room must be allowed for the potentiometers, switches and battery. Always take care that none of the components short out when the case is fitted together. Allow sufficient space around the components for efficient cooling. In normal use, with adequate ventilation, the components do not operate at an excessively high temperature. However, the power amplifier section may run at an elevated temperature when driven hard. Remember to allow for access so that the battery may be easily replaced when required.

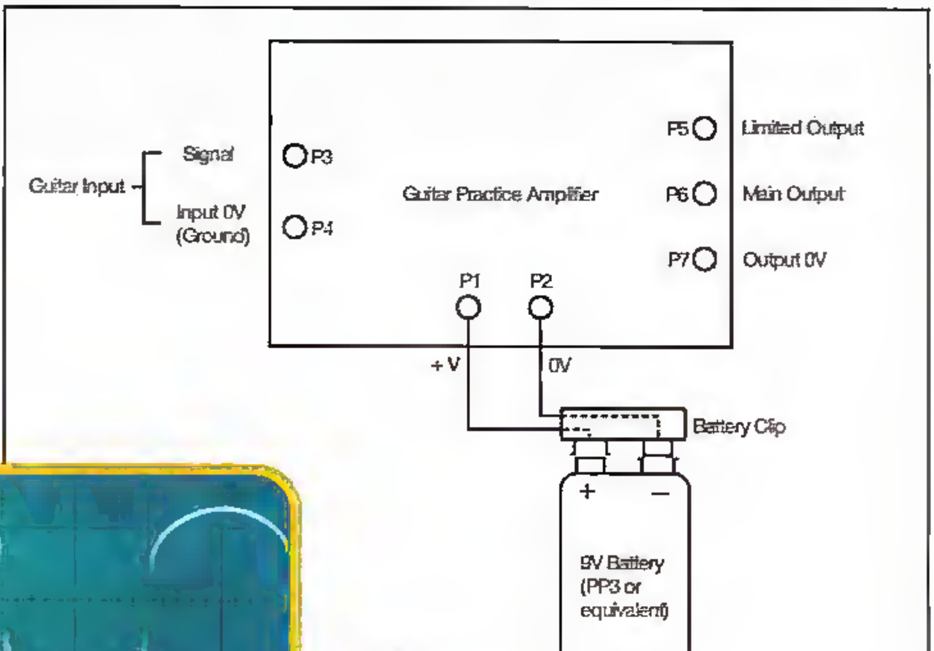


Figure 3. Wiring Diagram

Testing the Amplifier

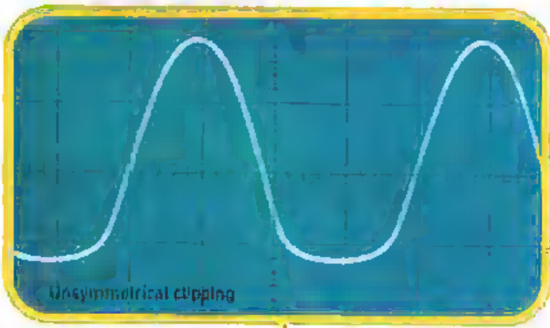
No special tools or equipment are required to test the amplifier but if a sine wave signal generator and an oscilloscope are available, these will allow the correct operation of the circuit to be verified before connecting a guitar. If available, it is also useful to connect a multimeter in series with the positive power supply rail in order to monitor the supply current when the circuit is first tested.

To ensure personal safety, it is recommended that the circuit board is temporarily installed in its housing during testing as components can occasionally explode if they are incorrectly connected or under certain fault conditions. However, do not permanently install the circuit board until testing is complete as it may be necessary to gain access to the circuit if a fault or error becomes apparent.

Check that S1 is set to the 'off' position. Connect a suitable 9V battery (PP3 or equivalent) to the circuit as shown in the wiring diagram (Figure 3). Set VR1 to minimum resistance. Set VR2 to the minimum volume setting and VR3 and VR4 to the centre position. Close switch S2.

Connect a sine wave generator set to 1kHz or other suitable audio signal source between P3 (input) and P4 (0V). The level of the signal source must be adjustable from zero up to a few tens of mV and to start with should be set to minimum. Some method is required to monitor the output of the amplifier. A pair of headphones is fine. To prevent possible damage to the headphones and your hearing when first testing the unit, it is recommended that the headphones are connected in series between terminals P5 (limited output) and P7 (0V). An oscilloscope may also be used to monitor the output.

