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ELECTRONICS and BEYOND **August 2001**

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01895-433649

USA Distribution :
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(001) 303-456-2060

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Electronics and Beyond is published monthly
By post, current issue £3.19 inc p & p
Back issues/articles available on request
All orders, payments and correspondance to:
Electronics and Beyond,
Units 17/18 Glanyrafon Enterprise Park
Aberystwyth
Ceredigion
SY23 3JQ
Cheques should be made payable to
Electronics and Beyond

Subscriptions: 01970 621039.
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Subscripton Rates:

	1 year	2 years	3 years
UK & Eire	£28	£50	£75
Europe *	£28	£60	£80
Rest of World	£62	£110	£140

Printed by Cradley Print, West Midlands

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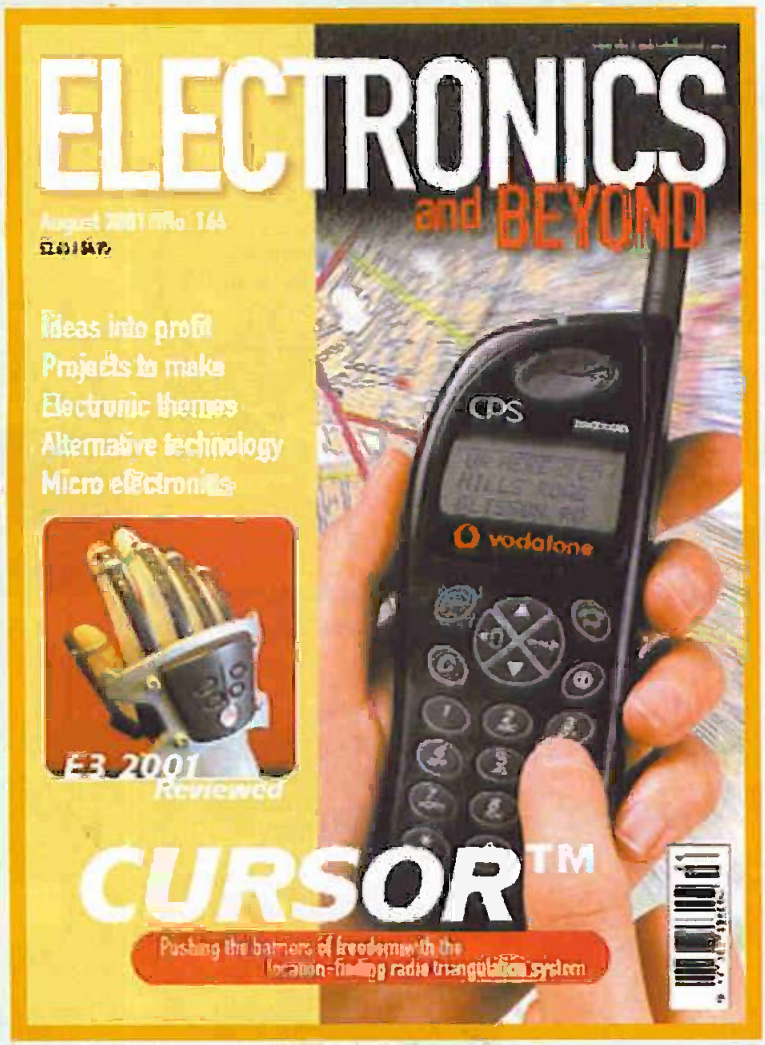

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The Past, Present and Future of Electronics

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.

You can contact me at jaldred@kanda.com.

Anna Penar – Media Sales Manager

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

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

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

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

Natasha Nagaoka – Publishing Manager

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

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

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

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

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

Paula Matthews – Subscriptions Manager

I was born in Sutton 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.

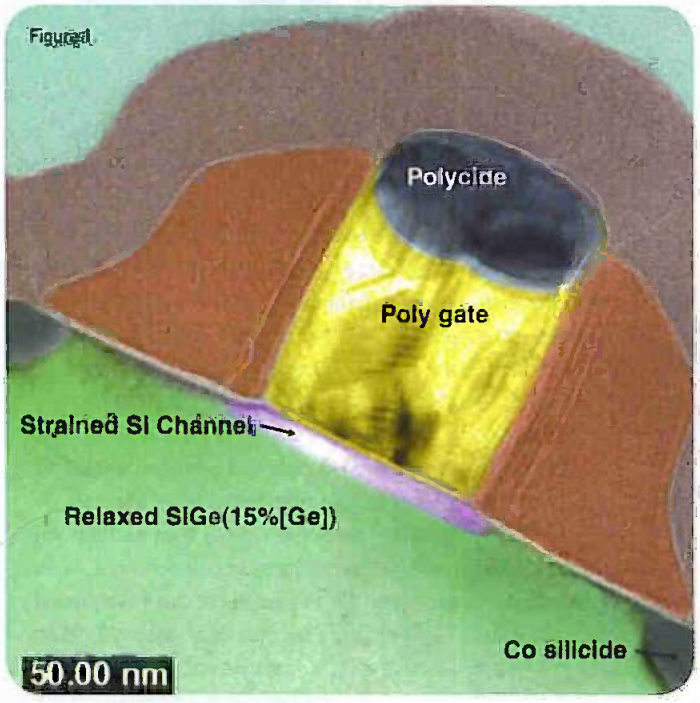
I look forward to talking to you and helping you with any questions you have as a subscriber to Electronics and Beyond.

Time for holidays...

While you are lazing on the beach, why not read about life without electricity in the depths of Winter in a house on a hill, a real-life story from AG Hamilton in our red section this month. We also take you to E3 translated in plain English as the Electronic Entertainment Expo which is the most important of all the events in the video gaming industry. Our News Editor gives you a review of the 'big four' consoles from Nintendo, Microsoft, Sony and Sega. Leaving the modern world behind, Mike Holmes takes us through Part 2 of his restoration of an Antique Radio.

If you do get lost in the jungle this Summer, unable to find your way having left your map in the hotel and you cannot find a friendly passer-by in the vicinity then perhaps you might consider GSM as a means of making sure you don't get eaten alive, just look in our blue section for the details of this revolutionary technology in 'Cursors ™- pushing the barriers of freedom'. In Web Electronics, this month we have a historical bias and a topical one in relation to Marconi who like many high-tech organizations are feeling the bite of the current downturn, we hope that you will give us your thoughts in future issues on the state of what were once seen as infallible giants. In our special short story, we look at the flip side of Ham Radio in the Special R.D.F Event by one of our readers, Ken Smith. If you would like to get to grips with PCB's, have a look at Harvey Twyman's series on PCB Assembly Techniques. You may need a Quiz Timer or Dice Simulator or a Low Power Amp then see our project section this month. Is Intelligence the Key to success in business, how important is scanning, generating and utilising intelligence, see Ideas in to Profit for some answers. This August, we also introduce Peter Brunning's Public Diary and see the trials and tribulations of setting up a website in practise. If you live in a dark street then perhaps you may consider getting your local council to construct some wind-powered green street lamps to lighten your path home. For lazy days we also have a lazy project, the Lazy Person's Diode Tester by David Clark. Try and catch the bunny as we give you the second part of the GPS Logger with a Rabbit ....

We, at Electronics and Beyond hope you enjoy your holidays



IBM Alters Silicon To Increase Chip Speeds

Figure 2.

IBM have announced a breakthrough method to alter silicon – the fundamental material at the heart of microchips – which is expected to boost chip speeds by up to 35 percent. Called 'Strained Silicon', the technology stretches the material, speeding the flow of electrons through transistors to increase performance and decrease power consumption in semiconductors.

IBM estimates that strained silicon technology could find its way into products by 2003. 'Most of the industry is struggling with extending chip performance as we approach the fundamental physical limits of silicon,' said Randy Isaac, vice president of science and technology, IBM Research. 'We're able to maintain our technology lead by also focusing our research on innovative ways to improve chip materials, device structures and design. This approach to R&D makes possible breakthroughs like strained silicon'.

The new technology takes advantage of the natural tendency for atoms inside compounds to align with one another. When silicon is deposited on top of a substrate with atoms spaced farther apart (such as silicon germanium), the atoms in the silicon stretch to

Figure 3.

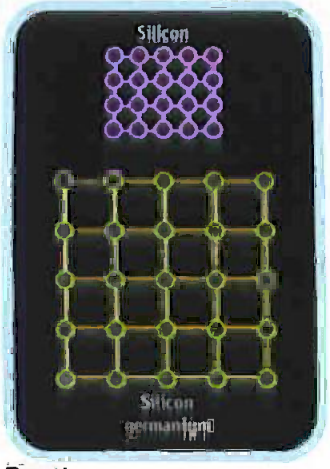
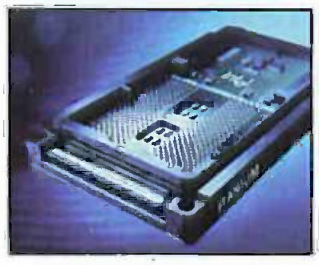


Figure 4.

NEWS bytes

Intel Introduces Xeon and Itanium Processors



Intel have introduced two new processors over the last couple of months. The Xeon (pictured) is designed for high-performance and mid-range, dual-processor enabled workstations and will ship at frequencies up to 1.7 GHz. The Itanium is the first in a family of 64-bit products aimed at the uppermost portion of the user market.

Intel expects Xeon-based workstations to achieve performance increases

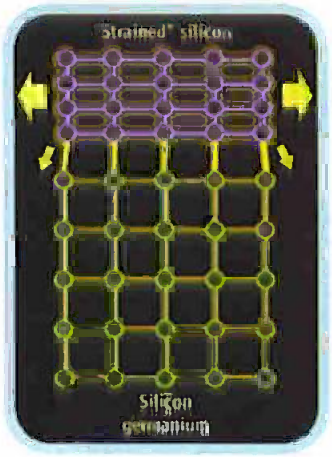


Figure 5

line up with the atoms beneath, stretching – or 'straining' – the silicon. In the strained silicon, electrons experience less resistance and flow up to 70 percent faster, which can lead to chips that are up to 35 percent faster – without having to shrink the size of transistors.

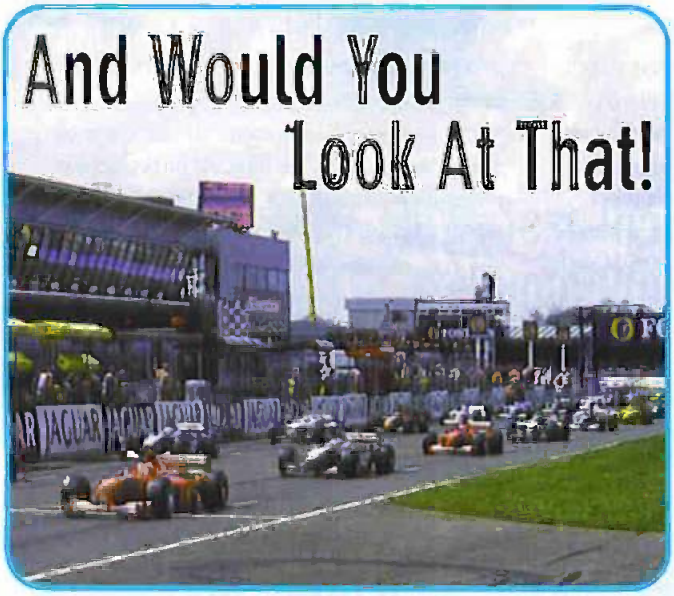
Figure 1 shows a transistor built with strained silicon, Figure 2 shows electrons flowing through a current silicon chip, and Figure 3 is an image of electrons flowing through 'strained silicon'.

Figure 4 shows an array of atoms in a silicon lattice (top) and a silicon germanium (SiGe) lattice (bottom). Note that the distance in the silicon germanium lattice is spread farther apart than in the silicon.

Figure 5 shows that when silicon is put on top of silicon germanium, the atoms in the silicon stretch to align with the atoms in the silicon germanium.

More information on IBM's related semiconductor research can be found at www.chips.ibm.com/bluelogic/showcase

And Would You Look At That!



With the exception Michael Schumacher, who is well known for excelling in the wet, nobody cheers up when they see the raincloud gathering over a Formula One race circuit. Such things happen, however, and they tend to happen at British motor racing events quite a lot. The people at Silverstone have taken no chances in making sure that if it does rain, the power systems around the racetrack will not be affected.

For the third successive Grand Prix MGE UPS Systems and European Power Services (EPS) are working in unison to make sure the only power problems experienced are those associated with launch control. The two companies are supplying a containerised UPS system and standby generator. These will virtually eliminate harmonic disturbance and provide instant standby AC power via a bank of high-voltage batteries to feed the race control complex in the event of a mains failure.

The need for such a solution was brought home to the Silverstone directors in the lead up to the 1998 Grand Prix, when electrical storms caused a spike in the power supply, sending major ripples across the facility's feed lines and crashing all race control computers. Luckily, the ensuing chaos did not result in the event being postponed, as it was fixed in time for the race sessions to proceed. The experience, however, left Silverstone management adamant that this type of disturbance would not be repeated at any of its future motor-sport events.

Samsung Unveils First Ultra-Slim 9.8mm Handset

Samsung have released pictures of what is at present the slimmest handset phone in the industry. At only 9.8mm it is less than 1cm thick, breaking a significant barrier and throwing the gauntlet down to other mobile phone manufacturers to do the same.

The SPH-N2000 (Korean product name) is a flick-type handset incorporating a 4-grey LCD, internet browser ME (Micro Explorer), an upgraded SMS (Short Message Service), sample emoticons and a memory capacity that can store up to a thousand phone numbers.

http://samsungelectronics.com/news/telecommunications.

NEWS bytes

between 30 and 90% over systems featuring the Pentium III and expects dual-processor server platforms based on the Xeon to be available in the second half of 2001.

The Itanium has been in development for almost 10 years and it should have appeared two years ago. HP, IBM, Compaq, Dell, and Silicon Graphics have announced systems based on the new chip aimed at competing directly with Sun Microsystems' workstations and servers.

Intel has also dropped the prices of some of its Celerons and Pentium IIIs to fend off competition from AMD, who have also been releasing faster desktop chips, including a 1.4Ghz Athlon processor.

Generator Sales Skyrocket in America's 'Rolling Blackout State'.

California has gained a name for itself recently throughout the USA and beyond as the 'rolling blackout state'. Given its well-publicised problems, it is hardly surprising that in a recent survey nearly one in four California homeowners indicate they are considering buying a home generator in the next two years.

Already the sales of home power generators have skyrocketed. In the US as a whole, 17% of homeowners plan to purchase a generator in the next two years; in California, that number is 24%. California is the 10th largest consumer of energy in the world, using more power than all of France.

In a sign that not

NEWS bytes

much has changed to alleviate its problems, the state faces an estimated shortfall of at least 3,000 megawatts of power this summer.

Merlin Release Maxcharge Alternator Controller

This new alternator charge controller is designed to overcome many of the electrical problems found on specialist vehicles, plant and industrial engines. It is designed to overcome many of the charging problems caused by the alternator's own internal regulator when heavy charging loads are encountered. By using Maxcharge you can turn your alternator into a 3-stage smart battery charger. The company claim a 30% improvement in recharging speed and increased safety.

Maxcharge (£200) is also fully programmable. By using an embedded reed switch and a magnetic programmer (supplied) users can customise their charging regime to suit their own specific batteries. It is pre-programmed with six regimes for: Standard Lead Acid, Deep Cycle Lead Acid, Sealed Lead Acid, Gel, Optima and the latest AGM battery technology.

Unlike any other controller of its type, it has a digital display to keep users informed of its status and aid in programming. The unit is also equipped with a fault memory allowing engineers to quickly correct even intermittent faults.

Merlin Equipment Ltd can be contacted on 01202 697979 or through www.the-merlin-group.com.

New Satellite Series PCI Expansion Chassis for PCs, Macs and Suns

Adept Scientific have announced the release of a new Satellite series PCI expansion chassis from Measurement Computing Corporation, the new name of ComputerBoards Inc. Compatible with a PC, Macintosh or Sun system, this portable unit is available in two table-top models, with or without built-in temperature monitoring, and provides eight additional PCI slots.

The Satellite chassis includes an internal monitoring system that continually measures power supply voltages, air temperature between each slot and cooling fan functionality. Software supplied with the chassis allows users to easily monitor their system. The software program is accessible through VB/C++ examples and a DLL file.

The Satellite series chassis introduces an option to easily extend computer systems across all PCI-based industry platforms. The series allows OEMs, VARs and System Integrators to deliver a complete system without a PC, saving time as well as potential support headaches. This also saves end-users' outsourcing and equipment costs.

The tabletop PCI chassis provides access to system boards with the removal of two screws, rather than disassembling an entire system to install a board. This approach provides a quick and easy solution for system reconfigurations. The chassis also simplifies board connections by offering front-access connections for field wiring.

Each chassis has a 32 bit and 33MHz embedded industry standard Intel 21150-AC bridge chip that assures compatibility with virtually all PCI computers. You can find out more by visiting www.adeptscience.co.uk.

Fluke Put Waveform Maths Functions Into ScopeMeters

Fluke, worldwide leader in professional electronic test tools, have upgraded their 190 Series ScopeMeters with a new firmware release that adds powerful waveform maths capabilities. It is now possible, for example, to multiply individual channel inputs to calculate power graphs.

The 190 Series are digital dual-input oscilloscopes available with bandwidths up to 200 MHz and real-time sampling rates of 2.5 GS/s. Each input has its own digitiser, so it is possible to simultaneously acquire and analyse two waveforms. With the new waveform mathematics capability, these input waveforms can be added, subtracted or multiplied. This allows for one input channel, for instance, to be used to measure the voltage across a device while the other input may be set up to measure the current through that device. The display can then show both waveforms plus a trace representing the multiplied traces, representing power as a function of time – useful for fault-finding excessive dissipation that could lead to premature failure.

These new functions are built into version 4.0 of the firmware. Owners of ScopeMeters with V3.x firmware are entitled to a free upgrade, for which a software upgrade tool is available via www.fluke.com/scopemeter. ScopeMeters running earlier firmware versions can be upgraded at Fluke authorised service centres for a nominal charge.

COMPONENT NEWS

New Benchtop Test Tools Catalogue From Agilent

Agilent Technologies has published a new 36-page catalogue covering a range of low-cost, professional benchtop instruments available through distribution channels. Available from Agilent Distributors throughout the UK, the free publication covers basic instruments for signal measurement, and power and signal sourcing, as well as various connectivity products.

Illuminated Push-Switches From Quiller

Available exclusively in the UK from Quiller Electronics are these compact illuminated push-button switches manufactured by Otto. The LP3 is a straightforward push-button version with low contact resistance, while the LP5 has an alternate push-on, push-off action with a high degree of positive tactile feedback. Both types are moisture and dust proof. These tall domed-style buttons are available in translucent white, red and amber, and printed legends can be supplied to order. Contact: www.quiller.com (sales@quiller.co.uk) 01202 436777.

Fluke Test Tools Catalogue 2001

Fluke has just released its Test Tools 2001 Catalogue. The 48-page full-colour book is available free of charge, and contains complete descriptions of features and specifications for Fluke's full line of electrical test tools. Sections include handheld digital multimeters, basic electrical testers, ScopeMeters, insulation resistance testers, process calibration tools, power quality tools, clamp meters, digital thermometers and accessories. Contact Ken West (0207 942 0700, ken.west@fluke.com) for further details.

Blue-Green LED Panel Meters from Datel

Datel's new DMS-30PC-VFS Series Digital Panel Meters combine brilliant blue-green LED's with a optical filter to create an affordable readout said to be visually indistinguishable from costly Vacuum Fluorescent Displays (VFDs), which have well known shortcomings such as high power consumption and complex drive circuitry. These silicon-carbide LEDs have excellent clarity and readability and are said by the manufacturers to be visible even under the brightest ambient light conditions. www.datel.com for further details.

Sonare 5.1 from ARC Acoustics

The Sonare system from ARC Acoustics incorporates 5 NXT flat speaker panels, which can be either free-standing or wall mounted, as well as a compact active subwoofer together with connecting cables and wall mounting brackets. Available from the beginning of August, they will have a RRP of £229.90 inc VAT. 01638 721237 or email arcacoustics@aol.com.

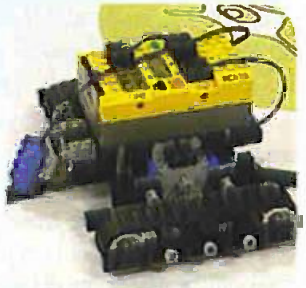
NEWS bytes

SHARP Wireless LANs

Also from SHARP, are new wireless LAN devices either as a module for on-board installation of as a PC card for direct insertion into notebooks, or other network components such as routers or bridges. Wireless LANs are at present used in hospitals by doctors to access patients' files through their portable notebooks or industrial pen PCs.

For further details see www.sharpsme.com.

Acroname Use LEGO To Build On Web Site



Acroname (Featured Last Issue) have added a LEGO section (www.acroname.com/lego/lego.html) to their web site. In LEGO Central you can read about new LEGO Mindstorms products, events and competitions, learn tips and tricks, and more as the site continues to be developed.

Peter Brunning's Public Diary

August 2001

If you have read one of my books you will realise that I do enjoy writing. One of the problems writing technical books is that I seldom get the chance to really hammer away at the keys; there is always evaluation required during the writing. The idea of this diary is to give me an opportunity to allow my thoughts to run wild without the constraints of needing to consider the technical implication.

The first topic that I want to ramble on about is the Brunning Software web site. Up until the 5th May this year (2001) I had never been online, a fact that surprised many of my customers. 'How can you be a software company and not have a web site?'. A good question to which my answer was that I was too engrossed in my writing to risk being diverted by other matters. However the arguments put to me by a customer who had had great difficulty locating our telephone number finally tipped the balance. He was so obviously right we did need to have a web site.

So on the 5th May 2001 I signed up with madasafish.com and had my first experience of being on line. It was every bit as soul destroying as I had imagined. My first task was to see what other people had produced so I toured the web visiting various sites simply to study the general feel. Then I searched for sites with naked females and was offered quite an amazing range of pictures. While I adore the sight of naked females displaying their natural soft curves from whichever viewpoint they choose, I am most definitely not wanting to see females being degraded in any way. All us males have very base instincts built into our structures but it is our civilised appreciation of the female side of life which makes us conform.

I got carried away. I was intending to write about the reasons why I had not previously been on the web. When I am writing I use two computers, a portable to type the actual words and a desk top to test out any programmes that I am writing about. Both of these computers contain invaluable information. Obviously the data is backed up (on CD) but the problem is bigger than just needing to be able to recover from data loss. I need to know that my words have not been altered and that my programmes have not been tampered with. For this reason all my book text and programme text is stored as encrypted data, but some of the data cannot be encrypted as it is used by other programmes. I had decided that neither of my main computers will ever be connected to the web. If and when I decided to use the web I would need to purchase a computer solely for that use. And that is what I did in early May this year. I visited a computer fair in Colchester and for just 185 pounds purchased a second user P200 with 2Gb hard drive already setup to use on the web with modem and software installed.

I am now at last ready to make the point of this writing. A week or so back the madasfish.com site failed and for a whole evening I was unable to add my latest modifications to the Brunning Software site. A day or two later an advertising leaflet arrived in the post from BTinternet. A telephone call to them convinced me that it would be cheaper using their pay as you go service than the rate being charged by madasafish.com (I was in fact misreading the advertising leaflet as the prices had just changed but the person I spoke to did not point this out to me). It was agreed that BTinternet would send me a CD so that I could sign on to their system.

This little story now goes from bad to worse and confirms my worst fears about the dangers of exposing a computer to these automatic systems. A day or two later I had not received the promised CD so I visited the BTinternet web site, still convinced at that time they would be lower cost. So instead of waiting for the CD I used their site to sign up. So far so good and very easy to do. No problems!

I had used btinternet.com several times for access when it occurred to me that I was still dialing 0845 so therefore the cost would be the same as madasafish.com. I rang the BT sales line but the girl did not know about internet charges. I rang the internet number and was told to ring the sales number for prices. A typical big company problem. I had too many other problems to get bogged down in this!

A few days later the promised CD arrived. I popped it into my internet PC and clicked onto prices to find out how much I was being charged. It seemed to need to install itself before the question could be answered so I clicked onto install. It ignored the fact that my system was already setup with the latest versions of internet software and went through the process of installing a complete set of programmes. When it had finished I was asked if I wanted to sign up now and clicked onto NO.

I clicked onto prices and no more information was available than before it had installed itself. I resolved I had had enough I would return to using madasafish.com. So intending to forget about this waste of an hour I decided to check for emails. Horrors of horrors there was to be no escape! I was returned to the btinternet sign up message. Did I want to join now or later? 'I have already joined a week ago' I shouted at it but to no avail. Try as I might my access to the web was now blocked. It was sign up or never get on again. So I thought 'Hell let it do it if it must' and clicked onto sign-up-now. I input the same data as before and was told that I could not use that user name as it was already taken! 'Yes I know, that is what I am trying to tell you' I shouted at my computer screen. So I signed on with a different name, went right through the process and then tried to logon. I was again given the sign up now or later message!

I tried to clear it all out but it wouldn't go. New software wouldn't install because it was already there. Two hours later I finally found the answer. I had in desperation deleted all the internet software but it actually hadn't gone. I was able to ask internet explorer to install the previous version and it did it successfully. I had tried to do that an hour previously without success.

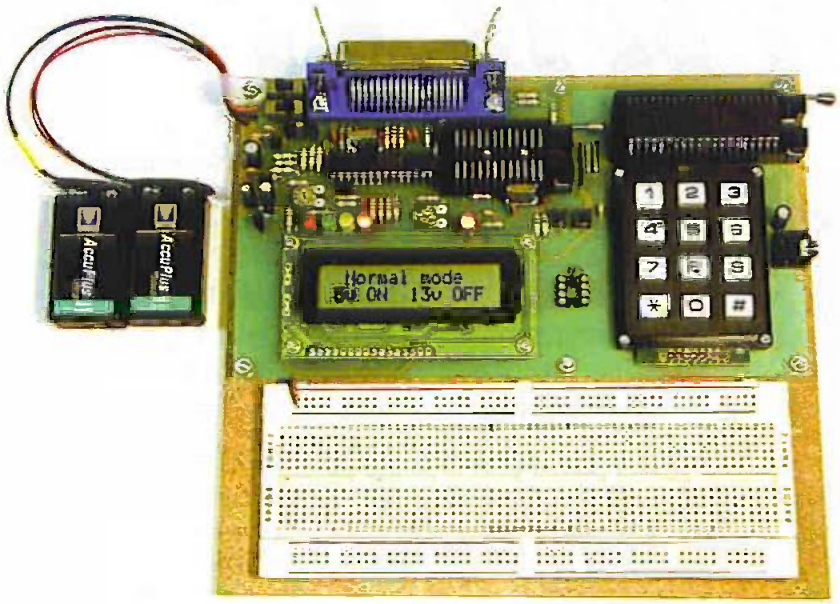
Half of an afternoon and a whole evening had vanished and all I wanted was to know how much I am being charged when I use btinternet pay-as-you-go. The only mistake I made was allowing the CD to install itself when I was already signed up to the service I wanted.

Now a few days later I have evaluated all the data and this is what I summise. If I had signed up before the 1st June 2001 I would have been given an 0844092 number which is charged at 2p/minute daytime and 1p/minute evenings and weekends but because I signed up after 1st June 2001 I have been given an 0845 number which is charged at 4p/minute daytime, 1.5p/minute evening, and 1p/minute weekends.

It was 1st June when I first rang btinternet and I explained that I wanted to join because their prices were lower than madasafish. I suspect that the people I spoke to knew that the prices had just increased to the same level as madasafish but did not want to discourage me from signing up to their service. I will keep the btinernet pay-as-you-go connection as an alternative but on principle I will use madasafish.com whenever I can.

To read more of my ramblings visit www.brunningsoftware.co.uk click onto 'sterio pictures' then click onto 'Peter Brunnings diary.'

Learn The Easy Way!



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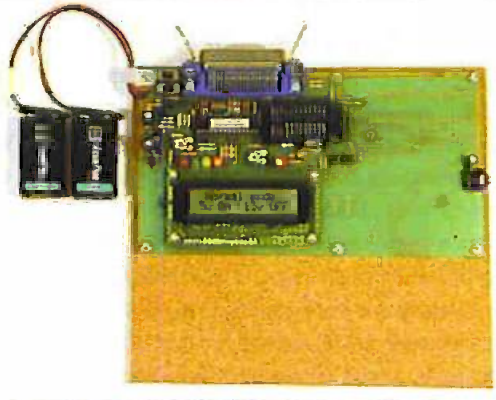

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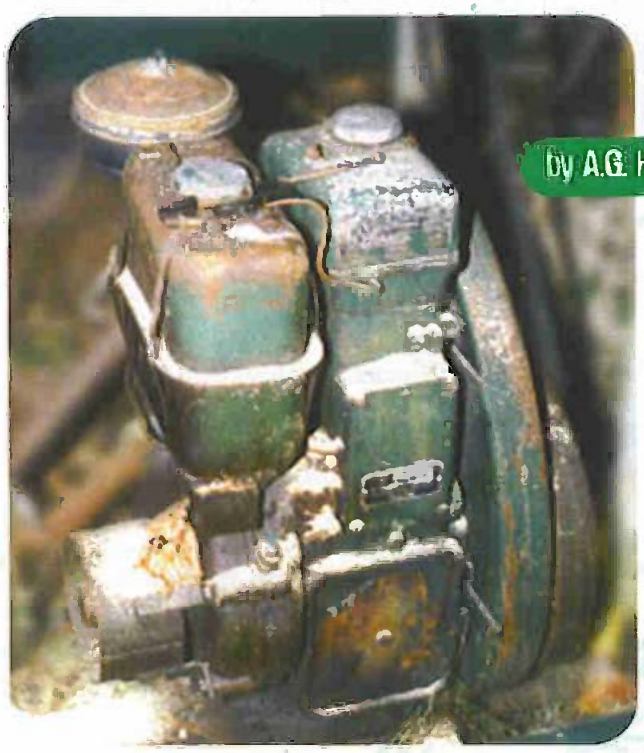
ELECTRICITY?



by A.G. Hamilton

A.G. HAMITON-GREY RELIVES HIS EXPERIENCES OF LIVING WITH AND WITHOUT ELECTRICITY AND, LATER ON, INSTALLING HIS OWN DIESEL GENERATOR TO POWER HIS HOME – SOMETHING THAT WORKED SO WELL, HE NEVER DID GET HIS HOUSE CONNECTED UP TO THE NATIONAL ELECTRICITY GRID.

What is it? You can't smell it, you can't see it, but if you can make it and sell it, what a price you can charge for it.

We just flick a switch or push a button and there it is. We take it for granted that it will be there whenever we want or need it – we possibly waste a lot of this form of energy.

Just imagine if you only had a measured amount to use at any one time. In the mid 1980s my wife and I bought a smallholding of a few acres 1100 feet above sea level in the Cambrian mountains. Lovely views of over thirty miles to the south-west, the house facing due west, beautiful sunsets, but no mains water or drainage, also no electricity.

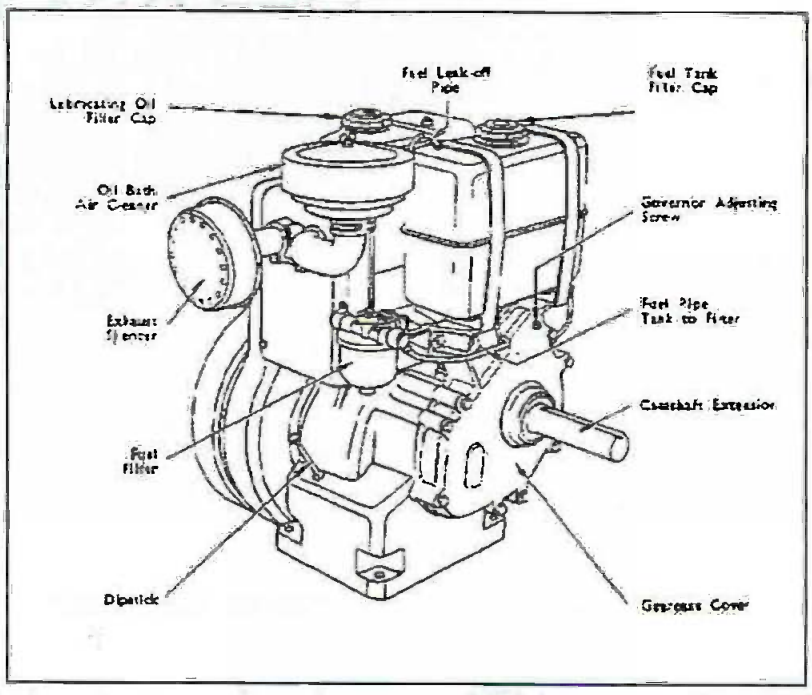
Water came from a spring in a neighbouring field and was brought to the house by a hose-pipe laid on the ground, lighting was by LPG and the toilet was the well-known bucket and chuck it system. No means to power a television and Mr Bayliss's radio was not yet on the market. The lighting was very romantic, if not very bright (but good enough to stop you tripping over the dogs and cats and various forms of footwear). It gently hissed and flickered and looked very cosy, even better if we were gently tipsy. As I sat in my favourite armchair in this rosy glow I thought back to my childhood in the country.

Our radio, or wireless as it was then called, used valves (or tubes in the USA). For you younger readers these were glass bottles filled with the most intricate structures made out of wires, mesh and some pieces of metal which could be silver, black or grey in colour, terminated in four, five or eight pins in the base. For power, the wireless had 2 circuits, high tension supplied by a 120V dry battery and a low tension circuit powered by a glass accumulator which gave 2V at a few amps to power the heaters in the valves. This wet cell had to be charged weekly at the local garage, which had an exchange system and cost 6d (2?p). In the towns, of course, mains electricity was the norm and usually consisted of 1 socket (15 amp round pin) on the landing for those lucky enough to own a Goblin vacuum cleaner, no sockets were required in the bedroom, 1 socket in the hallway, 1 in the lounge and the same for the dining room. This led to the use of several adapters, which could look like a Christmas tree sticking out of the wall. A whole variety of sockets were available at the time: 2, 5 and 15 amp, both in 2 or 3 pin variations. Each individual socket was supplied by rubber covered cable which ran back to the fuse box – no fused plug tops like today. All the cables for power and lighting arrived at the fuse box like a huge pile of black spaghetti pouring out of the wall. No RCDs. If you blew a fuse everything else just carried on working, whereas nowadays at the slightest provocation the whole ring shuts down. Even something as simple as ironing became a problem for the family. An adapter with a pull switch fitted into the lamp fitting and then the iron connected into this – no earth, no temperature control, only on or off. The lamp swinging violently as mother dashed away with the smoothing iron, this made reading very difficult with shadows leaping all over the room. But at least I could listen to the radio; a 1936 mains radio with a built in frame aerial, it had a turntable to allow the radio to be turned for the best reception, and provision for an external long wire aerial. This allowed me to experiment with various lengths of wire strung across the garden, enabling me to listen to foreign stations at night. One of my favourites was radio Luxembourg 208, a very early pop station. Unfortunately this was prone to fading and as a result I could only learn the words to popular songs over several nights. Some songs I have never heard the beginnings or endings to – so if I sing half a song, blame radio Luxembourg 208. This radio was still running well into the 1960s, never having had a repair or even had the back off, except when I was very young and curious and wanted to find out why you had to turn the radio to improve reception.

Sorry I digress; such are the failings of an old man, back to the plot. After a few weeks of the novelty of no electricity I decided to do something about it and I was advised to contact a man who lived 6-7 miles from us. I called at the local tractor dealer and enquired if they knew of a man who sold generators. They replied 'OH you mean the mad Dutchman' and then told me how to find him. I set off wondering if this was the wisest thing to do. Well the outcome was that the mad Dutchman was indeed Dutch but definitely not mad – a doctor of physics, ex Dutch royal airforce fighter pilot and inventor of the police personal radios while in employment with Philips the electronics company. I explained the situation and he advised us to buy a diesel generator as this would be longer lasting and more economical to run. So we purchased

from him an ex government Lister standby generating set. A Lister air cooled single cylinder diesel engine coupled to a 240V 3KW generator mounted on a frame that looked like 2 RSJs. We brought it home on a trailer, as it was too heavy to move with only 2 people, this became its home for 6 months.

The excitement of having 3KW of power proved too much and a rapid search of the house produced 1 angle poise desk lamp and an extension lead. 2 or 3 swings on the handle and the engine burst into life, we rushed indoors and stared at the lamp stood in the centre of the room (that was as far as the extension lead would reach). We marvelled at this symbol of power, all ours – we were making our own electricity. Several weeks and many extension leads later we had power all over the house and a chest freezer donated by a friend. We wondered if we could keep it frozen during times when the generator wasn't running. An article in a woman's magazine provided the answer – a chest freezer would remain frozen for up to 18 hours. This gave me the idea of putting several large ice-cream containers filled with water in the bottom (not mine, the freezer), this gave us a layer of about four inches of solid ice, this ensured that everything stayed frozen when the generator wasn't operating. This system worked extremely well for over 3 years.



Over a period of time we learnt many lessons. If we only ran lights the exhaust valve stem would carbon up, making it impossible to start the next day. The answer was to remove the rocker cover, push down the exhaust valve with a screwdriver and let it snap up 2-3 times and all was fine. A small spanner and screwdriver became essential equipment to be kept next to the engine. We decided to run a heavier load to see if it made any difference. An old oil filled radiator was put into service as a dummy load and after this I never had to decoke the exhaust valve again. At our altitude, well above the snow line, we had severe frosts and this had two major effects on our lives: The water froze in our hose-pipe water supply in November but I had dug a well during the summer months and by breaking the ice with a big steel rod we carried water to the house in buckets. The other problem was the diesel fuel waxing up – at very low temperatures a jelly-like substance forms in the fuel and will not flow through the fuel system. Desperation, motivation, necessity, call it what you will, led me to use a glass blow lamp to warm the filter housing and inlet manifold, this cured the problem of starting. Something I'd heard or read about many years earlier was that if you add 10% paraffin to the diesel it lowers the waxing point.

I carried out some tests to determine the cost of making our own electricity. The generator cost £350 and had a built-in 1 gallon tank (4.45 litres), this obviously is too small a tank for our needs so beside the generator I stood a 5 gallon translucent tank on a small shelf which I marked in gallon increments. This set up let me determine that it would run for 10 hours on 1 gallon of red diesel, cost then: 40p (which equated to 4p per hour). I tested at varying loads, which seemed to make no appreciable difference in fuel consumption. Maybe on full load the engine ran hotter and it was more efficient. The extension leads that trailed all over the house worked well till one evening the puppy decided to water one of the 4-way rubber blocks, which promptly caught fire. No damage except for the smell of burning rubber but it made me get to work on wiring the house.

Over the previous few months I had been collecting any electrical fittings that were being thrown out by people carrying out house renovations, etc. I had in fact collected enough material to completely wire the house including the luxury of a lamp over the generator, which meant that I could go in at night and see if all was well.

After about three years I thought that mains electricity was no longer a luxury but a necessity and I contacted our local electricity board. After a lot of questions about the location of the house they decided that we did not exist. I explained that we had never had mains electricity, so they would not have a record of our house. Having settled this problem I sat back and waited for a quotation. When it finally arrived I had to sit down in shock – they wanted £13,000 to supply us with their electricity and send me electric bills as well.

I talked to the person that dealt with new installations. When I mentioned that £13,000 seemed a lot for some wooden poles and some cable I was told that £900 was for a transformer that I had to buy. I pointed out that if we decided to move, a £900 transformer would not be a lot of use to me. 'You can't take it with you' I was told. I argued that I had bought it so it was mine. 'No, in the contract you sign you buy it but it stays'. I tried a different tack – once they had put the supply into the property they would send bills forever more and over a period of time they would be in profit – I mean, I have never heard of anyone tell the electricity board to remove a supply from a property and that they would make other arrangements. He was not impressed by this argument. Ploy 3, if I ran my generator for 10 hours every day, 365 days a year using 1 gallon per day at 40p per gallon the total cost would be £146 per year. £13,000 would keep us in diesel for 89 years! We decided not to buy their electricity and keep the generator and its little foibles.

When living with a generator you adjust your lifestyle to suit the fact that you only have a finite amount of energy. When switching on any equipment you listen to the exhaust note of the engine to make sure it can cope with the extra load. This habit remained even after we eventually moved house, much to the amusement of our friends.

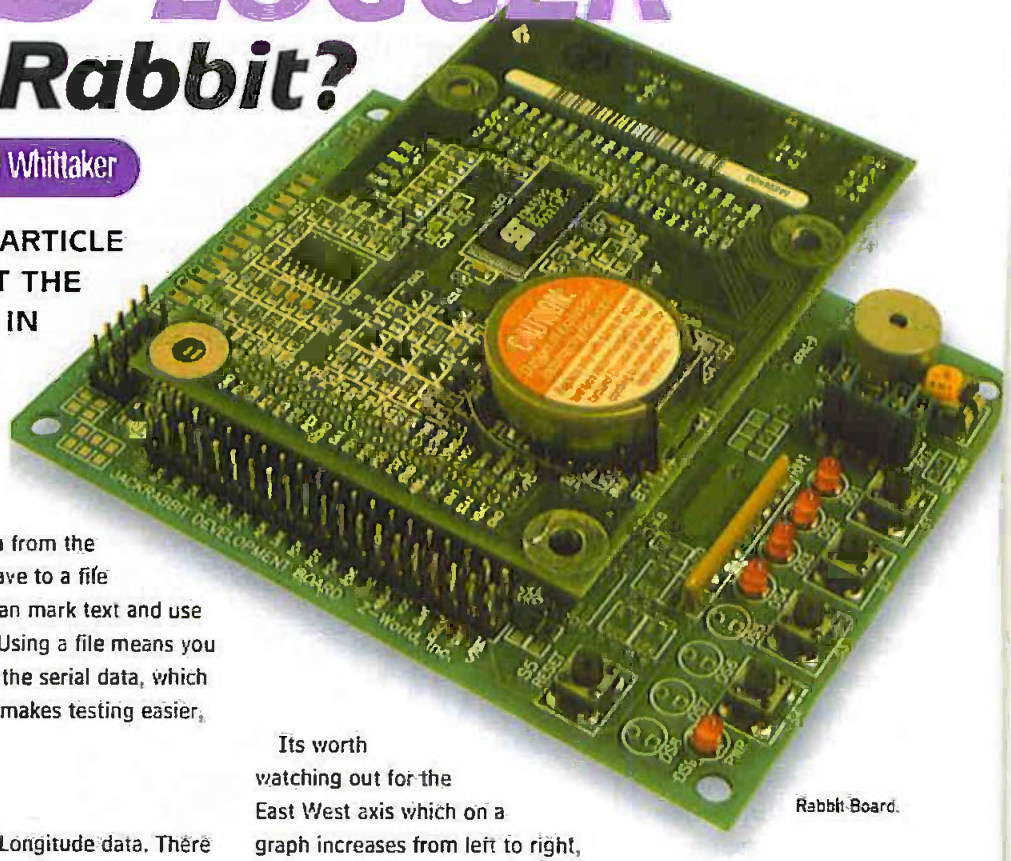
Maybe you will think about having your electric supply removed and put in an electric generator, make your own, with no standing charges, meter rental and, of course, those quarterly bills.

Just a thought!

• Photo courtesy of Roland Craven
• Illustration Courtesy of Paul Pavlinovich

A GPS LOGGER with a Rabbit?

by Richard Whittaker



Rabbit Board.

THE FIRST PART OF THIS ARTICLE SHOWED HOW TO COLLECT THE POSITION DATA, BUT NOW IN PART 2 ITS TIME TO FIND A WAY TO PLOT THE DATA ON A MAP.