Switch on the amplifier (close S1). After an initial click the output should remain silent. Advance the setting of VR2 about a quarter of its travel and slowly increase the input signal level. The signal should be clearly audible at the output. At low level, the output should faithfully reproduce the input signal without introducing a significant degree of distortion. If a sine wave is applied to the input, the output should also be sinusoidal. Adjust the setting of VR1 so as to increase the gain of the preamplifier stage. As long as the input signal level is sufficient, a point should be reached where the preamplifier stage starts to clip. The effect of diode clipping is illustrated in Figure 4. This creates an audibly harsher sound at the output. When monitored using an oscilloscope, the clipping effect should be clearly recognisable (see Photo 1). Opening S2 should result in a slightly different waveform and increased output level. Careful observation will show that the negative half of the waveform clips at a lower level than the positive half. Photo 2 shows the sort of waveform produced.



The effect of tone controls VR3 and VR4 may not be immediately obvious when driving the amplifier with a single frequency test signal and this feature is best tested with a guitar connected to the input. Alternatively the frequency response may be checked by sweeping the frequency of the test signal over the audio frequency range whilst observing the level of the output signal compared to the input signal. For this test, the input signal level and the setting of VR1 should be adjusted so that clipping does not occur.

When testing the amplifier for the first time, it is important to watch out for signs of high frequency instability. If this problem is going to occur, it is more likely to be present when VR1 and VR2 are set for maximum gain and when the tone controls are adjusted to provide treble boost. Instability may be present continuously or just on the peaks of the output waveform. The problem is best detected using an oscilloscope as the effect is not always audible. If an oscilloscope is not available, pointers to look out for that may indicate the presence of high frequency oscillation include a whistling sound from the headphones and a sudden rise in supply current level if the gain of the amplifier is increased when there is no input signal. If instability is found to be present, switch off the amplifier and double check the component values and wiring layout.

Using the Guitar Practice Amplifier

The amplifier offers a simple way to practice at home with a minimum of annoyance to other occupants and is therefore primarily designed to be used with headphones. The input is relatively high impedance (about 100k) and will accept the output from most types of transducer. However, always check that the guitar is compatible with this type of input before connection.

In addition to use with headphones, the main output at P6 will drive an 8 ohm loudspeaker if required. The loudspeaker could be enclosed in the case but if the enclosure is relatively small there will tend to be a lack of bass response. Therefore, it is probably better to fit a suitable connector so that an external speaker cabinet may be connected. A switch may be fitted to select either the internal loudspeaker or the external output. The available power is limited, so don't expect too much volume.

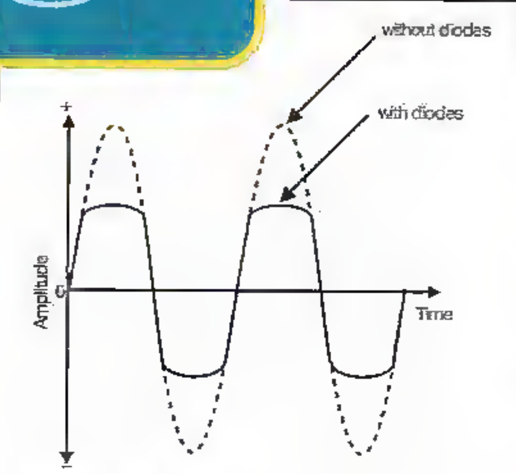


Figure 4. Diode Clipping

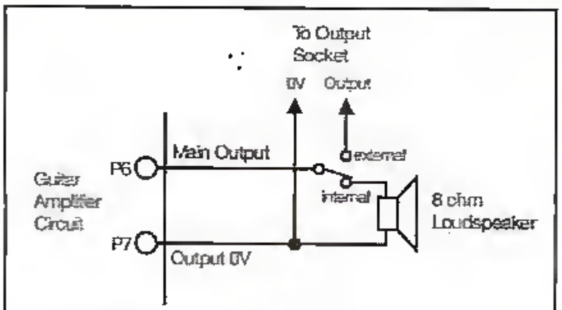


Figure 5. Connecting a loudspeaker

Care should be taken never to short the main output to P7 (or any other part of the circuit) as this may result in irreparable damage. The drive current at P5 is limited by R10 and therefore this output may be used to drive low impedance headphones. The main output at P6 has no additional limiting resistor and therefore caution is required if the output is used to drive headphones. In either case, the output ground connection is made to P7 (0V).

In order to obtain the best sound it is usually necessary to play around with the volume and tone control settings. To use the amplifier without the fuzz effect, set VR1 to minimum gain position. Then adjust VR2 to a suitable volume level. When the fuzz effect is required, carefully increase the setting of VR1 until the desired level of distortion is obtained. It is sensible to reduce the amplifier volume before adjusting VR1. Try both settings of S2 and adjust tone controls VR3 and VR4 to see which sound is preferred.