Capture the GPS data

First I can use Hyperterminal to capture the data from the Rabbit board. The capture buffer can be set to save to a file from the Transfer/Capture Text menus, or you can mark text and use Copy and Paste to transfer the screen contents. Using a file means you don't need to bother with real time collection of the serial data, which makes the display program a lot simpler. It also makes testing easier, since the data never changes between test runs.

Plotting

Next I need a program which plots Latitude and Longitude data. There are several ways to do plotting from the code of a program. In Windows programs it is possible to use almost any rectangular window, picture box or text box as a canvas to draw points on. The big problem is in managing the data which makes up the plotted points. The code of the program must handle repainting the screen when another window covers the map and then uncovers it again. There is quite a bit of code in handling all the niceties, so to get things going quickly I chose Delphi and its TeeChart graphing component to do most of the work. Almost all versions of Delphi include TeeChart, but you will have to look around the components for it. In my Delphi 5 it is on the Additional tab and labeled as Chart with an icon which looks like some kind of pie chart. Its a very good component but not well documented.

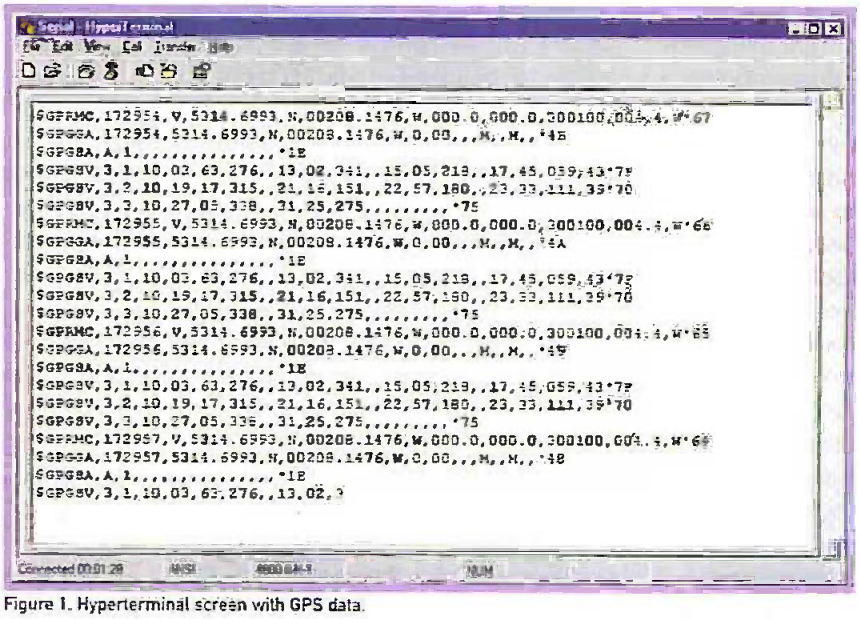


Figure 1. Hyperterminal screen with GPS data.

TeeChart is designed to plot data so all I need to give it is the X-Y coordinates of the points collected from the GPS. It deals with all the Windows bits. The maximum and minimum extents of the graph axes control the magnification of the plot. I set them to show the largest plot I can get.

Its worth watching out for the East West axis which on a graph increases from left to right, but the GPS data is in degrees West, which increases from right to left. Again the graph plotter component allows selection of an inverted X axis to correct this. The North South vertical axis is OK since it increases from bottom to top which is the same as the degrees North from the GPS data. If you are in the southern hemisphere the plot axes may need to take account of latitude in degrees South, which needs an inverted Y axis. There are several choices in the GPS receiver which can achieve the same inversion of axes, for example, degrees East. You must learn how to program them though.

The plotted data looks good, and it looks like the track of my route, but it would be much better if it were superimposed on top of a map. Then I could see just where the data leads. First I tried to plot the graph on paper. Getting the scaling to match a map correctly is almost impossible and unless I use clear film, the map cannot be seen very well. I guess the best result for me would be to use the PC program to plot the position onto a map on the screen. TeeChart

allows a background picture which acts as a background to the plot, so what I need is a map image to put in it.

It's possible to scan a map and use the image as a background for the plot. I tried this, but maps are quite large and getting a good scan with no creases and also well aligned is difficult. I could do with another solution. So looking through my old cover disks from the computer magazines I found a couple of programs which show maps of Britain. These give quite good looking images when they are zoomed to maximum, so I decided to try and use one. Although some allow the GPS data to be fed directly into the program that is not much use to me, since I have collected all the data before hand. So my thoughts are back with the idea of a background image with my own program. The simplest thing I can do is screen capture the map as a BMP file and load that into the graph plot program. This is OK but only if I can calibrate the map against the graph plot extents. Several of the programs will not show the coordinates of the mouse on the map, but fortunately the AA Milemaster 99 version 2 does, and it is on the July 2000 cover disk of PC Plus magazine.

Figure 2. Raw position plot.

First zoom the map to cover the area of interest, then screen capture the image. I use Paint Shop Pro's capture but there are many other ways to do this including using the Print Screen button on the keyboard and then pasting the screen into the Paint program which is part of Windows. The whole screen image contains more than the map picture, so use the selection tool to draw a rectangle around the map image and use Copy to... on the Edit menu to save it to a file.

Now we have the image of the map, but we must get the coordinates of the corners of the image to do the calibration. I use the mouse to slowly approach the corners of the map in the Milemaster program. At the bottom of the screen a set of Latitude and Longitude coordinates show the mouse position. It is interesting that the projection of the map is not rectangular. For instance the X coordinate of the bottom left corner is not the same as the X coordinate of the top left corner. I guess the exact map projection depends on the mapping program, and we don't really know what it is. By collecting the coordinates of all four corners we are in a position to allow some corrections for these differences.

The other piece of work the program does is decode the file of GPS NMEA sentences. Only part of the $GPGGA line is used. The program scans along the line looking for the Latitude and Longitude parts and plots them as a cross on the graph. If you use the program with your own data, make sure the data is output to the file as degrees minutes and decimal minutes. GPS receivers can be set up to give different data formats such as decimal degrees, which would still be read but produce unusual plotted points. You should also note that for the plot to match the map, the map image needs to just fill the graph window. Achieve this by pulling the edges of the program window to show just the complete map image.

Collecting the 'Live Data'

Now I have a system to collect position data from a GPS receiver, using the Rabbit module to save a position just every 30 seconds or so, and a PC program which can show the positions overlaid on a map, but I need a route to check the whole system is working as expected.

Running the GPS module on the table inside my house, limits the number of satellites in view and although it sometimes saw three or four satellites through the window, this seemed to only happen at 9:30pm for about 30 minutes! Not very satisfactory at all, so I decided to car mount the system so it could be taken for a drive.

Power becomes a problem. The mains power supply in the house isn't available in the car, only the 12V of the car battery. I should be able to access this 12v from the cigarette lighter, and having a collection of cigarette lighter plugs made me think it would be no problem. But alas none fitted my car. It was news to me that there are so many variations.

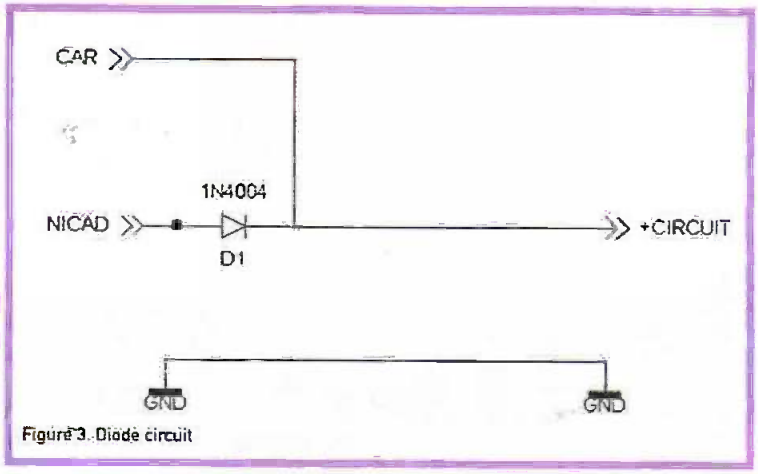


Figure 3. Diode circuit

Not wanting to wait for a new plug to arrive, I examined my alternatives. Both the GPS and the Rabbit have voltage regulators which work to give 5V. If I can provide, say at least 7V, the regulators can provide the stable supplies. So what power do I have available? Rechargeable batteries fitted into a battery holder seems a good choice. The holder carries eight AA cells which gives about 9.6V, so it should work. A quick test needed just a few wires and proved effective. The next question is will the battery last long enough? Well the batteries are 600mA hour cells, and the GPS together with the Logger use about 300mA between them, so I should get about 120 minutes from a fully charged battery pack.

That sounds good so I put the batteries in the charger to get them ready. In the mean time I checked the car to see where the antennae could be fitted and still allow the cable to enter the vehicle without leaving a door open. For the first time I found a reasonable use for the sun roof. You may guess that I don't like sun roofs. They usually give me a burnt head and make a lot of noise when moving. I love air

conditioning, but I'll have to save a bit more for that. But back to the antennae, which sticks magnetically to the car roof just outside the sun roof. The cable drops down onto the passenger seat where the GPS module and logger can sit in a plastic crate.

I haven't packaged the parts properly because in the end I want a hand portable or back portable system to use when walking, but I need to work out a suitable power supply for the system first.

All the elements are ready so I plugged in the battery power and went for a drive round a set of roads, taking about 20 minutes to complete. The LEDs flash regularly showing the logger is receiving and storing data. Off I went. Everything worked well until about 100m from the end of the run when the LEDs stopped flashing and one stayed on. What's gone wrong? When I measured the battery pack the voltage had dropped below the reset voltage of the Rabbit board. Not wanting to give up, I changed the batteries and tried again and once more the batteries failed just as I finished the journey! This wasn't going to work, and I needed a new idea.

Car cigarette plugs are quite expensive when you look at the prices in the catalogues, but I recalled seeing many cheap mobile phone car adaptors in the local shops. Off I went to see if I could get an adaptor for less than a new plug. My luck was in and I bought a suitable plug with phone adaptor for £5. I pulled the plug apart and rewired it to provide 12V to the circuits. That got me going in the car. To get the circuits back into the house I needed to keep the power supplied. A couple of diodes, and the battery pack attached through a plug in connector, allows me to run the equipment either from the car battery or the rechargeable battery pack. The battery pack powers the crate so I can carry it indoors to unload the data into Hyperterminal.

Listing 1 - Rabbit C Program Listing

```
// GPS logger - © Copyright Vision Software 2000
//*************************************************************
#define BINBUFSIZE  255 // serial buffer size must be a power of 2 - 1
#define BOUTBUFSIZE 255 // output buffer
#define CINBUFSIZE  255 // serial buffer size must be a power of 2 - 1
#define COUTBUFSIZE 255 // output buffer
#define maxs 254
#define timeout 30000UL // will time out 3000 milliseconds after receiving
                        // a character unless cof_serBread completes

main()
{
int getOk, done;
int vswitch1,vswitch2,vswitch3,reci,outcount,wrapcount;
char s[maxs + 1];       // plus 1 for null terminator
char recs[300][70];
wrapcount=299;          // maximum number of records
done = 0;
vswitch1=0;             // initialize virtual switch as off
vswitch2=0;
vswitch3=0;
reci=0;                 // recorded lines counter
outcount=0;             // output lines counter

WrPortI(SPCR, &SPCRShadow, 0x84);  // setup parallel port A as output
WrPortI(PADR, &PADRShadow, 0xff);  // turn off all LED's

serBopen(4800);
serCopen(4800);
while (!done) {
 if( (PADRShadow & 1) == vswitch1)
  BitWrPortI(PADR, &PADRShadow, !vswitch1, 0);  // light the LED depending on the
switch
 if( ((PADRShadow & 2) >> 1) == vswitch2)
  BitWrPortI(PADR, &PADRShadow, !vswitch2 , 1); // light the LED depending on the
switch
 if( ((PADRShadow & 4) >> 2) == vswitch3)
  BitWrPortI(PADR, &PADRShadow, !vswitch3 , 2); // light the LED depending on the
switch
 loophead();
 costate {                                      // read a line of the GPS data
  wfd getOk = cof_serBgets(s, maxs, timeout); // yields until return or null
terminated string
  if (getOk) {
   vswitch2 = !vswitch2;
   if ( (s[3]=='G') && (s[4]=='G') && (s[5]=='A') ) { //only SGPGGA lines
    if ( ((s[11]=='0') && (s[12]=='0')) ||
         ((s[11]=='1') && (s[12]=='5')) ||
         ((s[11]=='3') && (s[12]=='0')) ||
         ((s[11]=='4') && (s[12]=='5'))
         ){  //00, 15, 30, or 45 seconds only
     strcpy(recs[reci],s);
     reci++;
     if (reci>wrapcount) //wrap the index at the end of the array
      reci=0;
     vswitch1= !vswitch1;
     s[3]=0;              //prevent a false repeat
    }
   }
  }
 }

 // print the saved lines
 costate {
  if ((PADRShadow & 4) == 4){
   serCputs("GPS Logger v1.0\n\r");
   while(reci!=0) {
//    printf("%s\n",recs[outcount]);      // output to stdio debugger window
    wfd cof_serCputs(recs[outcount]);    // then yields until the string is
written
    wfd cof_serCputs(" \n\r");
    yield;
    outcount++;
    if (outcount>=reci){ //end
     reci=0;
     outcount=0;
    }
   }
   vswitch3 = !vswitch3;  // reset the LED
  }
 } // end of costate

 // also check button 1 and toggle vswitch on or off
 costate {
  if (BitRdPortI(PBDR, 2))
   abort;                 // if button not down skip out of costatement

  waitfor(DelayMs(50));   // wait 50 ms

  if(BitRdPortI(PBDR,2))
   abort;                 // if button not still down skip out

  vswitch3 = !vswitch3;   // toggle virtual switch since button was down 50 ms

  // now wait for the button to be up for at least 200 ms before considering
another toggle
  while (1) {
   waitfor(BitRdPortI(PBDR, 2));  // wait for button to go up
   waitfor(DelayMs(200));         // wait additional 200 milliseconds
   if (BitRdPortI(PBDR,2))
    break;                // if button still up break out of while loop
  }
 } // end of costate

}

while (serBwrFree() != BOUTBUFSIZE) ;     //allow transmission to complete
before closing
serBclose();
}
```

So with the system set up in the car I drove round the test route on roads just south of Macclesfield. The power held out this time and at the end I used the battery to carry the logger to the computer. The plot on the computer screen is shown in Figure 4. The GPS track doesn't lie on the road. It is close though. This data was collected before selective availability was turned off. There is also a question of how accurate the map is when it is fully zoomed. I also guess my understanding of GPS datums is not good, but at least the track shows on the map and is within 100m or so of the road.

Summing Up

Well there is the complete project from logging the data from the GPS to plotting it on the screen of the PC. When I first started the project a GPS module was the cheapest way to get going but now there are complete GPS units like the eTrek which include the antennae and its own battery power. You can sit the eTrek in the car window and it receives satellite signals very well. Also the plotting software needs improving to better match the GPS Latitude and Long data to the map coordinates. Give it a go for yourself, though.

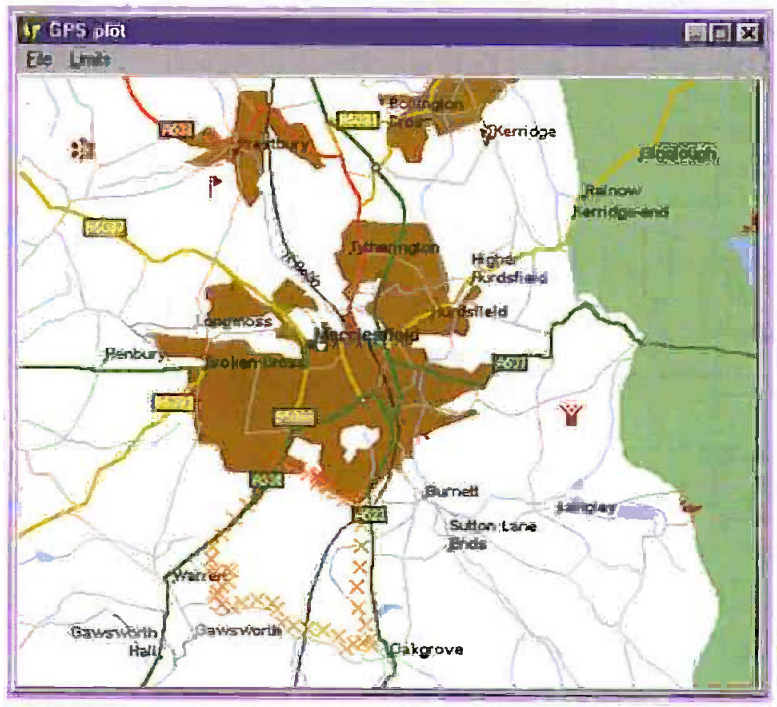


Figure 4. Route plot on map

Where to get things

- A version of Hyperterminal can be downloaded for free from www.hilgraeve.com or you can buy an enhanced version from the same address. It may also be on your Windows CD rom.
- Software for this article is available from www.visionsoftware.freeserve.co.uk
- Rabbit 2000 kit www.rabbitsemiconductor.com
- UK supplier of the Rabbit development kit. 2001 www.2001elec.co.uk
- Impulse Corporation Limited, Unit 2 Littleton Business Park, Littleton Drive, Huntingdon, Staffordshire WS12 4TR. Web: www.impulse-corp.co.uk Email: sales@impulse-corp.co.uk
- Garmin GPS information from www.garmin.com.

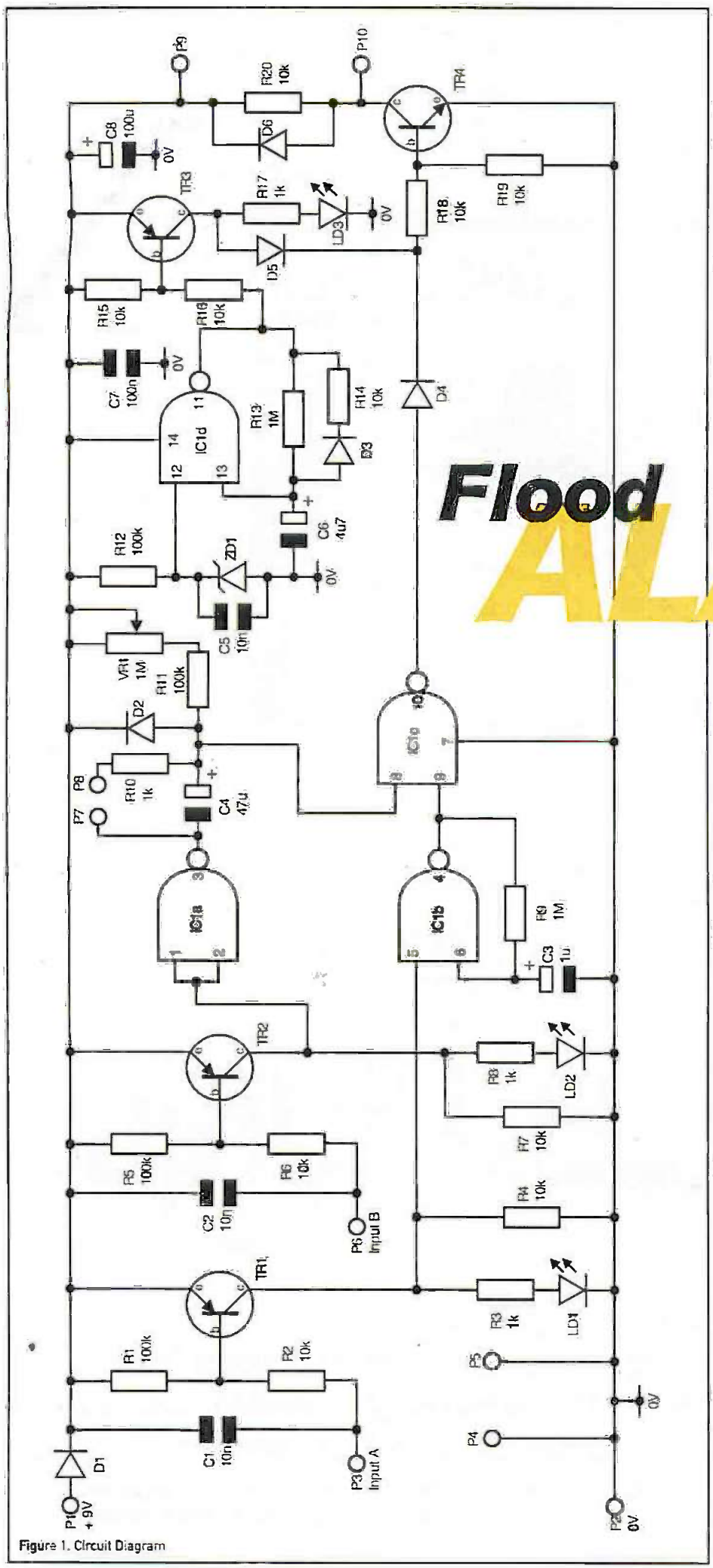


Figure 1. Circuit Diagram

ANYONE WHO HAS SEEN THE NEWS ON TELEVISION WILL BE AWARE THAT FLOODING HAS POSED A SERIOUS THREAT IN LOW LYING AREAS OF BRITAIN DURING THE PAST YEAR, CAUSING SIGNIFICANT PROPERTY DAMAGE.

Flood ALARM

by Gavin Cheeseman

Some will probably have been unfortunate enough to experience the effects of flooding first hand. If a house becomes flooded when the occupants are asleep or otherwise unaware of the situation, clearly the results can be catastrophic.

In this article we look at a simple circuit that will provide an audible indication when water is detected. When set up correctly, it can give advanced warning if flooding starts to take place. Unlike simple water alarms, the circuit features two inputs, allowing the coverage of two separate zones. There is also a low battery indicator to show when the battery requires replacement.

Operational Details

For ease of identification the two inputs have a different alarm sound. Input A is designed to pulse a buzzer when triggered. Conversely, if input B is triggered the buzzer sounds continuously. If both inputs are triggered, input B takes priority and the alarm produces a continuous sound from the buzzer. Whatever the case, LED's indicate if an input is active. Input B has an optional time-out. When set, the alarm will sound for a short period if input B is triggered, until the time-out is complete. After the timeout period has elapsed, the output condition is determined by the alarm status of input A. That is to say, if input A is not triggered the alarm will

revert to silence. If input A is triggered the alarm buzzer will emit a pulsed sound.

The circuit diagram of the flood alarm is shown in Figure 1. Input A comprises terminals P3 and P4 and input B uses terminals P5 and P6. Each input is connected to a pair of conductive probes. If the resistance between the probes falls due to the presence of water, a small current flows and the associated transistor (TR1 or TR2) is turned on. Current flows in the collector circuit, illuminating either LD1 or LD2 depending which input has been triggered.

The alarm section of the circuit is based around a CMOS 4093 quad schmitt NAND IC. If the collector of TR1 switches high due to the presence of an alarm condition at input A, this results in a logic high condition at one of the inputs of IC1b (pin 5). IC1b is configured as a low frequency relaxation oscillator. The presence of a logic high condition at IC1 pin 5 enables the oscillator, which applies a low frequency square wave to one input of IC1c. The second input on IC1 pin 8 is normally high in the absence of an alarm condition at input B. In these circumstances, IC1c effectively acts as an inverter and the square wave signal is fed to output transistor TR4. As a result, the load connected between terminals P9 and P10 (normally a piezo buzzer) is switched on and off repetitively.

If an alarm condition occurs at input B, TR2 turns on applying a high condition to both inputs of IC1a (pins 1 and 2). IC1 pin 8 is pulled low by IC1 pin 3, via capacitor C4. This results in a continuously high output at IC1 pin 10 and TR4 is turned on applying current to the output load. C4 slowly charges and when the voltage at IC1 pin 8 reaches the switching threshold, the output of IC1c returns to low, switching off TR4 unless there is an alarm condition at input A, in which case the output switches back to pulsing mode. VR1 allows the timeout period to be adjusted. If terminal P7 is connected to P8 the alarm timeout is disabled and the alarm will sound continuously until the cause of the alarm condition at input B is removed, or the battery is discharged.

IC1d and associated components form a 'low battery' indicator. The circuit pulses LD3 and TR4 when the supply voltage has dropped to a level where battery replacement should be considered. The output pulse from IC1d has been set to be narrow so as not to draw a high current from an already failing battery. Some buzzers may not respond to such a short pulse. If required, the length of the pulse can be extended without changing the duty cycle by increasing the value of C6 to 10uF. The pulse will also repeat less regularly.

Construction

The circuit may be built using almost any construction medium. Matrix or strip board is a good choice. Start by fitting the lowest profile components such as the resistors and IC socket followed by larger parts such as the electrolytic capacitors. Do not insert IC1 into the IC socket until all soldering is complete. The layout of the circuit is not particularly critical but it is recommended that C7 is mounted as close as possible to IC1.

To avoid the risk of component damage as well as for safety reasons, the electrolytic capacitors and semiconductors must be fitted paying attention to the correct polarity. The negative lead of the capacitor is normally the shorter of the two and is also indicated by a minus (-) symbol marked on the component body. As marking conventions may vary between manufacturers, refer to the manufacturer's data sheet if the polarity of the component is not absolutely clear. Details of the semiconductor pin-outs are shown in Figure 2.

Figure 3 shows off board wiring. If required, a switch may be connected between terminals P7 and P8 to allow the alarm time-out to be switched on or off. Please note: the time-out only applies to input B.

The circuit will switch a standard piezo buzzer with drive circuit (a piezo transducer alone is not suitable). The buzzer must be suitable for operation at supply voltages between about 4V and 9V to allow the alarm to operate correctly when the battery voltage is low. The buzzer supply current should not exceed 50mA.

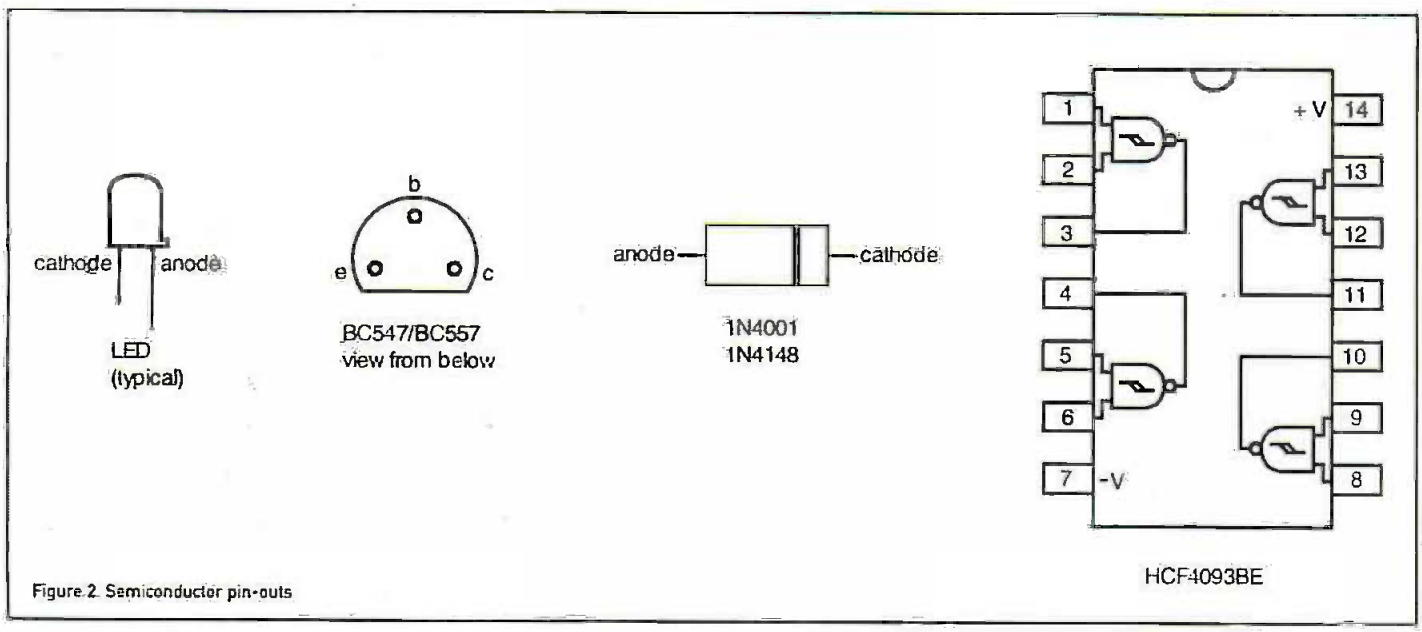


Figure 2. Semiconductor pin-outs

Testing the alarm

The circuit is designed to operate from a 9V PP3 type battery (or equivalent). A multimeter, set to read current, may be connected in series with the positive power supply rail. This allows the current to be measured during testing and can sometimes indicate if there is a problem with the circuit. Always set the meter to a high current range to start with, switching to a lower range once the approximate current consumption is known.

Connect the battery and set switch S1 to the 'on' position. When the input terminals are open circuit, all LED's should remain off and the output buzzer should be silent. Connect a link between terminals P3 and P4. The output buzzer should beep repetitively and LD1 should illuminate, indicating that input A has been triggered. Disconnect the link and the alarm should return to silence. Next connect the link between terminals P5 and P6 (input B). LD2 should light and the

alarm should sound as before but the tone should be continuous. After a period of several seconds the buzzer should switch off. If a link is then connected to input A, the buzzer should pulse as normal. Disconnect the link and connect terminals P7 and P8 together. Reconnect the link at input B. This time the buzzer should sound continuously until the link is removed. After testing disconnect all links.

If you have access to a variable power supply, disconnect the battery and temporarily connect the power supply in its place between terminals P1 (+V) and P2 (0V). Both inputs should remain open circuit. When the voltage of the power supply is set to 9V, the circuit should remain silent. However, if the power supply voltage is slowly reduced, a point should be reached where the alarm buzzer starts to emit short beeps. This confirms that the battery low circuit is operating. Remove the connections to the power supply and replace the battery.

The current consumption of the circuit is in the region of 100uA in standby mode, so unless the alarm is continuously sounding, the battery should last many weeks before replacement is required. If the circuit is not in use for a very long period, the battery should be removed to avoid damage due to leakage etc.

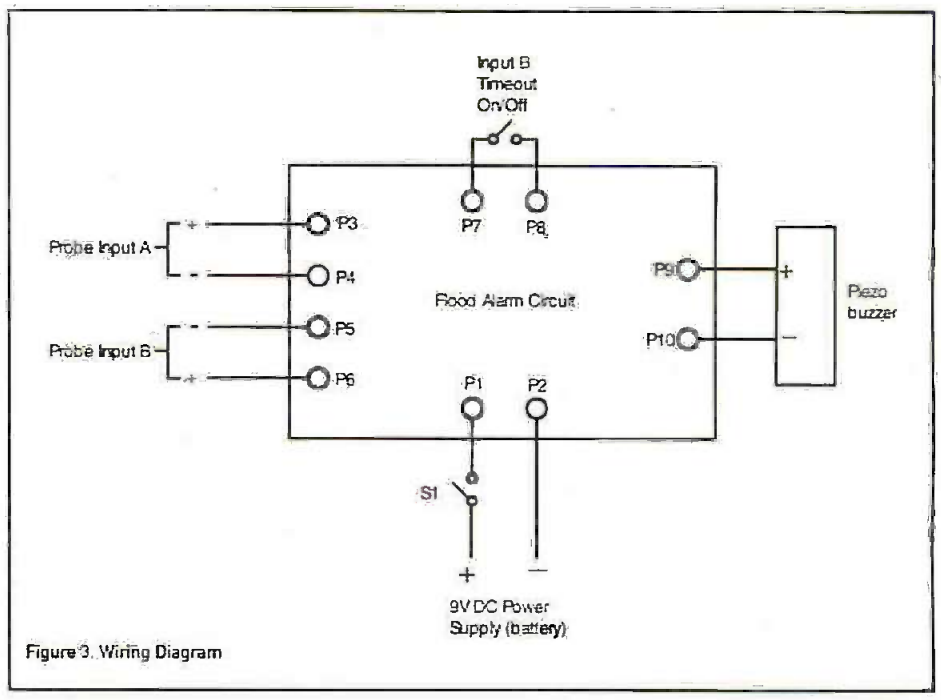


Figure 3. Wiring Diagram

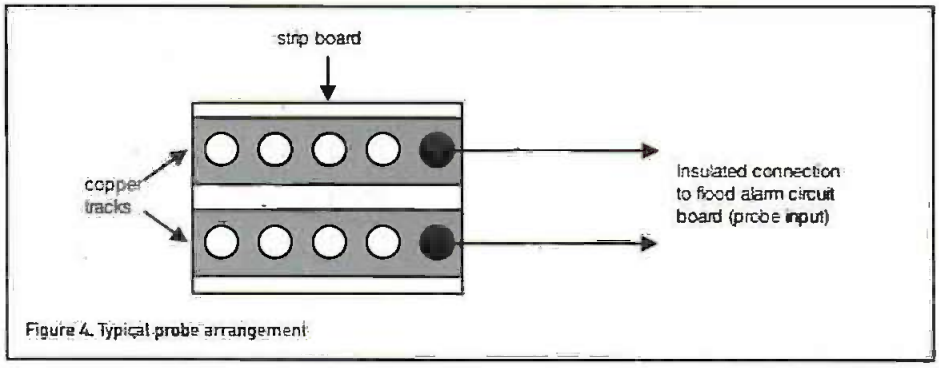


Figure 4. Typical probe arrangement

Probes

The shape and configuration of the probes is not particularly critical as long as there is enough contact area and the probes are not spaced too far apart. A length of bell wire with stripped ends can be used but steps must be taken to ensure that the ends do not accidentally short together, as this will result in a false alarm. A small piece of strip-board may be used as illustrated in Figure 4. The only disadvantage with this type of arrangement is that the alarm may continue to sound until the circuit board is completely dry. This is unlikely to present a serious problem in most applications but if required the effect can be reduced by using tracks that are spaced further apart. Similar considerations apply in areas subject to condensation etc. A larger area may be covered by running two bare parallel wires with insulating spacers. Under normal conditions the two contacts must be high resistance. Any leakage may trigger the alarm. Specially designed cables are available for use with flood alarms.

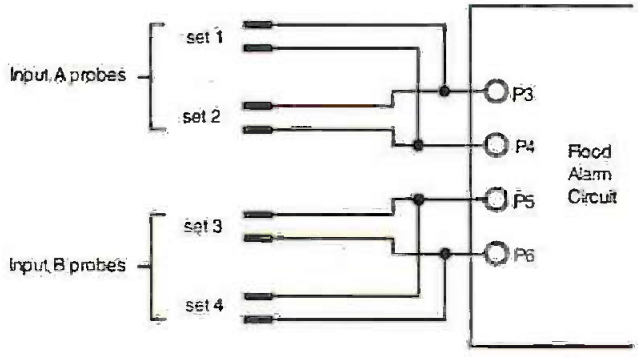


Figure 5. Connecting probes in parallel

Although the alarm has only two inputs, cables from several different sensors may be connected in parallel to each input allowing a larger area of coverage (see Figure 5). Try to avoid unnecessarily long cables as these will tend to couple high frequency noise to the input of the alarm. If RF pickup causes false triggering, it is often possible to rectify the problem by fitting suitable ferrite beads or rings to the inputs close to the alarm circuit.

Using the alarm

Where and how the alarm is installed depends on the specific circumstances. One point to remember is that water should not be allowed to come into contact with the alarm circuit board as this will usually result in irreparable damage. Therefore, it is sensible to mount the unit high up where it is less likely to come into contact with water, if a flood occurs. The unit should preferably be indoors but if it is mounted outside, it is essential to protect the circuit from the elements. It should be noted that CMOS IC's function poorly at temperatures below zero. The alarm buzzer must be audible. For example, there is little point in mounting the unit at the end of the garden or in an outbuilding if you cannot hear the buzzer when it sounds. However, if the alarm is used to protect an outbuilding situated some distance from the dwelling, it may be sensible to extend the buzzer lead rather than using very long probe leads.

If possible, the probes should be positioned so that an alarm condition occurs before the floodwater reaches a problem level. The two inputs can be used in different ways. For example, the alarm could be used to cover two entirely unrelated zones.

Alternatively, input B could be set to time-out mode with the probe positioned to give an early indication that the water level is rising. The probe for input A would be placed at a higher level to show when the water has reached a level where it poses a serious threat.

The unit may also be used to cover indoor areas such as kitchens and bathrooms where flooding may occur due to a tap being left on or a plumbing fault.

Finally...

As with most alarm systems, it should be remembered that the flood alarm is not foolproof and will not provide absolute protection against flooding. However, when correctly installed, the unit may provide an early warning of the occurrence of flooding that may otherwise go unnoticed until a much later stage.

Parts List

Resistors (minimum 0.5W metal film)		
R1, 5, 11, 12	100k	4
R2, 4, 6, 7, 14-16, 18-20	10k	10
R3, 8, 10, 17	1k	4
R9, 13	1M	2
VR1	1M trimmer pot.	1
Capacitors (voltage rating 16V or greater)		
C1, 2, 5	10n Ceramic	2
C3	1u Electrolytic	1
C4	47u Electrolytic	1
C6	4µ7 Electrolytic	1
C7	100n Ceramic	1
C8	100u Electrolytic	1
Semiconductors		
TR1-3	BC557	3
TR4	BC547	1
IC1	4093BE	1
D1	1N4001	1
D2-6	1N4148	5
ZD1	BZY88C4V7 or equiv.	1
LD1-3	Red LED	3
Miscellaneous Items		
14 pin DIL socket		1
9V Battery (PP3 or equiv.)		1
PCB terminal pins		10
Buzzer		1

Suitable parts can be obtained from major component suppliers such as Farnell Components and Maplin Electronics.

Air Your Views

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

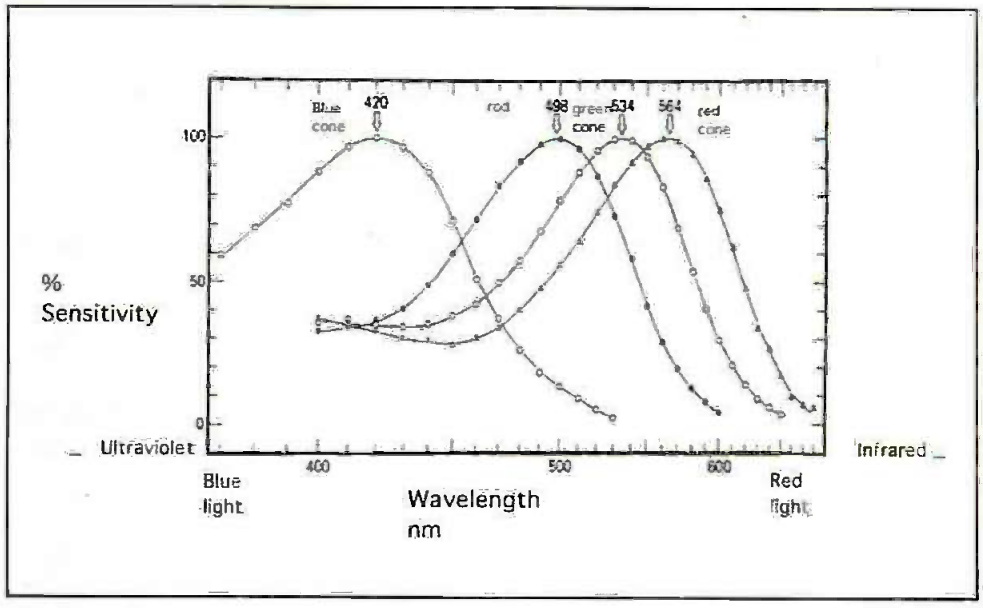
**Air Your Views,
Electronics And Beyond,
17/18 Glanyrafon Enterprise Park,
Aberystwyth, Ceredigion. SY23 3JQ.**

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

Colour Vision

I may be able to help in answering the queries put forward by Petra Morgan (Air Your Views, June) in response to the article by Mike Bedford on colour.

The first query regarding why we can't see ultraviolet (UV) or infrared (IR) light is relatively straightforward to answer. The light sensitive retina at the back of the human eye contains four types of photoreceptor comprising 3 kinds of cones and the rods. The latter are responsible for vision at low light intensities and reproduce the world in shades of grey. The cones work at higher light intensities and are responsible for colour vision. The three kinds of cone and rods are sensitive to light of different wavelengths as shown in the figure below. Blue cones have a spectral sensitivity to light that peaks at 420 nm, green cones peak at 534 nm and red cones at 564 nm (Rods have their peak sensitivity to light at 498 nm, i.e. they respond to green light). Each one of the millions of colours that we perceive is produced by a unique pattern of stimulation of the three cones. This is called the trichromatic theory of colour vision.



The spectral sensitivity of the cones spans the wavelengths between about 370nm and 680nm. These wavelengths comprise the visible spectrum that we see. IR and UV, with wavelengths that lie outside this range, are not readily detected by cones and hence we cannot see them. However, this is not the complete story. The human retina is sensitive to ultraviolet light as short as 350 nm. However, the failure of the short wavelengths to stimulate the photoreceptors is due to the fact that the fluids in the eye absorb these wavelengths before they can reach the retina. Also if the intensity of IR is high enough, wavelengths as long as 1050 nm may be detected as flashes of light.

The major query, regarding the perception of colours if we were able see UV and IR, is more difficult to answer. It might be possible, if mutations occurred where the photoreceptors developed increased sensitivity to IR or UV and/or the composition of the eye fluids changed, to see these wavelengths. However, perception of colour in the brain is very much a private world. Imagine trying to describe what a colour looks like to someone who is totally colour blind. It is virtually impossible. Now assuming that someone could see

wavelengths of light outside our visible spectrum what would he/she perceive? We can make an informed guess because of the way that the three different types of cone connect to nerve cells in the visual cortex at the rear of the brain. It is here where the conscious perception of vision takes place. Just as there are three types of cone there are three kinds of nerve cell associated with colour vision in the cortex. One type, the 'red' cell, receives input exclusively from red cones, and gives rise to the sensation of redness. Similarly, the 'green' and 'blue' cells receive their inputs solely from green and blue cones. Thus if the red cones were able to detect IR they could only produce the sensation of redness, since they would stimulate only the 'red' cells in the brain. Equally, if the blue cones could detect UV this would still only be perceived as blue by the brain. Thus regardless of how far our cones' sensitivity extend into the IR and UV we would probably only see colours between red and blue. It would need presumably a fourth type of cone allied with a fourth type of colour cell in the visual cortex to produce entirely new colours. We do know from studies on colour-blind individuals, where there is usually a loss of one type of cone that their colour vision is different from ours. For example in red/green colour blindness where there is a fault in the red or green cone people perceive colours made up from only blues and yellows; if there is a fault in the blue cones the colour spectrum is comprised of only reds and greens. A fault in either the red or blue cones reduces the red and blue extent respectively of the visible spectrum. A rare condition where all cones are faulty or absent results in monochromatism in which only greys are perceived.

Finally, we do know that some animals can see into the infrared and ultraviolet regions of the electromagnetic spectrum. Insects can see UV (bees) or IR (butterflies). What they perceive at these wavelengths though is a complete mystery.

Michael P Osborne
DSc, PhD, BSc
Retired Reader in Neurobiology from the University of Birmingham

Website Relaunch

I notice you have changed the look of your web site – is this the reason why May didn't appear on there at all? How about having the magazine accessible in full on the web site – it's fine to read about what's in it, but where are the links to click on to read more?

John Hagan (via email)

I have been following the Excel series in your magazine, and have tried for a number of weeks to download the examples. However the website still shows the latest issue as being April.

Are there any plans to update this site.

Ted Hatchett (via email)

I like the new site, but what about some Flash animation? You can do anything with web sites nowadays, and I think it would really benefit from it.

Ray Gressing (via email)

We have, as many of you have noticed, now redesigned the web site with an easier to use interface and more material from the magazine itself. The workbooks are now up to date and can be accessed via the interface down the side of the new E&B pages. We will continue to update and improve the web site on a regular basis. As for putting the whole magazine on the Internet – we are a commercial magazine and only the big newspapers can really afford to duplicate all of their material on their sites. We will be including some sample pages as well in the future, and you can also see at an instant exactly what is in the magazine. As for using Flash, we realise that not everybody has the Flash plug-in, and we have to design the web site with all of our readers in mind. Irrespective of this, there are just as many people who immensely dislike Flash sites because of their long loading and animation times as there are people who are in favour of them.

102 = 100 (?!)

The section on Powers (Introducing AVRs, June) took a bit of reading before any sense could be made of it as the final printed version superscript numerals have become normal sized text and so no longer represent figures to the power of 10. I think any newcomer – the article is aimed at them – will be totally confused and probably give up.

The first paragraph implies the article is not aimed at those already familiar with the concepts. I cannot see anywhere where the article explains the acronym AVR so that the uninitiated might know whether the article might be of interest to them (notwithstanding, the content is of good general interest anyway).

Ian Watson (via email)

We apologise for this error, and we certainly hope that no readers gave up reading the article because of it. As you have realised, the superscripts in the text somehow returned to being normal sized characters, even though they were correctly sized in the original text we were given. Clearly 102 does not equate to 10 x 10, but 10^2, of course, does. When reading the article, if any statements seem not to make sense (such as 27 = 128), look upon the last digit of one of the numbers as a power, and you should be able to understand what the article is saying. This is one of a series of articles introducing the subject of microelectronics, and does not actually just apply to AVR. Also, strangely enough, AVR isn't a proper acronym; so there wasn't in fact anything to explain.

Wind Powered STREET LAMPS

by Teresa Auciello

'GREEN COLUMNS' ARE THE NEW ENVIRONMENTALLY FRIENDLY WAY TO PROVIDE AMENITY LIGHTING.

The micro wind turbine, which is just less than 1 metre across, generates power from the wind that is stored in batteries housed in the base of the 6 metre high column. The power can then be drawn off at dusk as the lamp switches on and automatically off at dawn. These innovative new columns give local authorities a cost-effective alternative to normal street lamps in areas where no grid connection exists and in particular at open rural areas where the wind turbine will perform at its best. The systems can be supplemented by a solar photovoltaic panel to take maximum advantage of available renewable energy sources at no cost.

The company, Marlec Engineering, that manufactures the Green Column has also developed other applications for wind and solar power and more recently designed and supplied a solar powered lighting system for bus shelters to be installed at locations in the Derbyshire area. These stand alone systems offer the convenience of needing little, if any, major works in the locality so are quick and convenient to install. Even where multiples might be required, environmental, as well as financial considerations may still favour the use of Green Columns like the sports field footpath in Cirencester where a row of 28 Green Columns provide lighting from a primary school to the main road.

The micro wind turbines used are one of a range of Rutland Windchargers which have been sold and installed world wide for over 20 years from the company's base in Corby where systems are specified for a multitude of applications. Most commonly windchargers and solar panels in the UK are used by boat owners to keep batteries topped up for navigation equipment and lighting but they can also be found at remote telecommunications and monitoring sites where the cost of installing mains power is prohibitive.

On a larger scale we already see grid connected wind turbines in the countryside and proposals are afoot for installing turbines offshore where the wind resource is abundant. The Government have committed to spending £100 million on renewables over the next few years and the industry is hoping that some of those funds will be directed towards home owners to encourage the installation of photovoltaic systems in the home that will send electricity meters flowing backwards!

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

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

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

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

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

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

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Your guide to CE MARKING

PART 3 GETTING YOUR PRODUCT TO PASS.

by Gareth Bradley

You've got a new product and you want it to pass, preferably first time. What can you do? Firstly it is a lot easier quicker and cheaper to ensure that EMC is thought about during the design stage of the product.

PCB layout design is important, a PCB that has had no consideration to EMC can contribute to EMC problems.

Increasing the width of power supply tracks on the PCB can help reduce the common impedance values which will help reduce EMC problems.

Minimising the loop area formed by the power tracks and the ground tracks will also help. This is done by keeping supply and return tracks close together. This will reduce pick up from external magnetic fields and reduce radiation from the board itself. See fig 1 for example of good layout and bad layout.

If your product is multi layered then use of separate power supply planes and ground planes can significantly reduce the common impedance values. If your PCB is only single side or double sided then the use of power planes and even a single ground plane may be impossible. In these cases the use of low impedance buses to reduce supply line impedance. These are available from various suppliers. They consist of two metal strips separated by a thin insulating layer with PCB pins for mounting and power take off. These provide a low impedance supply and the use of a separate distribution bus for power supplies will allow the routing of other signals to be simplified.

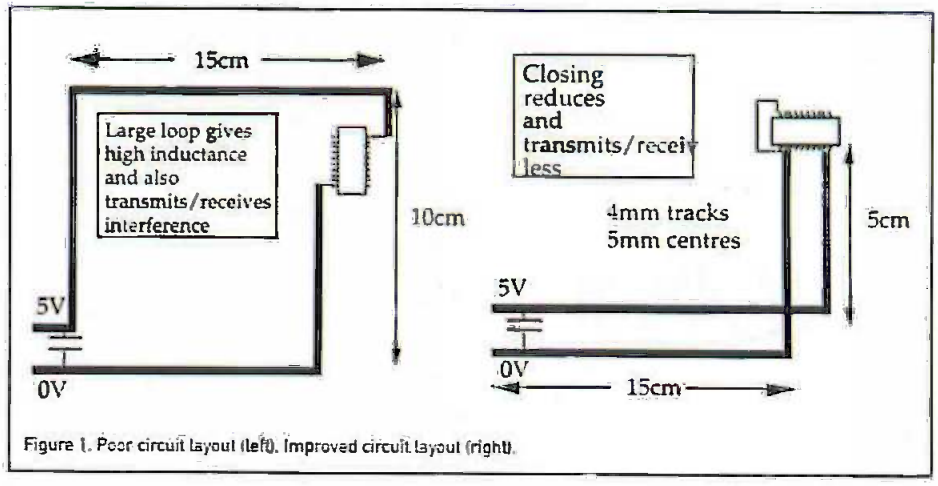


Figure 1. Poor circuit layout (left). Improved circuit layout (right).

Also having return paths for signal tracks and also minimising the loop area that can be formed by these signal tracks will help reduce EMC problems. See Figure 2 for examples.

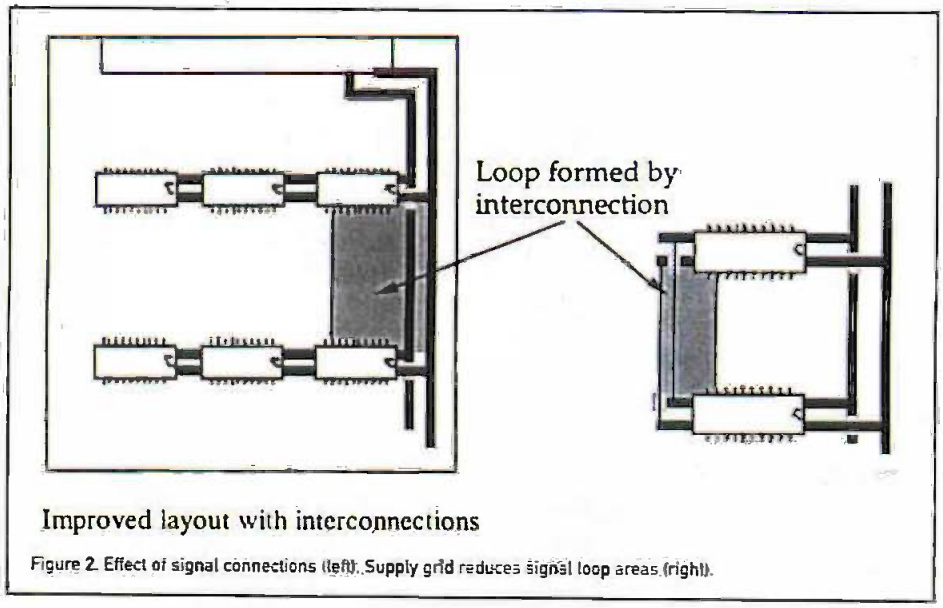


Figure 2. Effect of signal connections (left). Supply grid reduces signal loop areas (right).

The use of slower devices in the logic family can also help. The speed of the rise and fall times of devices contribute to the overall EMC performance of the product. The slower the rise and fall time of the devices the less they will contribute to the EMC performance. The functionality of the product may limit the choice on which logic family is used.

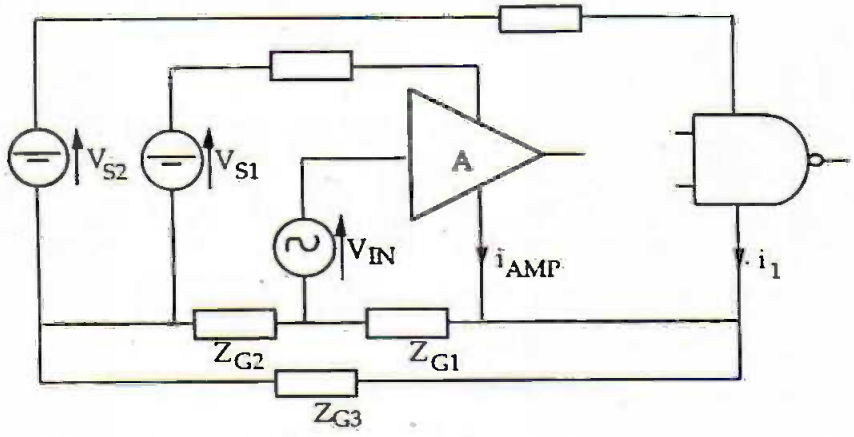
For particularly sensitive circuits which are used on the same PCB as power logic or power circuits such as signal conditioning circuits and a-d converters. The common of ground connections for each supply should be connected together at one point (if needed at all).If the common or ground connections are made at more than one point then this can cause problems. It can cause return current to flow along the small signal common track and create common impedance coupling which is not wanted. See fig 3 for examples.

The most common and basic way of helping towards reducing the EMC problems is the use of decoupling capacitors across Vcc and ground.

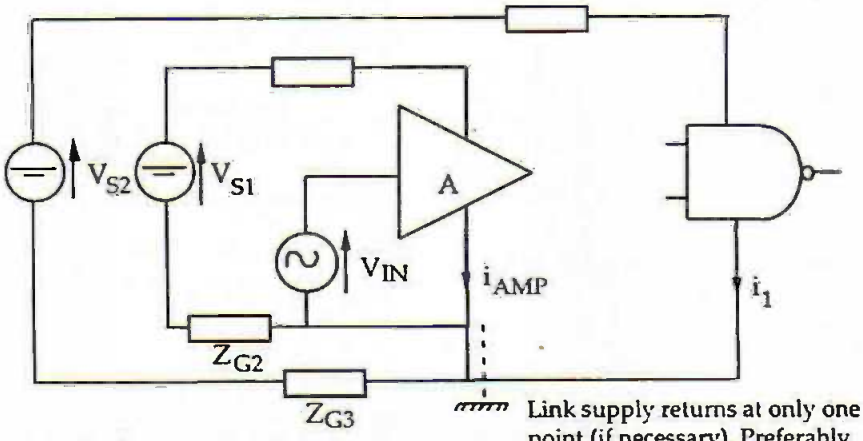
Capacitive coupling can be a big problem as far as EMC performance goes.

If you have any two conductors in proximity this will cause a capacitive coupling effect. This does not just apply to any PCB tracks in proximity but also applies to any components with metal cases that are nearby the source(heatsinks and mounting hardware etc).Any change applied to the potential of the source conductor or PCB track will cause current flow in the victim conductor which will result in a change in the potential of the victim conductor. Reduction of capacitive coupling can be achieved in several ways.

1. You can increase the distance between the source and the victim. This will reduce the actual coupling capacitance.



The wrong way to do it



This is how it should be done

Link supply returns at only one point (if necessary). Preferably at system ground point

Figure 3. Use of separate power supplies to minimise coupling between circuits.

2: Use of a ground plane.
3: The use of an earthed screen between the source and the victim to prevent the electric field produced by the source from reaching the victim. The screen must be made of conductive material and must also be properly earthed.
4: Use of guard conducters to reduce the coupling effect.

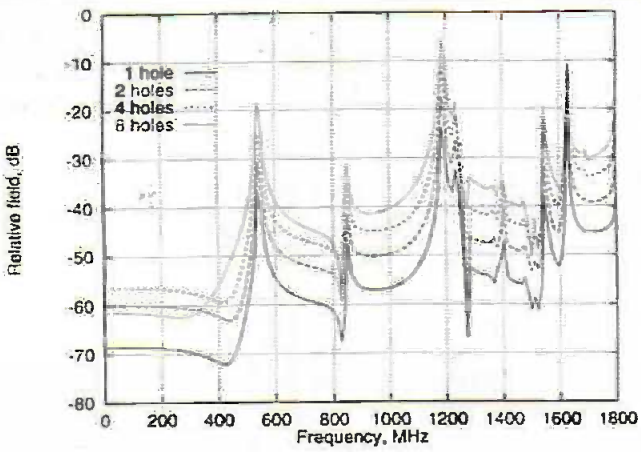


Figure 4. Effects of increasing number of holes.

When designing the PCB careful layout of the components on the PCB is a good measure against capacitive coupling. Do not run sensitive analogue circuits next to high power or switching circuits.

Inductive coupling is when a magnetic field exists around circuit carrying current, any change in the current flow produces a proportional change in the magnetic field and this change can induce currents in other nearby circuits. The most common source are ones that large are rapidly changing currents are present. Switching regulators, high speed logic circuits with fast rise and fall times, power switching circuits, and power amplifiers are all examples.

This inductive coupling on PCB is usually due to long parallel tracks or running them in closely coupled loops. This can be avoided with the following techniques.

1: Increasing the distance between the tracks to reduce mutual inductance.
2: The use of an earthed screen between the circuits.
3: Using a ground plane near the cause of the coupling. Eddy currents induced in the plane cancel out some of the magnetic field.

Any tracks that run near power tracks that cross the power track at right angles are not effected by this it is only parallel runs that are effected.

Overall emissions from the product can be reduced and even nullified by the use of metal cases.

A completely closed box will offer good protection against emissions. For every hole that is placed in the case this will reduce the effectiveness of the shielding. The shielding effectiveness will vary depending on the size and amount of the holes. See fig 4 for examples. It is better to have separate holes than combine any of the holes. The amount of fastenings and type of fastening can make a difference, the more secure they are the better the protection. Where any cables leave and enter the case, the position of these cables in relation of the Case can also make a difference to the overall EMC performance. See Figure 5.

There are companies that specialise in providing solutions to minimise EMC emissions. These products include caskets to go on any lid or any part of the case that detaches. There is also paints available to coat the inside of the case. These paints can offer quite good protection.

Useful links

1.www.spraytech.co.uk
2.www.applicoat.com
3.www.lairdtech.com

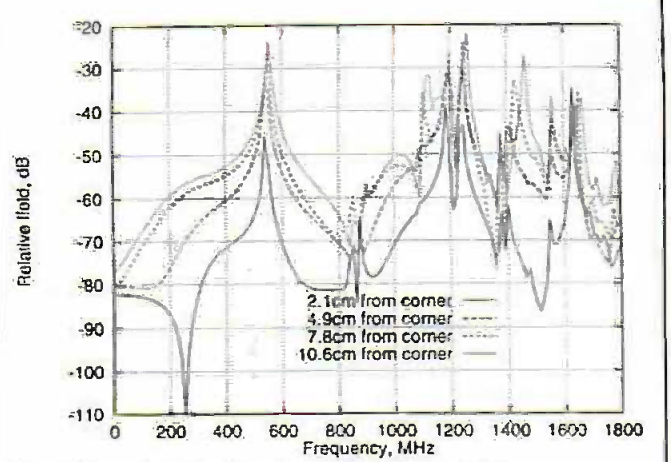
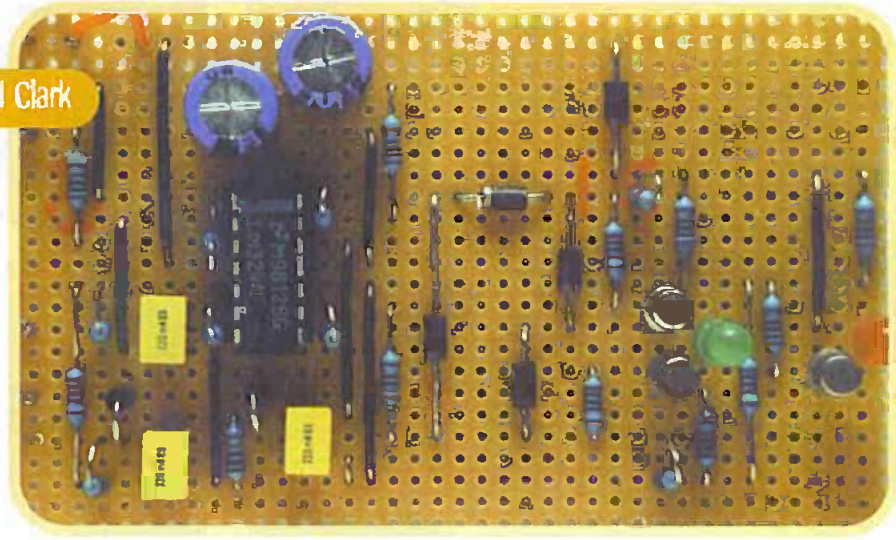


Figure 5. Comparison of varying entry point for cable penetration.

The lazy person's DIODE TESTER

by David Clark



THE LAZY PERSON'S DIODE TESTER WILL TAKE THE HARD WORK OUT OF CHECKING DIODES, PERHAPS THOSE RETRIEVED FROM THE BOTTOM OF THE SALVAGED COMPONENTS BOX. SIMPLY CONNECT THE TEST LEADS TO THE DIODE - THERE'S NO NEED TO WORRY ABOUT GETTING THE POLARITY RIGHT - THE CIRCUIT DOES THE REST! A RED AND A GREEN LIGHT EMITTING DIODE (LED) INDICATE WHETHER THE DIODE IS FAULTY OR OK WITH ONE SIMPLE CHECK.

There's no need to mess about swapping leads to test the conduction in both directions, and no more having to guess whether the p-n junction is operating correctly by deciphering the resistance reading on a multimeter. This device will test whether or not a diode does just what a diode is supposed to do - rectify.

As well as being an extremely useful device in its own right the circuit uses several principles that it is instructive to see employed in a practical situation.

Functional Description

The circuit is composed of five main blocks:

- dual voltage supply
- oscillator
- signal steering, rectification and smoothing
- amplification
- logic and LED drivers

(See figure 1).

The dual voltage supply converts a single 9V supply into a regulated and smoothed ± 4.5V supply for the circuit.

The oscillator generates a square wave at approximately 2 kHz to provide the test signal that is applied to the diode.

The form of the signal that appears at the input to the signal steering, rectification and smoothing circuit will depend on whether the diode is functioning correctly or not. The signal steering, rectification and smoothing circuit generates from this input signal two other signals that allow the unit to differentiate between a faulty and an OK diode.

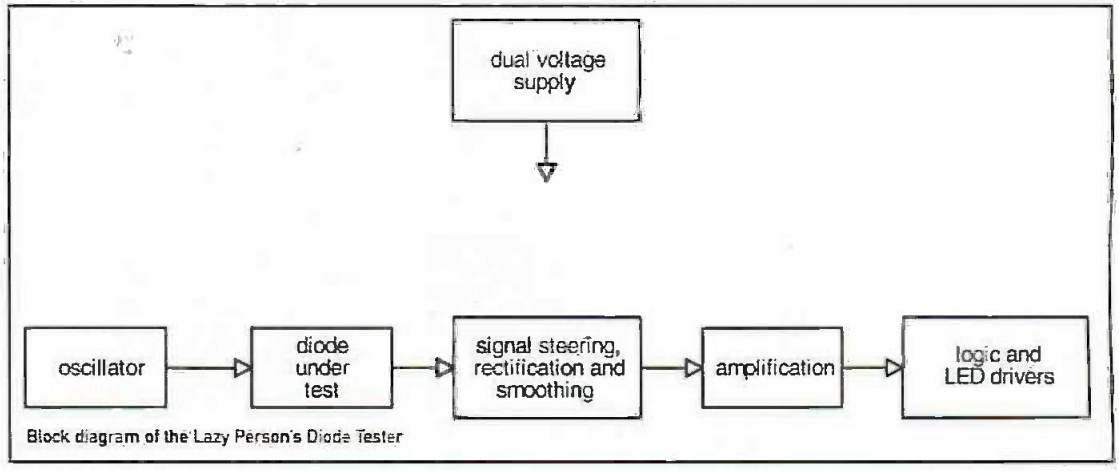
Before the voltages can be applied to the logic decoding part of the circuit they must be 'standardised'. This is the role of the amplification stage.

The amplification stage converts the signals into either a 0V or a + 4.5V level. These are then effectively '0' or '1' logic signals which can be applied to the next and final section.

The logic and LED driver section decodes these signals and switches on the green LED if the diode under test is OK, or the red LED if it is faulty and not rectifying ie either open circuit, short circuit, or acting as a resistance or impedance.

The next sections describe how each part of the circuit works. The circuit diagram is shown in figure 2.

Dual Voltage Supply



Block diagram of the Lazy Person's Diode Tester

As the intention of the circuit is to test a diode without having to worry about which way round it is connected into the circuit a test signal that flips between a positive and a negative voltage is used. This means that the circuit must be powered by both a positive and a negative supply voltage. Obtaining two voltages from a single battery is straightforward - the mid-point

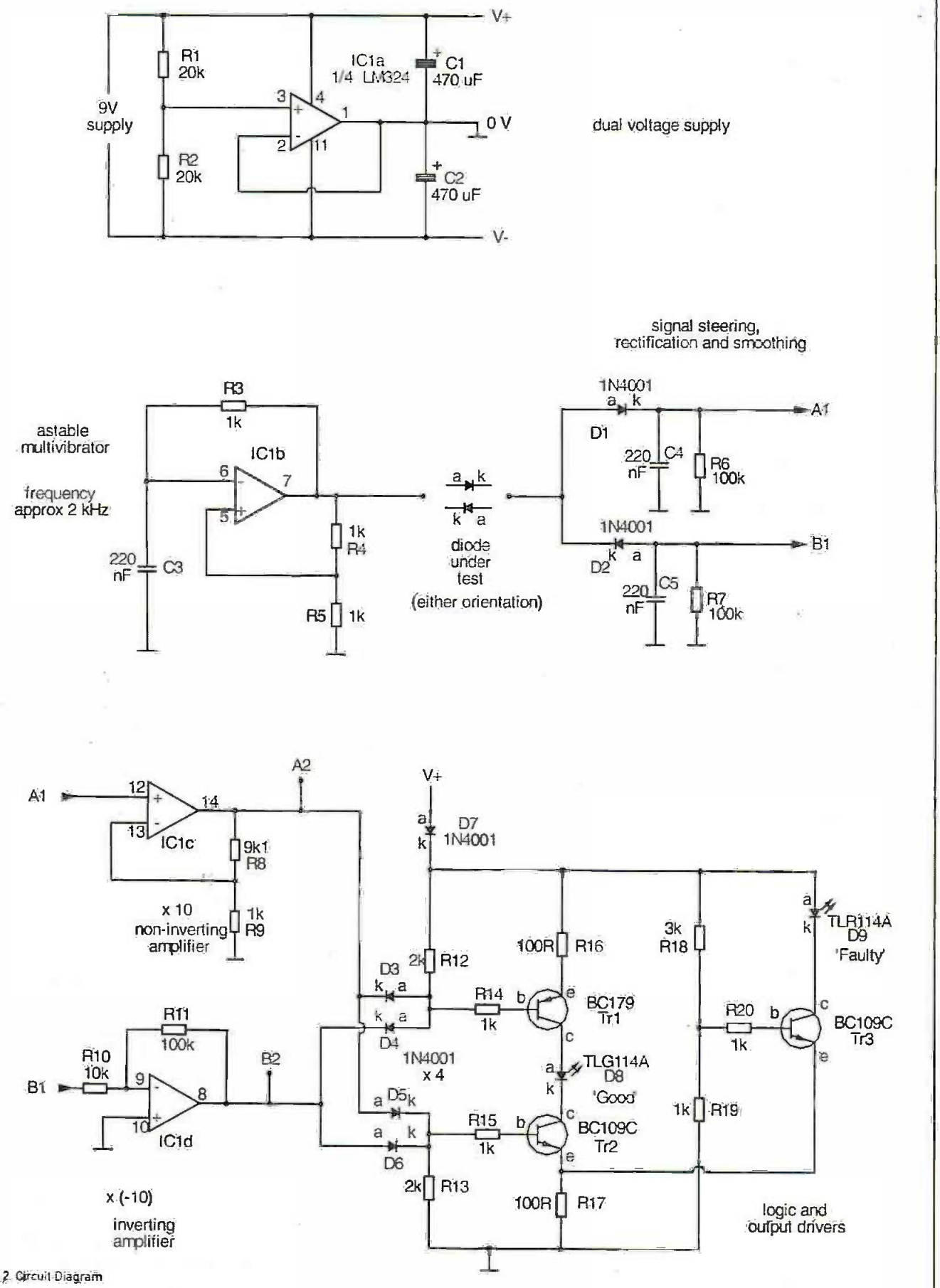


Figure 2 Circuit Diagram

of a two-resistor voltage divider between the positive and negative terminals of the battery provides a zero volt reference point and an op-amp voltage follower maintains this reference voltage even under varying supply current demands on both supply rails. The capacitors provide smoothing to prevent any spikes or dips appearing on the supply voltage rails that might be generated by the square wave oscillator or that are introduced by the power supply if one is used instead of a battery.

Oscillator

The oscillator is an op-amp astable multivibrator operating at around 2 kHz, a frequency that will test audio frequency, radio frequency, signal and rectification diodes. It also means that extreme values are not required for the oscillator and smoothing and rectification components.

Signal Steering, Rectification and Smoothing

This section generates one of four possible combinations of voltage on points A1 and B1 depending on the four possible states of the diode under test, namely:

- non-conducting in both directions, ie open circuit (faulty)
- conducting in both directions, ie short circuit or acting as a resistance or impedance (faulty)
- rectifying in one orientation (OK)
- rectifying in the other orientation (OK)

D1 and D2 rectify any non-rectified signal present, for example if the diode under test is short-circuited. Otherwise they pass on unchanged (other than introducing a further diode voltage drop) any signal already rectified by the test diode. The signals are 'steered' by the respective diodes to C4/R6 or C5/R7. The time constant for these capacitor/resistor pairs is long compared to the period of the astable waveform thus smoothing it and providing a DC output. The resistors also provide a discharge path to allow the output voltages to sink to zero when there is no signal present.

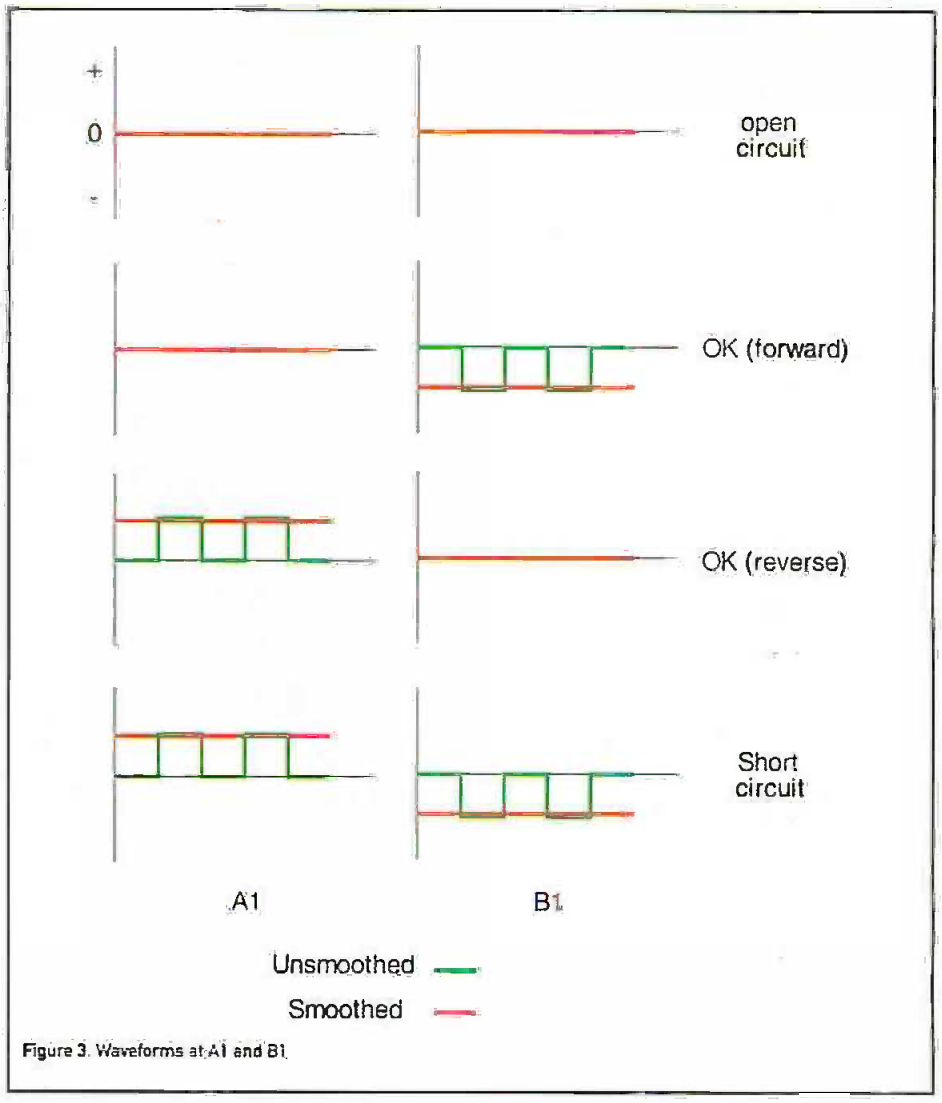


Figure 3. Waveforms at A1 and B1

Figure 3 shows the waveforms that result at A1 and B1 for each of the possibilities.

Amplification

It can be seen that the signal at A1 is always zero or positive, and that at B1 is always zero or negative. Their magnitude is around 1 to 1.5 volts, due to the astable output voltage being 'dropped' across the diode under test and D1 or D2. To 'standardise' these signals to form the basis of logic signals two amplifiers are used, both with a gain of around 10, one being inverting (IC1d) and one non-inverting (IC1c). Thus the signals at A2 and B2 are either at around V+ (logic '1'), gently 'saturating' at the maximum op-amp output, or 0V (logic '0'). In fact logic '0' is likely to be not exactly zero, but a few millivolts positive or negative due to any op-amp offset current present. This however is still a great deal less than the voltage necessary to give a false '1' namely the ±700 millivolts it would need to cause any of the diodes D3 to D6 to conduct.

Figure 4 illustrates the signals at A2 and B2; table 1 shows these represented as logic signals.

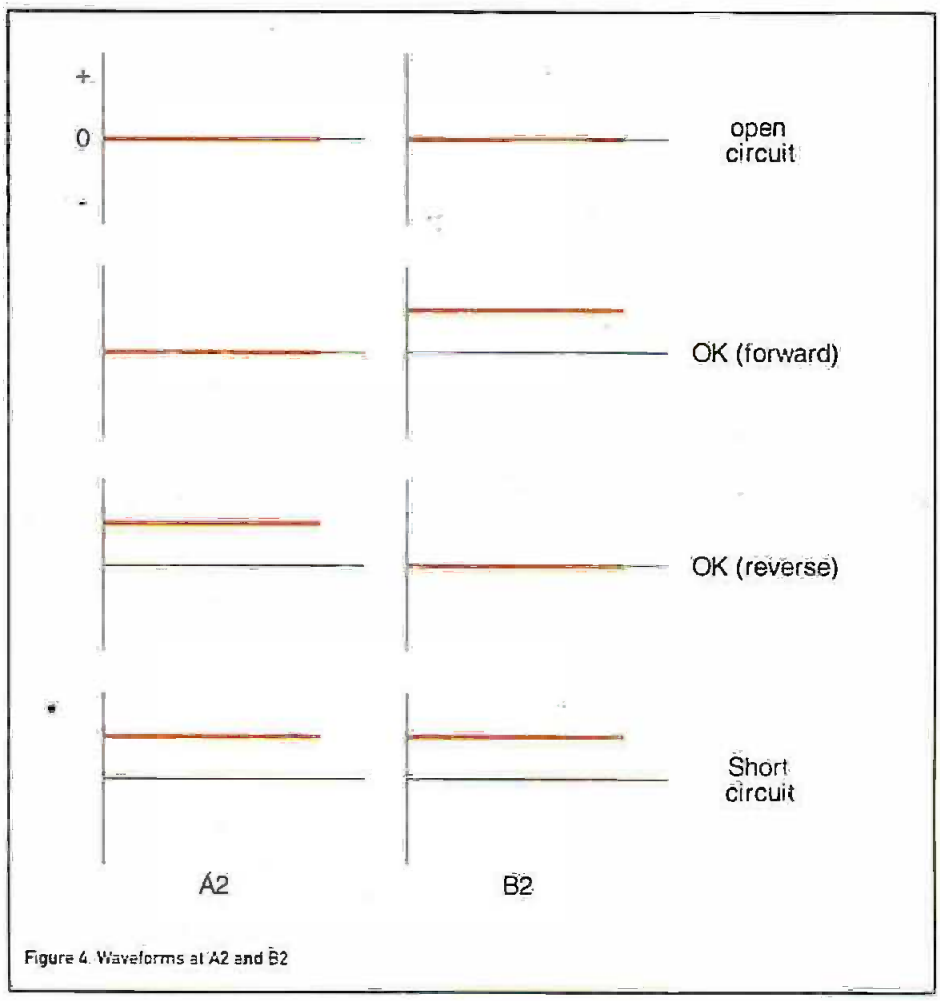


Figure 4. Waveforms at A2 and B2

Diode Under Test	A2	B2	Green LED	Red LED
Open Circuit	0	0	Off	On
OK (forward)	0	1	On	Off
OK (reverse)	1	0	On	Off
Short Circuit	1	1	Off	On

Table 1

This demonstrates that the green LED needs to light, indicating that the diode is OK, when A2 and B2 are in opposite logic states, but to not light if they are in the same logic state. This is the logic 'exclusive OR' or 'XOR' function. The table also shows what is perhaps obvious, that the red LED, indicating that the diode is faulty, needs to light when the green LED does not. The final section of the circuit implements both the logic and diode driver functions.

Logic and LED Drivers

To implement logic and diode driver functions together it is practical to use a circuit employing transistors, resistors and diodes instead of using integrated circuits (ICs) containing committed logic gates in combination with a transistor current driver. This avoids the special power supply requirements that are necessary when interfacing logic gates with op-amp circuitry.

One realisation of an XOR function is shown in figure 5 and this is implemented in this section as follows.

Having the green 'OK' LED in series with transistors Tr1 and Tr2 means that it will only light when transistor Tr1 AND transistor Tr2 are both conducting. This is equivalent to gate G3.

Tr1, being a PNP type, will conduct in this arrangement when its base is '0'. D3, D4, R12, R14 and Tr1 therefore act as a negated input OR gate (gate G1).

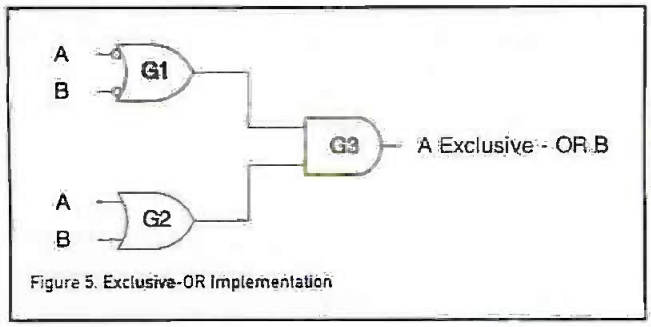


Figure 5. Exclusive-OR Implementation

Tr2, being an NPN type, will conduct in this arrangement when its base is '1'. D5, D6, R13, R16 and Tr2 therefore act as an OR gate (gate G2).

If either A2 or B2 is exclusively '1', ie the other is '0', then V1 will be '0' and Tr1 will conduct. V_2 will be '1' and Tr2 will also conduct, hence the OK LED will light.

However if both A2 and B2 are '1' then V_1 will be '1' and Tr1 will not conduct. The OK LED will not light.

If both A2 and B2 are '0' then V_2 will be '0' and Tr2 will not conduct. Again, the OK LED will not light.

By virtue of the fact that there will be a voltage drop across it when conducting, diode D7 effectively reduces V+ slightly to this section of the circuit and so ensures that Tr1 will switch off fully when A2 or B2 is '1'.

The 'Faulty' LED

Through the voltage divider action of R18 and R19, V3 is fixed at around 1V. Tr3 will therefore conduct, lighting the 'Faulty' LED D9, if the voltage between the base and emitter is around 0.7 V, which it will be if the OK LED is not lit. But if the green OK LED lights the current through R17 increases, increasing the voltage drop across the resistor. This reduces the voltage between the base and emitter of Tr3 to less than the 0.7 V required for it to conduct, switching it off and extinguishing D9. The 'Faulty' LED therefore lights whenever the OK LED is not lit, in other words the 'Faulty' LED always lights unless the diode under test is functioning correctly as a rectifier.

Construction

A suitable strip board layout for this project is shown in figure 6, and the appropriate track cuts necessary are shown in figure 7. Note that the characters 'k' and 'a' associated with D1 and D2 shown in figure 6 indicate that the cathode and anode respectively for these vertically positioned components are uppermost.

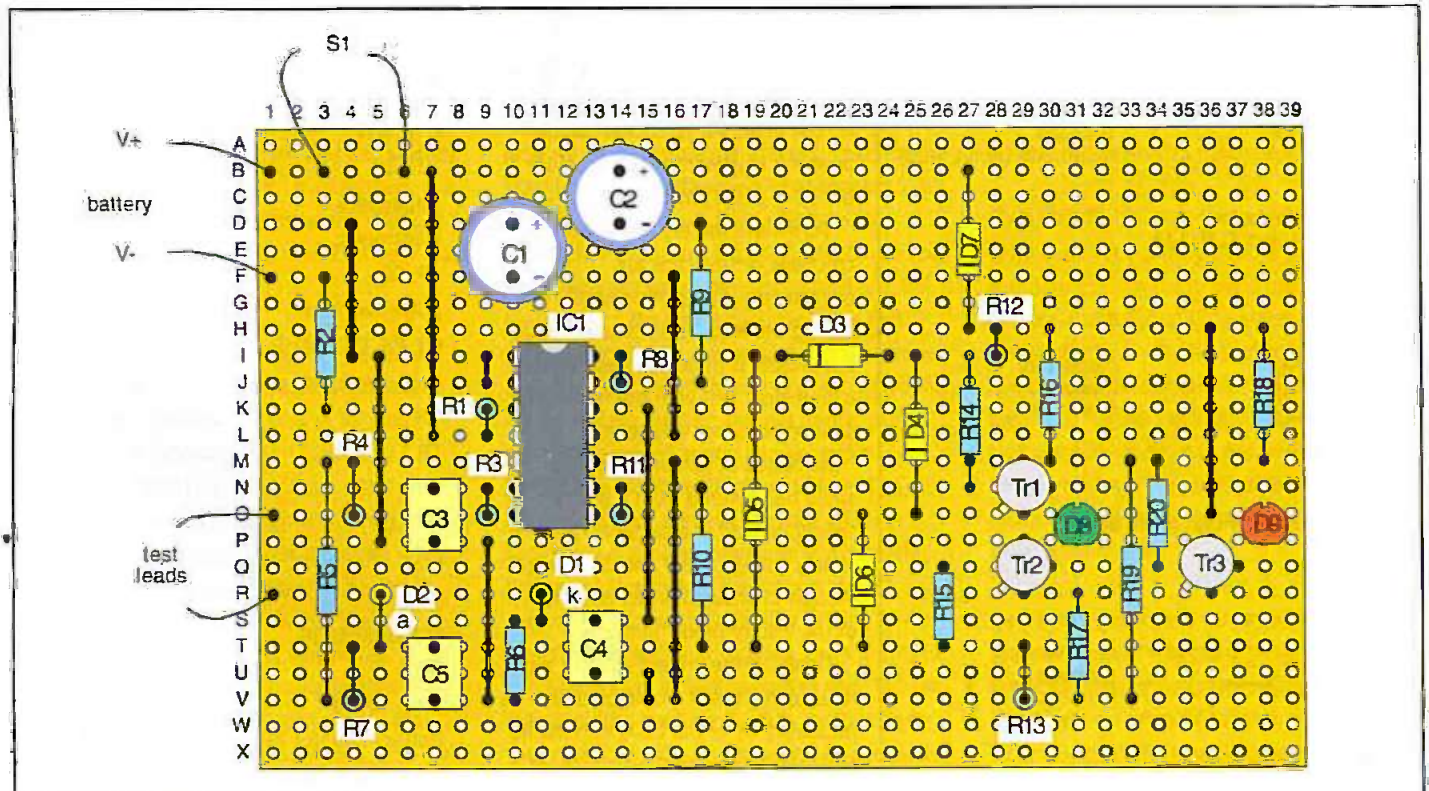


Figure 6. Strip Board layout (component side)

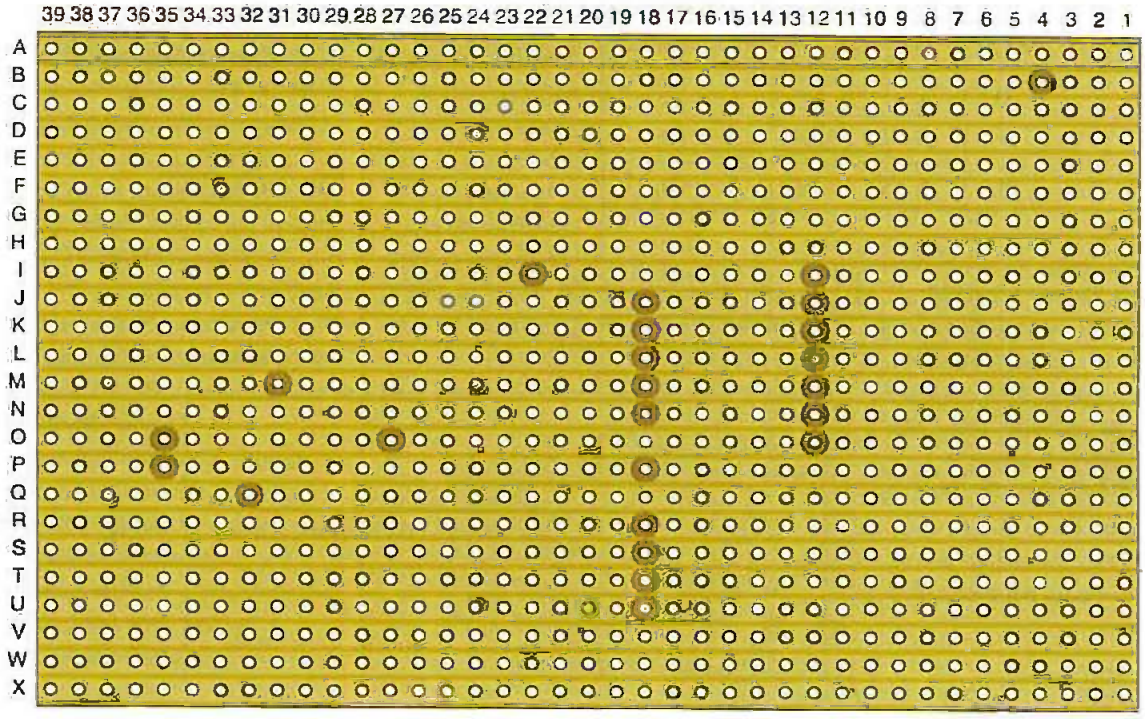
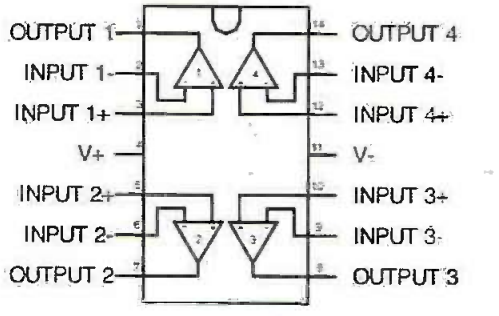


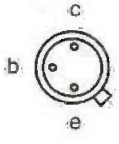
Figure 7. The Track Cuts Required On The Strip Board Layout (track side view).