Experimenting with the Tone Controls

Some readers may like to experiment with the response of the tone controls but some caution is required as too much gain at high frequencies can result in instability. Changing the values of capacitors C9 and C11 will alter the frequency response of the circuit. Similarly if the tone control components (R7, R9, VR3, VR4, C9, C11) are omitted, the response will be flat over much of the audio frequency range tailing off only at low and high frequencies. In this case the voltage gain of the amplifier is determined by the internal feedback components of IC2. So as to maintain stability, where R9 is fitted, the value should not be less than 10k.

Battery Life

Battery life is dependant on how the amplifier is used. If the unit is used to drive a loudspeaker at full volume, it will drain the battery more quickly than when it is used at comparatively low volume levels to drive headphones. For best performance always use a long life alkaline battery.

Parts List

Resistors (minimum 0.5W metal film)		
R1	100k	1
R2, 3, 9	10k	3
R4, 5	1k	1
R6	47k	1
R7	220R	1
R8	10R	1
R10	120R	1
VR1, 4	100k variable pot lin.	2
VR2	10k variable pot log.	1
VR3	1k variable pot lin.	1
Capacitors (voltage rating 16V or greater)		
C1, 4, 6, 8, 9	100nF Ceramic	5
C2, 3, 5	10uF Electrolytic	3
C7	100uF Electrolytic	1
C10	47nF Ceramic	1
C11	10nF Ceramic	1
C12	220uF Ceramic	1
Semiconductors		
IC1	LF351	1
IC2	LM386N-1	1
D1	1N4001	1
D2-5	1N4148	1
Miscellaneous Items		
S1, 2	SPST toggle switch	1
P1-P7	PCB terminal pins	7

Diary Dates

2 – 4 October. ExCel, London.
WorkPlace 2001.
Tel: 020 8910 7910
www.workplace-event.co.uk

2 – 4 October. NAC Stoneleigh, Coventry.
Dynamic Warehouse.
Tel: 01322 660 070
Fax: 01322 667 633

2 – 4 October. Olympia, London.
Market Research Show.
Tel: 0207 970 6561
Fax: 0207 970 6740

2 – 4 October. NEC Birmingham.
Surface World 2001.
Tel: 01442 878 787
Fax: 01442 870 868

3 – 4 October. NEC Birmingham.
ProjectWorld
(formerly Project Management Exhibition).
Tel: 020 8541 5040
www.imark.co.uk/proman

3 – 5 October. NEC Birmingham.
Protecting Groundwater.
Tel: 0121 711 5885
www.environment-agency.gov.uk

5 – 6 October. NEC Birmingham.
National Franchise Show.
Tel: 020 8394 5100
Fax: 020 8785 3388

7 October. Shepton Mallett, Somerset.
Toy & Train Collectors Fair
Tel: 01373 452 857
Fax: 01373 462 557

8 – 11 October. NEC Birmingham.
Metals Engineering 2001.
Tel: 01737 855 528
www.dmgworldmedia.com

9 – 10 October. SECC Glasgow.
Electrical Engineering Exhibition.
Tel: 01732 359 990
www.eeeonthenet.net

9 – 10 October. Wembley Exhibition Centre, London.
Telebusiness
Tel: 01244 378 888
www.advanstar.com

9 – 11 October. Messe Stuttgart, Stuttgart, Germany.
Embedded Systems Conference (ESC) Europe
Tel: 020 7861 6330
www.allembedded.com/esce

10 – 11 October. Olympia, London.
Webmaster – Internet Show.
Tel: 01483 469 060
Fax: 01483 534 847

12 – 21 October. SECC Glasgow.
Ideal Home Show Scotland.
Tel: 020 8515 2000
www.dmgworldmedia.com

14 October. NEC Birmingham.
Toy & Train Collectors Fair.
Tel: 01949 21374

16 – 17 October. ExCeL, London.
Property Computer Show
Tel: 01273 836 800
www.pcsonline.co.uk

16 – 18 October. Olympia, London.
Broadband Communications Europe.
Tel: 020 7610 3001
www.broadband-convention.com

16 – 18 October. ExCeL, London.
FM Expo,
Safety, Health & Environment Solutions.
Tel: 01732 377 646
Fax: 020 8747 3856

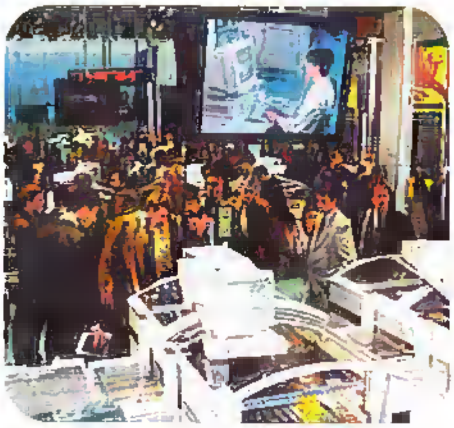
WHAT'S ON in Oct & Nov

Exhibitions

6 – 9 November. New Munich Trade Fair Centre.