LM 324 (from above)

a anode
k cathode (short lead)

LEDs (from below)
TLG114A and TLR114A



c collector
b base
e emitter

TO18 transistor can (from below)
•BC109C
BC179

a anode
k cathode

1N4001 diode

Figure 8. Component orientations

The correct orientation of the transistors, diodes and LEDs, and electrolytic capacitors needs to be observed. The polarity of an electrolytic capacitor is marked on its cover; figure 8 gives details of the physical configuration of the other components.

The usual order of mounting components should be followed, though it's not critical for this project. Fit the links and horizontal components first, then the capacitors and vertically mounted components, and finally the semiconductors, the IC last of all. An IC socket can be used if it is preferred not to solder the IC in place directly.

Terminate the test leads with small crocodile or test clips for convenience of testing. Colour coding the leads is not important as the project is of course designed for a 'one-stop' test with the test diode connected either way round.

As hinted at earlier the device could be powered from a power supply instead of a battery. The supply voltage of 9V should be kept though to ensure correct operation of the 'Faulty Diode' indicator.

Finally, if the project were to be housed in a box it would of course be necessary to fix the LEDs into the lid and attach them to the strip board by extra wiring.

In Use

Simply connect the diode under test to the test leads, either way round, and note which LED lights. Throw away any faulty diodes!

Parts List

Resistors (metal film, 0.6W, 1%)	
R1, R2	20k
R3, R4, R5, R9, R14, R15, R19, R20	1k
R6, R7, R11	100k
R8	9k1
R10	10k
R12, R13	2k
R16, R17	100R
R18	3k
Capacitors	
electrolytic	
C1, C2	470 µF
polyester film	
C3, C4, C5	220 nF
Semiconductors	
IC1	LM324
TR1	BC179
TR2, TR3	BC109C
D1 - D7	1N4001
D8	TLG114A green LED
D9	TLR114A red LED
Miscellaneous	
Sw1	SPDT switch
Strip board	
Battery clip (for PP3 power supply battery)	
Test clips or small crocodile clips	
Box to suit	

The ELECTRONICS Forum

THE ELECTRONICS FORUM IS A NEW INTERACTIVE FEATURE WHERE YOU CAN SEND IN YOUR QUESTIONS AND HAVE THEM ANSWERED BY OTHER READERS OF ELECTRONICS AND BEYOND. WE HAVE ANSWERED THE FIRST TWO QUESTIONS, BUT THERE ARE STILL A FURTHER FOUR THIS ISSUE THAT NEED ANSWERING. REMEMBER, THIS IS YOUR FEATURE AND FROM NOW ON, THE ANSWERING AS WELL AS THE ASKING IS ENTIRELY UP TO YOU!

Question: I have a power supply rated at 10VA. Why are ratings sometimes measured in volt-amps? Isn't this the same as a Watt?

Answer: For DC they may be taken as the same. In the case of AC the actual relationship is:

POWER (WATTS) = VOLTS * AMPS * POWER FACTOR

If the load on the power supply is purely resistive then they are the same since the PF=1. If the load is a reactive component, e.g. an electric motor, then the PF becomes less than 1 as a result of voltage and current being out of phase. Since the nature of the load was unknown to the power supply manufacturer it has been rated in VA.

Question: I have a CD player that has started to skip and jump during tracks. I suspect the laser unit. I have tried cleaning the lens but this hasn't helped much. Is there an easy way to test the laser unit?

Answer: The output level can be measured with an oscilloscope. A testpoint is normally provided for this marked EFM or RF (but not always so clearly marked!). Levels vary between makes of laser unit. A signal amplitude of 1.2 to 1.5v p-p is normally okay, but you will need to find out the exact acceptable levels for your laser unit. In addition the trace should form a series of clearly defined overlapping sinewaves. A level lower than the minimum indicates that the laser should be replaced – although it may still work perfectly with some discs. This test will require running the unit with the case off. Anyone in any doubt of their competence to do so safely should take the player to an electronic service engineer.

Question: In Star Wars, are the lightsabers real props or just animated special effects?

Answer: In a way they are both. The lightsaber prop the actors use consists of a plastic handle with a rod of aluminium attached. These aluminium rods are painted red, green or blue. Before the film goes to the special effects department, it looks very disappointing indeed.

For the first three films, animation was done frame by frame with the outline of each lightsaber blade being drawn onto an animation cel and then painted the appropriate colour. These cels were then made into a film, shot using a light diffuser over the lens (so as to produce the signature glow around the edges). The film at this stage shows what appears to be a battle in the dark, as it only features the blades moving against a black background. The final stage was to double-expose the film footage from the movie onto the same film.

For the prequels, a new digital option came into play. You might think this would make the whole process quicker, but the frames still have to be looked at one by one, and the blades individually outlined as before. The differences here are that the movie film is downloaded into the computer in extremely high resolution before the tracing and colouring is done, the diffusion is done frame by frame instead of at the end, and the cels in this process are virtual instead of real. The two pieces of film are then digitally merged and the result is a more realistic-looking sequence than was possible before.

And now it is your turn to answer...

Question: I'm looking for a circuit for a Capacitor ESR meter. Can anyone help?

Question: Almost two decades ago Hornby made an intelligent model railway controller called 'Zero-one'. Does anyone make anything similar today? Has anyone tried making their own? All information gratefully received.

Question: I have an old Acorn Archimedes A3000 computer, which I have not used for several years yet have somehow not managed to get around to disposing of. I could just break it up for parts, but there is always the option of customising it so as to give it a whole new and even unconventional role. Does anyone have any suggestions as to what I might be able to make using this very versatile little RiscOS machine?

Question: Do you know of anyone who I can contact about building remote control submarines? I want to build one with a camera and halogen light aboard, so that I can send it out into the local lake and receive live pictures on a monitor. This would then be used as a regular feature in the combined schools' fare we hold in the park every March. I know that is a long way off but I don't have much free time on my hands and would need to start fairly early.

If you have a question you want answered or think you can answer, send it in by post to the usual address or e-mail it to theeditor@electronicsandbeyond.com. Alternatively, you can go online and discuss it on the E&B Forum at www.electronicsandbeyond.com.

Diary Dates

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

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

26 August. SECC, Glasgow.
Scottish Computer Fair.
Tel: 01706 299 902
Fax: 01706 840 444

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

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

2 – 4 September. ExCeL, London.
ECTS – Computer & Video Games & Leisure.
Tel: 020 8309 7000,
Fax: 020 8987 7521
www.ects.com

5 - 6 September. Business Design Centre, London.
Exhib-IT – IT Recruitment Exhibition.
Tel: 01442 289 700
Fax: 01442 876 644
www.exhib-it.co.uk

11 – 13 September. NEC, Birmingham.
Total Marketing Solutions & The National Incentive Show.
+44 (0)20 8910 7870

11 – 13 September. NEC, Birmingham.
The Recycling & Waste Management Exhibition.
+44 (0)20 8277 5000

12 – 13 September. NEC, Birmingham.
Linux Expo 2001
00 33 1 43 458080

14 – 15 September. Olympia, London.
Visit – IT Recruitment.
Tel: 20 8267 4000
Fax: 020 8267 4237
www.visit.haynet.com

18 – 20 September. Earls Court, London.
Geographic Information Systems Exhibition & Association for Geographic Information Conference
Tel: 020 8309 7000
Fax: 020 8987 7521
www.gisexpo.com

18 – 20 September. NEC, Birmingham.
e-Business 2001
Tel: 020 7596 5095
Fax: 020 7596 5098
www.ebusiness-nec.com

19 – 20 September 2001. ExCeL, London.
ECIF – Electronic Components Industries Fair.
OnBOARD (Production Assembly Exhibition)
Tel: 01799 528 292
Fax: 01799 528 268
www.ecif.co.uk
www.onboard.co.uk

19 – 20 September. ExCeL, London.
MobileWorld Expo
Tel: 01923 676 867
Fax: 01923 676 747
www.mobileworldexpo.co.uk

19 - 22 September. Makuhari Messe, Chiba (near Tokyo), Japan.
World PC Expo 2001
http://expo.nikkeibp.co.jp/wpc/e/

21 – 22 September. Donington Exhibition Centre, Derby.
Leicester Amateur Radio Show.
Tel: 01455 823 344
Fax: 01455 828 273

WHAT'S ON in Aug & Sept

Exhibitions

18 - 20 September. Earls Court, London.

Geographic Information Systems Exhibition & Association for Geographic Information Conference

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Fax: 020 8987 7521
www.gisexpo.com

With the price of Geographic Information Systems (GIS) software and basic map and demographic data falling, more companies are utilising the technologies available and are discovering the potential of geospatial computing.

The Association for Geographic Information (AGI) is a not-for-profit organisation representing users and vendors of Geographic Information (GI) and GIS. Its members include government departments and agencies, local authorities, system and data suppliers and users from a wide range of commercial sectors including retail, finance, insurance and utilities.

The AGI Conference is twinned with the Geographic Information Systems Exhibition, which provides a valuable opportunity for existing and potential users to see Geographic Information Systems in action, as well as find out more about the business benefits GIS can bring to an organisation. There will be seminars, demonstrations and workshop programs, and over 130 of the key European vendors of GIS will be in attendance.

19 – 20 September 2001. ExCeL, London.

ECIF – Electronic Components Industries Fair.

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Fax: 01799 528 268
www.ecif.co.uk

The Electronic Components Industries Fair takes place at ExCeL in the Docklands, London on 19th and 20th September from 10am to 5pm. Entry is free. A full seminar programme will be running throughout both days (attendance also free). There will be over 120 exhibitors including Easby Electronics, Samwha, Dane-Elec, Vision Engineering, TDI and Powerbox.

Seminars:

Wednesday 19th September

11am 0201 Chip Component Design and Assembly Issues
12pm Component Availability Obsolescence Trends
1pm Design for Manufacture – A Manufacturing Case Study
2pm Designing a Test Equipment Strategy – Case Study
3pm Component Termination Options for Lead-free Reliability

Thursday 20th September

11am The transformation from flat panel displays to sub-systems
12pm The impact of single board computers in the embedded market

19 – 20 September 2001. ExCeL, London.

OnBOARD (Production Assembly Exhibition)

Tel: 01799 528 292
Fax: 01799 528 268
www.onboard.co.uk

Running alongside ECIF (see above) is its sister show, OnBOARD, which revolves around all aspects of electronic production and assembly. Running in the same venue

at the same time, entry is also free.

Seminars:

Wednesday 19th September

11am Practical Introduction of On-Line Training Rules
12pm CSP, Fine Pitch Zero Defect Printing
2pm Design Requirements and Optimisation for Automatic PCB Handling
3pm BGA Rework and Successful Component Recovery

Thursday 20th September

11am Introducing Automatic Optical Inspection and Where To Position Equipment
12pm Lead-Free Material Trends and Process Introduction
1pm Selective Soldering Design and Process Issues
2pm Designing Solder Carrier Pallets for High Soldering Yields
3pm Current Lead-Free Assembly Defect Guide

24 – 28 September. ExCeL, London.
European Microwave Week
020 7861 6391
Fax: 020 7861 6251
www.eumw.com

European Microwave Week will combine three conferences during the course of the week with the addition of short courses and workshops to complement the main sessions.

The 9th Gallium Arsenide Application Symposium will be held on September 24 and 25. The aim of this conference is to promote the discussion of recent developments and trends, and the exchange of scientific and technical information on Gallium Arsenide and other compound semiconductors. Special emphasis will be given to applications including telecommunications, automotive, sensor, military and space applications.

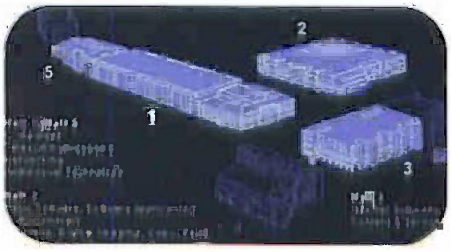
The 31st European Microwave Conference will be held from September 24 to 27. Its aims are to present the most recent advances in theory, techniques and systems in microwave, millimetre and sub-millimetre waves. Special emphasis will be placed on new applications in these fields.

The 4th European Conference on Wireless Technology will be held on September 27 and 28, and is a forum for the presentation and discussion of new developments in the field of wireless communications. Accurate modelling of systems, components and the development of new techniques and applications are key to the rapid and effective deployment of new wireless products and systems. The technical challenges of higher data rates and improved spectral efficiency must be met whilst simultaneously satisfying the commercial challenges of low cost and high volume production. The forum will feature presentations and discussions to address these challenges.

The banner title of European Microwave Week has only been in existence for the past four years, and the event has previously been held in Amsterdam (1998), Munich (1999) and Paris (2000). This is the first major microwave and wireless exhibition and conference to be held in the UK for four years, and the organisers are expecting a larger turnout this year than ever before.

25 – 28 September. Messe Basel, Switzerland.
Orbit/Comdex Europe 2001.
+41 61 686 2020
www.orbitcomdex.com

This autumn, the city of Basel in Switzerland (located in the three-country-corner, where Germany, France and Switzerland meet) will once again become the meeting place for the European and international IT sector as the halls of Orbit/Comdex Europe 2001 open up once again, this time under the motto 'Information technology – one step ahead'. Orbit/Comdex is the world's fifth largest IT



trade exhibition, with 1,450 exhibitors presenting their IT sector innovations to a qualified trade public on approximately 55,000 m2 of net exhibition area spread over 4 different halls (see inset). Last year's event was so successful that when the exhibition closed, 80% of the exhibition area had already been sold again for 2001.

In the same way as last year, the exhibition will begin with a symposium entitled 'Connecting Leaders', to which well-known business personalities will be invited. The supporting programme of the exhibition will comprise an international trade conference and case studies from Germany, the USA and Switzerland. Renowned speakers will report on the latest IT trends and developments, representing various points of view from fields including industry, the customer and new markets.

Please send details of events and exhibitions to jaldred@kanda.com.

Bookshop

Internet Made Simple In Colour (Second Edition)

Designed for inexperienced net users, who want to learn about (or learn more about) the possibilities of the Internet, this book is a good guide for those who do not have or do not want to have any technical or in-depth knowledge of computing.

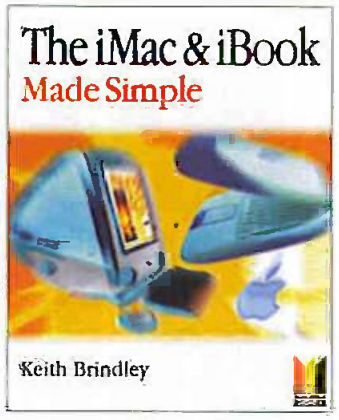
Setting up a computer to get online used to be fairly complex, but thankfully this is no longer the case. Getting online with any reasonably new PC and modern software is straightforward. The major problem faced by new users is working out what to do when they get on the Internet, and that is what this book sets out to address.

Topics covered include setting up the connection, web browsers, navigating the Web, search engines, using e-mail, reading newsgroups, downloading files, and creating your own Web pages. It is applicable to almost all computer systems, but its major emphasis is on Windows 95/98.

As you would expect, there are also a plethora of links to help you on your way to surfing the Internet, or even gently navigating it.

The Author: Previously a lecturer in Computer Programming, PK McBride is now a full time author, editor and typesetter.

Pages: 288pp
Price: £14.99



The iMac And iBook Made Simple

This book provides an introduction to the iMac (the new colourful computer from Apple) for new and inexperienced users. There are plenty of screen shots, and no technical or in-depth computer knowledge is required of the reader, so you don't need to know about Macs or PCs beforehand.

The iMac And iBook Made Simple covers using the bundled – and other – programs, customising, troubleshooting, and having fun with your iMac or iBook.

Chapter headings include: The Computer Newbie, The Macintosh Newbie, Beyond The Basics, Customising Your Computer; Power Tools, Appleworks, The Internet, and Problem Solving.

The Author: Keith Brindley is a freelance writer and journalist on electronics, as well as being an independent PC Consultant.

Pages: 160pp
Price: £8.99

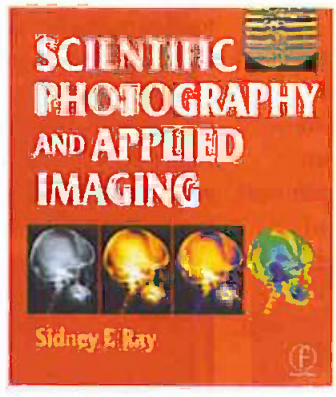
Microcontroller Cookbook (Second Edition)

Microcontroller Cookbook guides you through programming, interfacing, development work and circuit design using two of the most popular microcontroller families. The cookbook approach makes this an ideal book for anyone who has to get up and running quickly, so it is ideal for hard-pressed professionals and advanced electronics hobbyists. Enough theory is included to make this a suitable text for introductory microelecronics courses up to first year degree level, and new sections of reviews make this an ideal text for courses or independent study.

The new edition offers additional material on C programming and the use of compilers, an expanded section on macros, and a new section on the development of source code.

The Author: Mike James is a lecturer at Westland College, formerly of Yeovill College.

Pages: 208pp
Price: £19.99



Scientific Photography and Applied Imaging

Scientific Photography and Applied Imaging is a definitive book that fully encompasses the use of photography and imaging as tools in science, technology and medicine. It describes in one volume the basic theory, techniques, materials, special equipment and applications for a wide variety of uses of photography – from close up photography and photomacrography to spectral recording, surveillance systems, radiography and micro-imaging.

This extensively illustrated book contains all the information you need, whether you are a scientist wishing to use photography for a specialist application, a professional needing to extend technical expertise, or a student wanting to broaden your knowledge of the applications of photography. Indeed, the book will appeal to anyone with a technical interest in lens based media.

Each subject is introduced with an outline of its development and contemporary importance, followed by explanations of essential theory and an overview of techniques and equipment. Mathematics is only used where necessary and there are numerous applications and case studies described. Comprehensive bibliographies and references are provided for further study.

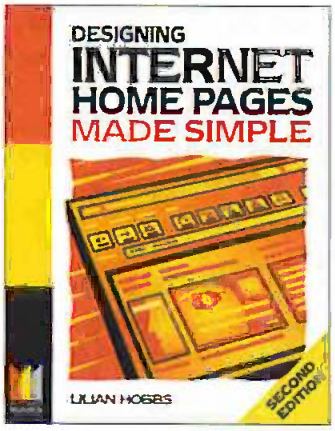
The book starts off by explaining the limits of visual perception, outlining light and radiation sources, and introducing the reader to the functions and uses of different types of equipment. Such topics as shutter systems, lighting, exposure determination and image processing are covered. The book then moves on to talk about subjects you rarely find covered in such detail all within one book – photofabrication, stereoscopic (3D) photography, photogrammetry, aerial photography, remote sensing, IR & UV recording, radiography, photographic visualisation, surveillance systems, low light level imaging, telephotography, and cavity and endoscopic systems. In addition, there are sections on underwater photography, panoramic photography, peripheral photography, the use of fisheye lenses, and even holography.

At £80 this is quite an expensive book, but you get what you pay for and if you have a serious interest in the

fascinating breadth of subjects covered by it, Scientific Photography and Applied Imaging is certainly worth the money. The judges at the 2001 Kraszna-Krausz Photography Book Award appreciated it as much as we did, awarding it with first prize in the Technical Photography category.

The Author: Sidney F Ray BSc MSc ASIS FBIPP FMPA FRPS is a senior lecturer in Photographic and Electronic Imaging Sciences at the University of Westminster.

Pages: 584pp
Price: £80.00



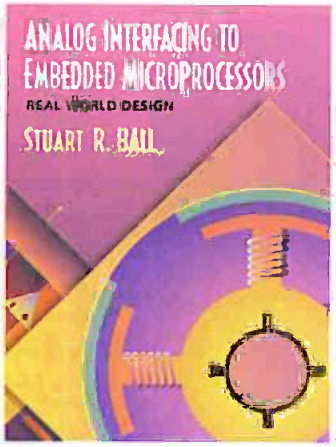
Designing Internet Home Pages Made Simple (Second Edition)

This book is aimed at beginners to HTML and Web page design. If you need to create and design your own Web pages that include both text and graphics, want your own Web page up and running quickly and efficiently, would like to know how to include Java applets on your Web pages, and need a self-teaching approach, then this book is exactly what you need. Bear in mind though, that it does not go too far beyond the basics and essentials.

Once you've mastered the rudiments of HTML with this book, you should perhaps consider moving on to HTML 4.0 Made Simple by P K McBride as this will consolidate your HTML skills and take you to intermediate/advanced level. If you buy both this book and the McBride one you'll be well on your way to creating exciting Web pages or sites of your own.

The Author: Lilian Hobbs PhD earned her PhD in database design and has designed and tuned databases for almost 20 years. She is now a member of a team that is introducing new features into the Oracle server. Prior to joining Oracle, she was a consultant in DEC's Rdb Development Group.

Pages: 192pp
Price: £8.99



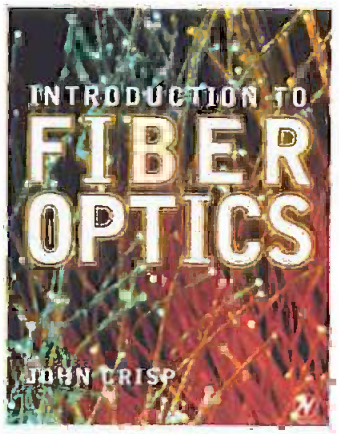
Analogue Interfacing to Embedded Microprocessors

This is a fascinating subject-specific book which addresses the technologies and methods used in interfacing analogue devices to microprocessors, providing in-depth coverage of practical control applications, op amp examples, and more.

At a time when modern electronic systems are increasingly digital, a comprehensive source on interfacing the real world to microprocessors should prove invaluable to embedded systems engineers, students, technicians, and hobbyists. Anyone involved in connecting the analogue environment to their digital machines, or troubleshooting such connections will find this book especially useful.

The Author: Stuart Ball is a senior electrical engineer who has worked for the past twenty years in the field of embedded control systems. He is the author of two other books on the subject: Embedded Microprocessor Systems and Debugging Embedded Microprocessor Systems.

Pages: 256pp
Price: £19.99



Introduction to Fiber Optics (Second Edition)

Already well established as an introductory text for engineers, managers and students, Introduction to Fiber Optics is now in its second edition, which includes new chapters on LANs, installation techniques, and the international BICSI standards.

It meets the needs of systems designers, installation engineers, electronic engineers and anyone else who wants to gain a working knowledge of fiber optics with a minimum of maths. Whether you are looking for a complete self-study course in fiber optics, a concise reference text to dip into or a course text that is readable and straightforward, this book has the solution.

The Author: John Crisp is a technical author and has written two other 'introduction to' books: Introduction to Microprocessors and Introduction to Digital Systems.

Pages: 240pp
Price: £16.99

HTML 4.0 Made Simple

This book is for more advanced users of HTML (HyperText Mark up Language). It assumes you know a little of HTML, but in case you don't the first few chapters serve as a basic 'crash course'. We would recommend you read a good introductory book such as Designing Internet Home Pages by Lilian Hobbs first, though, if you are a complete newcomer to the language.

The essentials of HTML are easy to master – you can learn enough to knock up a small, but well-formed site over a weekend. It will take you a little longer to work right through this book, but you will certainly find it worth the trouble. All you need for simple text-and-images pages is covered in the first four chapters. After that, lots more advanced material is covered to take you from a novice to experienced user.

The document and image files for the larger examples contained in this book can be found in the 'samples' areas of the Made Simple web site: www.madesimple.co.uk, making it far easier on the user than just working from the book alone.

The Authors: P K McBride (author of Internet Made Simple In Colour) and Nat McBride.

Pages: 208pp
Price: £12.99

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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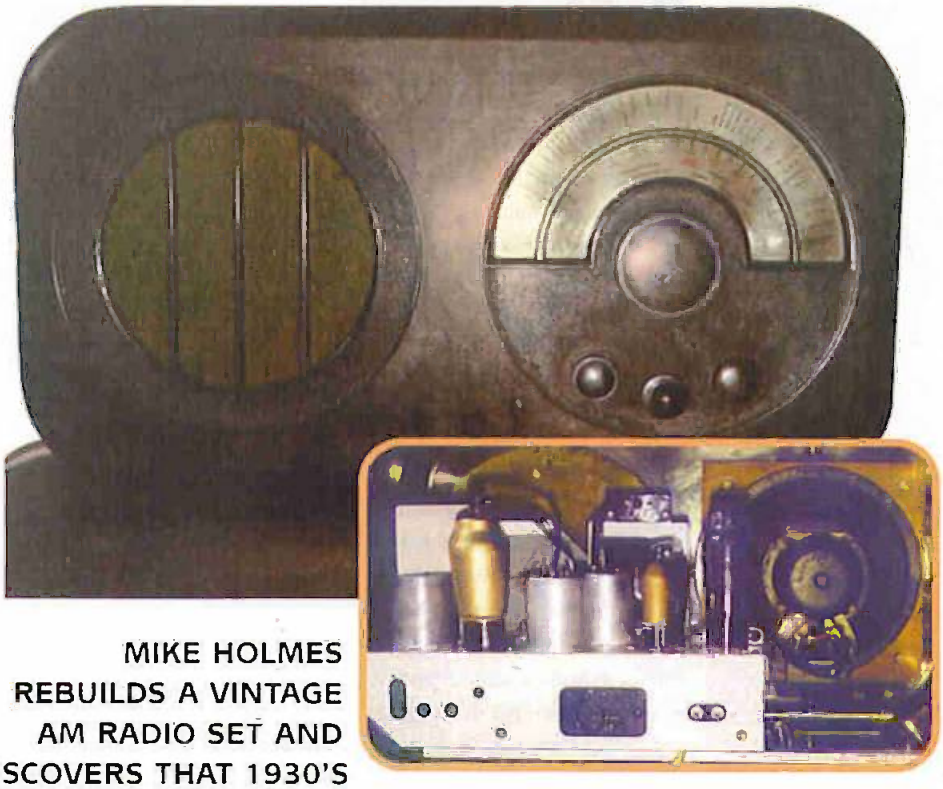
WIRELESS of Yesteryear

by Mike Holmes



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

PART 2

The circuit diagram of the receiver section is shown in Figure 1, and some other notable features can be described as we go through it. It shows that the superheterodyne principle was already quite advanced by 1934, including some sophisticated features such as AGC. So much so that the basic superhet has not essentially changed at all to the present day, with the exception of the introduction of solid state devices. This circuit is, of course, designed around the characteristics of the three valves used, which again have been well developed for their respective roles.

For example V1, the octode frequency changer, is exclusively a superhet front-end device, and at first sight is quite confusing to look at until one realises it is actually two valves in one, a triode and a pentode, operating in cascode. The triode is at the bottom, where the grid at pin 1 is its anode, and pin 2 its signal grid. This, together with T1, forms the local oscillator of the reaction coil type.

Above the triode are the normal three grids of a pentode, the first separated from the triode part by a duplication of the screen grid. The pentode's signal grid receives its input via the valve's top connector from the secondary of a double-tuned RF transformer, T2. No ferrite rods here, ferrites were either unknown or virtually impossible to make at this time; instead the coils are wound onto a wooden dowel, encased in a metal screen and buried deep in the interior of the chassis. The RF input is introduced via socket 'AE' from a long-wire aerial.

Along with the local oscillator, tuning is accomplished by VC1, a 3-gang, air-dielectric variable capacitor of titanic proportions ('A' in Photo 3b). It has a thick steel frame for absolute rigidity and is attached to the chassis top with vibration-proof mountings. An epicyclic reduction drive is attached to the front, concentric with the main shaft. This includes the dial pointer, comprising a metal arm carrying an MES bulb with a 'shadow mask' ('B' in Photo 3b). This projects a strip of light onto the back of the translucent tuning scale and includes a narrow bar through the centre of the aperture, which appears on the scale as a thin shadow by way of a fine cursor.

The RF Stage

In the pentode of V1, the RF is combined with the local oscillator waveform due to its cathode current being modulated by the wire mesh anode of the lower triode section. It should be well understood by now that in the superheterodyne principle, four signals are actually present at the anode (pin 7). These are the tuned RF frequency, the local oscillator frequency, the sum of the two, and the difference between the two. It is the difference, or intermediate, frequency that is isolated and passed on by the first double-tuned IF transformer T3. Changing to a lower IF allows more gain with greater stability in subsequent stages than if the RF were amplified alone.

S1 is the band selector switch for LW or MW, and its construction is quite unusual. It consists of a bank of eight reed type switches (S1a to S1h), actuated by Bakelite cams mounted on a common shaft. Mainly it shorts out the LW coils when MW is required, or not for the other case, but it also has a third position.

S1	a	b	c	d	e	f	g	h
LW								•
MW		•	•	•	•		•	
GRAM.	•					•		

Table 1.

Where direct audio input to the amplifier is required, it will be noted that the receiver is not disconnected from the volume control. Instead S1a shorts out the IF at source, so that the receiver is effectively 'silenced'. Understanding how this and other contacts functioned was crucial from the outset and the permutations were mapped as shown in Table 1.

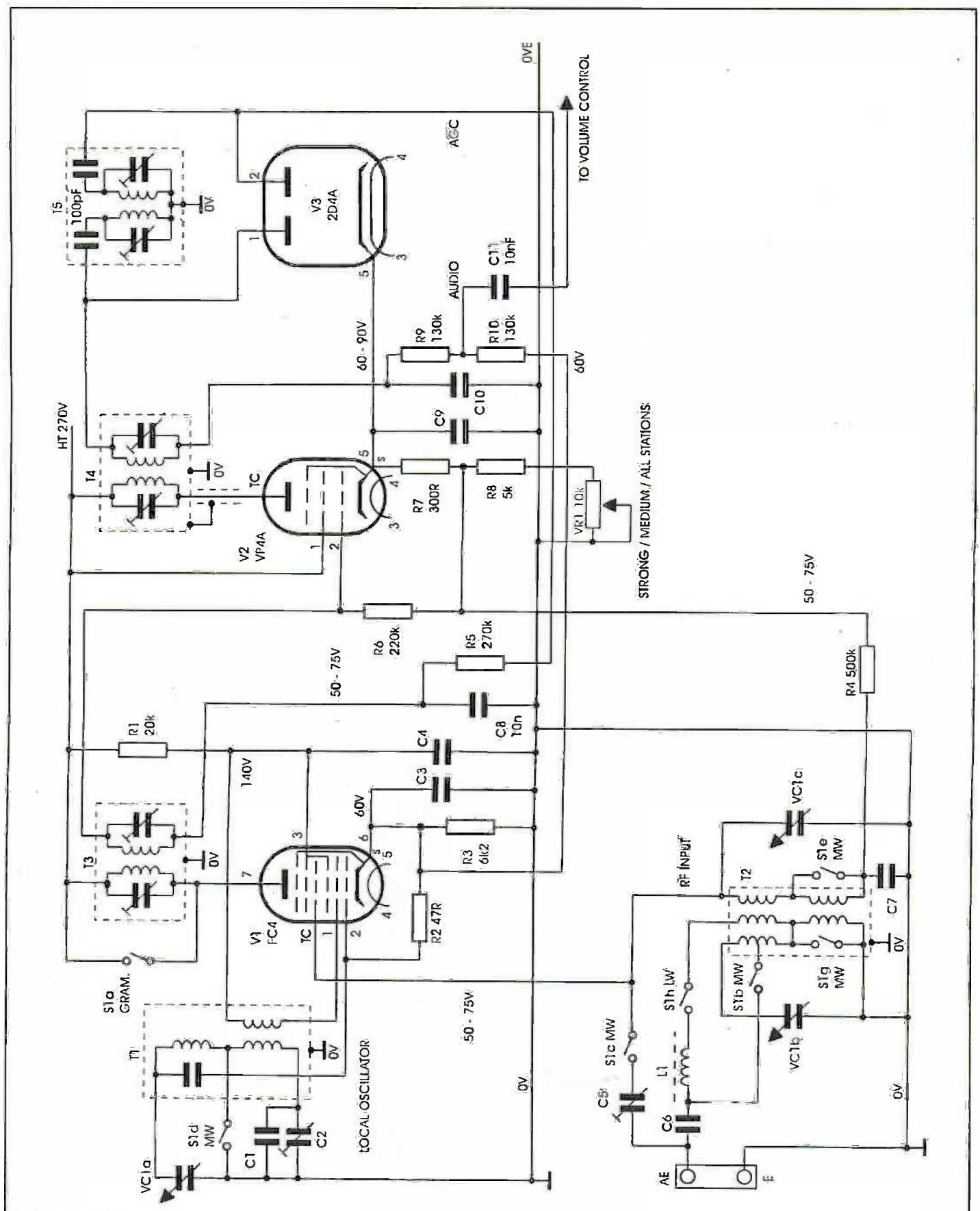


Figure 1. Circuit diagram of receiver section.

The IF Stage

The IF amplifier uses V2 as a variable-mu pentode type VP4A, where mu denotes gain. This is achieved by winding the signal grid with a varying pitch, so that where the DC bias becomes increasingly negative, electron flow through the narrowest gaps is cut off completely, progressing to the next narrowest and so on, eventually leaving just a short portion of the total grid area to produce a small variation of the electron flow, and hence the gain of the valve is at minimum. The variable DC comes about, of course, from an Automatic Gain Control (AGC) system and is derived directly from IF amplitude.

The VP4A is, or was, available with two base style options, either B7 or B5. The original was B7, where each electrode had its

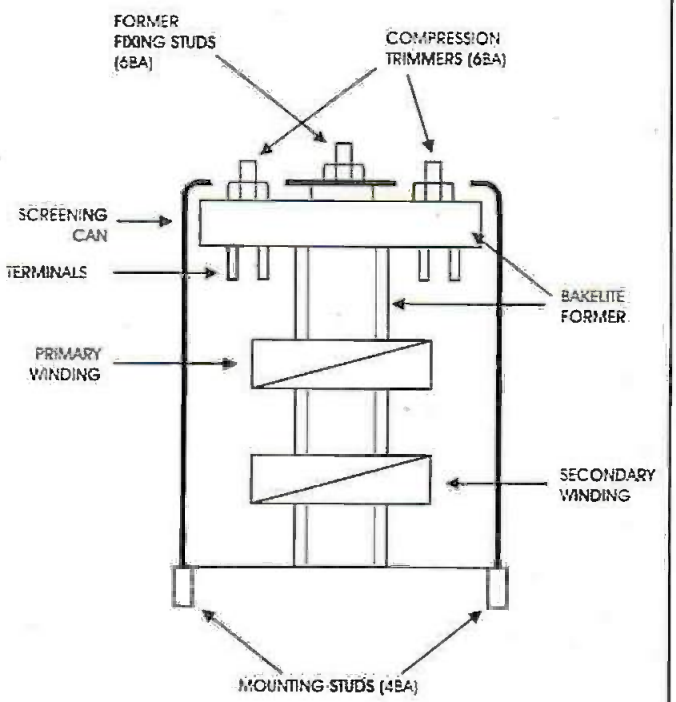


Figure 2. IF transformer construction

own pin. The replacement, however, was the B5 option, where cathode, suppressor grid and outer shield are all commoned internally on pin 5. This required replacement of the socket also, but did not change the original circuit.

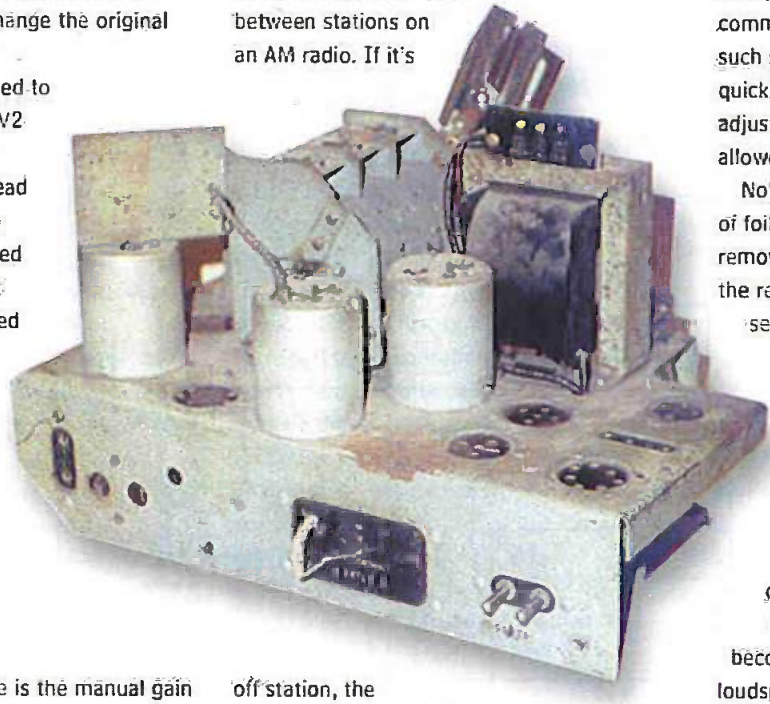
A metal screen is screwed to the top of T1 to separate V2 from V1 and prevent feedback, and the flying lead to V2 top connector had a length of bare wire wrapped around it as an attempt at screening. (Proper screened leads either did not exist in 1934 or were thought too expensive.) This was replaced with a piece of modern screened cable as it needed to be longer anyway.

The Detector

An especially novel feature is the manual gain control, VR1. In practice this not only varies the gain of V2 by changing its anode current, but also works as a squelch control through changing the threshold of the AM detector valve, V3. With VR1 at minimum resistance (maximum sensitivity), the cathode voltages of both V1 and V2 are practically equal at 60 Volts. That of V1 is communicated to the resistor chain R9 and R10, and thence to the anode of diode V3a via T4 secondary.

Meanwhile V3 cathode is directly connected to V2 cathode, and at this setting the diode is on the point of forward conduction so that very little IF amplitude is required to complete the process. As VR1 is increased, however, the detector will only conduct on successively higher and higher levels, and everything below this fails to reach the threshold and is muted.

This muting facility is an especially nice bit of extra sophistication and even works on the maximum sensitivity setting, because in use there is none of that nerve-jangling, rushing noise you normally get between stations on an AM radio. If it's off station, the loudspeaker is completely silent, and it's just one feature that makes the AC85 particularly pleasant to use.



It might seem that rectifying the output of T4 to derive the audio is all that is required, but this is not what happens. Instead it is used to excite a slightly modified T5, configured as a double-tuned, passive resonator, and it is to this that the diodes respond. Working like a DC restorer, positive peaks are 'clamped' to create a negative going offset that is communicated back through T4 secondary to appear on C10. IF is filtered out by R9 and C14, leaving the audio at the volume control. T5 secondary operates in exactly the same way with V3b to produce the AGC bias.

All the IF transformers are basically identical and their construction is illustrated in Figure 2. Because of the lack of ferrites, the former is wholly air-cored which means tuning adjustment must be done by making the capacitors variable. These are compression type trimmers actuated by nuts recessed into the top of the screening can. Holes are provided in the top of the can allowing wires to be drawn through the top if required (as is the case for T4 primary to the top connector of V2). The IF is surprisingly low by modern standards, at about 105 kHz.

Power Supply And Loudspeaker

Figure 3 shows the power supply and audio amplifier sections of the AC85. The sizeable mains transformer, T6, includes the input voltage selector on top (see also Photo 3b). This consists of a 3-way patch board and the required contact is made with a beautiful little brass screw with a knurled Bakelite head, the tip of which presses against a common bus bar behind. There are three such screws throughout the receiver and it quickly becomes apparent that these indicate adjustments or settings that the user is allowed to 'fiddle with'.

Note that the primary is shielded by a layer of foil called an Electrostatic Screen (ES); this removes the large potential difference across the respective ends of primary and HT secondary windings which might otherwise overstress insulation between layers. This was common in the days before the modern, split-bobbin type of former. The double-wound HT secondary of T6 is full-wave rectified by V6, the DC appearing on one half of the dual capacitor C12.

From here on the power supply becomes slightly confusing since the loudspeaker is obviously an inseparable part of it. The loudspeaker itself is recognisably modern enough in principle, having a 6 inches diameter, stiff paper cone complete with a corrugated surround suspension glued into an open steel frame or 'basket' (see Photo 6). Similarly, the voice coil is wound onto a paper tube and inserted into the ring gap of a magnet as you might expect, but it is at this point that the design deviates from

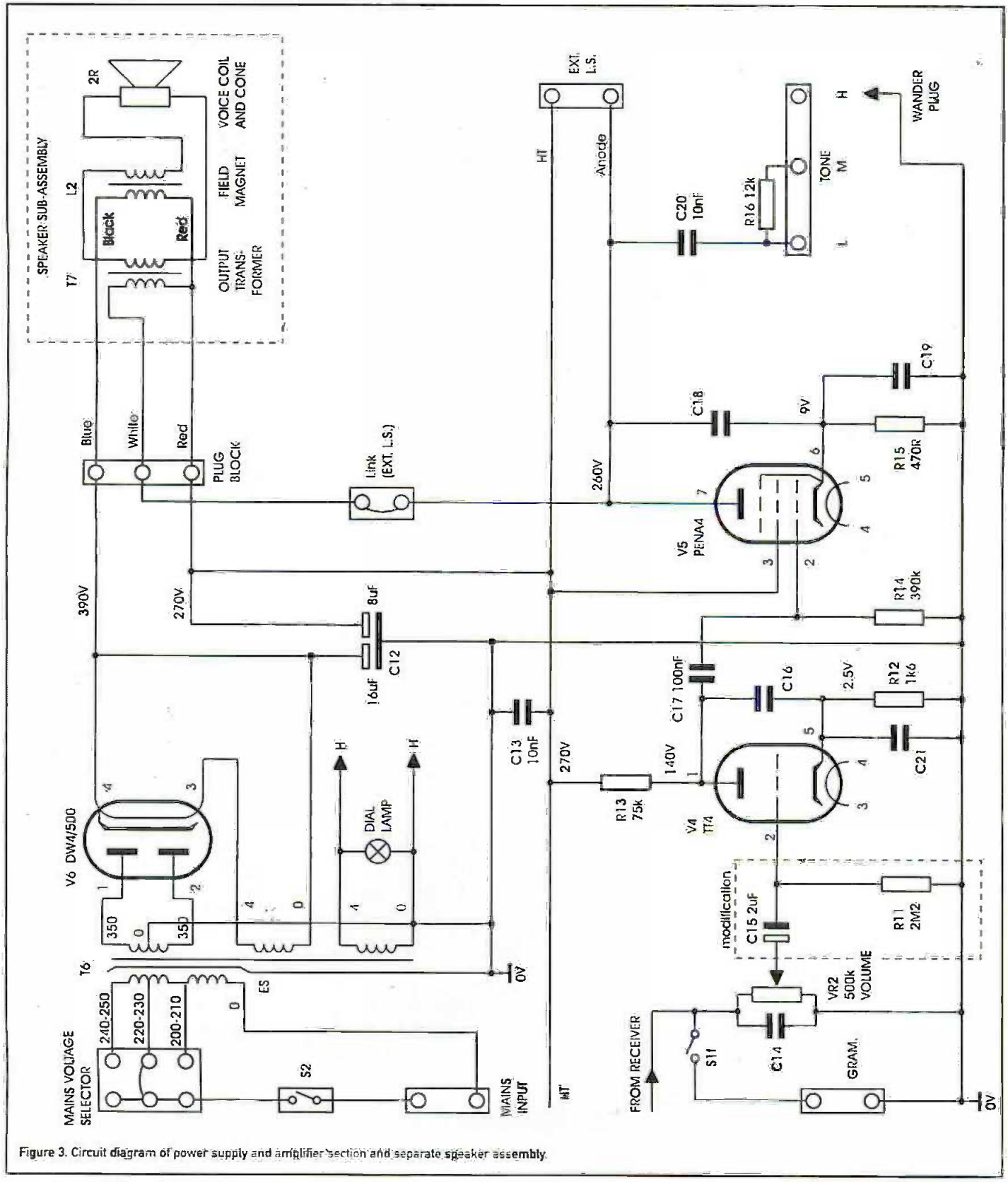


Figure 3. Circuit diagram of power supply and amplifier section and separate speaker assembly.

any modern counterpart, because this magnet is electric.