Productronica 2001

http://fair.productronica.de/english



The 14th International Trade Fair for Electronic Production takes place in Munich this November under the banner of Productronica 2001. The last time it was held was in 1999, when some 57,000 visitors came to view the offerings of 1,793 exhibitors.

Productronica focuses on the entire electronics-manufacturing sector, including services. Visitors will have access to 132,000 square meters of top international products as presented by the world's leading suppliers in this market.

Southern Germany is one of the largest high-tech regions in Europe. Many of the fair's visitors are from this region, and many also journey to Productronica from many places all around the world. More than 15,000 visitors at the 1999 event came from the United States and Asia.

The floorspace will be divided up into the following product sectors: manufacturing technologies for PCBs and other circuit carriers; test and measurement; materials processing; soldering technology; components manufacturing; product finishing; technologies in cable processing; component mount technology; microsystem technology; and semiconductors manufacturing.

14 – 15 November. Royal Highland Centre, Ingliston, Edinburgh.

LABtex (Laboratory Equipment and Services Exhibition) 2001

Tel: 01224 210122
Email don@don-mor.co.uk
www.don-mor.co.uk

With the demise of the Lab Show in London earlier this summer, a new two-day trade event in Edinburgh looks set to take over as the industry's main showcase in the UK. LABtex is aimed at those who specify or influence the buying of all types of laboratory and scientific equipment and services. The event, which is being held in association with BIA Scotland, the Scottish Optoelectronics Association, and the Institute of Nanotechnology, will include an exhibition, seminar programme and a conference, which will address several topics of current concern (such as e-procurement; health and safety, recruitment and retention, and business growth and expansion).

'Positioning this event in Scotland makes sense,' explains Don Morrison, MD of Don-Mor Productions Ltd, the organisers of the event. 'Scotland has a worldwide reputation for scientific research and is the logical choice for an event of this type. Whilst the IT and electronics sectors may be suffering from a downturn in the global market, recent news in the biotech sector is extremely encouraging and the recent announcement of a £75m funding award to Scottish universities (made through the Science Research Investment fund) will give a welcome boost to exhibitors'.

Visitors to LABtex will be able to see a wide range of equipment on display for analysing, testing, monitoring and measuring in the lab, the factory or the field. With around 100 exhibitors, this is expected to be the biggest event of its kind this year in the UK and it will be a major networking opportunity for lab technicians and scientists working in a diverse range of areas – academic, medical, biosciences, pharmaceuticals, oil and gas, food and drink, and many others.

14 – 15 November NEC Birmingham.

Sound Broadcasting Equipment Show

Tel: 01398 323700
Fax: 01398 323780
Email: dmcv@pointproms.co.uk
www.sbes.com

The Sound Broadcasting Equipment Show is a trade event open exclusively to broadcast professionals. It has grown, over the past twenty-five years, into the most important event for broadcasting to be held in the UK.

Attracting manufacturers and suppliers of sound broadcasting equipment and services from around the world, the SBES is now the only exclusively pro-audio show to held in the UK. As such, it is the ideal annual meeting place for sound broadcasters from independent radio, public service broadcasting, community and hospital broadcasting, TV sound, post-production, and freelance sound recorders and producers.

Running concurrent to the show will be a series of seminars on topics such as digital audio networks for broadcast, audio playout and distribution systems, sound systems within live broadcast studios, digital audio mixers, studio construction and infrastructure, recording on location, 'webcasting: where have we got to?' and 'transmission: quality or quantity'.

27 – 29 November ExCeL, London

Digital Solutions & The Digital Camera Show 2001

Ticket Hotline: 01491 614447
www.digitalsolutions2001.com
www.thedigitalcamerashow.com

For the first time, these two exhibitions will be running alongside each other. Entry will be free for the first 7,000 people to pre-register online and visitors will be able to move freely between the two events, which are both located in the ExCeL exhibition venue, London.

Digital Solutions is aimed at buyers of digital print products and workflow technology. All the latest products and services will be on display and there will also be free seminars and an education programme dedicated to helping newcomers further understand the benefits of 'buying in' to the digital process.

The Digital Camera Show will run a comprehensive education programme along similar lines to this. Like the Digital Solutions show it will also be free.