This has much to do with the fact that it has only been possible to make genuinely powerful, permanent magnets during the latter decades of the twentieth century. Prior to this electric magnets for moving coil speakers were the norm, powered, as here, by the HT supply. Moreover, in this design it doubles as an HT smoothing, low frequency choke, the resultant LC filtered output side being from the second half of C12.

The field magnet is 2,400 Ohms and carries the entire current consumption of the receiver, about 50 mA, thus dropping 120 Volts and consuming 6 Watts. Consequently the initial HT at C12a is high at around 400 Volts, coming out as a more typical 270 Volts at the receiver's main HT line.

Of special interest is the small secondary winding connected in series with the voice coil. Because there will be a certain amount of 100 Hz ripple current in the main winding due to its additional role as a smoothing filter, this will motivate the voice coil, producing audible hum. The secondary compensates by passing a proportional, reversed current through the coil, induced by the main winding and core. This seems really naff but is actually very effective; audible hum is extremely low and I suspect most of that is generated in the output stage.

The speaker unit had obviously not been

manufactured in-house, but bought in from an outside contractor whose quality control leaves much to be desired, as most mistakes and 'bodges' were found here. The magnet clamp bolts were nearly loose and — much more seriously — the voice coil was off-centre and rubbing on the magnet. Some copper was exposed but fortunately not cut through and no turns seemed to be shorted. This was recovered and after de-rusting and repainting, the speaker was reassembled properly with thread locking compound for all screws.

Correct alignment of the voice coil is achieved by a ring-shaped device glued into the centre of the cone, apparently made of black nylon and incorporating three flexible legs (virtually identical to the Isle Of Man emblem), consequently called a 'spider' (and now you know where the term 'spider' comes from in connection with loudspeaker cone suspension). Its central hole is anchored to a spigot extending from the centre pole piece by a screw, and there was an over-sized nut under the head of this screw because somebody couldn't find a suitable washer.

Audio Amplifier

Notice that the speaker assembly includes the output transformer bolted onto it (Photo 6). This is obviously a standard format of the time as external or 'stand alone' speakers were expected to be similarly equipped. Hence, if it is desired to connect an external loudspeaker this is taken directly from the anode of the output valve (with HT!), which then has to be isolated from its internal circuit by removing another Bakelite headed screw ('Link' in Figure 3). This subject is mentioned in The Handy Man And Home Mechanic, which recommends a permanent wiring installation buried in floors and walls (see Figure 4), presumably to negate long trailing leads carrying HT. (It omits to mention though whether such external speakers also need a power supply for their own field magnets.)

The audio amplifier is a modest but archetypal triode-pentode combination that, much later, would be combined into a single and much smaller glass envelope (for example Mullard ECL82); but at this stage valves were still largely separate. The output stage is single-ended class A. In addition to the permanent connection to the receiver output, an external audio source can be input via S1f from the 'GRAM.' socket (meaning gramophone). A compatible 78 r.p.m. record player would include a magnetic transducer in the pick-up arm, and the input impedance — actually R9 in parallel with R10, and not that of VR2 alone — is comparable.

Initially the volume control, VR2, was quite noisy, making 'scratchy' noises whenever moved. It turned out that C11 in Figure 1 was leaky, dropping about 12 Volts across VR2 and biasing on V4. This was cured by replacement with an axial polyester type, and just to make sure the input to V4 was decoupled from VR2 completely and given a new grid leak resistor, R11.

C17 was also leaky, turning V5 so hard on as to 'sag' the HT by 80 Volts (and might this have contributed to the original valve's failure?). This was replaced with a modern polypropylene equivalent and immediately after this the entire receiver, not just the output stage, worked a whole lot better. A crude 'tone control' is added, almost as an afterthought, where a wander plug on the rear panel is used to select either 'Low', 'Medium' or 'High' sockets.

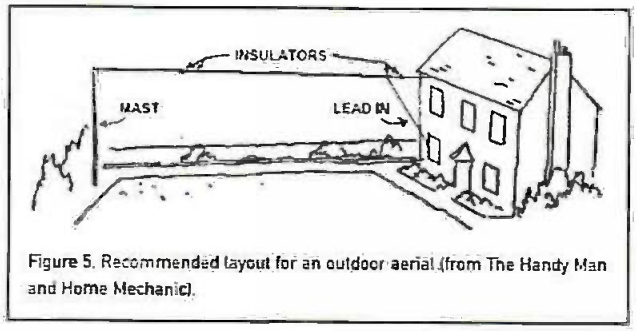


Figure 5. Recommended layout for an outdoor aerial (from The Handy Man and Home Mechanic).

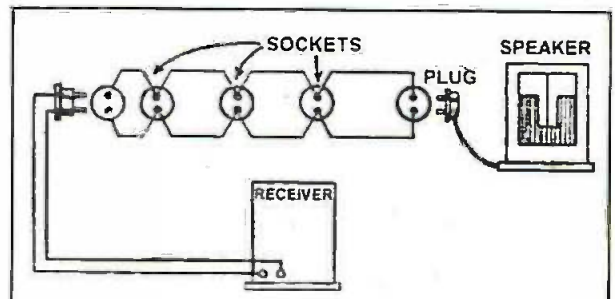


Figure 4. Recommended wiring diagram for connecting to an external speaker in one of a number of separate rooms in the house using under-floor wiring and wall sockets (from The Handy Man and Home Mechanic).

Arranging An Aerial

Restoration of the receiver was complete, while keeping as many of the original parts as possible, and the final stage was obtaining a signal and alignment of tuned circuits. As regards aerials, The Handy Man And Home Mechanic recommends an outdoor type as illustrated in Figure 5. The book specifies that the wire be between a high point of the house and a 25 feet high mast at the end of the garden, with insulators at each end (but fails to suggest suitable lengths). The down lead, at the junction of the aerial and the nearest insulator, '— should be ... at an angle and clear of the house, as the efficiency of the aerial will be reduced if allowed to touch the house.' Furthermore, '— a proper earthing switch or lightning arrester should be incorporated ... so that in the event of a thunderstorm, any charge induced may pass freely to earth without traversing any part of the receiver.' (!).

Figure 6 shows some of these devices, not least the earth tube, which is inserted into the soil outdoors to obtain an earth point (literally!). To ensure good connection with the ground the book advises: 'By its use the ground is kept moist in dry weather by simply pouring a bucketful of water down the tube.' The water is evenly distributed in the soil by means of a series of holes in the wall of the tube.'

Needless to say I did not resort to any such lengths since about ten metres of spare wire taped to a picture rail for an indoor aerial was more than satisfactory. I did, however, discover that earthing the chassis improved reception a good deal, but which of course was most easily got direct from the mains earth.

Alignment

Trimming the IF coils was easiest, and done with the aid of an oscilloscope to obtain greatest amplitude. Correct balance of T5 was particularly important. Trimming the RF coils had to be done from scratch since the

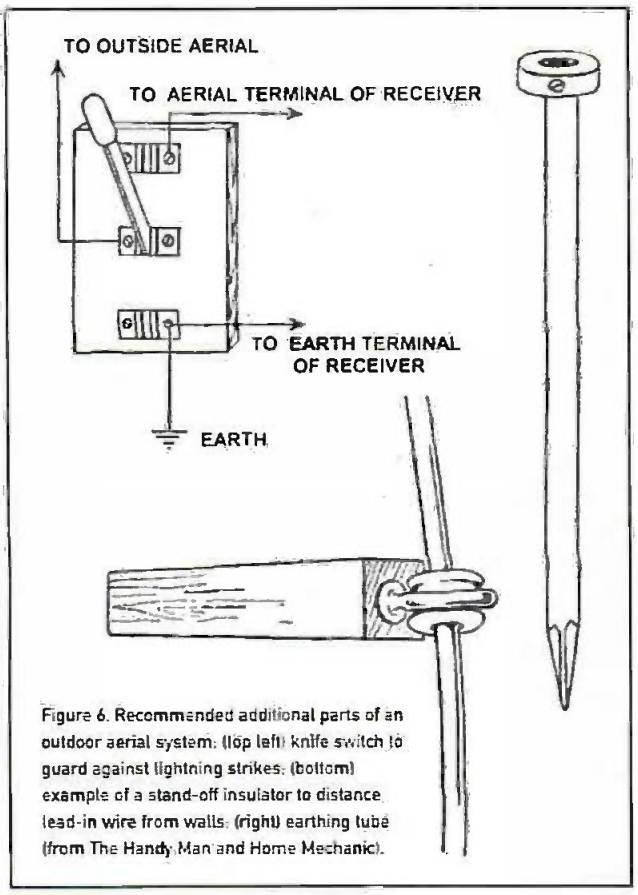


Figure 6. Recommended additional parts of an outdoor aerial system: (top left) knife switch to guard against lightning strikes; (bottom) example of a stand-off insulator to distance lead-in wire from walls; (right) earthing tube (from The Handy Man and Home Mechanic).

copper trimmers for VC1 had to be completely stripped, cleaned of verdigris and the underlying steel top panel removed of rust and repainted.

The tuning scale of the AC85 is 'back to front' compared with a modern receiver since it is calibrated by wavelength in metres, not kilohertz. Hence the left hand end begins at 200 metres on Medium Wave, or the highest frequency. The most accurate procedure was to turn VC1 to minimum, and apply a signal generator set to 1.5 MHz (equals 200 metres). The trimmers could then be adjusted to tune this in for maximum gain.

Of the three, that for VC1a, the local oscillator (T1) is the most sensitive, where degrees of movement of the screw could be measured in gnat's whiskers and had the most profound effect. The next most sensitive was that for T2 primary, and the least, T2 secondary. The latter two were best adjusted to the centre of two points where signal amplitude was discerned to drop off. The receiver's own squelch control, VR1, was extremely useful here since it was possible to set a threshold that was immediately audible through the speaker as it went off-tune. For final adjustments this was repeated against an actual weak radio station.

C5, a compression trimmer with a Bakelite headed screw, controls sensitivity, but not, as I discovered, in a way you might expect. Tightening it up actually decreases the sensitivity, almost as though some part (if not all) of T2 secondary was wired in anti-phase. Earlier on, in fact, I had noticed a short, isolated winding at one end of the T2 former that indeed appeared to be reverse connected to the remainder.

Performance

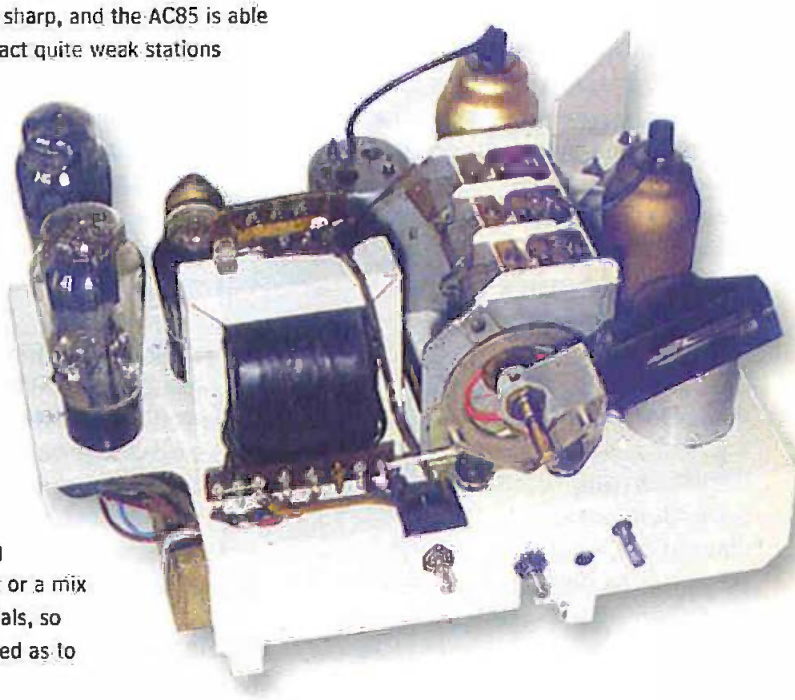
First off it must be said that the tone is quite superb — while the introduction of transistors allowed miniaturisation on a scale hitherto unimagined, resulting in the explosion of the 'portable trannie' and such like, it also meant that whole generations thereafter would be deprived of the experience of what a decent sized speaker in a decent sized box sounds like. Bass is plainly present, if somewhat limited in scope, and even the treble is reasonable. (Of course with AM you can adjust for treble by off-tuning.) Noise is zero apart from a little hum as mentioned earlier, even then it is only discernible in a dead quiet room with the sound fully off.

With the aid of its large knob, tuning control is smooth and slip-free and easily adjustable to within fractions of a millimetre if necessary. This is important since selectivity is quite sharp, and the AC85 is able to isolate and extract quite weak stations from a plethora of other, stronger ones close by, at least with enough competence to make them intelligible. The only problems were where two stations of exactly the same frequencies were received, resulting in a beating effect or a mix of both audio signals, so neatly accomplished as to sound deliberate!

There was not, however, very much in the way of whistling that results from close adjacent stations, all due no doubt to the selectivity of the double-tuned RF transformer, and what there was, was tolerable. The Handy Man And Home Mechanic mentions it, but only in this context: 'Whistling noises ... are often caused by a nearby neighbour fooling about with his old-fashioned set and allowing it to get into oscillation. If this annoyance persists and the owner can be traced, a few friendly but firm words will generally put matters right' (honestly I am not making this up). Of course the AC85 is slightly thrown by nearby sources of radio interference in the modern home, such as TV sets, computers, light switches and thermostats, but is not rendered unusable.

Choice of AM stations multiplies dramatically after dark and apart from the usual high power BBC and local ones, the AC85 was also able to get something from most of Europe. These included many from France and Germany (obviously), but also Spain and Portugal, Holland, Sweden and even Italy. Of particular interest were the Russian sounding examples, or which alternatively might have been from former Soviet Bloc countries. English examples comprised a few 'obscure' or local only transmitters in Norfolk, Suffolk and Cambridge, and also one or two low power London transmitters.

I hung on to it for as long as was decently possible but eventually the thing had to be returned to its rightful owner, which was a bit of a shame as I was quite getting into it. Now I want one.



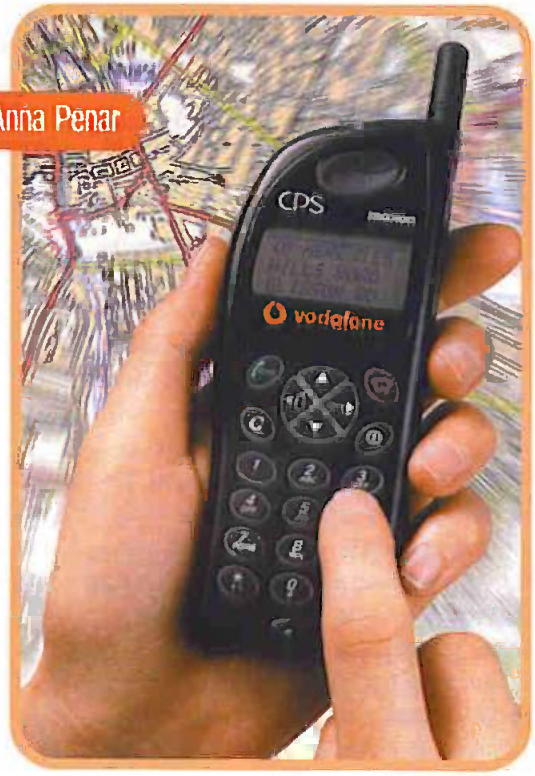
CURSOR™

pushing the barriers of freedom with the location- finding radio triangulation system

by Anna Penar

Imagine you are driving through a strange country, darkness is falling, you suddenly hear strange noises coming from the engine and ... your car is breaking down in the middle of nowhere. There is no friendly passer by to ask for directions. Not even an unfriendly one. What do you do?

The Cursor™ technology could be the answer. The only thing you have to do is contact the call center, which provides navigation services. The moment you call your Cursor sends a signal with your position, roadside assistance will instantly know where your car is, and a patrol van can be despatched to rescue you.



Mr. Chris Wade

I spoke to Mr. Chris Wade, CEO of Cambridge Positioning Systems, the company that owns the patent for the Cursor™. Amongst his recent achievements, he successfully managed the re-alignment of DSC's European organization strategy to that of a global company. This resulted in the successful integration of DSC by Alcatel following its acquisition. Chris Wade is a busy man, traveling world wide, who willingly shared his knowledge and ideas from Hong Kong for E&B readers.

How did the Cursor™ come about?

The inventor of the Cursor™, Dr. Peter Duffett-Smith, Chief Technical Officer at CPS, is a radio astronomer. He started development of the Cursor™ system in the 1980s in order to use it in astronomy. He worked on it for several years at the University of Cambridge's Department of Physics. In late 1998 the company started to take his ideas and put them into practice by creating the Cursor™ system.

How did the work proceed at CPS?

In 1998 there were just 2 engineers working on the project. Today they are 50 people working on the Cursor™ and other projects.

CPS is a pioneer in the development of location systems for mobile phones. It has carried out many trials of the Cursor systems, and these showed that people want location services and are prepared to pay for them.

The team at CPS is very enthusiastic about their invention. CPS employs exactly 100 people. The 'lucky one hundred' operate in an open culture, combining very hard work and a fun-loving attitude, as seen in lots of company events which all serve to develop the creative team.

What technology is used?

The new challenge of pinpointing users was undertaken by many companies which generated various approaches, such as TOA, OTD, A-GPS, and GDRS ...

CPS used the E-OTD (the Enhanced Observed Time Difference) technology, in which location measurement units (LMUs) are positioned on the host network's antennas. The technology measures how far away a mobile is from a minimum three base stations. The three base stations have different perimeters, which can meet at only one point, locating the position of the user. The location of the mobile phone is revealed as soon as the call is connected and can be shown as a reference point on a digital map display at the call center of the service the user has called. The cursor system is said to be capable of delivering accuracy to within 50 meters on GSM networks.

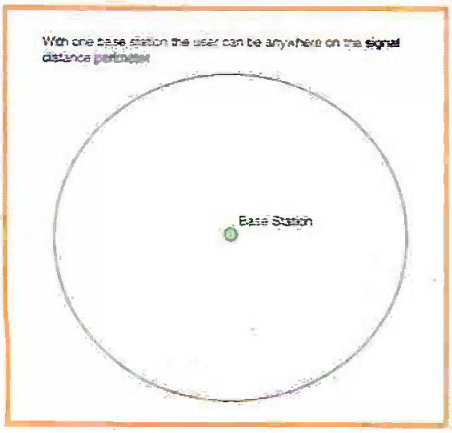
What are the typical applications for Cursor™?

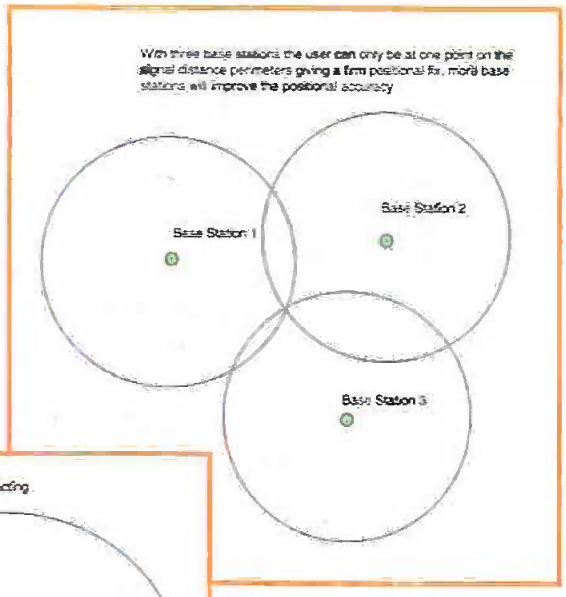
The vehicle breakdown situation is only one of many in which it is possible to use the cursor, such as:

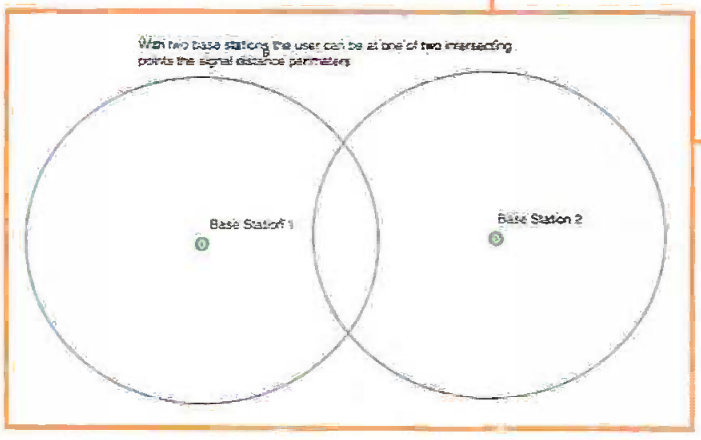
- You are in an unfamiliar city and would like to find the nearest Italian restaurant that takes Visa.
- Ability to find out about traffic conditions on your route to avoid possible traffic jams.
- Calls to emergency services, where someone injured in an accident does not know his location.
- Billing. A network can arrange different tariffs around the phone, like leisure zone or shopping district, to encourage people to make calls during the day.
- Urgent deployment and utilization of staff during working hours. The system can be used, for instance, by social workers, to send the closest staff member who is able to assist the client.

What unusual applications might the Cursor have?

Imagine a mother of three very lively and adventurous children: she could place small cursors on each child, as a precautionary measure, just to be able to find them if they get lost. The cursor might be placed on trains and buses to track their movement continuously. The future vision of advertising by a cross-walk- phones, where you can make







an offer just in time of passing by special shop, knowing preferences of the passer by. There are negative applications as well, when your jealous wife is asking you to leave the Cursor on, so she can position you when you are working, but unfortunately your lover is insisting to see you at the same time. Poor you ! What do you do ?

What is the expected position of the cursor™?

The main impulse for development of location services has come from the FCC's (Federal Communications Commission) 911 ruling, which came into effect in October 2001. It requires that all calls from mobile phones to emergency services in the US should be accompanied by the location of the caller. This should be a significant boost to producers of location services, and CPS is expecting to reach 40 % of global market share

According to Ovum's Mobile Location Services by 2005 there will be 129m cell phone subscribers in the US, all of which will have access to location services. It will be much the same in Western Europe, where estimates are that location services will be offered as standard to 188 million subscribers.

The in-car market is also going to be crucial. In Western Europe the report claims that by 2005 8 million private cars (3.3 million in North America) and1.9 million fleet vehicles (3.8 million in North America) will have mobile location devices fitted.

It has to be recognized that the introduction of location services requires a wide range of specialist partners – network operators, handset manufacturers and software application vendors. CPS' current partners include: Nortel, Intel, Ericsson, Maxton, Siemens. The challenge of creating an appropriate network can be still seen as work in progress and an opportunity for many market players.

What is the cost for both end-user and service provider?

The end user will pay nothing more, as the cursor will become a standard part of the mobile phone. The extra cost will be connected with the services that the client wishes to access. There are no extra costs for the service provider as well.

What is the main competition?

GPS (Global Positioning System) can be seen as the main competition for GSM. This satellite-based technology is widely used in maritime and mountaineering communities. GPS is a network of military satellites owned by the Pentagon and opened up partly for commercial use. Some telecommunication companies are considering putting GPS into mobile phones. The cost of such a mobile phone will be much higher than using GSM, because it requires a new type of handset. The expected cost of the battery is much higher and the battery would be bigger than GSM's. This is because of the way GPS works: it calculates the distance from at least three satellites and then uses a complex formula (the complexity is connected with the distance and constant revolution of the earth), which requires much stronger batteries.

Chris Wade drew an analogy with BMW, saying they produce very good but expensive cars, so not everyone can afford to drive one, which is to some extent the situation with GPS and GSM. The other considerable disadvantage of GPS is that it requires the handset to be in direct 'sight' of the minimum three satellites, which means it may not function as effectively in cities, where tall buildings can disturb the terminal's view of the satellites. A similar problem may arise inside buildings.

In comparison with GSM, GPS is losing out, especially in commercial appliances. GPS can be seen as a separate market segment, which excludes partly the competition.

What will be the life cycle of the Cursor?

It is expected that the technology will need to be renewed or updated every 3-5 years. The GSM system still needs some improvements and adjustments, but there are many enthusiastic engineers out there who enjoy being creative. The market players see how lucrative this business could be, so CPS tries to go with the requirements of the time.

Cursor™ can be seen as a step into the future, in which we travel great distances without fear of being lost and with the convenience of having all the necessary information to hand just at the right moment.

The interview with Chris Wade was run by our reporter Anna Penar and supported by cooperation with Citigate Technology.

OPTOCOUPLER Circuits

RAY MARSTON DESCRIBES THE OPERATING PRINCIPLES AND PRACTICAL APPLICATIONS OF A VARIETY OF OPTOCOUPLER DEVICES.

Optocoupler basics

An optocoupler device can be simply described as a sealed self-contained unit that houses independently-powered optical (light) Tx and Rx units that can be coupled together optically. Figure 1 shows the basic form of such a device. Here, the Tx unit is a LED, but the Rx unit may take the form of a phototransistor, a photo-FET, an opto-triac, or some other type of photo-sensitive semiconductor element; the Tx and Rx units are housed closely together in a single sealed package.

Most modern optocoupler devices use a phototransistor as their Rx unit; such a device is known simply as an 'optocoupler', since the input (the LED) and the output (the phototransistor) devices are optically coupled. Figure 2 shows the basic form of an optocoupler, together with a very simple application circuit. Here, when SW1 is open no current flows in the LED, so no light falls on the face of Q1; Q1 passes virtually zero collector current under this condition, so zero voltage is developed across output resistor R2. Alternatively, when SW1 is closed, current flows through the LED via R1, and the resulting light falls on Q1 face, causing the phototransistor to conduct and generate an output voltage across R2.

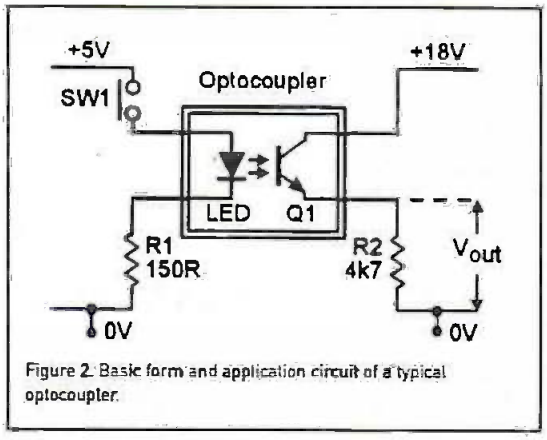


Figure 2. Basic form and application circuit of a typical optocoupler.

Major points to note about the Figure 2 optocoupler are that its output current is controlled by its input current, that a control circuit connected to its input can be electrically fully isolated from the output circuit, and that - since the input controls the output via a purely optical link - potential differences of hundreds of volts can safely exist between the input and output circuits. This 'isolating' characteristic is the main attraction of this type of optocoupler, which is generally known as an isolating optocoupler.

The simple application circuit of Figure 2 can be used with digital input/output signals only, but in practice this basic circuit can easily be modified for use with analogue input/output signals, as shown later in this article. Typical isolating optocoupler applications include low-voltage to high-voltage (or vice versa) signal coupling, interfacing of a computer's output signals to external electronic circuitry or electric motors, etc., and interfacing of ground-referenced low-voltage circuitry to floating high-voltage circuitry driven directly from the mains AC power lines, etc. Optocouplers can also be used to replace low-power relays and pulse transformers in many applications.

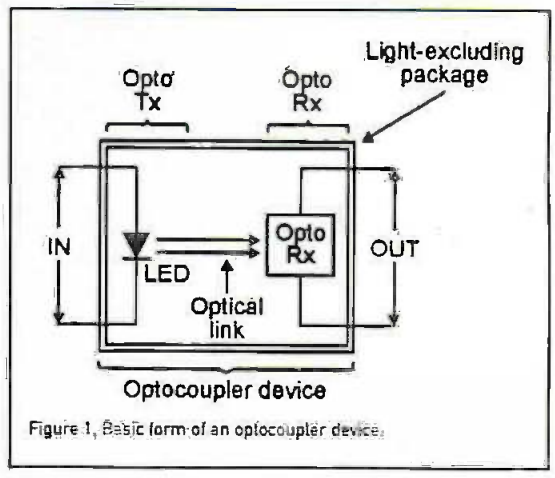


Figure 1. Basic form of an optocoupler device.

Special optocouplers

The Figure 2 device is a simple isolating optocoupler. Figure 3 and 4 show two other types of optocoupler. The device shown in Figure 3 is known as a slotted optocoupler, and has a slot moulded into the package between the LED light source and the phototransistor light sensor. Here, light can normally pass from the LED to Q1 without significant attenuation by the slot. The optocoupling can, however, be completely blocked by placing an opaque object in the slot. The slotted optocoupler can thus be used in a variety of 'presence' detecting applications, including end-of-tape detection, limit switching, and liquid-level detection.

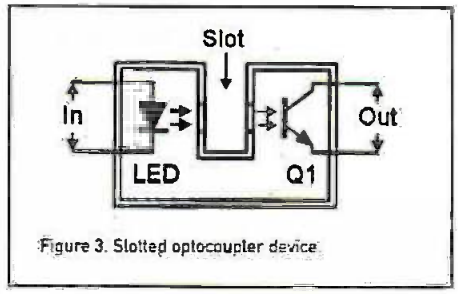


Figure 3. Slotted optocoupler device.

The device shown in Figure 4 is known as a reflective optocoupler. Here, the LED and Q1 are optically screened from each other within the package, and both face outwards (towards a common point) from the package. The construction is such that an optocoupled link can be set up by a reflective object (such as metallic paint or tape, or even smoke particles) sited a short distance outside the package, in line with both the LED and Q1. The reflective optocoupler can thus be used in applications such as tape-position detection, engine-shaft revolution counting or speed measurement, or smoke or fog detection, etc.

Optocoupler transfer ratios

One of the most important parameters of an optocoupler device is its optocoupling efficiency, and to maximise this parameter the LED and the phototransistor (which usually operate in the infra-red range) are always closely matched spectrally.

The most convenient way of

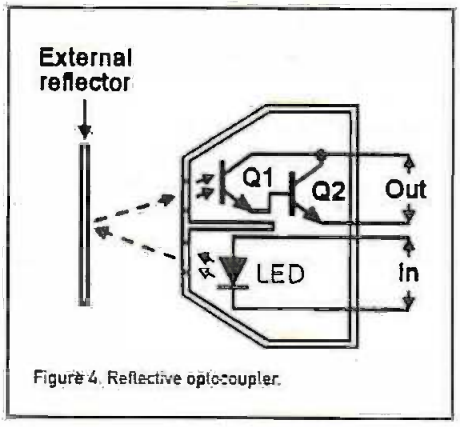


Figure 4. Reflective optocoupler.

specifying optocoupling efficiency is to quote the output-to-input current transfer ratio (CTR) of the device, i.e., the ratio of the output collector current (IC) of the phototransistor, to the forward current (IF) of the LED. Thus, CTR = IC/IF. In practice, CTR may be expressed as a simple figure such as 0.5, or (by multiplying this figure by 100) as a percentage figure such as 50%.

Simple isolating optocouplers with single-transistor output stages have typical CTR values on the range 20% to 100%; the actual CTR value depends (amongst other things) on the input and output current values of the device and on the supply voltage value (VC) of the phototransistor. Figure 5 shows three typical sets of output/input currents obtained at different VC values.

It should be noted that, because of variations in LED radiation efficiency and phototransistor current gains, the actual CTR values of individual optocouplers may vary significantly from the typical value. An optocoupler type with a typical CTR value of 60% may, for example, in fact have a true value in the range 30% to 90% in an individual device.

Other parameters

Other important optocoupler parameters include the following.

ISOLATION VOLTAGE. This is the maximum permissible DC potential that can be allowed to exist between the input and output circuits. Typical values vary from 500V to 4kV.

VCE(MAX). This is the maximum allowable DC voltage that can be applied across the output transistor. Typical values vary from 20V to 80V.

IF(MAX). This is the maximum permissible DC current that can be allowed to flow in the input LED. Typical values vary from 40mA to 100mA.

BANDWIDTH. This is the typical maximum signal frequency that can be usefully passed through the optocoupler when the device is operated in its normal mode. Typical values vary from 20kHz to 500kHz, depending on the type of device construction.

Practical optocouplers

Optocouplers are produced by several manufacturers and are available in a variety of forms and styles. Simple optocouplers are widely available in six basic forms, which are illustrated in Figures 6 to 8. Four of these (Figures 6 and 7) are isolating optocouplers, and the remaining two are the slotted optocoupler (Figure 8(a)) and the reflective optocoupler (Figure 8(b)). The table of Figure 9 lists the typical parameter values of these six devices.

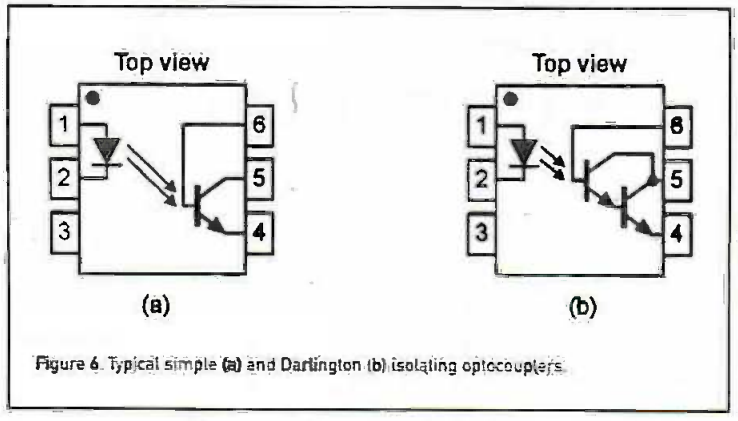


Figure 6. Typical simple (a) and Darlington (b) isolating optocouplers.

The simple isolating optocoupler (Figure 6(a)) uses a single phototransistor output stage and is usually housed in a 6-pin package, with the base terminal of the phototransistor externally available. In normal use the base is left open circuit, and under this condition the optocoupler has a minimum CTR value of 20% and a useful bandwidth of 300kHz. The phototransistor can, however, be converted to a photodiode by shorting the base (pin-6) and emitter (pin-4) terminals together; under this condition the CTR value falls to about 0.2% but the bandwidth rises to about 30MHz.

The Darlington optocoupler (Figure 6(b)) is also housed in a 6-pin package and has its phototransistor base externally available. Because of the high current gain of the Darlington, this coupler has a typical minimum CTR value of about 300%, but has a useful bandwidth of only 30kHz.

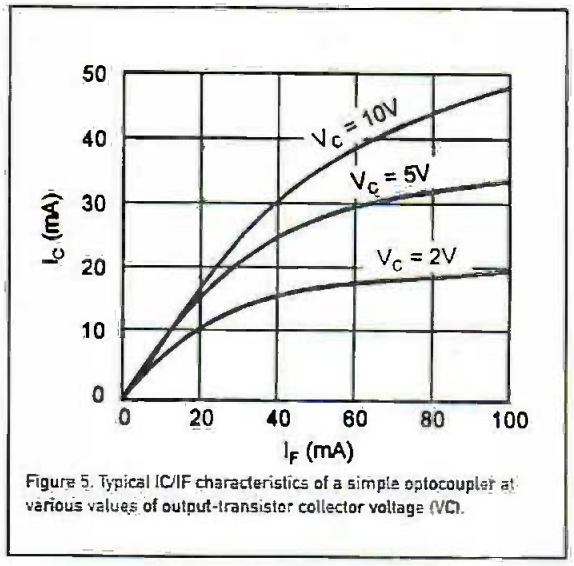


Figure 5. Typical IC/IF characteristics of a simple optocoupler at various values of output-transistor collector voltage (VC).

The dual and quad optocouplers of Figures 7 use single-transistor output stages in which the base terminal is not externally available.

Note in all four isolating devices that the input pins are on one side of the package and the output pins on the other. This construction gives the maximum possible values of isolating voltage. Also note in the multichannel devices of Figures 7 that, although these devices have isolating voltages of 1.5kV, potentials greater than 500V should not be allowed to exist between adjacent channels.

Isolating voltage values are not specified

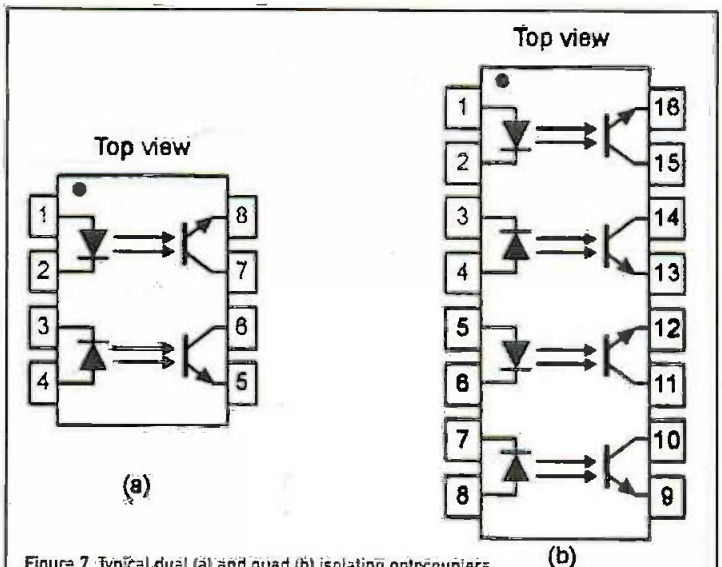


Figure 7. Typical dual (a) and quad (b) isolating optocouplers.

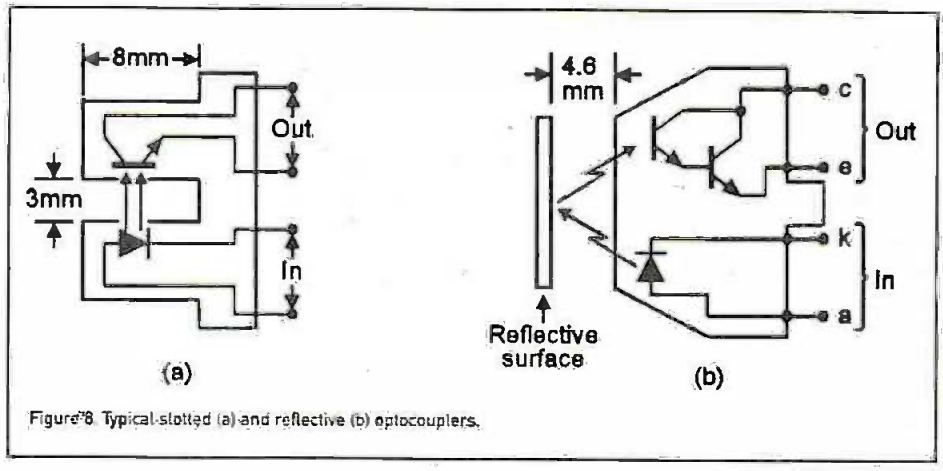


Figure 8. Typical slotted (a) and reflective (b) optocouplers.

for the slotted and reflective optocoupler devices of Figures 8. The Figure 8(a) device has a typical slot width of about 3mm, and uses a single output transistor to give an open slot minimum CTR value of 10% and a bandwidth of 300kHz.

Finally, the reflective optocoupler of Figure 8(b) uses a Darlington output stage and has a useful bandwidth of only 20kHz. Even so, the device has a typical minimum CTR value of only 0.5% at a reflective range of 5mm from a surface with a reflective efficiency of 90%, when the input LED is operated at its maximum current of 40mA.

optocoupler usage notes

Optocouplers are very easy devices to use, with the input side being used in the manner of a normal LED and the output used in the manner of a normal phototransistor. The following notes give a summary of the salient usage points.

The input current to the optocoupler LED must be limited via a series-connected external resistor which, as shown in Figure 10, can be connected on either the anode or the cathode side of the LED. If the LED is to be driven from an AC source, or there is a possibility of a reverse voltage being applied across the LED, the LED must be protected from reverse voltages via an external diode connected as shown in Figure 11.

The phototransistor's operating current can be converted into a voltage by wiring an external resistor in series with the collector of the device. This resistor can be connected to either the collector or the emitter of the phototransistor, as shown in Figure 12. The greater the value of this resistor, the greater is the sensitivity of the circuit but the lower is its bandwidth.

In normal use, the phototransistor is used with its base terminal open circuit. If desired, however, the phototransistor can be converted into a photodiode by using the base terminal as shown in Figure 13(a) and ignoring the emitter terminal (or shorting it to the base). This connection results in a greatly increased bandwidth (typically 30MHz), but a greatly reduced CTR value (typically 0.2%).

Alternatively, the base terminal can be used to vary the CTR value of the optocoupler by wiring an external resistor (RV1) between the base and emitter, as shown in the Darlington example of Figure 13(b). With RV1 open-circuit, the CTR value is that of a normal Darlington optocoupler (typically 300% minimum); with RV1 short-circuit, the CTR value is that of a diode-connected phototransistor (typically about 0.2%).

Parameter	Isolating optocouplers				Slotted optocoupler	Reflective optocoupler
	Simple type	Darlington type	Dual type	Quad type		
Isolating voltage	±4kV	±4kV	±1.5kV	±1.5kV	N.A.	N.A.
V_{CE} (max)	30V	30V	30V	30V	30V	15V
I_F (max)	60mA	60mA	100mA	100mA	50mA	40mA
CTR (min)	20%	300%	12.5%	12.5%	10%	0.5%
Bandwidth	300kHz	30kHz	200kHz	200kHz	300kHz	20kHz
Outline	Fig 6(a)	Fig 6(b)	Fig 7(a)	Fig 7(b)	Fig 8(a)	Fig 8(b)

Figure 9. Typical parameter values of the Figure 6 to 8 devices.

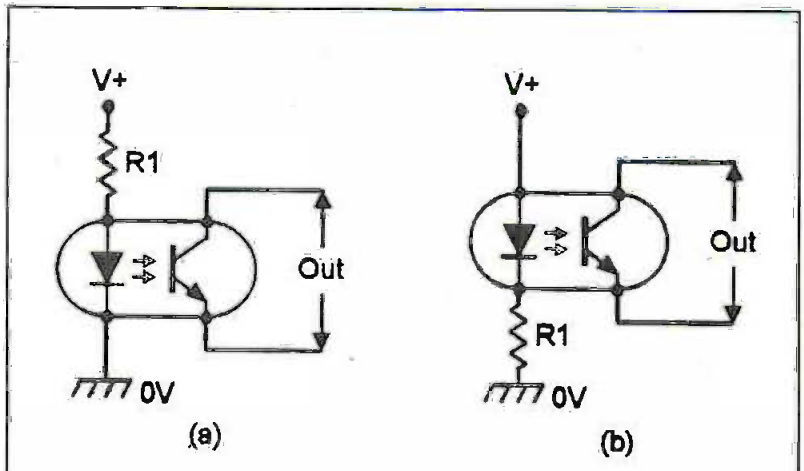


Figure 10. The LED current must be limited by a series resistor, which can be connected to either the anode (a) or the cathode (b).