More digital cameras are now being bought than conventional 35mm ones and it is predicted that there will be more digital cameras owned and in use than 35mm cameras by the end of 2002. If you are planning to be part of either of these statistics, then The Digital Camera Show will be well worth visiting this November.

Engineering & Graduate Recruitment Shows in October/November www.engineerjobs.co.uk

19 – 20 October, Wembley Exhibition Centre, London.

Friday, 11am to 5pm. Saturday 11am to 4pm

23 – 24 November, NEC, Birmingham.

Friday 11am to 5pm, Saturday 11am to 4pm

The National Engineering Recruitment Exhibition

Targeting both experienced and graduate engineers throughout the UK, the National Engineering Recruitment Exhibition includes a series of company presentations given by exhibitors to introduce their companies and highlight job opportunities to potential candidates.

Recruiters common to both exhibitions will include BAE Systems, BOC Edwards, Cisco Systems, National Air Traffic Services, The Patent Office and the Royal Navy. Lockheed Martin and Cranfield University will only be available at the London venue, whilst DERA, Honda UK, and Land Rover will only be available in Birmingham.

Free shuttle services to the exhibitions will be available from Aston University, the University of Birmingham and UCE every hour on the hour. A booking form will appear on the website shortly before each event.

6 – 7 November, NEC, Birmingham

The National Graduate Recruitment Exhibition

Tuesday, 11am to 5pm
Wednesday, 11am to 4pm

Like the NER exhibition, this is a free and convenient way of listening to and talking face-to-face with a wide range of graduate employers. Over 130 graduate recruiters from all over the UK will be present, and they will be looking for graduates from many and varied academic disciplines. There will be free careers seminars and company presentations, and a quiet area will also be provided for those who just want to sit and think for a while, or need somewhere to fill out a form.

Free transport will be provided from a number of UK locations – details of which will appear on the site around the second week in October.

13 – 14 November, The Academy, Manchester University

Enterprise Graduate Recruitment 2001

40 recruiters from areas such as sciences, engineering, marketing, sales, finance and teaching will be available at this exhibition. As is the case with National Graduate Recruitment, free transport will be provided and details will be placed on the web site four weeks prior to the date of the event.

Please send details of events and exhibitions to ialdred@kanda.com

Technology Watch

With Martin Pipe

THE TELECOMS INDUSTRY MAY BE IN THE DOLDRUMS RIGHT NOW, BUT THE TECHNOLOGIES CONTINUE TO ARRIVE THICK AND FAST. THE TECHNOLOGY TO BE DISCUSSED THIS MONTH - BLUETOOTH, NAMED AFTER A 10TH-CENTURY VIKING KING - ISN'T PARTICULARLY NEW, BUT THE FIRST PRODUCTS ARE NOW BEGINNING TO HIT THE MARKETPLACE.

Bluetooth is, in actual fact, the name of a cross-industry 'special interest group' (SIG) that was founded back in 1998. The founder members of Bluetooth, which has a web site at www.bluetooth.com, include Ericsson, Nokia, Intel, IBM and Toshiba. Since its formation, all manner of telecommunications and IT companies have jumped on board. At the last count, nearly 2500 organisations had signed up to the SIG.

Bluetooth's raison d'etre is a short-range point-to-point radio communication standard that's slated to replace tangle-happy cabling and the less-than-reliable IrDA (line-of-sight infra-red) system. The most most obvious applications are the transfer of data between mobile computers, hand-held peripherals and mobile phones. Nokia sells a 'connectivity pack' that includes a pair of Bluetooth transceivers. One takes the form of a replacement battery pack for its 6210 GSM mobile phone, while the other is a mini-PCMCIA card for a portable computer (unfortunately, the drivers only cope for Windows 98 or later - and not, as one would logically expect, Windows CE devices). With this £200 kit, you can use your 6210 as a truly wireless modem. Although the 6210 doesn't support GPRS, it is compatible with Orange's HSCSD system, which will deliver transfer rates of up to 28800bps (against GSM's top rate of 9600bps).


6210 connectivity kit

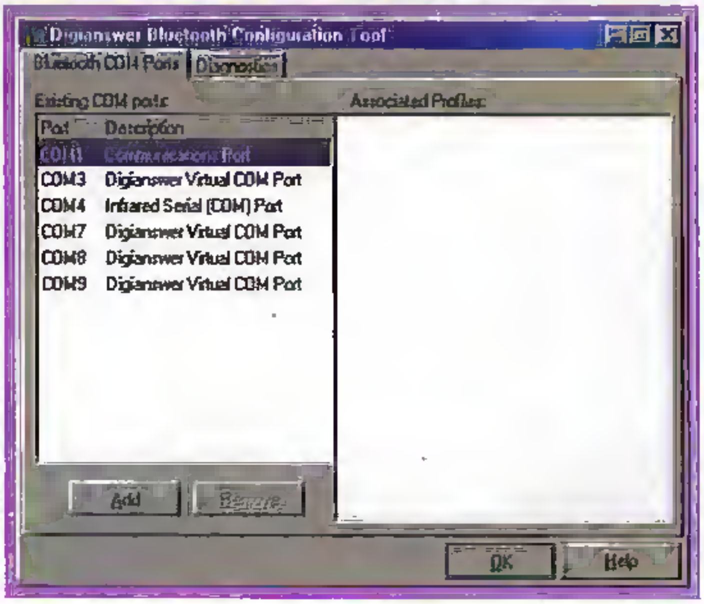
If our experience with the Nokia product is anything to go by, Bluetooth is going to be a resounding (and idiot-proof) success. The hardware is easy to install, being true 'plug-and-play'. Nor did we have any trouble with the Windows software. After rebooting your notebook, you can run the 'Bluetooth Neighbourhood' program, which seeks out any Bluetooth devices in the area - including your 6210, should it be powered up. If it is, it will appear in the program's main window. At the same time, an icon appears on the top-left of the phone's display to indicate that Bluetooth communication is now in effect. Clicking on the '6210' icon invites you to enter its unique transceiver 'passkey', which is printed on a supplied label (Bluetooth devices are individually-addressable, and the communication that goes on between them is 'secure'). This procedure only has to be carried out once - unless you have to reinstall the software for some reason, or have specified a 'bonding' (i.e. expiry) time in the program's set-up menu.

Before you can do any useful work, though, you have to run the 'modem setup' program that's located on the CD-ROM. Do this, and 'Nokia 6210 Bluetooth' then appears on your list of Windows modems. You can then assign this option to any program that needs it. To get online, the Bluetooth Neighbourhood program must always be running in the background. We found that the system was reliable in its operation, with no 'glitches' or crashes - we were able to access our dial-up Internet connection through the Bluetoothed 6210 without any mishaps whatsoever. Even moving the phone to different rooms whilst on-line failed to break the connection. To conserve phone battery life (the transceiver consumes 75mA when operational, against 1mA when it's 'sleeping'), be sure to be sure to 'break' the connection when it's not needed. This comment applies to any Bluetooth device, of course.

In terms of released products, Nokia was pipped to the post by arch-rival Ericsson. A few months ago, the latter company sold a Bluetooth personal hands-free headset for some of its handsets (such as the T28). As with the Nokia kit, this consists of two components - the hands-free headset itself, and a module that plugs into the base of the phone itself. £200 can be considered a lot of money for something that's normally bundled free with mobile phones nowadsys, but the Ericsson product does have some advantages. First of all, the headset can be separated from the phone by distances of up to 10m - against the 50cm or so of the average 'wired' hands-free headset. Secondly, the phone module will communicate with other Bluetooth devices. We can expect to see these increase in number over time. Computers and printers with Bluetooth built in are on the horizon (lest we forget, H-P sold an IrDA-equipped LaserJet not so long ago). Computer input devices, such as handwriting scanners (the much-hyped CPen, for example) and wireless mikes for voice-recognition are also ripe for the Bluetooth treatment.

German computer peripheral company Elsa has announced a fully-blown car kit, albeit in prototype form. The system reproduces the incoming side of the call through the car's audio system - the driver's dulcet tones, meanwhile, are picked up via a lozenge-shaped microphone located somewhere convenient.

Elsa Bluetooth handsfree car audio interface prototype



Left: 6210 connectivity kit

The company presumably hopes to sell the idea to the car manufacturers (Elsa's kit was installed in an electric version of Ford's Ka - itself a prototype). Why? Thanks to Bluetooth, a car kit will work with any compatible mobile phone - regardless of manufacturer. Today's car kits, conversely, tend to be specific to a particular range of phones - if you change your phone, you'll need to rip out the car kit and replace it with one specific to the new model. Buy a car with a Bluetooth hands-free kit fitted as standard, and you'll be able to use it with your Bluetooth phone as you drive it off the forecourt, no doubt telling your friends about how much the vehicle has depreciated as you do so...