Digital interfacing

Optocoupler devices are ideally suited for use in digital interfacing applications in which the input and output circuits are driven by different power supplies. They can be used to interface digital ICs of the same family (TTL, CMOS, etc.) or digital ICs of different families, or to interface the digital outputs of home computers, etc., to motors, relays and lamps, etc. This interfacing can be achieved using various special-purpose 'digital interfacing' optocoupler devices, or by using standard optocouplers; Figures 14 to 16 show circuits of the latter type.

Figure 14 shows how to interface two TTL circuits, using an optocoupler circuit that provides a non-inverting action. Here, the optocoupler LED and current-limiting resistor R1 are connected between the 5V positive supply rail and the output-driving terminal of the TTL device (rather than between the TTL output and ground), because TTL outputs can usually

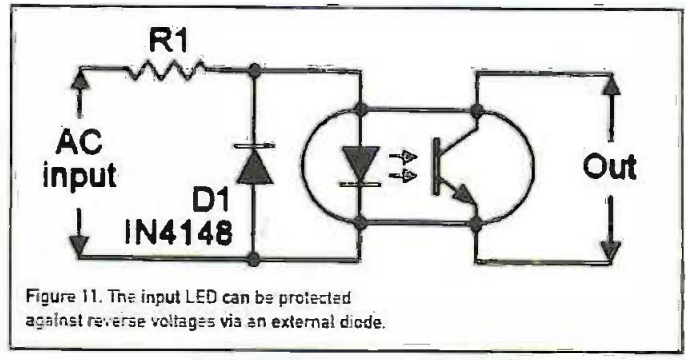


Figure 11. The input LED can be protected against reverse voltages via an external diode.

sink a fairly high current (typically 16mA) but can source only a very low current (typically 400?A).

The open-circuit output voltage of a TTL IC falls to less than 0.4V when in the logic-0 state, but may rise to only 2.4V in the logic-1 state if the IC is not fitted with an internal pull-up resistor. In such a case the optocoupler LED current will not fall to zero when the TTL output is at logic-1. This snag is overcome in the Figure 14 circuit by fitting an external pull-up resistor (R3) as shown. The Figure 14 circuit's optocoupler phototransistor is wired between the input and ground of the driven (right-hand) TTL IC because a TTL input needs to be pulled down to below 800mV at 1.6mA to ensure correct logic-0 operation.

CMOS IC outputs can source or sink currents (up to several mA) with equal ease. Consequently, these devices can be interfaced by using a sink configuration similar to that of Figure 14, or they can use the source configuration shown in Figure 15. In either case, the R2 value must be large enough to provide an output voltage swing that switches fully between the CMOS logic-0 and logic-1 states.

Figure 16 shows how the optocoupler can be used to interface a computer's output signal (5V, 5mA) to a 12V DC motor that draws an operating current of less than 1A. With the computer output high, the optocoupler LED and phototransistor are both off, so the motor is driven on via Q1 and Q2. When the computer output goes low, the LED and phototransistor are driven on, so Q1-Q2 and the motor are cut off. The reverse of this action can be obtained by wiring the optocoupler's output in series between R2 and Q1-base, so that Q1-Q2 and the motor turn on only when the computer output goes low.

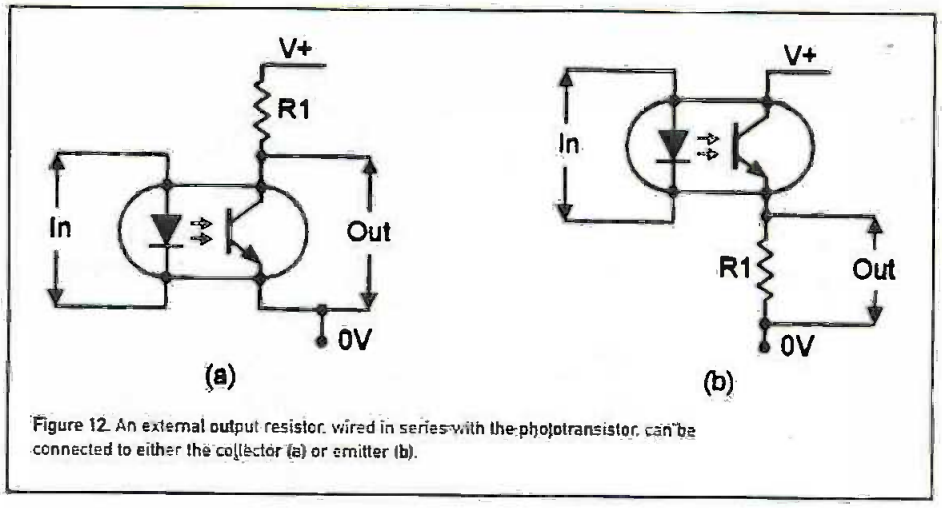


Figure 12. An external output resistor, wired in series with the phototransistor, can be connected to either the collector (a) or emitter (b).

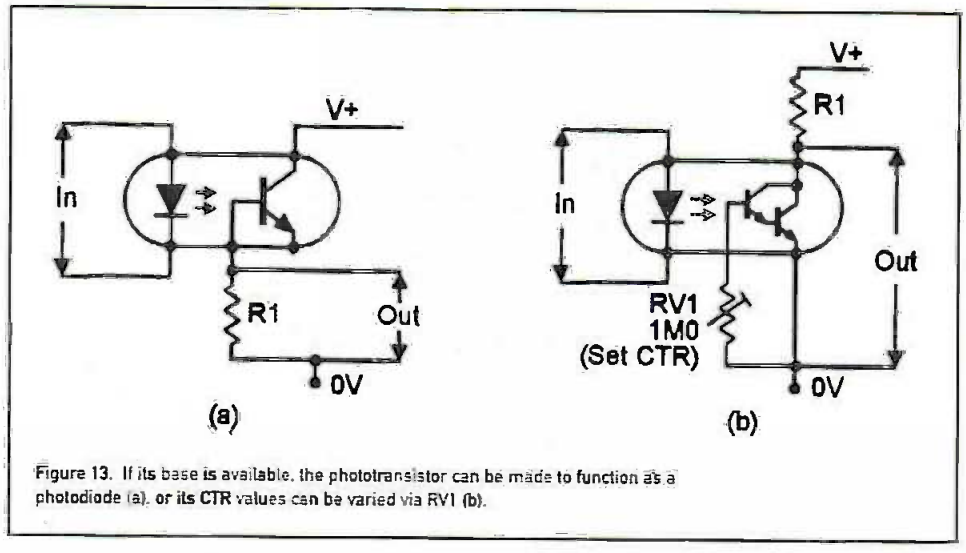


Figure 13. If its base is available, the phototransistor can be made to function as a photodiode (a), or its CTR values can be varied via RV1 (b).

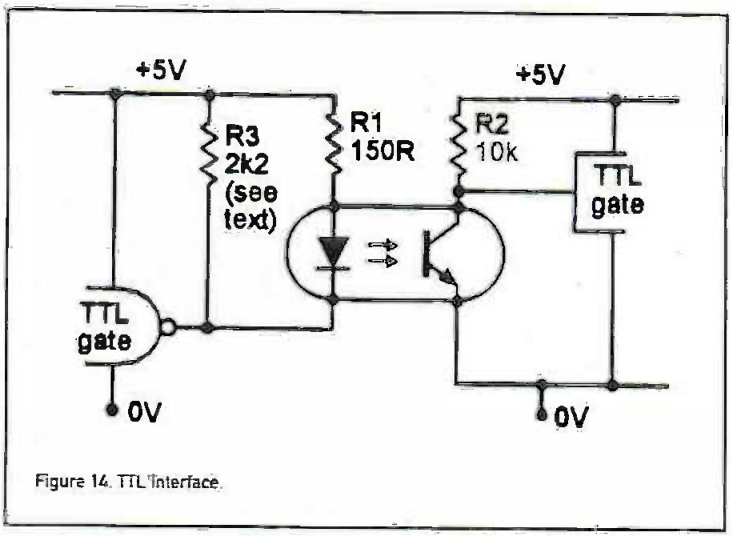


Figure 14. TTL interface.

Analogue interfacing

An optocoupler can be used to interface analogue signals from one circuit to another by setting up a standing current through the LED and then modulating this current with the analogue signal. Figure 17 shows (in basic form) this technique used to make an audio-coupling circuit.

Here, the op-amp is connected in the unity-gain voltage follower mode, with the optocoupler LED wired into its negative feedback loop so that the voltage across R3 (and thus the current through the LED) precisely follows the voltage applied to the op-amp's pin-3 non-inverting input terminal. This terminal is dc biased at half-supply volts via the R1-R2 potential divider, and can be ac-modulated by an audio signal applied via C1. The quiescent LED current is set at 1 to 2 mA via R3.

On the output side of the optocoupler, a quiescent current is set up (by the optocoupler action) in the phototransistor, and causes a quiescent voltage to be set up

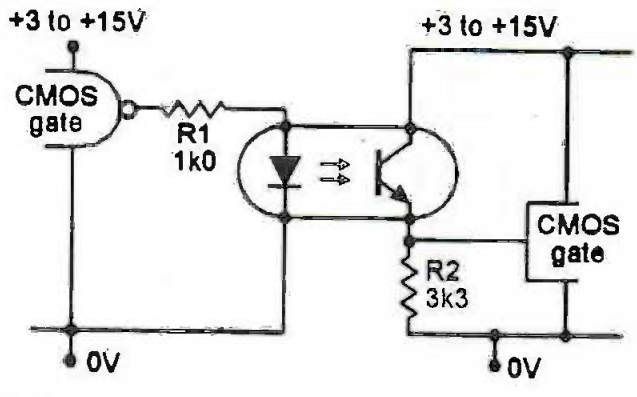


Figure 15. CMOS interface.

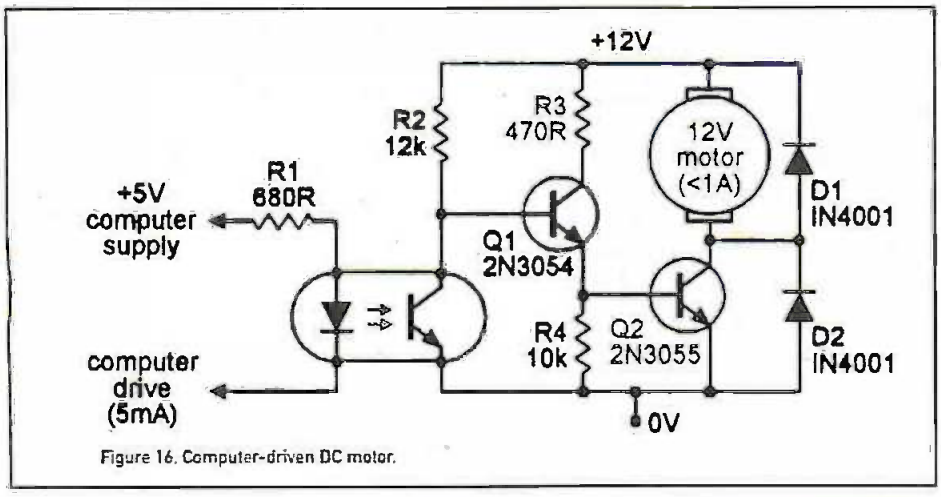


Figure 16. Computer-driven DC motor.

across RV1, which should have its value adjusted to give a quiescent output value of roughly half-supply voltage. The audio output signal appears across RV1 and is dc-decoupled via C2.

Triac interfacing

An ideal application for the optocoupler is that of interfacing the output of a low-voltage control circuit (possible with one side of its power supply grounded) to the input of a triac power-control circuit that is driven from the AC power lines and which can be used to control the power feed to lamps, heaters, and motors. Figure 18 shows an example of such a circuit; the figures in parenthesis show the component values that should be used if 115V AC (rather than 230V) supplies are used; the actual triac type must be chosen to suit individual load/supply requirements.

The Figure 18 circuit gives a non-synchronous switching action in which the triac's initial switch-on point is not synchronized to the AC power line waveform. Here, R2-D1-ZD1 and C1 are used to develop an AC-derived 10V DC supply, which can be fed to the triac gate via Q1 and hence used to turn the triac on and off. Thus, when SW1 is open the optocoupler is off, so zero base drive is applied to Q1, and the triac and load are off. When SW1 is closed, the optocoupler drives Q1 on and connects the 10V DC supply to the triac gate via R3, thus applying full AC mains power to the load.

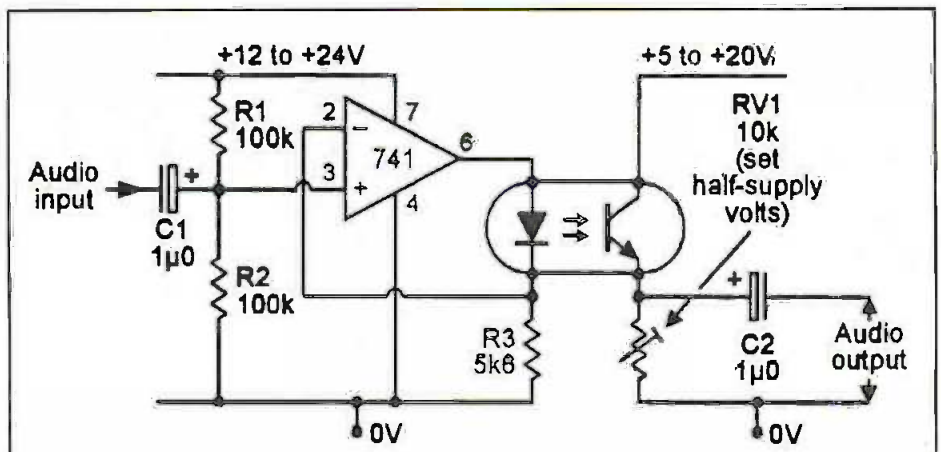


Figure 17. Audio-coupling circuit.

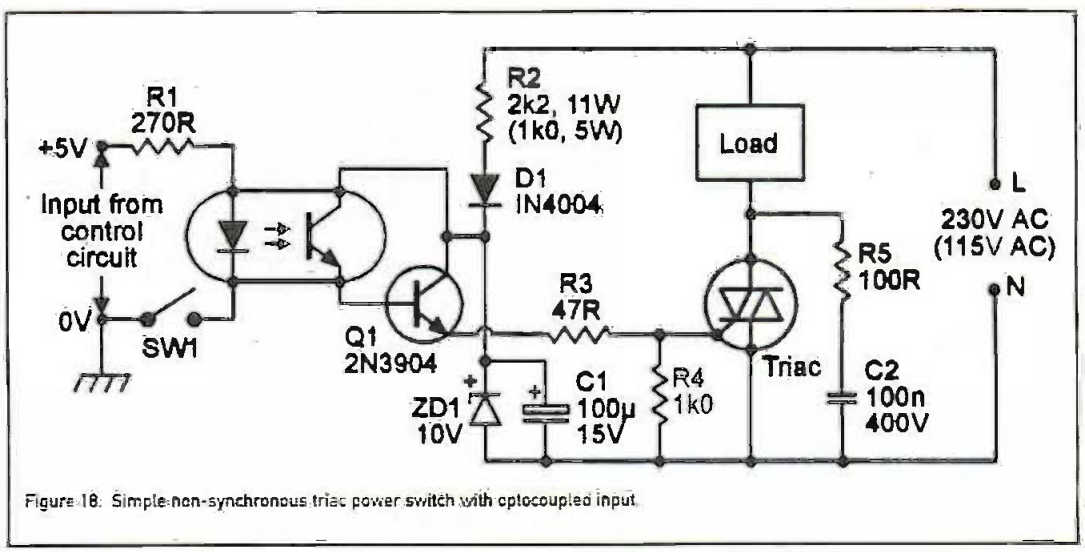


Figure 18. Simple non-synchronous triac power switch with optocoupled input.

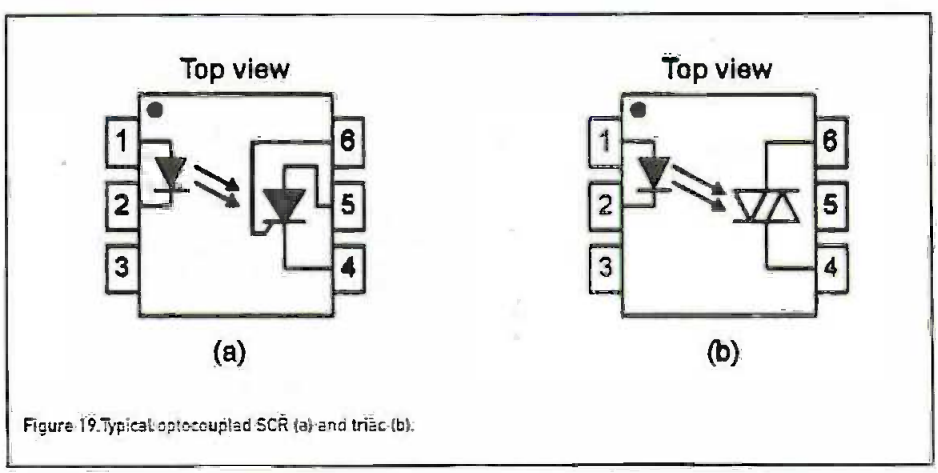


Figure 19. Typical optocoupled SCR (a) and triac (b).

Optocoupled SCRs and triacs.

SCRs (silicon controlled rectifiers) and triacs are semiconductor power-switching devices that (like transistors) are inherently photosensitive. An optocoupled SCR is simply an SCR and a LED mounted in a single package, and an optocoupled triac is simply a triac and a LED mounted in a single package. Such devices are readily available, in both simple and complex forms; some sophisticated triac types incorporate interference-suppressing zero-crossing switching circuitry in the package.

Figures 19(a) and 19(b) show the typical outlines of simple optocoupled SCRs and triacs (which are usually mounted in 6-pin DIL packages); Figure 20 lists the typical parameters of these two particular devices, which have rather limited rms output-current ratings, the values being (in the examples shown)

300mA for the SCR and 100mA for the triac. The SCR device's surge-current rating is 5A at a pulse width of 100?S and a duty cycle of less than 1%; the triac device's surge rating is 1.2A at a pulse width of 10?S and a duty cycle of 10% maximum.

Parameter	Optocoupled SCR	Optocoupled triac
LED characteristic		
I_F (max)	60mA	50mA
SCR/triac characteristic		
V_{MAX}	400V	400V
I_{MAX} (rms)	300mA	100mA
I_{SURGE} (see text)	5A	1.2A
Coupling characteristic		
Isolating voltage	±1.5kV	±1.5kV
Input trigger current	5mA typical (20mA max)	5mA typical (20mA max)

Figure 20. Typical characteristics of optocoupled SCRs/triacs.

Optocoupled SCRs and triacs are very easy to use; the input LED is driven in the manner of a normal LED, and the SCR/triac is used like a normal low-power SCR/triac. Figures 21 to 23 show various ways of using an optocoupled triac; R1 should be chosen to pass a LED current of at least 20mA; all other component values are those used with a 230V AC supply.

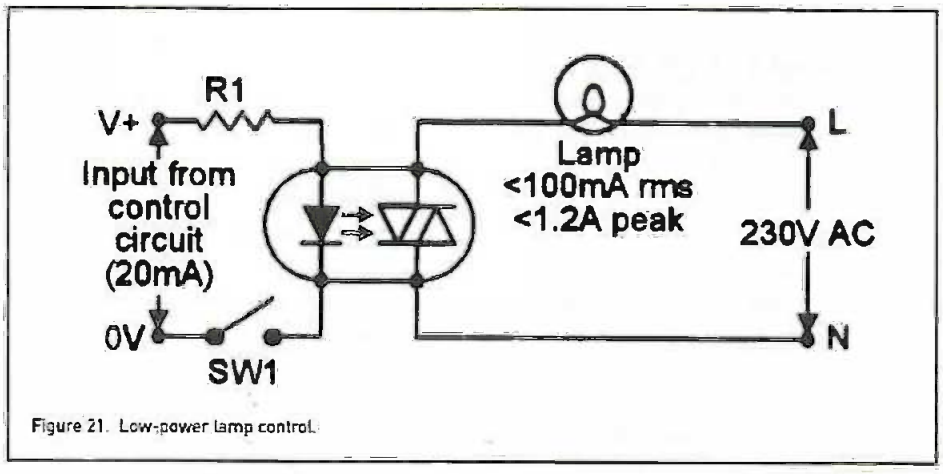


Figure 21. Low-power lamp control.

In Figure 21 the triac is used to directly activate an AC line-powered filament lamp, which should have an rms rating of less than 100mA and a peak inrush current rating of less than 1.2A.

Figure 22 shows how the optocoupled triac can be used to activate a slave triac, and thereby activate a load of any desired power rating. This circuit is suitable for use only with non-inductive loads such as lamps and heating elements, using a triac of suitable rating.

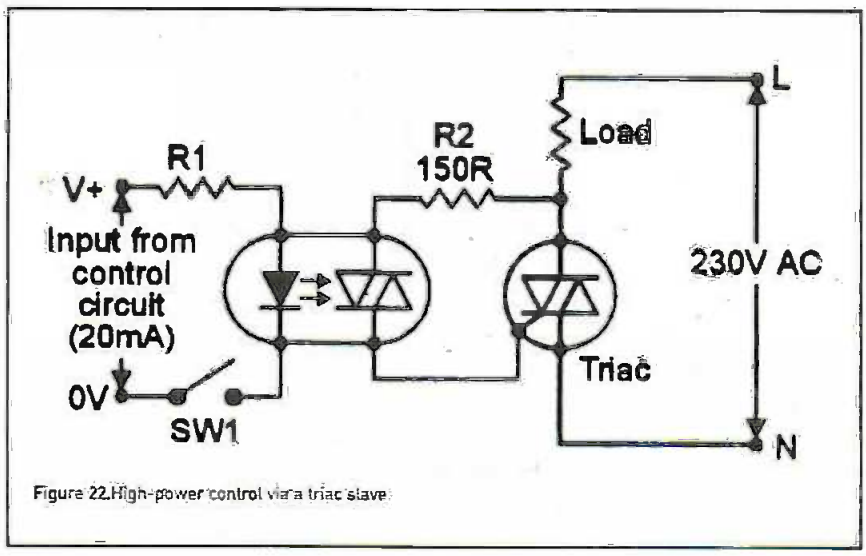
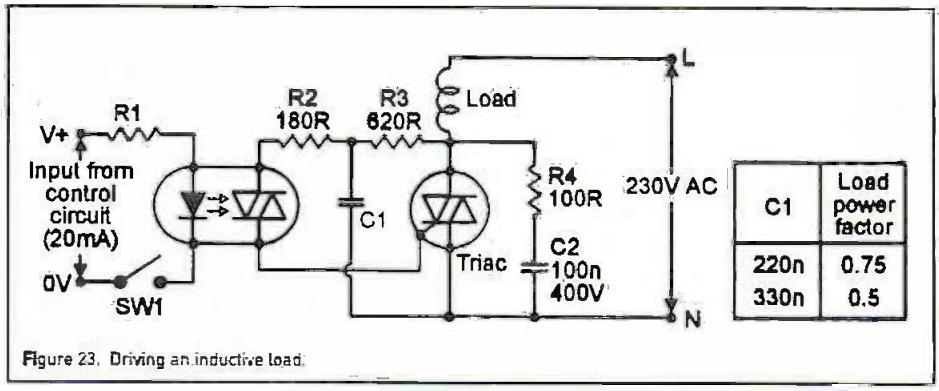


Figure 22. High-power control via a triac slave.

Finally, Figure 23 shows how the above circuit can be modified for use with inductive loads such as electric motors. The R2-C1-R3 network provides a degree of phase-shift to the triac gate-drive network, to ensure correct triac triggering action, and R4-C2 form a snubber network, to suppress rate-of-rise (rate) effects.



C1	Load power factor
220n	0.75
330n	0.5

Figure 23. Driving an inductive load.

Optocoupled SSRs.

An optocoupled solid-state relay (SSR) is a device that can be used as a superior replacement for many types of low-power electromechanical relay. Like a normal relay, it provides complete electrical isolation between its input and output circuits, and its output act like an electrical switch that has a near-infinite resistance when open and a very low resistance when closed and which - when closed - can pass AC or DC currents with equal ease, without suffering 'offset voltage' losses.

Siemens are the present market leaders in the optocoupled SSR field. Their basic design has an IR LED input stage and a dual n-channel MOSFET output stage that (unlike a dual bipolar transistor stage) does not produce significant offset voltage drops when biased on. The IR LED's output is coupled to the inputs of the MOSFETs via a bank of 25 photovoltiac diodes that - when illuminated - apply a 15V turn-on voltage to the MOSFET gates.

The simplest device in the Siemens range of optocoupled SSRs is the LH1540AT, which is housed in a 6-pin package and has an output that acts as a normally-open (NO) single-pole switch. The device has an isolation voltage rating of 3.75kV and a maximum output load voltage rating of 350V. The LH1540AT has three output pins, which allow its two output IGFETs to be used in series for AC operation, or in parallel for DC operation. When the input LED is passing a current of 5mA, the output can handle maximum load currents of 120mA and has a typical 'on' resistance of 25 ohms when used in the AC configuration, or 250mA and 5 ohms in the DC configuration. The device has typical on/off switching speeds of less than 1mS.

Other devices in the Siemens optocoupled SSRs range include ones that have outputs that act as singe-pole or 2-pole NC, NO, or change-over switches.

PCB Assembly Techniques

by Harvey Twyman

I'M SURE YOU'VE NOTICED THE RAPID DECLINE IN THE AVAILABILITY OF CERTAIN DUAL-IN-LINE COMPONENTS. THE DEVICES MIGHT STILL BE AVAILABLE BUT ONLY IN THEIR SURFACE MOUNT FORM. SO HOW DO YOU CONSTRUCT PCBS USING THESE TINY DEVICES?

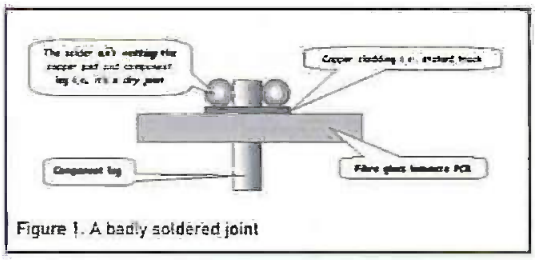


Figure 1. A badly soldered joint

To enable you to keep up with the technology, this article contains a series of special techniques that only require low cost hand tools. It's mainly intended for Prototype PCB designs where manufacturing costly Plated-Through-Hole PCBs for a 'One-Off' is uneconomic.

Working Practices

We know the term 'Design for Manufacture', however here we need to 'Design for Prototype'. The techniques described in this article require certain 'working practices'. These techniques described later can only be successful if the guidelines below are followed:

CAD Considerations

The PCB Design will need modification at the CAD Level to enable these techniques to be workable: VIA pads need to be at least 55 to 60mil diameter if the drilling is to be done by hand. SMT Rectangular Pads must be longer so that they protrude out and are visible even when the device is sitting on the pad. This is so that you can observe and create a reliable joint when manual soldering.

Lighting

Use 2 standard 60W desk lamps one either side of your work area and placed low to the bench to give maximum intensity. This will illuminate the work area adequately and not produce shadow. Visual inspection is the key to success. Most faults are visible with the lighting described above. With these techniques you have to rely totally on your own eyes for quality control. The more light you have, the more you'll see.

Keeping Everything Clean

Before any soldering work is done on the pads they need to be cleaned with IPA (see below) using a soft toothbrush style brush to remove oxides. The PCB will re-oxidise within an hour, so clean just before you intend to solder. IPA (Isopropyl Alcohol) is used in aerosol sprays as a solvent and is a common component of such products like magnetic tape head cleaning solutions. It has the advantage that it evaporates quickly.

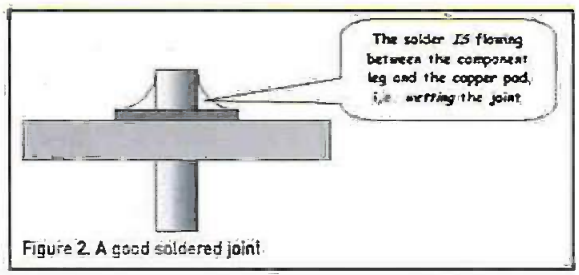


Figure 2. A good soldered joint

Hand Tools

Standard tools are adequate for the job, except for the ones mentioned below:

Soldering Iron

Modern Temperature Controlled types are adequate. The solder tip needs to be pointed thus giving access to individual SMT joints. Pointed tips when used on SMT Pads have an added advantage of less heat capacity. So once placed on an SMT pad the temperature drops rapidly. This has the advantage that quick joints can be made on the tiny pads without them getting damaged.

Tweezers

Don't use sharp ones! These may damage delicate SMT resistors. Flat ended types are preferable as rounded ones can't be used to pick up the smaller SMT devices. Solder Braid: use the narrowest grade you can. Fat ones take too long to heat up which may damage the pads.

Inspection Eyeglass

These are available in different magnifications. A 8x magnification is adequate. Using any higher doesn't display enough board area. There are some types available with a built-in measuring facility. These are important for checking actual PCB pad and drill hole sizes.

Cut and Crop Tool

Also known as Cut and Clench or Cut and Crimp. The tool automatically squashes the wire flat before cutting above it. This tool is used in the VIA Technique described later.

Heat Gun

This type of tool is required for removing (reworking) SMT components, This is the only tool that needs a certain amount of training to use successfully. This will be described later. Heat Guns come in 2 forms: Paint Strippers are relatively cheap and generate a wide column of very hot air with limited control over the air flow. These are more suited for removing the larger SMT devices or where heating a larger surface area of the PCB is required. Hot Air Tools are designed to heat small areas and usually have a proper air velocity control to regulate air flow and thus the temperature. Thus these are more suited for removing the smaller SMT devices. Generally though, as we're more interested here in a low cost solution, the techniques described later will be referring to the paint stripper type of tool.

Good and Bad Joints

The knowledge of how to create good and bad Joints is essential. For those of you already familiar with the subject, please bear with me as beginners may be participating.

The reasons for a bad joint

- The copper cladding is oxidised – Clean with non-abrasive methods: Scrub with

small brush using IPA solvent, re-solder within a few minutes before oxidisation occurs again.

- Soldering iron bit needs wetting – press the tip into the special wetting paste provided.
- Not applying the solder tip and solder to the joint simultaneously.
- Not enough heat being applied to both the component leg and pad.

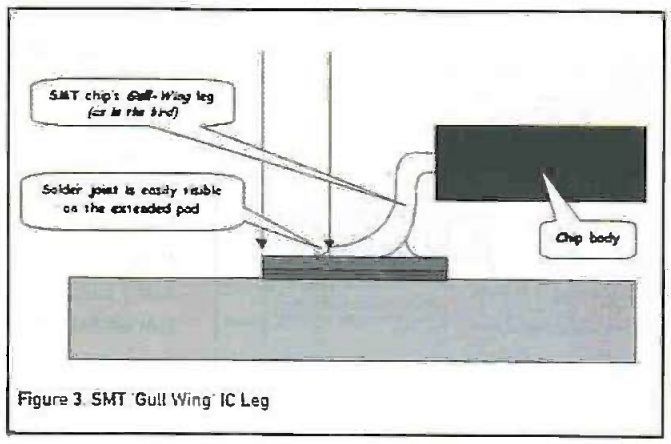


Figure 3. SMT 'Gull Wing' IC Leg

Facts about PCBs and Soldering

- The copper cladding is glued to the fibre glass laminate.
- The melting point of the solder is 180°C.
- The melting point of the glue is 150°C.

Therefore when the solder is molten, the copper cladding is 'floating' on molten glue! The reason why the glue's temperature is lower than the solder's is by design. This is to insure that the copper cladding's expansion is unimpeded by the glue. This means that PCB pads are very vulnerable during soldering.

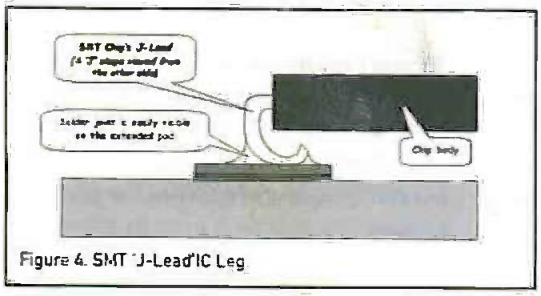


Figure 4. SMT 'J-Lead' IC Leg

Figure 1 shows an example of a badly soldered joint; Figure 2 shows an example of a good one.

Soldering Rules

1. Take care not to press too heavily on the pads, otherwise the pads will lift up and will be very difficult to repair.
2. Moving components before the solder has solidified may again either lift the copper tracks or cause a dry joint.
3. Apply the soldering iron tip and solder to the joint simultaneously and keep there until the solder flows correctly over the joint.
4. Remove the soldering iron tip immediately after the smoke from the flux within the solder disappears, approximately 2 seconds after the solder melts.
5. Only use silver-loaded solder for SMT joints (2% Silver).

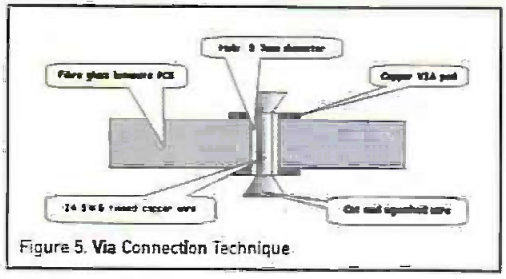


Figure 5. Via Connection Technique

Tin Plating

Don't tin plate your PCB unless the plating solution is new! The solution can become heavily contaminated from being used just a few times. These contaminants make it much more difficult to solder. This rule is essential particularly for SMT PCBs. Prototype PCBs don't need tin plating anyway. They still remain clean looking years later. They won't go green unless exposed to severe climatic conditions.

SMT Pads

Surface Mount Pad sizes seem to vary with every designer. They all have their own criteria. Here we are Designing for Prototype so need to have pads that are longer than normal.

PAD Specification for SMT Components:

The SMT Pad must be designed in the CAD stage specifically for hand soldering and...

- can be the same width or wider as the SMT leg.
- must be longer than the IC leg positioned on it, to allow ease of visual inspection and hand soldering of the joint.

Figure 3 is an example of an SMT 'Gull Wing' IC Leg; Figure 4 shows an SMT 'J-Lead' IC Leg.

VIA Holes

Double Sided PCBs made as a Prototype probably won't have Plated-Through-Holes. So how can you cope with VIA holes?

Some of the tracks on a double sided PCB connect from one side of the board to the other. Most of them connect via a component's leg, but some don't. These connections that don't are called VIAs.

On commercially manufactured PCBs these VIAs are produced by a system called Plated-Through-Hole. This process electroplates all the inside of the holes with copper.

However a simple technique is described below that doesn't require the expensive Plated-Through-Hole technology.

VIA Connection Technique (Figure 5)

A special Cut and Crop Tool is used to produce a reliable connection through the VIA hole pads. There are various names used for this tool, including 'Cut and Clench' and 'Cut and Crimp'.

Using 24 SWG tinned copper wire: Place the wire in the VIA hole. (Hole should be 0.7mm diameter); Use the cut and crop tool to produce the result; Solder both sides of the wire link.

IC Sockets

Without Plated-Through-Hole Technology, IC Sockets have to be soldered both sides to act as VIA connections.

There are 2 common types of IC sockets in use today:

DIL (Dual-In-Line) Sockets

Available in various sizes from 8 to 64 pins. However their quality can vary. By far the best is the turned PIN type.

Unfortunately they're the most expensive. However they do give better electrical contact with the IC leg, which is very important for reliability.

When creating a double-sided PCB tracks need to be connected to the DIP socket from both sides of the board. The solder side connections are easy, but the component side connections get obstructed by the socket's plastic body, making soldering difficult if not impossible.

A special jig is used to extract the pins from their former. This makes the soldering of the component side pin much easier.

The JIG described in Figure 6 is for extracting the DIL IC socket pins. The IC sockets used are a 16 way turned PIN type. These are used as they represent the cheapest way of purchasing the socket pins. The JIG shown below can be constructed from a 4" vice mounted vertically.

PLCC (Plastic-Leaded-Chip-Carrier) Sockets

Available in various sizes from 20 to 84 pins. The surface mount type described here (Figure 7, Left Hand Side) are purchased with a centre section which needs to be removed by gently pressing it out with a screwdriver. The result is shown on the right-hand side of

Figure 7.

The reason for removing the PLCC socket's centre is so that VIA hole links, discussed previously, can be placed in the centre of the PLCC socket, i.e. underneath the PLCC device. The socket raises the PLCC device off the PCB enough to accommodate for the height of the via links but only when the centre section of the PLCC socket is removed.

If Plated-Through-Hole technology isn't available to you, but you need to produce double sided PCBs, then this technique described is a solution.

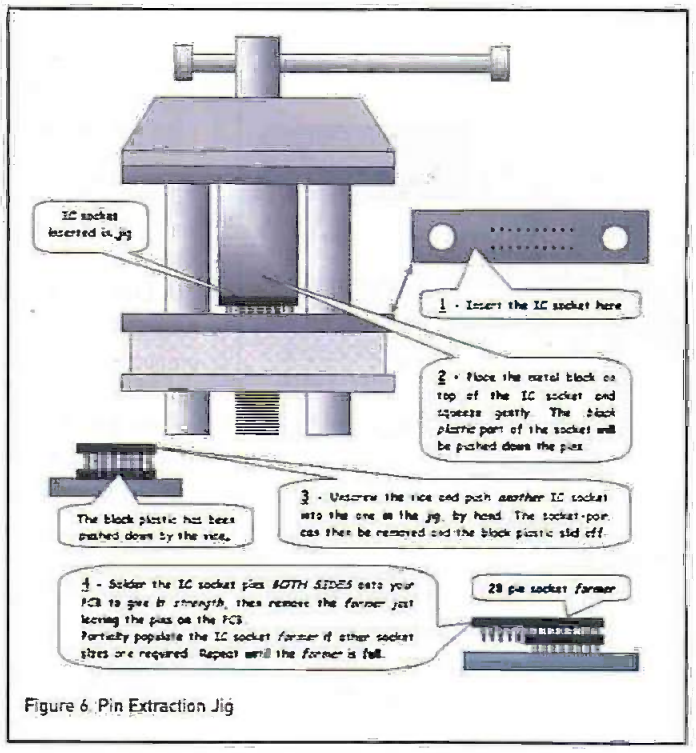


Figure 6. Pin Extraction Jig

Solder Levelling (Figure 8)

Surface mount pads need to be tinned with solder prior to mounting the component.

Commercial PCB manufacturers use a process called hot solder levelling which produces a 'flatter' solder joint. If this process is not available there is an alternative technique using solder braid to achieve the same result.

Scrub the pads with a small brush while applying IPA solvent. Apply the solder (must use the 2% silver type) to the SMT pad.

Place the solder braid on the pad near to the track connecting the pad.

Apply the soldering iron to the top of the braid resting on the pad. While the solder is molten, slowly drag the braid away from the pad in the opposite direction to the track connecting it.

Take care when dragging the solder braid. As stated previously, the pad is floating on molten glue which is holding the pad on the board. This is the reason for dragging the braid away from the track that connects to the pad. The track prevents the pad from moving out of position.

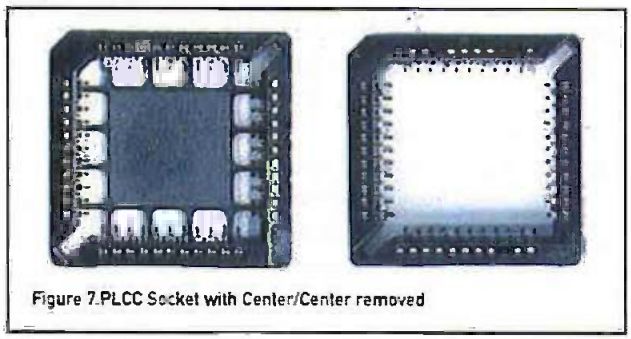


Figure 7.PLCC Socket with Center/Center removed

Fine Pitch SMTs

Components are shrinking in size all the time so the ability to be able to solder these tiny devices 'by hand' is essential.

The fact that SMT components are getting smaller is common knowledge. The problem is that the larger SMT components are becoming unavailable too!

Therefore the techniques described previously have to cope with the smaller more common components as well.

A Special Technique

Normally the device pads are soldered individually. However this is not possible with these fine pitch devices as the pitch between the device's leads are too small.

Therefore place the soldering iron between 2 adjacent leads.

Apply solder and heat as normal. Remember not to keep the heat applied for very long, particularly as the pads are so small, the glue holding the pad will melt. This will almost certainly short circuit the 2 leads together.

The excess solder can be removed using solder braid described in the solder levelling technique mentioned previously.

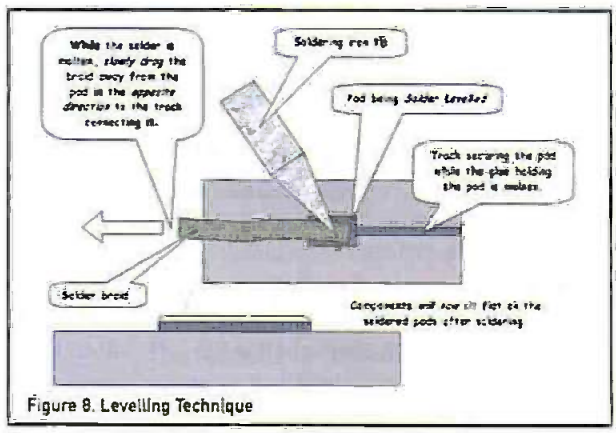


Figure 8. Levelling Technique

Handling SMTs (Figure 9)

Handling SMT devices correctly is essential to prevent both damage and contamination.

The physical size of SMT components demands the use of tweezers. However SMT components are very fragile and thus a blunt nose type is essential. Sharp tweezers can easily damage SMT resistors. The resistive film on SMT resistors for example is very thin and damage could either change the value or even make it completely open circuit!

Resistors come in various physical sizes:

- 1206 - 0.12' by 0.06' This size is the easiest to handle.
- 0603 - 0.06' by 0.03'
- 0402 - 0.04' by 0.02' These will blow away if breathed on!

The component value is printed on them in the form:

- 1K5 1500 Ohm
- 390R 390 Ohm
- 1M8 1,800,000 Ohm

Capacitors are available in the same sizes as above but have no identification marks on them at all! So DON'T MIX THEM UP!

It's important that you use the largest of the SMT components available, for ease of handling.

The pads on SMT components are pre-tinned and sealed in airtight packaging. This is to prevent the pads oxidising. They also have use-by dates similar to food stuffs. Therefore only open the packaging just before use.

The use of carousels to hold lots of unpacked SMTs is not advised for the above reasons.

All SMT components must only be touched with tweezers! Fingers will contaminate them with grease, which will be very difficult to remove and subsequently difficult to solder.

Electrostatic damage can occur when CMOS inputs are exposed to high voltages as

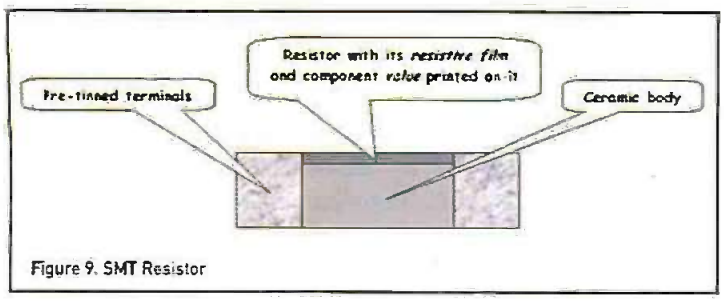


Figure 9. SMT Resistor

low as 60 Volts. However it's more likely to be KVolts.