Mobile phones with integrated Bluetooth are already - Nokia reckons that by 2003, there will be 250 million of 'em globally. The recently-introduced Ericsson T39m is quite an impressive package - and a small one to boot. In addition to IrDA, it supports - amongst other things - IrDA, WAP, Internet (POP3/SMTP) e-mail, GPRS and HSCSD. Oh yes, and it's tri-band too. A great choice, then, for travellers to the US - some parts of which are spanned by GSM1900 coverage. Ordinary dual-band phones only cater for GSM900 and GSM1800. I had a chance to try out the T39m, which sells for £100 with contract, and was thoroughly impressed with it. The GPRS capabilities of the T39m are 3 timeslots download, 1 timeslot upload (also known as 3:1). Translated into English by Ericsson, this equates to a maximum download speed of 43.2kbps (i.e. 4Ω times as fast as GSM data). One would presuppose that you would be able to surf the net quickly using your Bluetooth-connected notebook - but the networks won't let you. At this stage, GPRS has been 'firewalled' to let only WAP traffic through.

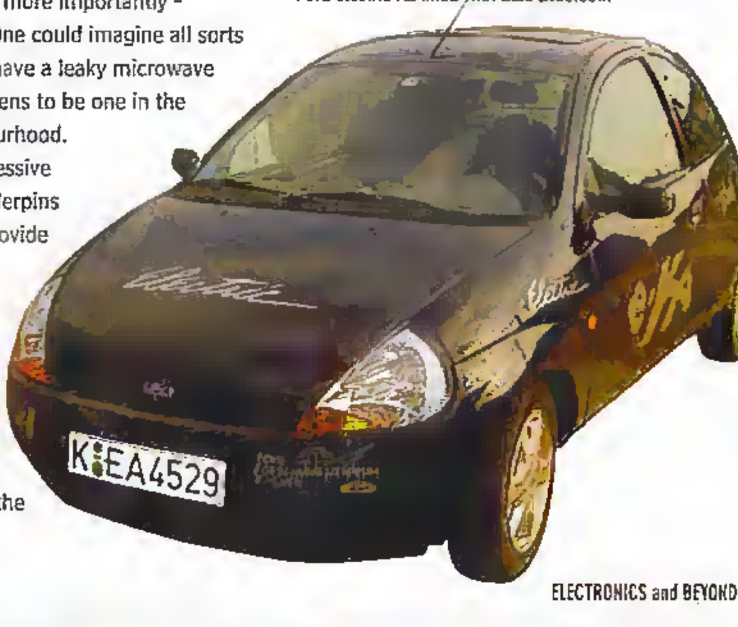
Bluetooth is currently quite expensive, but we can expect to see a VLSI chip that contains all of the required digital/RF circuitry. Owing to the tiny wavelengths involved, the aerial will be small enough to be etched onto the PCB. Product developers, meanwhile, will benefit from software development kits for product developers.Although Bluetooth currently adds around $30 to the manufacturing cost of a mobile phone, the cost will fall in time to under $5. The current 1.0 version of Bluetooth cannot manage a gross (the aggregate of transmit and receive paths) rate of more than 1Mbps - the latest version of IrDA is therefore faster. Bluetooth is, however, easier to use. You don't need to bother with lining up the infra-red windows of both devices as you do with IrDA. And because Bluetooth employs low-power radio rather than optical paths, there's no need for line-of-sight. As long as the two Bluetooth devices are within ten metres or so of each other, then they should able to communicate. Walls won't prove obstructive either, unless they're lined with metal.

Frequencies? Bluetooth will operate on the licence-free 2.45GHz industrial, scientific and medical (ISM) band. In UK homes, these frequencies are used for the latest breed of video senders and - more importantly - microwave ovens. One could imagine all sorts of problems if you have a leaky microwave oven, or there happens to be one in the immediate neighbourhood. Hopefully, the impressive technology that underpins Bluetooth should provide some guarantee of dependability. Spread-spectrum and frequency-hopping technology were, until recently, unheard of outside the field of military communication. Bluetooth will use these techniques to automatically find available radio channels (the standard currently specifies 79 of these), and retune if interference is experienced. Indeed, each 'packet' of data is transmitted on a different frequency 'hop' - which helps to reduce the possibility of unauthorised interception by hackers. As another deterrent, authentication and encrytion are also supported.

Frequency-hopping and authentification also addresses the issue of congestion - in some areas, there could be a lot of Bluetooth activity (hands-free headsets, file transfer) going on within that ten-metre radius. Bluetooth will also support up to three simultaneous voice channels, or mixed data/voice. This opens up the worlds of multi-player gaming, technical support and simultaneous talk and fax/e-mail. Other potential future applications are also quite exciting. In the automotive field alone, we could have automatic payment for petrol (pumps would be Bluetooth-enabled), automatic tollbooths (DART-Tags brought up to date!), security systems (Bluetooth 'keyfobs') and even engine management units that dial up roadside recovery operators via your mobile phone in the event of a breakdown. Then there are the other applications - school and home networking, digital cameras and MP3 players.