The use of wrist straps and earth mats are essential while handling any CMOS device.

When handling devices away from the electrostatic-free area, always hold the device tightly in the palm of your hand, keeping its pins discharged through your damp skin.

Removing SMTs (Figure 10)

This is called 'rework' in the manufacturing trade, as the job has to be repeated. Reworking a job costs a company money. Therefore it's important to get things right every time by monitoring quality at all stages of assembly to reduce the necessity for rework.

Excessive heat during rework may damage the components, the PCB's pads, and de-laminate the fibre glass PCB itself – i.e. a bulge appears in the PCB due to trapped gases expanding. Therefore priorities have to be established when reworking as to which is more important, saving the component or the PCB's pads.

The pads are usually treated more importantly than the components. PCB repair is always more difficult and time consuming when compared to the cost of purchasing new components.

Removing a 2 Pinned SMT Device

Place the soldering iron tip 'flat' over the 2 component pads. Place extra solder to the tip to improve 'thermal conduction'. The 'surface tension' of the extra molten solder will 'suck' the component off the PCB and onto the tip.

Removing Multi Pinned SMT Devices

There are several options, but the cheapest are discussed below:

Using a Heat Gun

This may cause damage to the surrounding components and PCB if too much heat is applied. This can be a very effective method if the surrounding area is protected from the heat. This can be achieved by either using special high temperature selotape available or by keeping the Heat Gun in motion over the PCB area to control the temperature.

As long as care is taken to localise heating, the only problem will be that the solder on the adjacent small components may also become molten. They may even get blown away! However as long as the heat gun has a wide funnel of air, the air pressure shouldn't be enough for this to occur.

Once the solder is molten the component can be either taken off with tweezers or more easily by tapping the PCB on the bench. However beware, this may also dislodge other adjacent components that have molten solder.

Cutting The Chip's Legs Off

This method involves sacrificing the component, to save the PCB:

Cut all the legs off the component using either a fine pair of side cutters or if the legs are very small then a sharp knife can be used. Great care is required in not damaging the PCB's pads when pressing down with the knife.

Using solder wick, prepare the pads for a new component by applying the solder levelling technique described previously.

Of the 2 methods described above the Heat Gun method has an advantage that it is less damaging to the PCB's pads from the sharp knife as long as the Heat Gun is kept in motion as described above.

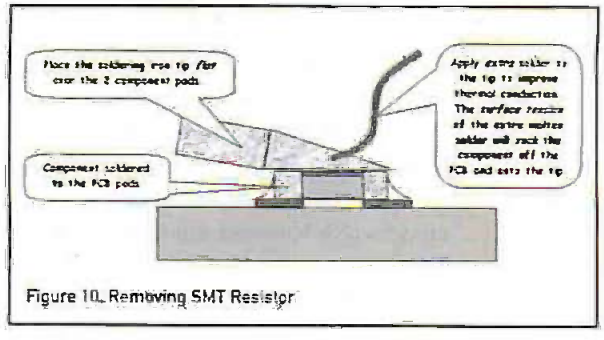


Figure 10. Removing SMT Resistor

And Finally

Another popular method of rework is to use a proprietary product called Low Melt™. This is a special low melting point solder but does require extra equipment support so isn't discussed here in detail. Further information is available from the manufacturers at www.zephyrtronics.com.

Frequently Asked Questions (FAQs)

There are always many ways of solving the same problem. Here are some Frequently Asked Questions (FAQs) from feedback emails I have received.

Question: You mention using a pointed tipped soldering iron – surely wouldn't a wide tip be better?

Answer: If your PCB has a solder mask layer then a wide tip can be used. A Solder Mask Layer will encourage the solder to fall either side of the mask so reducing bridgeing. This article is intended for prototype PCBs that don't have a Solder Mask Layer. Therefore a pointed tip is easier to solder individual SMT pads.

Observation: The fine tip has a very low thermal capacity because of its size. Therefore the temperature drops extremely quickly when it comes into contact with the pad. Once off the pad it regains its higher temperature also very quickly. The higher thermal capacity of the rest of the bit charges up the tip quickly as well. This drop in temperature has the advantage that the solder melts quickly on the pad but the temperature dropping protects the pad and its glue from overheating and causing damage.

Question: You use solder wire instead of solder paste - Why?

Answer: Solder Paste requires a lot of handling considerations: Storage in a Refrigerator; Thawing out for at least 30 minutes to room temperature; Manual application to SMD pads using applicators is messy due to its very thick consistency. Manual Soldering using solder paste can also cause solder balling where the temperature is accelerated too high that causes the solder to boil, bubble and spit its solder balls everywhere over the board with a possibility of causing short circuits. However by using Solder Wire none of these occur.

Question: Wouldn't it be better to use a hot air pencil instead of a soldering iron?

Answer: Hot Air Pencils are difficult to set up in terms of their air temperature. The air velocity controls are usually very fiddly to adjust the flow to achieve the correct temperature. If the air pressure is set too high, it can be strong enough to blow the SMT devices off their pads. You are usually heating an area of the PCB so it takes longer to melt the solder. However a soldering iron solders quickly without all the other problems mentioned.

by Gavin Cheeseman

Low Power AUDIO AMPLIFIER

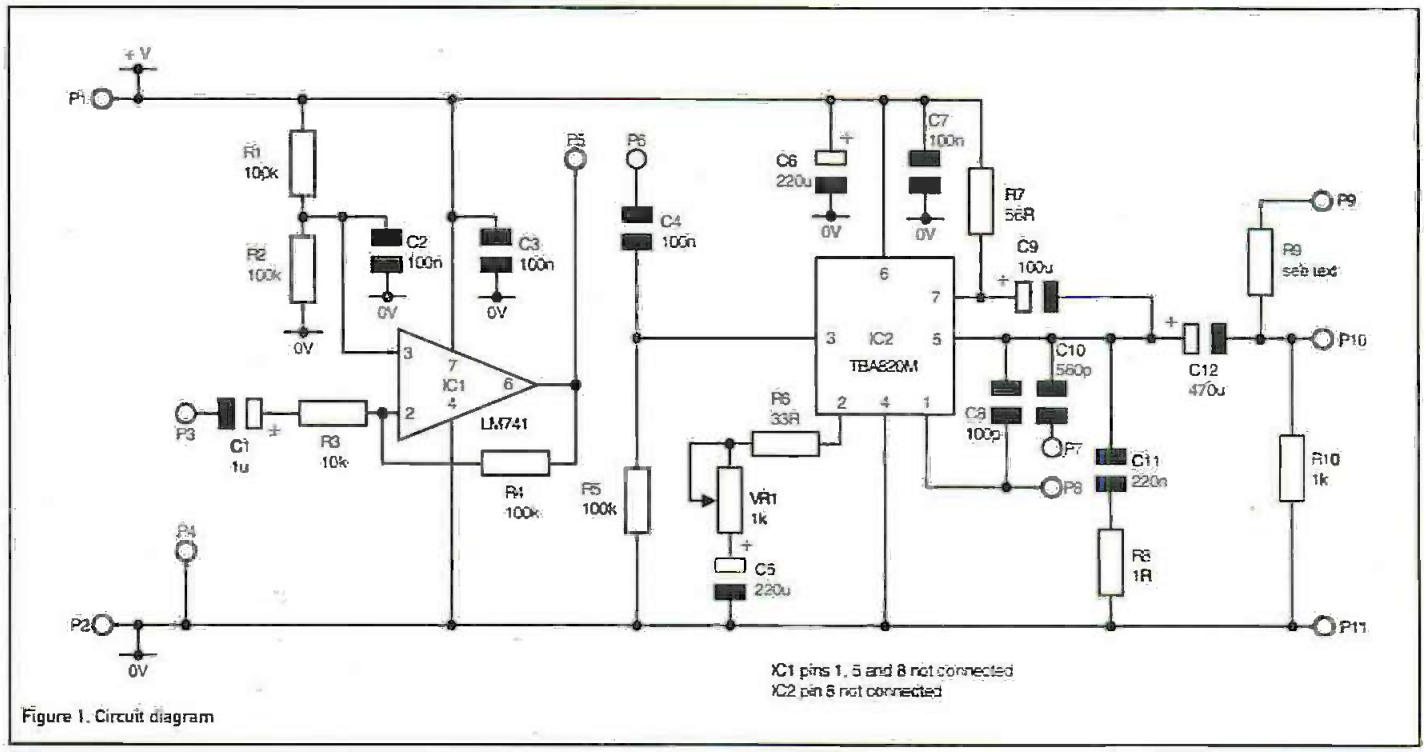


Figure 1. Circuit diagram

In this article we look at a low power audio amplifier with a host of different uses. The circuit is easy to construct and uses readily available components. It is ideal as a headphone amplifier, for applications such as intercoms and door phones and as an add-on to existing projects such as simple radio receivers.

Circuit Description

As may be seen from Figure 1, the circuit is based around the TBA820M power amplifier (IC2). For many applications, the device provides sufficient gain without the need for any additional stages. However a preamplifier stage is included to provide an additional boost when the input signal is insufficient to drive the amplifier directly.

The preamp stage is based around operational amplifier IC1. The IC is configured as a standard inverting amplifier with a voltage gain of 10. The potential divider formed by resistors R1 and R2 is used to provide a half supply reference to the non-inverting input (pin 3) of the op-amp. Capacitor C2 helps to ensure that the reference voltage is relatively free of high frequency noise. Input signals applied on terminal P3 are AC coupled to the preamplifier stage via C1. The voltage gain is set by the values of R3 and R4 and C3 provides high frequency supply decoupling. The amplified signal is made available on terminal P5. It should be noted that the output of this stage is directly coupled and therefore has a DC offset of approximately half the supply voltage. This does not present a problem when driving an input that is capacitively coupled but in any other situation a suitable coupling capacitor should be added.

Input signals are applied to the power amplifier on terminal P6 either from the preamplifier (P5) or directly from an external source depending on the signal level. The signal is AC coupled to the input of IC2 by C4. The power supply is de-coupled by C6 and C7. Variable resistor VR1 allows the gain of the stage to be adjusted with R6 limiting the maximum gain. Capacitors C8 and C10 are used for frequency compensation. Connecting terminal P7 to P8 connects C10 in parallel with C8 reducing the high frequency response of the circuit. This may be used to reduce noise in applications where the full audio bandwidth is not required. The presence of unwanted high frequencies at the output is minimised by C11 and R8. These components are required for the stable operation of the circuit and should not be omitted. Output signals are coupled to P10 via C12 with P9 providing a current limited output that may be used when driving headphones etc. The value of R9 depends on the specific application but might typically be 120 ohms for headphones. In most cases the output at P10 will be connected to an 8 ohm loudspeaker. However, in the absence of an external load, R10 provides a charge path for C12.

Construction

The amplifier can be constructed using almost any standard type of circuit board. Matrix board or strip board is fine. If the preamplifier section is not required, the relevant components can be omitted so as to save cost and space. These are R1-R4, C1-C3,

IC1, P3 and P5. Without the preamplifier, the circuit will also operate over a wider range of supply voltages and is therefore ideal for low voltage battery powered operation.

Try to keep interconnections between components as short as possible. It is usually easiest to start by fitting the small components such as resistors first leaving larger parts until last. The use of DIL sockets for the IC's is recommended. IC pin-outs are shown in Figure 2. Although the devices are not particularly fragile, the IC's should not be fitted until all soldering is complete. This minimises the chance of inadvertent damage resulting from overheating with a soldering iron.

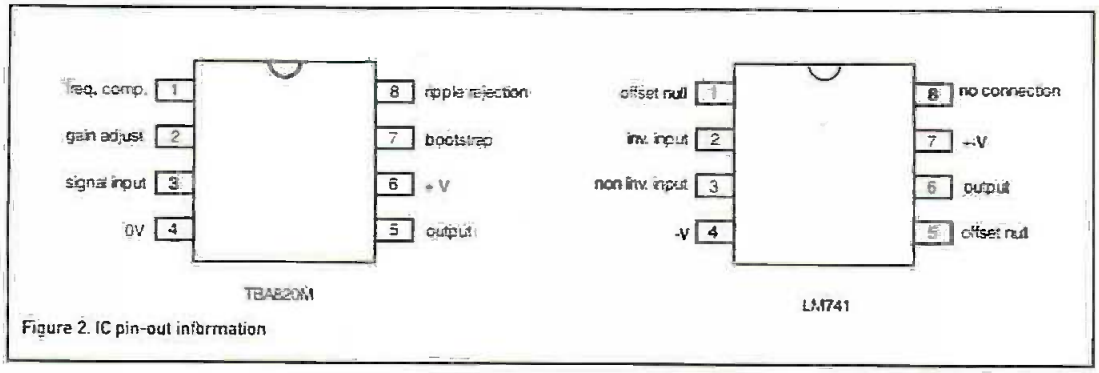


Figure 2. IC pin-out information

Electrolytic capacitors must be fitted observing the correct polarity so as to avoid the possibility of component damage or explosion. The negative lead of the capacitor (normally the shortest of the two) is usually indicated by a minus symbol (-) on the component case. Always double check the supplier/manufacturer's data if unsure.

When all of the components have been soldered onto the circuit board, take a second look at the soldering to make sure that there are no unwanted short circuits or dry joints. Also check that all of the components are correctly connected and of the right value. It is easier to correct these problems before applying power, as even a simple mistake can seriously damage the components.

Power Supply

The circuit is designed to operate with a 12V 500mA DC power supply (the voltage may be reduced if the preamplifier section is omitted). When the circuit is not powered from a battery, a regulated power supply should be used. In either case the supply should have a current capability of at least 500mA. Unless the power supply current is limited to less than 1A, do not forget to fit a fuse in series with the positive power supply lead. It is surprising just how much current even small batteries can deliver under short circuit conditions.

Without the preamplifier section the circuit will operate with power supply voltages as low as 3VDC but it should be remembered that at this voltage, the output power will be considerably reduced.

Basic Test Procedure

Figure 3 shows the necessary connection information for the amplifier. A suitable signal source is required. A sine wave signal generator covering the range 20Hz to 20kHz is ideal but if this is not available a simple oscillator such as that shown in Figure 4 may be used. This circuit outputs an impure signal which is not ideal but does allow the basic functionality of the amplifier to be tested.

When operating the amplifier outside an enclosure it is sensible to wear eye protection. Under certain fault conditions (e.g. when the device is incorrectly connected or the circuit is suffering from instability), the temperature of small amplifier IC's can increase rapidly. This condition can be destructive and may occasionally result in parts of the IC being expelled. Over many years of use, I have never experienced this sort of problem with the TBA820M but caution is always advisable, particularly when powering a new circuit for the first time.

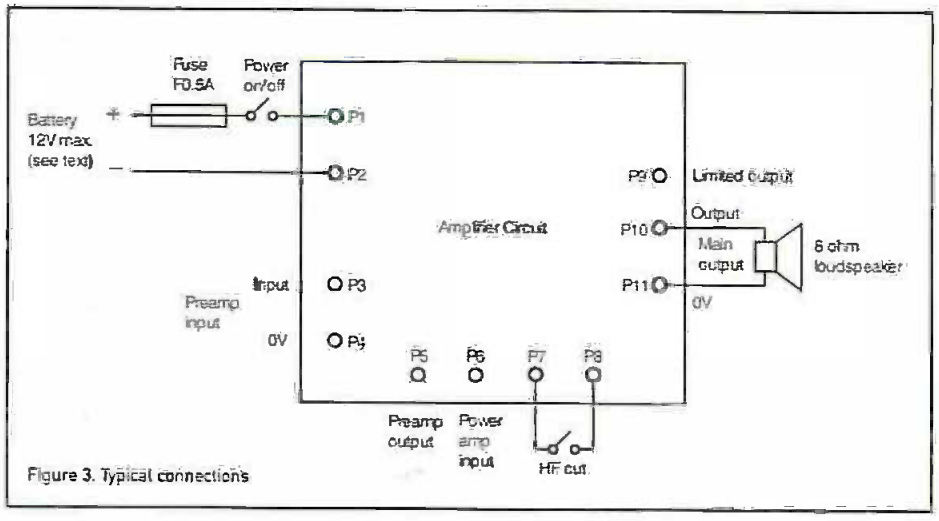


Figure 3. Typical connections

Before applying power to the circuit, set VR1 to maximum resistance (minimum gain). Connect the power supply to the circuit. Terminal P1 is connected to +V (battery positive) and P2 is connected to 0V (battery negative). If available, a multimeter set to read current should be connected in series with the positive power supply lead. This enables the current consumption of the circuit to be monitored and can give an early indication when a fault condition is present.

Switch on the amplifier. There may be an initial click after which the circuit should remain silent except for a quiet hiss from the loudspeaker. The current consumption of the circuit should be just a few mA. A high power supply current at this stage suggests there may be a problem. If this happens, switch off immediately and check for short circuits.

If all is well, a suitable test signal may be applied to the amplifier input. The input signal is connected between terminal P6 (input) and P4 (0V). If a signal generator is used, set the frequency to 1kHz (sine wave). Before connecting the signal source, make sure that the signal level is set to zero (minimum). Slowly increase the signal level until a tone can be heard from the loudspeaker. Try adjusting VR1 on the amplifier board. As the resistance of VR1 is reduced the gain of the amplifier should increase, resulting in a louder output from the loudspeaker. Depending on the level of the input signal, a point may be reached where the amplifier runs into distortion (clipping). This is usually fairly easy to detect particularly when the input signal is a pure sine wave, as the sound of the tone becomes much harsher. At this point the amplifier is being overdriven and either the level of the input signal or the amplifier gain (VR1) should be reduced. It is sensible to avoid running the amplifier at maximum power continuously. If an oscilloscope is available, the output signal at P10 may be monitored and the point at which clipping occurs can be clearly seen.

Next check the preamplifier stage (IC1). With no input signal, the standing voltage at the output of IC1 (terminal P5) should be approximately half of the supply voltage. So with a 12V supply, P5 should sit at around 6V. The easiest way to test the preamplifier stage is with a signal source and an oscilloscope. Apply a 100mV peak to peak 1kHz sine wave to the input of IC1 between P3 (input) and P4 (0V). Monitor the output on P5. The output amplitude should be approximately 1V peak to peak.

If an oscilloscope is not available a rough indication that IC1 is working correctly can be obtained by connecting together terminals P5 and P6 so that the output of the preamplifier is driving the input of the power amplifier. VR1 should be set for minimum gain. Connect a signal source (level set to minimum) to the input of the preamplifier on P3 (0V connection to P4). Slowly increase the signal level until a signal is clearly audible in the amplifier loudspeaker. Now, remove the link between P5 and P6, disconnect the signal generator from P3 and connect it to P6. The sound level from the loudspeaker should be less without the additional gain of IC1. Please note: the amplifier is easily overdriven when the preamplifier is being used.

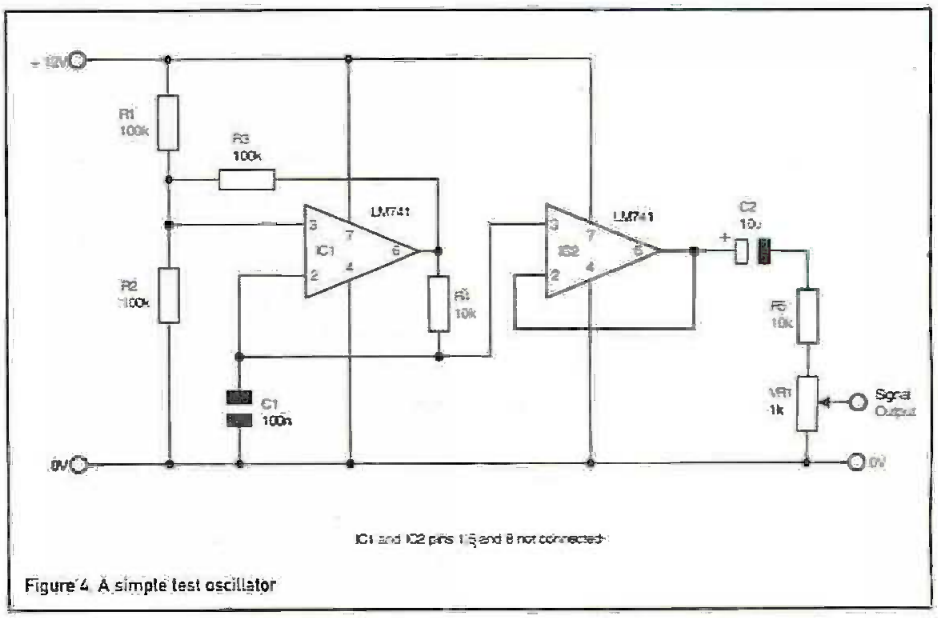


Figure 4. A simple test oscillator

Housing the amplifier

The type of housing used for the amplifier will depend on the final application. If the amplifier is being used as a permanent add-on to another circuit, it will usually share the same enclosure. The circuit does not take up much board space and in many cases should be relatively easy to accommodate. Alternatively, to make a stand alone unit, the amplifier can be housed in its own case with a battery supply or power socket and sockets for inputs and outputs. If the loudspeaker is housed in the box a switched socket may be used at the output so that the internal speaker is disconnected when the external speaker connector is plugged into the socket. Air should be allowed to flow freely around the components so as to maintain efficient cooling.

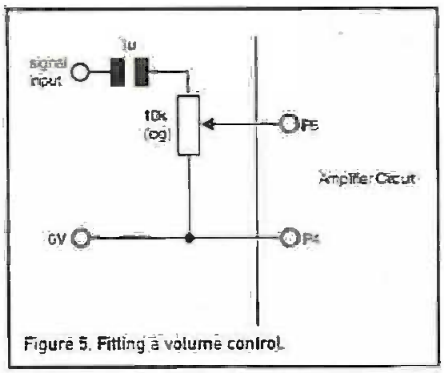


Figure 5. Fitting a volume control

Fitting a volume control

A volume control may be fitted to the input of the circuit if required as shown in Figure 5. A standard log potentiometer is used and may be mounted on the same circuit board as the amplifier or wired externally. The leads to the potentiometer should be kept as short as possible to minimise unwanted noise pickup.

Minimising external pick-up

External noise pickup can be a problem with any high gain amplifier. The problem becomes more pronounced when connecting leads are long. Common examples are mains derived hum and RF pickup.

Mains derived noise manifests itself as a continuous buzzing sound from the loudspeaker. The best cure for this is to use screened leads at the input. Hum can also relate to earth loops where earth returns are taken back to various points in the circuit. Star earthing all 0V connections to the same low impedance point usually results in an improvement.

RF pickup can be an absolute menace when an amplifier is being used with long connecting leads, for example as part of an intercom or door phone system. Short wave radio stations are often the cause. The signals are picked up by input, output and power leads, which may form a resonant length at a frequency where strong signals are present. Signals are rectified by the semiconductor junctions in the IC's which form a crude AM detector. Often, the interfering stations are clearly audible from the loudspeaker. This problem is not always easy to cure. It depends on the source and amplitude of the interfering signal. Possible cures include changing the length of the leads, fitting ferrite rings or beads to the leads close to the amplifier and fitting small value capacitors (a few pF) across the input leads. Reducing the gain of the amplifier may also result in a cure.

Parts List

Resistors (minimum 0.5W metal film)		
R1, 2, 4, 5	100k	4
R3	10k	1
R6	33R	1
R7	56R	1
R8	1R	1
R9	see text	1
R10	1k	1
VR1	1k variable trimmer	1
Capacitors (minimum voltage rating 16V)		
C1	1uF radial electrolytic	1
C2, 3, 7	100nF ceramic disc	3
C4	100nF polyester layer	1
C5, 6	220uF radial electrolytic	2
C8	100pF polystyrene	1
C9	100uF radial electrolytic	1
C10	560pF polystyrene	1
C11	220nF polyester layer	1
C12	470uF radial electrolytic	1
Semiconductors		
IC1	LM741	1
IC2	TBA820M	1
Miscellaneous Items		
Circuit board (eg strip-board)		
8 pin DIL sockets		2
P1 - P11, PCB pins		11
8 ohm loudspeaker (2W*)		1
Fuse F500mA		1
SPST toggle switch		2

* Loudspeaker power rating may be reduced at lower supply voltages in line with amplifier output power.

Parts are widely available from component suppliers such as Farnell Components and Maplin Electronics.

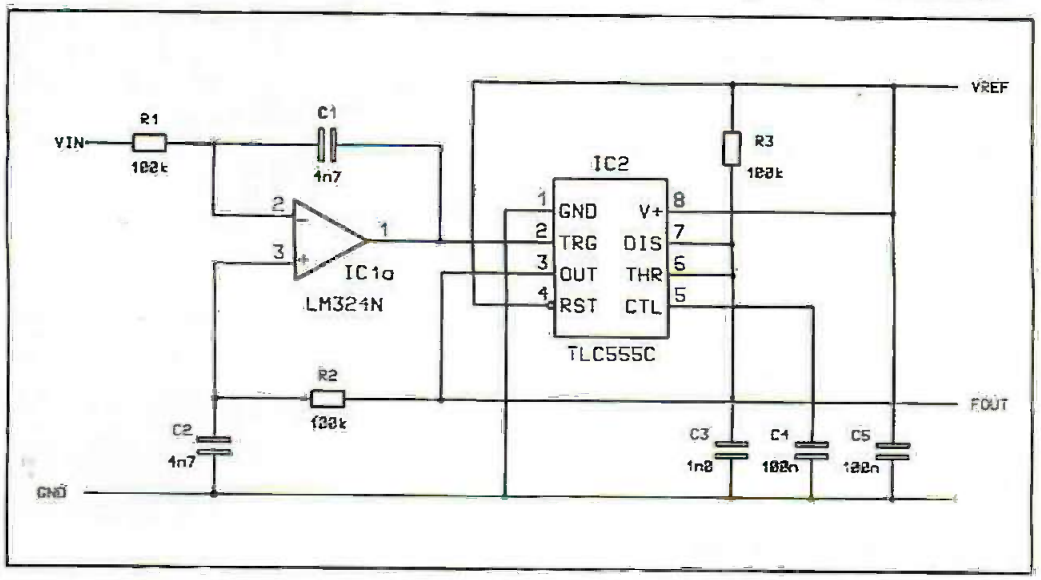
Voltage to Frequency CONVERTER

THIS CIRCUIT PRODUCES A STREAM OF CONSTANT WIDTH PULSES AT A RATE DIRECTLY PROPORTIONAL TO THE (INPUT VOLTAGE)/(REFERENCE VOLTAGE).

It differs from other similar circuits in operating from a single supply voltage yet having the input directly referenced to the negative (ground), and only one op-amp and a timer chip are required as active components. The basic operation is also similar to other VFCs - the output pulse rate is adjusted so that the averaged voltage of the pulse stream is equal to the input voltage. Usually, if not using bipolar supply rails, the input voltage would require some kind of level shifting, needing another op-amp at least. No level shifting is needed in this version.

The timer used here is a CMOS version of the ubiquitous 555 timer. The output of this chip switches from rail-to-rail, being CMOS, rather than to 1.5V below the positive supply as with the bipolar version. Since in this circuit the high level of the 555 output is also the VFC reference voltage, this is a distinct advantage. When the trigger pin is taken below 1/3 of the supply voltage, the output immediately goes high and the timing operation starts. The output pin is kept high after the normal time if the trigger pin is still low, which is a desirable feature in this circuit as it ensures that the circuit will always start up. It is possible to use other one-shot timers, as long as they have a negative going trigger and a positive output pulse; for instance, in a mainly digital circuit a spare half of a 74HC123 dual timer could be used. The one-shot using a couple of NAND gates might be another. To ensure start-up with a timer like the '123 requires a few components more, to force the output high as long as the trigger is low.

The op-amp must accept and operate with inputs near the negative supply level, and the output must be capable of going down to at least the trigger level for the timer. The LM324 is one such device. It can also work from 5V, which is handy. The schematic doesn't show the supply for the op-amp, which could well be the same as for the timer, but doesn't have to be. The timer works up to an absolute maximum of 18V, but 15V is the sensible limit. Both the 324 and the 555 will work at 5V, so it would be easy to use this in an otherwise digital circuit, and if there is a microcontroller available, two port pins could then be co-opted into taking on the timer function.



Operation:

The input voltage VIN must always have a DC path to ground. Assume VIN is lower than that on the filter capacitor C2: the op-amp output will rise steadily as the difference is integrated by C1. The timer trigger input will rise above the trigger point (VREF/3), releasing the timer and allowing its output to switch to GND once the delay time has elapsed (which it may already have done). The C2 voltage will then decay towards GND, eventually falling below VIN. At this point, the direction of the op-amp integrator output will change direction from rising to falling.

After some time, the integrator output will become lower than the VREF/3, and the 555 output will switch to its high level, which is VREF. This will cause the voltage on C2 to rise. When it becomes higher than the input voltage the integrator again changes direction, with the op-amp output falling once more, and the cycle repeats.

Why is the output rate proportional to the input voltage? The simple no-maths explanation is that with a fixed pulse width the average voltage of the stream is proportional to its frequency. The timer is connected as an oscillator, since there is positive feedback from the output to the trigger via the filter capacitor and the op-amp, which puts that timer-output derived sawtooth on the trigger input. If the pulse waveform average is higher than the input voltage, the integrator will tend to drift up away from the timer trigger level, and the timer will get triggered later, so reducing the rate. Conversely, if the rate is too low, the integrator will tend to fall below the trigger level, the timer will be triggered earlier, and the rate will rise. This is where the 555 trigger behaviour comes in handy – if there is an input voltage but no pulse stream, the integrator will eventually fall below the trigger level and the 555 output will be forced high, so the C2 voltage will rise to the VIN level. It will always start.

Value Selection

The waveform on the capacitor C2 is the normal charge/discharge curve for a C-R with a rectangular pulse train applied. It turns up at the op-amp output as a linear sawtooth,

though, as the action of the integrator adds a compensating curve if the two time constants associated with the op-amp are the same. That is, if C1*R1=C2*R2. The amplitude of the waveform at the op-amp output is the same as on capacitor C2, but it is shifted so that the lowest level reached is set at the trigger voltage for the 555, VREF/3. This shift may be up or down, depending on the input voltage level.

For linear VFC operation, the op-amp output must not reach its upper limit and saturate. This can be prevented by ensuring that the product of C2*R2 (and therefore also C1*R1) is larger than the value of the 555 output pulse width, limiting the maximum amplitude of the waveform on C2. There is a trade-off, as the higher the op-amp time-constants the smaller is the amplitude of the op-amp output signal, which has consequences in increased noise-induced pulse jitter, and the longer is the settling time after a change in VIN. Operating both chips from 5V, a ratio of around 4 will be safe, less than 3.3 may to lead to op-amp saturation. The higher the operating voltage, the closer the time-constants can become.

The frequency range of the VFC depends on the timer output pulse width, which is 1.1*C3*R3 seconds; this is the minimum period for the output cycle. If reached, the output would be permanently high, as this would actually be a 100 duty cycle, but the notional frequency would be 1/(1.1*C3*R3) = 0.909/(C3*R3)Hz. With the input voltage at VREF/2 there will be a 50 duty cycle output, the period will be 2.2*C3*R3, and so the frequency will be 1/(2.2*C3*R3) = 0.454/(C3*R3). For the values used here, mid point frequency will be 4545Hz. Minimum frequency (for a grounded input) is zero. The scale is linear, with the reachable upper limit depending on the maximum working common-mode voltage of the op-amp; that is 1.5V below the supply for the LM324. If this is lower than VREF, then this sets the maximum effective range of VIN. By adding another resistor from the inverting input to ground, the input voltage scaled as required, though of course it does not increase the reachable maximum output frequency. For instance, changing R1 to 200k and adding a 200k to ground will double the range of VIN without changing the time constants. It also ensures the requirement is also satisfied that a DC path is maintained for the inverting op-amp input to ground. The TLC555 is specified to work well beyond 1MHz, which will be out of range for the 324 op-amp, but up to 100kHz should be fine.

The Special R.D.F. Event

A short story by Ken Smith.

Young Peter Meredith was doing well in his hobby interests. He'd achieved a good pass in the examination for the Amateur Radio Novice Licence. He had been lucky to get a place in the study group set up for it by a radio ham at the local youth centre. Peter followed the radio exam success with an equally impressive one in the Morse Code test. This was offered by an official examiner at the local Amateur Radio Society that Peter had also recently joined. He passed the test easily at fourteen words per minute.

He thought to himself, it's time I sent all my Certificates to the authorities. Soon, the Government issued licence to transmit by radio with his callsign, '2E01JLH' proudly hung on his bedroom wall.

There was one cloud on the horizon. This year saw hardly any activity in the Grantleigh School Electronics club. The teacher, who was a Radio Ham and had held the club transmitting licence, had left at the end of the last term. Peter gained his interest and had really become keen on radio-electronics from the inspiration of this teacher, and was very sad to see him go. Even Peter saw that this chap, Mr. Hollis had been rather a 'father-figure' for him in the absence of a father at home. There weren't many teachers these days who cared like that.

Peter made efforts to keep things going and regularly helped a few first year pupils to build kits from Maplin and make small amplifiers during lunch time meetings. That was a big achievement considering that the new science master knew hardly anything about amateur radio and wasn't very keen on Electronics. He seemed rather a remote person. Perhaps he thought Peter was slightly big headed with a transmitting licence and so on.

On the other hand, though somewhat reluctantly, this teacher had at least allowed Peter to run his first year lunch time hobby group in the School Laboratory.

Peter tried hard to advance in the local Amateur Radio Society. The Society's Committee was organising a Top Band Radio Direction Finding contest for the spring and Peter wanted to enter it and get somewhere in the contest. Yet his lack of experience and absence of a suitable Top Band radio receiver made it difficult. He knew the radio wavelength of Top Band was 160 metres and thought of trying to build a set from a kit or by collecting components and having a go at his own design of receiver. But time would run out and he would still need much practice at the other skills of Radio Direction Finding, like taking bearings and map-reading before the date of the contest.

Then he remembered something. I know, he thought with a touch of desperation, there's an ancient Top Band receiver and directional aerial in the back of the old apparatus cupboard in the Physics Lab. It's a bit heavy, but I'll sneak it out. The new teacher won't know its gone. So a day or two later Peter did his bit of teaching to the first years on how to solder components to a circuit board. Then waiting for the teacher to leave the room, he sent the younger boys out early so that he could creep into the Laboratory preparation room. There he rummaged round and found the old receiver. I hope it works, he thought, and could not resist the temptation to wrap it up in a parcel and sneak it out of school. It soon appeared in his bedroom, where fixing it up with new batteries, also 'borrowed' from the Physics Lab. he found that when he turned it on, the familiar rushing noise came from the headphones. Tuning around on the wavelength dial, Peter soon received some stations loud and clear. Oh that's great, he thought, better than I'd hoped.

...Peter tried hard to advance in the local Amateur Radio Society. The Society's Committee was organising a Top Band Radio Direction Finding contest for the spring and Peter wanted to enter...

He kept the set on his side table next to his computer. While tuning around the dial again listening for stations the next evening, he noticed the faded paper label stuck on the side of the box. 'Grantleigh School, 5th Form Club. Top Band D.F. Receiver. G8TL Design'. Peter thought to himself, I'd better cover up the label when I take it out. I don't want anyone to see it.

'Where did you get that?' asked his mum.

'Oh, er, an older kid at school let me have it.' He blushed at the dishonesty, noticing for the first time the faded name 'Hazlett' barely legible in the corner of the back panel.

During the next local Amateur Radio Society meeting, Peter said he had a D.F. receiver which tuned into Top Band.

'I didn't actually make it. I got it from school', he more honestly told the radio hams at the club, 'But I need some help using it - and using the map'. Peter looked round expectantly hoping that one or two of the older members would volunteer to give him a hand.

No-one took much notice, but as he left the meeting to go home a bit early, a man he couldn't quite recognise in the dark said to him, 'Hello young man, I hear you want some practice taking D.F. bearings?'

'Yes, that's right Mister, er. . .'

'Alright, I'll turn on the special event station, Golf Bravo Three Delta Echo Delta. I will call on the Top Band frequency of 1.975 Megahertz. Would Saturday afternoon be a suitable date for you? I suggest you start off on the recreation ground. Bring an ordnance map and listen out at 3-30 p.m. . . .'

'Oh yes', said Peter, 'that'll be great! Er, thanks.' He took out his pen and began to write down the details on the back of the radio society Newsletter he'd collected from the club meeting. He turned to look again at the stranger, but the street was empty.

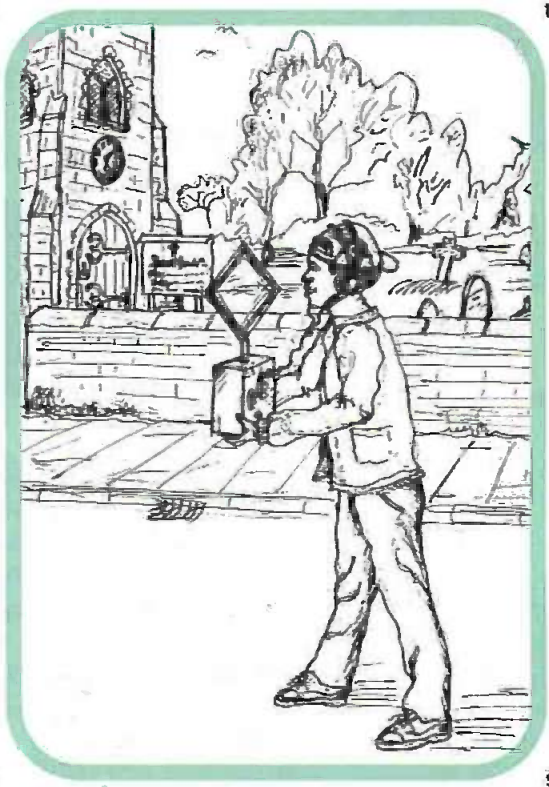
Peter went back into the club to see if the man had gone to the meeting. He couldn't see any new faces among the gathering, so he

described to the others as best he could the mysterious radio amateur who had spoken to him. 'Er, I didn't quite get his Callsign - Delta Echo - something, I think...' Peter announced.

'Doesn't sound like anyone in our Society?', said Jack, the club chairman, 'Besides, no-one else has come in here since you left. We all thought you'd gone home.'

'Huh, lad, are you sure you're not imagining it!?', another member asked, overhearing Peter's conversation.

Peter felt slightly embarrassed and didn't press the point anymore. He still wondered who the man was. Then he left the Radio Club meeting for the second time and wandered home thinking about what had happened.



The weekend soon arrived. Peter put on a warm jacket and his baseball cap against the cold December weather and went out to the recreation ground on the Saturday afternoon. Complete with the rather bulky receiver and map of the Grantleigh area, he turned on the radio and tuned it to 1.975 MHz. After a moment he heard, 'Hello 2E01JLH, Golf Bravo Three Delta Echo Delta calling. Turn the receiver and its directional aerial to a null in the signal during the time I send a tone. When the signal disappears at the null, take the compass reading of the aerial direction. Here's the tone, Brrrrrrrrrr.'

Peter was very excited to hear the clear signal. He turned the set and aerial round and found he could null the signal very easily. He looked at the compass and murmured to himself, 'Thirty two degrees east of north . . . Hmm!' Then the signal came up again. 'Hello, I hope you got that? Now Peter, draw the bearing line across the map from where you are.'

Peter started and took in a sharp breath. His mind was racing now as something dawned upon him.

How did this operator GB3DED know my name, he thought, when did I give him my Callsign?

But there was the radio signal clearly calling him. Nothing much to do now but to draw the bearing on the map. The signal came up once more. 'Are you listening Peter? Walk for a quarter of an hour along the Bamberton road, then tune in for another bearing, take the null as before and draw the new line.'

Peter walked along the road. The few brown leaves blowing in the cold east wind, rustled under his feet. He felt quite mystified. Very strange, he thought, and couldn't quite put his finger on it. I suppose someone told him about me - who I was. Yet no-one seemed to know this man at the Radio Society. He spoke to me first outside the club meeting. How strange, especially as he'd talked about the DF contest. I don't know his name at all - just that mysterious Callsign? Ah well, I'd better press on. It's very odd though, I wish I'd brought a friend...

The quarter of an hour was up. Yes there was the signal. '2E01JLH from Golf Bravo Three Delta Echo Delta. Null the tone again lad. Draw the bearing on the map again - are you ready? Brrrrrrrrrr.'

Peter drew the second bearing. The two lines crossed near the church in the village of Bamberton about three and a half miles away. That will take quite a bit of walking, Peter thought, and started off. He listened now and then but did not hear any more signals on the way.

Eventually he saw the distant houses and church of Bamberton and was pleased to arrive there some minutes later. The receiver was beginning to feel very heavy and his arms were aching. He placed the set on a wall and turned it on again. Straightaway he heard a very strong signal. 'Hello Peter, turn down the attenuator knob, you'll find it near the headphone jack on the receiver you're using, then take another bearing. That should get you home and dry! Oh, by the way, do take the receiver back to school, won't you? Think of your young beginners in the first year - they will want to use it later, don't you think? I'm sure a bright lad like you has hopes to be an example to them about honesty, is that right!?'

Peter started with shock-horror! How had this man known about his misappropriation of the receiver? How did he know about the first years? The shock of this message completely threw Peter. He had been too surprised to take a bearing. The transmitter must be very near though, the signal was so loud. Now Peter felt he didn't really want to meet the other operator who had been guiding him. He felt embarrassed and looked around nervously. But all was quiet.

The boy began to feel quite despondent, guilty in fact while he stood outside the churchyard. He hardly dared to listen again, but with some apprehension continued to do so, yet he never heard another signal. He ambled into the churchyard and sat on a stone seat feeling strangely confused. He looked at the grey, darkening sky. It would be dusk soon and certainly he would have to walk home in the blackness of a wintery evening. He caught his breath and shuddered at the thought of the journey back alone through the spooky shadows of Bamberton Lane.

Presently the jovial white haired Vicar came walking along the Churchyard path and said, 'Hello young chap, sitting there in the twilight! Penny for your thoughts, as the old saying goes. What have you got there, an old wireless set?'

'Er, oh, yes sir,' Peter stammered a little, 'I've been trying to practice Amateur Radio Direction Finding. I don't know where the hidden transmitter is, but signals I had sent to me seemed to come from a radio ham somewhere around your church.'

'From around the church! I think you must be mistaken about that. There's been no-one around here but me and no radio hams live near. Yet my dear young fellow, what you say is most interesting, because we had a very keen ham in the village quite a number of years ago. He was interested in the Radio Direction Finding too. If I remember rightly, he ran events at the church fetes when I was a young curate. Oh, he must have died some thirty odd years ago.' With that, the old priest shuffled among the gravestones.

'Ah, come along the path a little way, see there, you can just make out his name on the grave. Er, 'in loving memory ... Raymond Hazlett', yes, that's it! Well, I must be away to get ready for late evensong.'

Peter felt very weak at the knees. The Vicar walked off into the distant gloom leaving him alone in the dark churchyard. The boy felt shocked and sat down heavily on the cold stone bench, not really knowing what to do. He gulped hard as he heard the old priest's fading tones, 'I do believe Hazlett was Science Master at Grantleigh School ...'

The End

electronics classified

GQRP Club

QRP in the ham radio world means 'Low Power' and is generally defined by international agreement between QRP clubs as 5 watts. However QRP isn't just a issue of power. There are probably more 'homebrewers' in this special interest section of ham radio than elsewhere. There are active and thriving clubs throughout the globe that produce world class technical magazines - usually quarterly. The GQRP Club was founded in 1974 by the Rev. George Dobbs G3RJV who is both secretary and editor of SPRAT our magazine. To find out more, you can contact George on 01706 631812, or visit our website at www.gqrp.com.

Bristol Contest Group

The Bristol Contest Group consider themselves the 'Maclaren' of Amateur Radio. They continually make technical improvements in antennas, transceivers, and computers to try and win the worldwide radio contests, in which they compete against other clubs from the UK and abroad. They mostly use portable stations set up around Bath and elsewhere in the UK, but this year the team travels to the island of Curacao in July for the 'Islands on the Air' contest organised by the RSGB (Radio Society of Great Britain). Anyone from the West Country holding an amateur radio license is a potential member. See http://ourworld.compuserve.com/homepages/g3xsv/.