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

Ford electric Ka fitted with Elsa Bluetooth



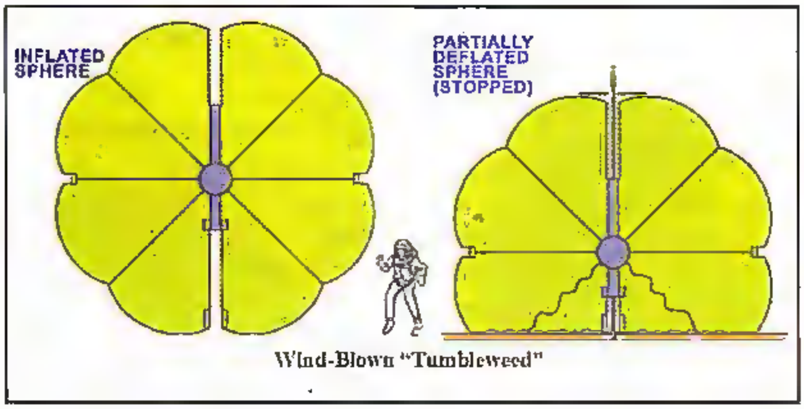
< Rover and Rover – life imitates art, but which one is the strangest

THE STRANGE BUT TRUE STORY OF HOW AN AMUSING ACCIDENT IN THE DESERT INSPIRED A NEW AND HIGHLY UNUSUAL KIND OF MARS ROVER – A TWO-STORY HIGH INFLATABLE BALL DESIGNED TO EXPLORE THE PLANET WHILST BEING PUSHED ALONG BY MARTIAN AFTERNOON WINDS...

The Tumbleweed Rover

Imagine the scene: you are out in the Mojave Desert testing the latest prototype Mars Rover when suddenly one of the spherical balloon tyres breaks loose and makes a run for it across the desert. Fans of the cult 1960s TV series The Prisoner will appreciate the joke. In the series Patrick McGoohan was constantly thwarted in his attempts to escape the sinister Village by a giant white ball called Rover. Whilst the writers of The Prisoner were uncannily accurate in their depictions of a lot of technological devices which are commonplace today, they cannot possibly have foreseen that one day NASA scientists would be prototyping a giant inflatable Rover for possible future missions on Mars.

The 'Tumbleweed Rover' as it has been named, was one of those great inventions discovered entirely by accident – and that accident was the one in the Mojave Desert where the shoulder-high spherical wheel broke off and blew away in the wind.



Technician Tim Connors had to flag down a passing all-terrain vehicle to chase after the wheel. The winds were only about 20 miles per hour but the wheel, in Tim's own words, 'went a quarter of a mile in nothing flat'.

'It soared,' said colleague Jack Jones, 'Tim was flying over the sand dunes trying to catch it. The ball went up steep, steep cliffs of sand. Nothing stopped it'. Until, that is, Connors on the borrowed ATV managed to catch up and corral it.

Everyone who was witness to the event was impressed. The idea of making an inflatable spherical rover was not new, but previous prototypes had been small and tended to get stuck against knee-high rocks. The answer, it seemed, was to make the tumbleweed-style explorer as big as possible. 'Therein was planted the seed,' said Jones, 'that if we make these things big enough, nothing will stop one'.

'Big enough', it seems, will eventually mean two storeys – enough to swallow six Patrick McGoohans, maybe more. In the thin winds of the Martian afternoon, the Rover could accelerate to speeds of about 10 metres per second. It will be equipped with water-detecting instruments held in place by tension cords and will be able to stop and 'park' itself by partially deflating. To get going again, all it needs to do is re-inflate.

Mission controllers would be able to decide roughly where the Rover goes by waiting for the wind direction to change before re-inflation, but there is a more precise means of control over the vehicle being discussed – a centre-of-mass control device that would allow the ball to be steered by pumping fluid to its left, right or centre.

The Sphere-Wheeled Rover whose runaway wheel inspired the design of the Tumbleweed

Prototypes of the Tumbleweed at quarter size (1.5m) have been tested out this summer with extremely encouraging results. The experiments confirm that a sphere of 6m in diameter should be able to climb over or around one-meter rocks and travel up slopes of 25 degrees and higher in the thin, but breezy Martian air.

Future tests in coming months will include drop tests in the desert with a prototype Tumbleweed made out of Vectran – the same material used for Pathfinder's airbag landing system, and long-range testing of thousands of kilometres in a harsh Arctic or Antarctic environment.

For more information about Mars exploration you can go to mars.jpl.nasa.gov, and for more information on The Prisoner, you can visit the UK and US appreciation society websites on www.sixofone.org.uk and www.ThePrisonerAppreciationSociety.com.