If you want to send in anything for Electronics Classified, then send in details of your clubs, queries or items wanted to:

ELECTRONICS CLASSIFIED,
ELECTRONICS AND BEYOND,
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ABERYSTWYTH, CEREDIGION. SY23 3JQ.
FAX: 01970 621 040,
E-MAIL: jaldred@kanda.com.

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

Amateur Radio On The Web

Here are some more Amateur Radio web sites.

Aberdeen Amateur Radio Society: www.aars.freeserve.co.uk

Basingstoke Amateur Radio Club: www.barc.fsnet.co.uk

Bracknell Amateur Radio Club: http://ourworld.compuserve.com/homepages/baugh/bracknel.htm

Bristol UK Amateur Radio Clubs: www.goldhill.pwp.blueyonder.co.uk

British Amateur Television Club: www.batc.org.uk/index.htm

Cambridgeshire Repeater Group: www.gsl.net/crg

Clifton Amateur Radio Society: www.clifton.dircon.co.uk

Crowborough Amateur Radio Society: www.gsl.net/g0crw

East Cork Radio Group: www.necl.ie/EI7M

Grantham Amateur Radio Club: www.garc.org.uk

Guernsey Amateur Radio Society: www.gars.org.gg

Harlow & District Amateur Radio Society: www.gsl.net/g6ut

Ilford Group RSGB: http://homepages.tesco.net/~esoteric

Kvarnbergets Amateur Radio Club: http://ham.te.hik.se/clubs/sk0ux

Manchester Wireless Society: www.manchester-wireless-society.co.uk

Mid Glamorgan Amateur Radio Group: http://homepage.ntlworld.com/mw0cna/index2.html

New Zealand Association Of Radio Transmitters: www.gsl.net/zl1aa

Newbury & District Amateur Radio Society: www.nadars.org.uk

West Wales Coastal Breakers: www.wwcb.telinco.co.uk/wwcb.htm

Reading & District Amateur

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Use this form if you are submitting your entry by post or by fax

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Address:

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Radio Club: www.radarc.org
Royal Signals Amateur Radio Society: www.rsars.org.uk
South Bristol Amateur Radio Club: www.sbarc.co.uk
South Dublin Radio Club: www.qsl.net/ei2sdr
South Eastern Amateur Radio Group: www.angelfire.com/tx3/searg
South Notts Amateur Radio Group: www.snarc.org.uk
The Radio Society of Great Britain: www.rsgb.org.uk
United Kingdom Radio Society: www.ukrs.org

How to find your local Amateur Radio society:

The best way to meet local radio amateurs is through the various local club meetings. There are too many local clubs to list in full on this page, but a full list can be found by going to the Radio Society of Great Britain's web site and clicking on 'Clubs' on the site navigation bar (found by clicking on most links from the home page). Then click on 'Affiliated Clubs' and you will be presented with an interactive map to work from. There you will find all the details you need to find out about the location and activities of your local amateur radio club or society.

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Institute of Inventors.

The Institute of Inventors is a voluntary, non-profit inventors' club, run by professional engineer inventors, with help for all private inventors --evaluation of new ideas, gadgets and inventions, prototype drawings and development, patent specification, drawings and applications, licensing of intellectual property to maximise inventors' chances of earning money on inventions with merit. The institute also undertakes commissions for customised inventions as required by industry and governments to enhance the quality of life on this planet for maximising the miracle of man's inventiveness. 19-21-23 Fosse Way, Ealing, London. W13 0BZ. United Kingdom. Tel: +44 (0)20 8998 3540, +44 (0)20 8998 6372. Internet: http://members.aol.com/mikinvent/index.html. e-mail: mikinvent@aol.com.

ROUGOL.

The RISC OS User Group of London is a leading force in the world of RISC OS. We have regular meetings, with provision for refreshments, and excellent presentation facilities. The group has over 120 members, and is the fastest growing RISC OS user group in the world. We hold meetings on a wide range of topics, in a variety of locations, and at different times, catering for all. We generally intend holding meetings every six or seven weeks. Everyone on our mailing list will be kept informed of these and other ROUGOL initiatives. Go to http://rougol.jellybaby.net/ to see our home page.

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web electronics

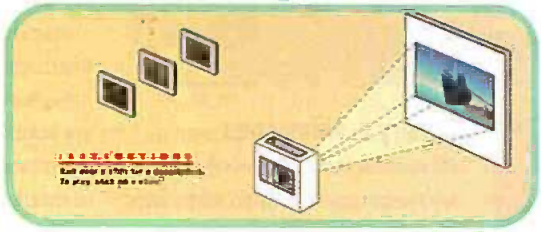
THIS ISSUE WE DEVOTE WEB ELECTRONICS TO THE SUBJECT OF HISTORY. WE HAVE SEARCHED THROUGH A RANGE OF SITES – SOME FASCINATING, SOME BEWILDERING, AND A LOT THAT ARE MOST DEFINITELY NOT WORTH WASTING ANY PRINT SPACE ON.

The sites that we have chosen are all worthy of a look and, no doubt, this month we have something for everyone interested in the rich and fascinating history of electronics. If you have any other suggestions for web sites of this nature, you can post them on the new E&B website's Forum area. Our new-look web site can be accessed at www.electronicsandbeyond.com.

Stop Press... Stop Press

Last month Marconi announced plans to cut their global workforce by 6 , 1,500 of the job losses to be in the UK. The news came just as we were finalising the magazine, and presented us with a dilemma – as we had already made a big feature of Marconi's new online museum, Marconi Calling. There was an initial feeling that we would have to cut this item, so as not to offend people, but because the site deals with Marconi's history, we thought that we would include it, and this is why:

There are a lot of large companies around today who make optimum use of the fact that they own a name that goes back to a golden past of pioneering inventions and discoveries that literally did change the world. The companies way back were built by and around individual people, and whilst the workforce may not have been treated any differently from today (people did, of course, have less rights back then), it is important to remember that all companies are built on the work of all the employees who have ever worked there. The Marconi Calling site does have features on Marconi itself, but what it is mostly about is people – be it the man behind the name, or the people whose lives were touched or changed by the new avenues in communication the Marconi company were responsible for opening. Guglielmo Marconi was a remarkable man and discovering about his life and achievements through this site is a good way of paying respect to all the individual men and women at the company who stand to lose their jobs over the coming year.



We would like to hear your comments about large companies and the way that they deal with people. Is it right that companies should make job losses so as to keep the company healthy, or do you think that the health of the company has nothing to do with it at all. Should there be tighter controls on the way that companies can lay off their workforce? Perhaps you think that in Britain in particular, this would not have happened had the Labour government signed up to the single European currency? Send your opinions in to Air Your Views and we will publish them in a later issue.

Marconi Calling

Marconi plc is a global communications and IT company with around 55,000 employees world-wide. It has research and development facilities in 19 countries, manufacturing operations in 16 countries, and serves customers in over 100. It supplies advanced communications solutions and technologies for the Internet.

Up until 30th November 1999 the company used to be called GEC – like Marconi, this is a name with over a century of history behind it (The General Electric Company was formed in 1886). But a long history of sales and mergers had left the company with the rights to the name, first used back in 1900 when the thirteen year old Wireless Signal and Telegraph Company rebranded itself as Marconi's Wireless Telegraph Company and the Marconi International Marine Communication Company was formed.

Now, for the first time, Marconi have opened their historical archive to the public through the world wide web. Marconi Calling is a fascinating exploration of the life of founder Guglielmo Marconi, his scientific discoveries, the impact of wireless and the development of modern communications.

In essence, the site is more of an online museum, split up into four galleries. In this special Web Electronics feature, we will introduce you to each of the galleries and what you can expect to find there. We really do recommend that you visit this site because it is one of the best presented and animated sites, of any nature, we have seen. Be aware, however, that the site is optimised for machines running at 450MHz or above and a high-speed connection. It also requires the Flash plug-in (version 4). If you do not have this, you can download it from the site itself, or instead load up the alternative HTML version (the HTML version provides quick access to the online archive only).

All the galleries can be accessed through the home page at www.marconicalling.com.

Marconi Overview

In what can best be described as a small foyer area to the four main galleries, Marconi's life and achievements, as well as the legacy of his company and name, are set out in four sizeable and very well written documents.

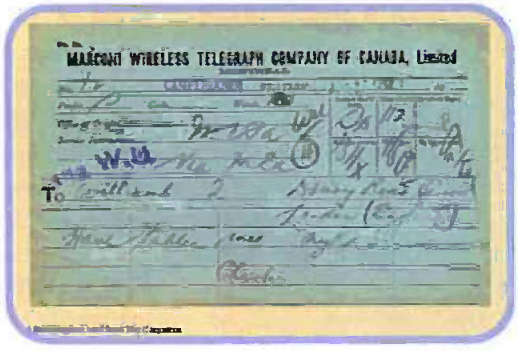
Marconi was the first person to bridge the Atlantic by wireless – a milestone celebrated by the launch of this site based around

him. The experiment cost £50,000, a vast sum in those days, and many respected scientists believed that the curvature of the earth would prevent the wireless waves from spanning the Atlantic. Marconi's own experience of such waves already reaching destinations beyond the horizon led him to believe it could be done, and he persuaded his board of directors to agree to the experiment.

Quoting from the web site, this is what happened next:

'Marconi chose sites at Poldhu in Cornwall, Cape Cod in Massachusetts (USA), and later, Glace Bay in Canada. In September 1901, the 200 feet aerial masts erected at Poldhu were blown down in a storm. Despite this setback Marconi decided to continue, and a temporary aerial was erected. He agreed to replace the system of masts with a permanent structure of four wooden towers. It was also decided that, initially, transmission should be attempted to the nearest landfall on the American continent, namely in Newfoundland, rather than to Cape Cod where, in November, the masts were also blown down in a storm.

Marconi sailed to Newfoundland in November 1901, with two assistants and his equipment. The colonial government of Newfoundland offered him assistance and he was loaned premises at Signal Hill in St. John's in which to set up his apparatus. On 11 December the first attempt at transmission from Poldhu took place. A weak signal was received but the wind was so strong that the balloon holding the aerial aloft was lost. On 12 December, after losing one kite, a second was launched with the aerial attached and the signal from Poldhu was heard unmistakably by both Marconi and Kemp, his assistant. 'The chief question,' recalled Marconi, 'was whether wireless waves would be stopped by the curvature of the Earth. All along I had been convinced that this was not so. The first and final answer came at 12:30 when I heard ... dot ... dot ... dot.' It was Poldhu's letter 'S' in Morse code.'



Although in North America Marconi was hailed as a benefactor and honoured by the American Institute of Electrical Engineers, and by Alexander Graham Bell and Thomas Edison personally, the British press were sceptical and Marconi returned to England with his case unproven. In 1902, however, he sailed to America on the SS Philadelphia, which had been fitted with aerials attached to the 150ft masts. As the ship sailed west, signals were sent from Poldhu and they came through clearly on the Morse code receiver. The captain attested that readable messages were received up to 1,551 miles at sea and reception of the letter 'S' was maintained for up to 2,099 miles. At last Marconi's sceptics were silenced.

Gallery 1: Marconi Past And Present

This exhibition highlights and contrasts moments from Marconi's life with the Marconi company as it is today. There are photographs, quotes and actual audio and video clips – all of or relating to Marconi and other people and events of the time. You can then read about what the company does now – and there are sections here about optical networks, mobile networks, vending machines, and turntable lasers.

Gallery 2: Milestones

Once it had been shown that wireless made commercial sense, it went on to play a pivotal role in many famous historical events. In this gallery there are four 'slides' to choose from, each one shows a different moment from history where wireless played an important part. After clicking on a slide you will go to a page featuring interactive animations and information.

One of these slides features how the infamous murderer Dr Crippen was caught with the help of radio, another features key transmissions from events such as the Hindenburg disaster and Churchill's 'finest hour' speech. A third slide, appropriately enough, tells the story of Marconi's transatlantic wireless signal.

The last slide shows the part that wireless played in the unfolding story of the Titanic, even as it was sinking. You can read actual telegram messages sent to and from people on the ship. These messages are very poignant and include ones from the start of the voyage, before the collision, during the collision, after the collision, and ones from survivors taken aboard the rescue ships. One of these reads merely 'Safe on Carpathia – Holrey lost. Meet me'. Another is to the Marconi Operator on the Carpathia – 'Send your story American exclusively worth $200 tonight'.

Gallery 3: Communication

From pigeon carriers and semaphore, through wireless and the development of television, to today's broadband networks, this section is another interactive interface with written information on all the different types of communication that have been used throughout history.

Gallery 4: Archive

This is a more extensive collection of all of the features found within the other three galleries, plus many extras. For example, there are hundreds of photographs, information on numerous key events, biographies, images of actual newspaper articles relating to Marconi and his company, radio equipment and artefacts, royal messages, and a much larger database of messages and untransmitted messages from the Titanic and Carpathia. There are also photographs and documents, including a six page report of the Titanic enquiry, which has five printed pages and a hand written note on the final page.

The History of the Royal Institution of Great Britain

The Royal Institution is well known as one of Great Britain's

finest scientific establishments. It was founded in 1799 and has had a long and important role in both scientific research and education. The RI web site (www.ri.ac.uk) has information on the role of the Institution, current lecture programmes, the Davy Faraday Research Laboratory, and the famous Christmas Lectures.

Click upon 'History' after entering the site and you will have access to the biographies of several famous scientists from the RI's history, including Michael Faraday – the discoverer of electro-magnetic induction, electro-magnetic rotations, the magneto-optical effect, diamagnetism, and field theory – who worked there as Chemical Assistant and, later on, Superintendent of the House. These biographies are interesting and quite well written – although the majority of them turn out to be external links.

There is a museum dedicated to Faraday in the basement of the Royal Institution building, in the room he used to work in. This is a marvellous restoration of his laboratory, with original scientific apparatus, manuscripts and personal belongings on display, and it is a shame that more is not made of it on the site itself. There is a link to a page featuring a brief explanation of what the museum is, along with one picture, but you could almost miss this and it could really benefit from some more effort being put into it, because it is the kind of thing you feel people would visit the Royal Institution site for.

You would also think that they would make a bit more of their history, but the explanation of the Royal Institution's rich past is very disappointingly shallow. The animated timeline listed at the top of the history page is really just a collection of barely annotated photographs, and the tour animation is hardly even that. Hopefully the organisers of this site will improve it sometime, but in the meantime we do suggest you visit it if you have any interest in Faraday and would like to find out more about the Faraday museum; its visiting times and admission details.

International Vintage Electronics Museum

Go to www.etedeschi.ndirect.co.uk/museum/index.htm for the web presence of this small but well stocked museum located in Hove. There are over 1,000 items on display at the museum, and some of these can be found in JPEG form on the web site. The site is more of an inventory of items than a fully-fledged web site, but it is a good site to look at if you are interested in visiting any electronics museums – reason being, you can find out what is on show there before you decide to go. There are a lot of people who collect items related to electronics, and many of these people have very specific interests. Search this site to find out if the International Vintage Electronics Museum has anything you especially want to see.

If you do want to visit the museum, here is a list of things you can expect to find and do...

- Listen to today's radio on a 1922 crystal receiver
- See videos of Marconi's life, restoration of Vintage sets, transistor collecting, story of Sony etc.
- Operate a vintage (1933) valve set
- See Marconi's autograph
- Read newspapers with the news of Marconi's first transatlantic transmission
- Consult one of the largest collections in the world of Marconi Books, magazines, and ephemera
- Make a telephone call on a vintage 1923 candlestick telephone
- Watch 405 TV transmission on a bakelite TV set (1950)
- Operate a spark transmitter
- See a Tesla coil in operation
- Listen to a genuine Edison phonograph in action
- See a collection of Novelty Radios
- Record and listen to your own voice on a wire recorder (1949)

If you do not have access to the Internet, the museum's address is 54 Easthill Drive, Hove. BN41 2FD. The curator is Enrico Tedeschi and you can phone him on 01273 701650 for further information about visiting. It is essential, according to the web site, that you phone him before you decide to go.

The site is part of Enrico's main site -- Old Radio : Digital World (www.etedeschi.ndirect.co.uk), which is also worth a look – there is an electronic magazine, news, views, items for sale and wanted and a commercial photo library based, presumably, on the museum collection.

A Thumbnail History of Electronics

Maintained by L.S. Taylor of the Electrical Engineering Department at the University of Maryland, this is another paragraph-by-paragraph event-by-event collection of web pages. Each paragraph comes with a thumbnail photograph of an electronics pioneer, hence the name. It starts off with William Crookes (born 1832) whose observations of cathode rays and the dark space at the cathode led to the discovery of x-rays and of the electron. This is more of a who's who of electronics, rather than the Brief History pages which have their content ordered in terms of events, even where it moves into short biographies. You can access the index page at www.ee.umd.edu/~taylor/Electrons.htm.

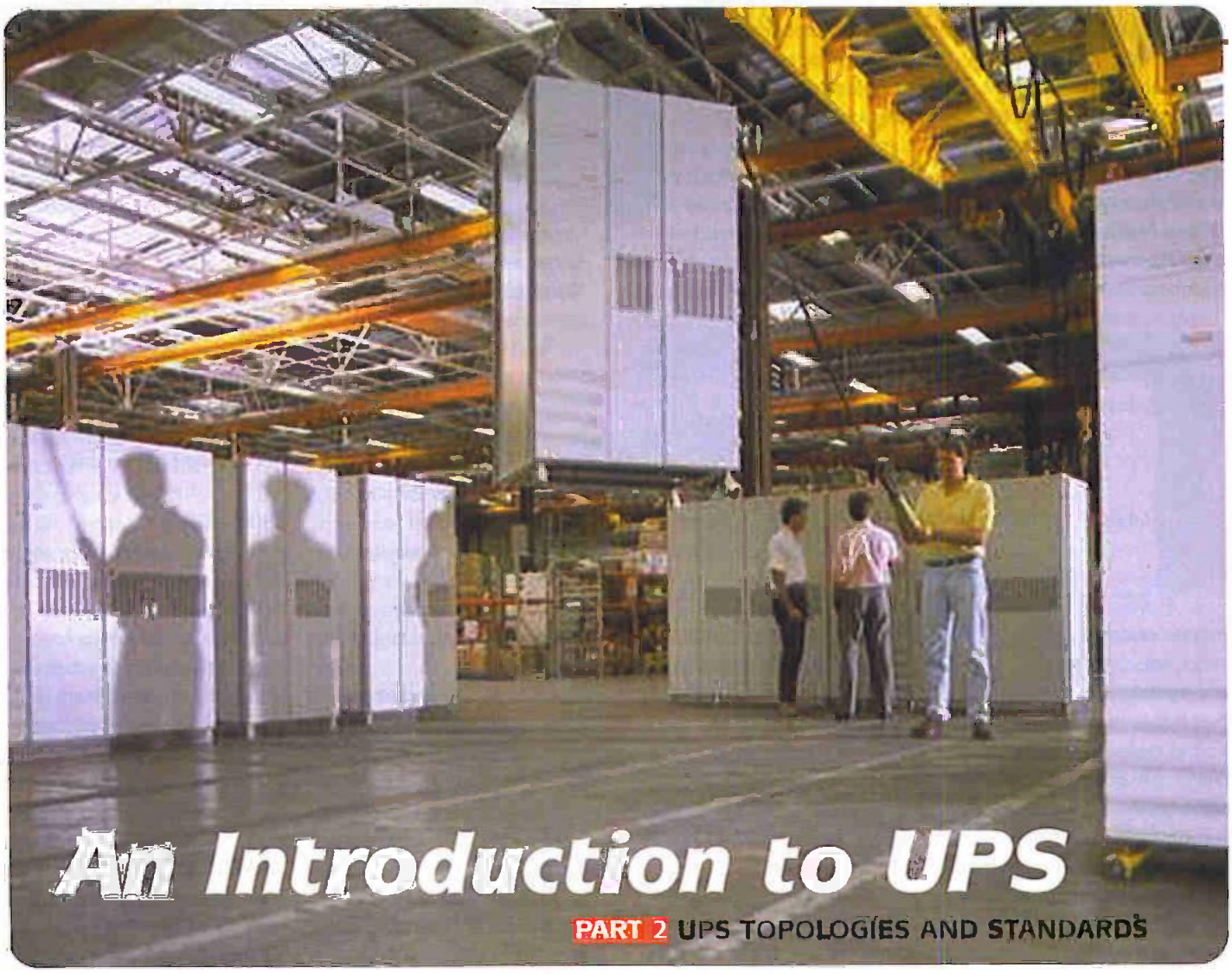
Apple History

www.apple-history.com is a site that provides a broad history of the Apple Computer company from the invention of the Apple I in 1976, through troubled times to the current revival. There is also a comprehensive gallery of Apple models with photos and specifications.

Seven Sites

Starting next month we will be publishing the details of web sites owned by and sent in by you, the reader. Each month we will pick out seven of these sites at random and publish their URLs within the magazine for other readers to type in and visit. All you have to do is send the details in an email to jaldred@electronicsandbeyond.com with the number 7 in the subject line. Remember to tell us the classification group the site falls into (Personal, Community, Educational, Commercial) and explain in your own words clearly and concisely what the site is about. We look forward to hearing about them.

Powering THE INTERNET



An Introduction to UPS

PART 2 UPS TOPOLOGIES AND STANDARDS

Last month, Shri Karve introduced us to Uninteruptible Power Supplies and their relevance within the Internet Supply sector. This month he takes a closer look at the three types of UPS – Passive Standby, Line-interactive and Double Conversion – and explains why there was a need for the International Electrotechnical Commission, (IEC) to establish these standards.

The Need For A New Standard

Mass-produced UPS first appeared on the market in the 1970s, essentially to meet the needs of large computer systems in terms of continuity and quality in the supply of electrical power. They then evolved to adapt to the vast increase in the number of sensitive loads and their diversification, due to the explosion in digital technology.

As a result, UPS were modified to meet the needs of applications such as mini and then microcomputers, industrial processes, instrumentation, telecommunication, etc.

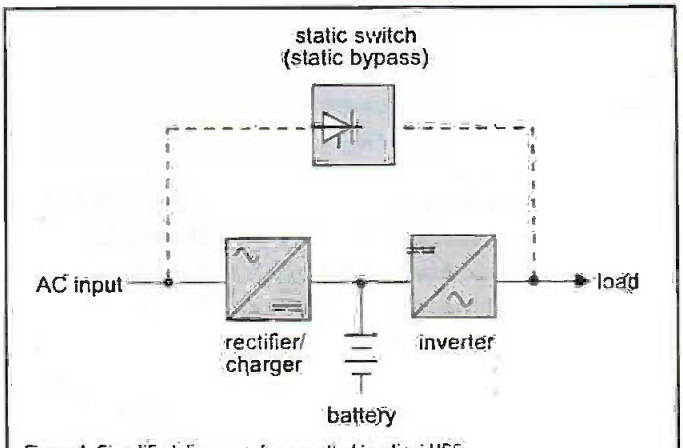


Figure 1. Simplified diagram of a so-called 'on-line' UPS

Adaptation to markets undergoing such rapid change necessitated a wide series of technological innovations and an extension of power ratings. Progress was made in both directions, toward lower and higher ratings, to meet the respective needs of microcomputers and the vital applications of digital telecommunication systems. That is why the term UPS today covers very diverse products ranging from a few hundred VA up to several million VA.

During this process of

adaptation and change, the techniques employed for UPSs became more diverse, depending on the type of application protected, its criticality and power level. At the same time, the description selected to qualify products was often confusing and even misleading to consumers.

Back in the 1970s, the term 'on-line' UPS was commonly used (see figure 1). It refers to a UPS topology comprising primarily: An input rectifier/charger that rectifies the AC-input supply voltage used to charge a battery as well as support an inverter; A battery supplying backup energy in the event of a utility power outage; An inverter that supplies power with a consistently high level of quality (frequency, voltage, etc. within tight tolerances); A static switch (static bypass) capable of transferring the load to bypass power without a break in the supply of power, thus enabling 'downgraded' operation of the load (i.e. not supplied with quality power via the inverter).

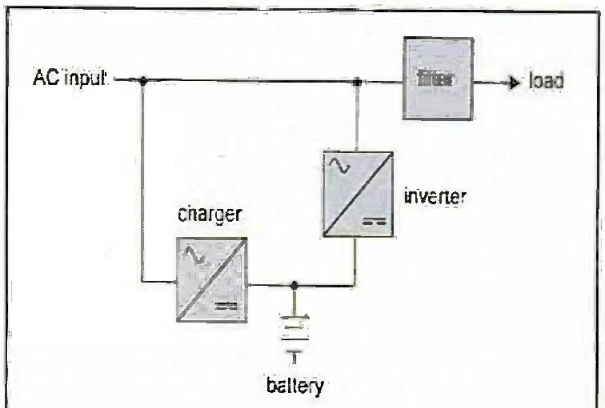


Figure 2. Simplified diagram of a so-called 'off-line' UPS

The standardisation bodies observed that the term 'on-line', which taken literally means 'on utility power', does not represent the true situation in this topology. The load is supplied by the inverter and not directly by the AC mains. The term was nonetheless fairly rapidly construed to mean a UPS supplying a load continuously via an inverter connected in series with the AC mains. This term concerns primarily high-power UPS (≥ 10 kVA).

In the 1980s, the types of loads and the range of power ratings increased substantially and 'off-line' UPSs were developed, the term 'off-line' being simply the opposite of 'on-line'. This term is used to describe a topology (see figure 2) in which the inverter is not connected in series with the AC-mains, but rather in parallel in a passive standby configuration. It does not operate continuously, but only when the AC-input supply voltage goes outside tolerances.

This topology includes a filter whose function is not clearly defined and is occasionally presented misleadingly as a voltage-regulation function. It does not include a static switch (static bypass), with a result that load switching times are too long for some applications.

Again, the standardization bodies observed that the term 'off-line' (literally 'not on utility power'), does not represent the true situation in this topology. The load is primarily supplied directly with AC-input power supplied from the utility and the inverter action is demanded only sporadically, in the event of a problem with the utility power. Users nonetheless fairly rapidly adopted this topology and the term 'off-line', primarily for low-power UPS (£ 2 kVA).

In the 1990s, further techniques were developed. The term 'line interactive' is used for UPS implementing reversible inverters. However, the uncertainty created by the many versions of topologies exposed consumers to abusive tactics. For example, some UPS were termed 'in-line' and in some cases, the term 'on-line' was utilized in a very misleading manner. Over a period, this situation, which allowed a certain number of ambiguities and even outright fraud, played against the interests of consumers and penalized reputable manufacturers.

The need to establish a standard with clearly defined terms became unavoidable and that is why the International Electrotechnical Commission working group undertook to draft a standard on the types of UPS and the methods utilized to measure their performance. Cenelec, the European standardization committee adopted the contents of the IEC standard.

Standards IEC 62040-3 and ENV 50091-3 distinguish the following three types of UPS topologies – Passive Standby, Line-interactive and Double Conversion. These terms refer to UPS operation with respect to utility power, i.e. the distribution system upstream of the UPS. The standards define the following terms for input power: Primary Power – power normally continuously available which is usually supplied by an electrical utility company but sometimes by the user's own generation plant; and Standby Power – power intended to replace primary power in the event of primary power failure.

Practically speaking, a UPS has one or two inputs: The normal AC input (sometimes called Mains 1) is supplied with primary power; The bypass AC input (sometimes called Mains 2), when it exists, may also be supplied with primary power or, where possible, with back up power (for instance a separate cable from the same main low-voltage switchboard).

Passive Standby UPS

Normal Mode: The load is supplied with utility AC-input supply, generally via a filter / conditioner which eliminates certain disturbances and can also provide voltage regulation. The standards do not mention this filter and speak simply of a 'UPS switch'. They do, however, stipulate that 'Additional devices may be incorporated to provide power conditioning, e.g. ferro-resonant transformer or automatic tap changing transformers'. In this instance the inverter is on passive standby.

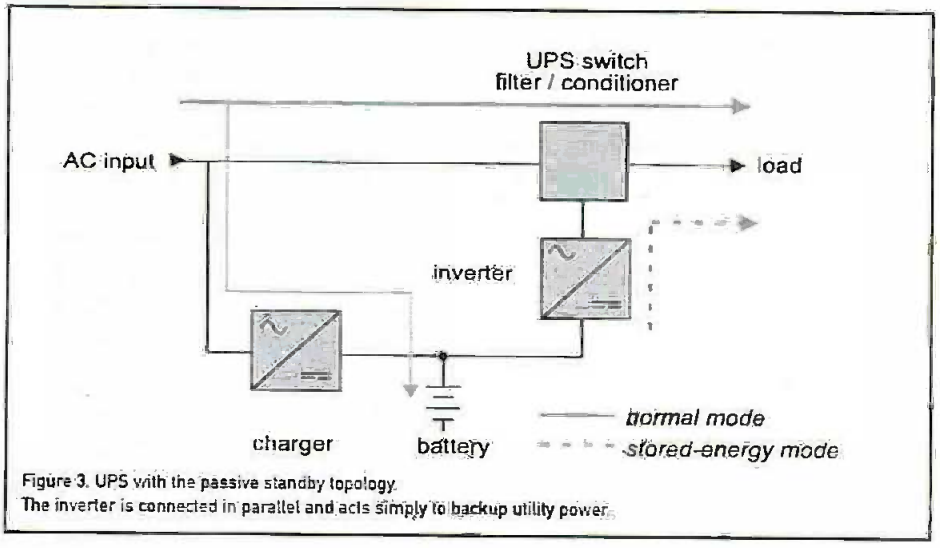


Figure 3. UPS with the passive standby topology.
The inverter is connected in parallel and acts simply to backup utility power.

Stored-Energy Mode: When the AC-input supply voltage goes outside the specified tolerances or fails, the battery and the inverter ensure continuity in the supply of power to the load with a very short switching time (generally < 10 ms). The standards do not mention a specific time, but do stipulate that 'the load is transferred to the inverter directly or via the UPS switch (which may be electronic or electro-mechanical)'.

The UPS continues to operate on battery power for the duration of the backup time or,

as the case may be, until the AC-input supply voltage returns to within the specified tolerances, at which point the UPS returns to its normal mode.

This topology is the result of a compromise between an acceptable level of protection against disturbances and cost. Practically speaking, because of its disadvantages, this UPS topology is used only for low power ratings (< 2 kVA). It cannot be used for frequency conversion.

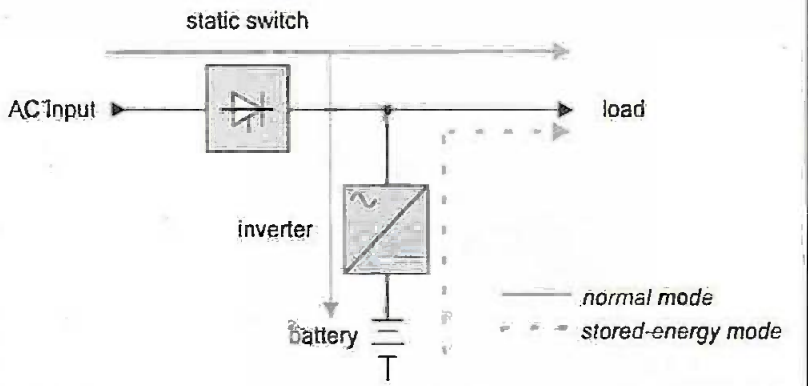


Figure 4. UPS with the line-interactive topology. The inverter is connected in parallel and acts to backup utility power. It also charges the battery. Through its reversible operation, it interacts with utility power.

Line-interactive UPS

Normal Mode: The load is supplied with 'conditioned mains power' via a parallel connection of the UPS inverter with the AC mains. The inverter is operational to provide output voltage conditioning and/or battery charging, whilst the output frequency is dependent upon the AC mains-input frequency.

Stored-Energy Mode: When the AC-input supply voltage goes outside UPS preset tolerances or fails, the inverter and battery maintain continuity of power to load. The switch (e.g. a static switch) disconnects the AC-input supply to prevent backfeed from the inverter. The UPS runs in stored-energy mode for the duration of the stored-energy time or until the AC-input supply returns to within UPS design tolerances, at which point the UPS returns to normal mode of operation.

Bypass Mode: This type of UPS may include a maintenance bypass. In the event of a UPS internal malfunction, the load may be transferred to the bypass input via the maintenance bypass.

This topology is poorly suited to sensitive loads with medium to high power ratings because frequency regulation is not possible. For this reason, it is almost never used at such ratings.

The so-called 'Boost/Buck', 'AVR' (automatic voltage regulation) and 'Delta Conversion' topologies all belong to the line-interactive category.

Double Conversion UPS

Normal Mode: The load is continuously supplied via the rectifier/charger–inverter combination which carries out a double conversion AC-DC-AC, hence the name of the topology.

Stored-Energy Mode: When the AC-input supply voltage goes outside UPS preset tolerances or fails, the inverter and battery continue to support load power. The UPS runs in stored-energy mode for the duration of the stored-energy time or until the AC-input supply returns to within UPS preset tolerances, at which point the UPS returns to normal mode.

Bypass Mode: This type of UPS is generally equipped with a static bypass (often called a static switch). If this is present, the load can be transferred without a break to the AC bypass via the static bypass under the following conditions – UPS internal malfunction; Load current transients (inrush or fault clearing); Overloads; End of battery backup time. However, presence of a bypass implies that the input and output frequencies must be identical and that a transformer must be installed in the bypass if the input and output voltages are not the same. The UPS is synchronized with the source of the bypass AC supply to ensure transfer of the load without a break of power. Another circuit, called the maintenance bypass, is usually provided for maintenance purpose. Operation is carried out by a manual switch.

This is the most complete topology in terms of load protection, regulation possibilities and performance levels. It is in fact the 'on-line' topology presented at the beginning of this article. The standards state the term 'on-line' and advise that it should not be used. They recommend use of the term 'double conversion' which is a much more accurate description of the operating principle.

This topology makes possible no-break operation during load transfers from normal mode to the bypass mode and back, using the static switch. It also ensures total independence of the output voltage and frequency with respect to the input voltage and frequency. Due to their numerous advantages, double conversion UPS are used almost exclusively for the protection of critical application of higher power ratings (from 10 kVA and upwards).

Conclusion

For low power ratings (< 2 kVA), the three types of standardized UPS are all employed. For high power ratings, double conversion UPSs are used almost exclusively. Double-conversion UPS represents the vast majority of sales for medium to high power ratings (95% from a few kVA upwards and 98% above 10 kVA). This is because the double-conversion topology offers a large number of advantages in meeting the needs of sensitive loads at these power ratings, due primarily to the position of the UPS connected in series with utility power. What is more, this type of UPS has very few weak points, with the exception of the higher price, which is compensated by the superior level of performance that is often indispensable given the critical nature of the loads supported.

Part 3 Next Month

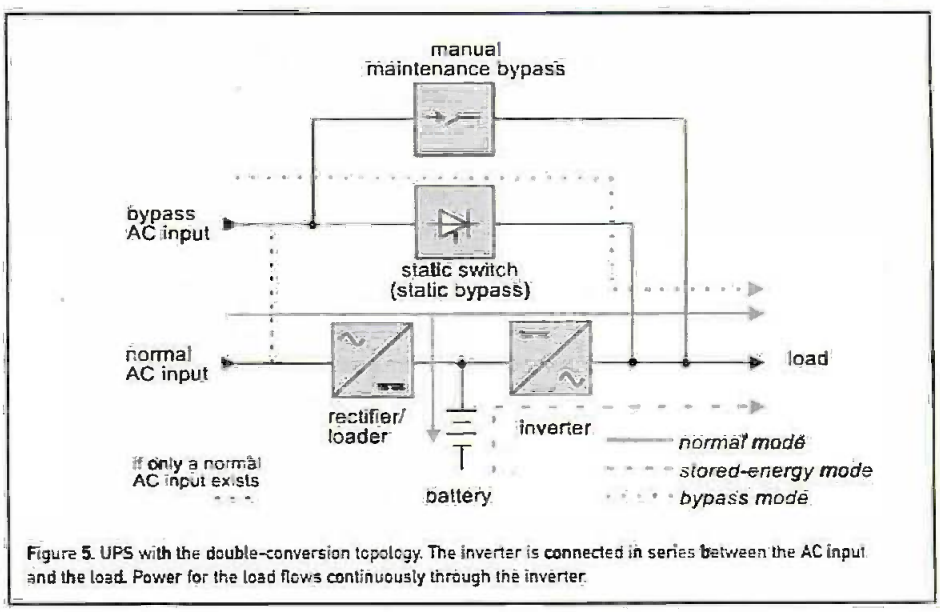


Figure 5. UPS with the double-conversion topology. The inverter is connected in series between the AC input and the load. Power for the load flows continuously through the inverter.

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Intelligence: the key to SUCCESS

by M.W. Jones

Today's high technology companies operate in an increasingly turbulent, high velocity environment. The companies that thrive are able to successfully scan this environment and bring products to market in compressed time frames. The ability to sustain competitive advantage will differentiate the winners from the also rans. Winning practitioners need to be a mix of profit and pedlar buoyed up by an inexhaustible supply of energy and obsession. But all of this may not be enough in an environment where visions can become epitaphs. Near the end of the Second World War, Tom Watson the patriarch of IBM recalled 'I think there is a world market for about five computers'. A generation later Ken Olsen of DEC made a prediction with respect to the infant personal computer market by flatly stating 'There is no reason for an individual to have a computer in their home'.

So how do companies get it right more often than the competition? The process of technology forecasting is one of the key determinants of sustaining commercial success and taken in concert with the ability to scan the environment the foundations for success can be firmly established.

Environmental scanning is not a passive activity. The amount of data that surrounds a company is overwhelming. But to be useful data has to be turned into intelligence. It is intelligence - that is data that forces you to take action - that is important to a firm. Too many firms collect data - too much of it. A pro-active highly integrated process of adsorbing not absorbing data is what is required. The challenge is to acquire intelligence from wherever it is to be found. Universities, academic conferences, journal activity and specialist books are fertile areas for companies. These sources can augment the data the company is harvesting from the traditional areas such as the market, the industry environment and the macro-environment.

Motorola University has developed a four step process to help. The first step is to establish the conduits through which data can flow from the competitive business environment into the company. The harvesting of this information must be systematic and continuous. This information must be then filtered - the wheat from the chaff, and turned into intelligence. The 'so what' test should be applied to all information. Say for instance you are dependent upon a single supplier for a particular component. What if it runs into difficulty. So what would you do - turn to another supplier or place employees into the company to ensure early feedback of problems and early generation of solutions. The third step is to direct this intelligence into structures into the company that allow efficient storage and utilisation of knowledge. Knowledge management is a growing area in business research and in high velocity environments the ability to sort data, generate intelligence and act decisively in tight timeframes is the major source of competitive advantage. The result is the possession of a rich picture which a company can spot the best routes of advance, vital market ground and obstacles to success. This rich picture will help your company manoeuvre over the landscape achieving objectives and hitting targets.

Technology forecasting techniques can also assist and a summary of these areas is shown in the table below.

Of these I favour the scenario - building process. One of the leading exponents of this process is of the St Andrews Management Institute in the UK. Much of their early work was carried out in Shell in the 70s and since then the art of scenario generation has gained many exponents.

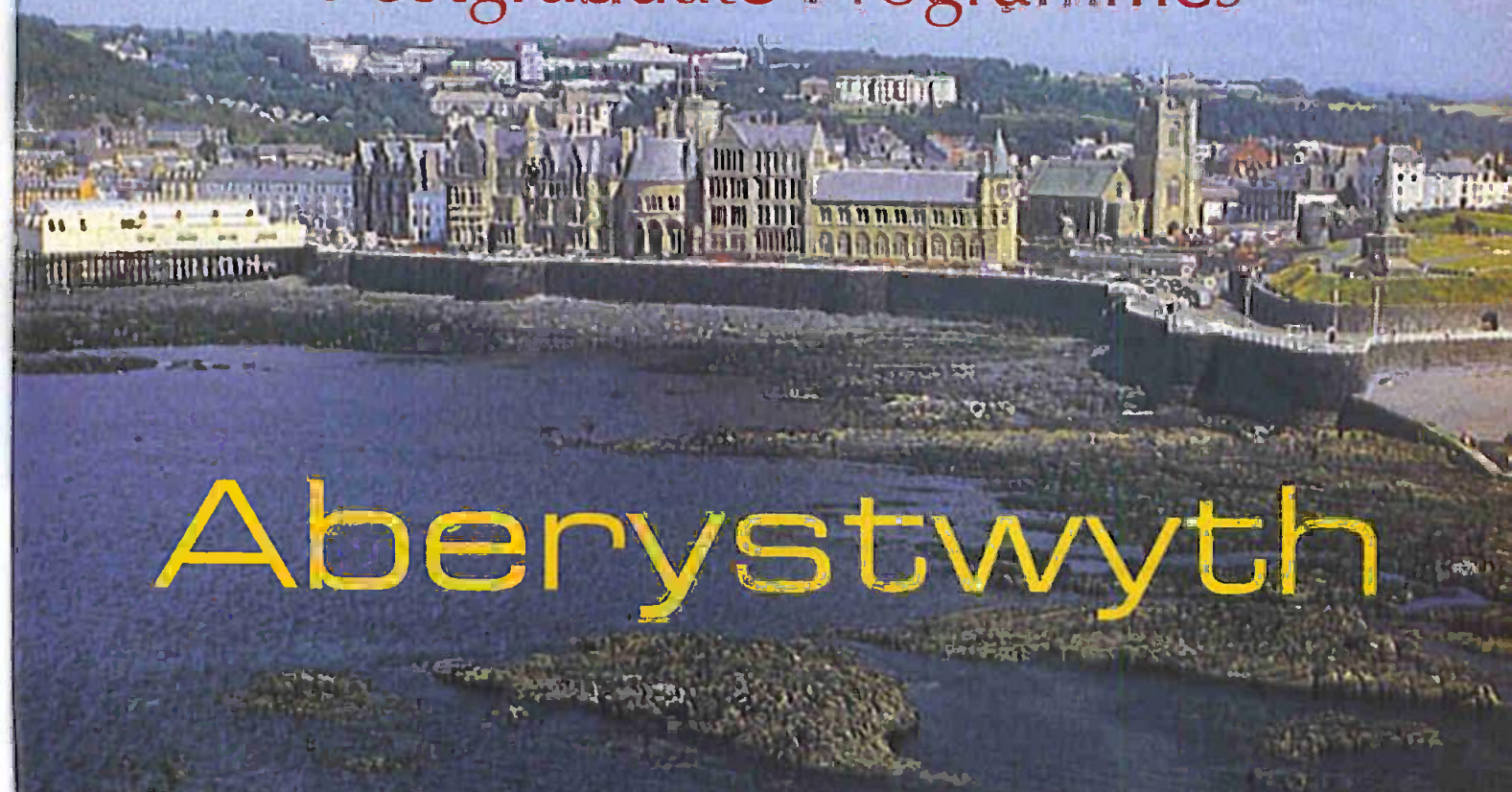
I hope this article has caused you to reflect on how you are going to position your company to prevail within the uncertain conditions that surround you, your company and the product. The importance of scanning, generating and utilising intelligence and developing a rich picture of your market sector is critical. Good Luck!

M.W. Jones is the Director of the School of Management and Business at the University of Wales Aberystwyth. The School runs the largest e-business specialist Management Masters in the UK. Formerly he was the Director of the MBA at Cranfield School of Management.

Forecasting Methods	Advantages	Disadvantages
Expert Opinion	InexpensiveConvenient	Biases of experts can render predictions useless
Trend Extrapolation	Easy to understand Software available	Inaccurate even for short term Does not take causation into account
Scenario Building	Forces consideration of multiple possible futures	Too qualitative for some decision support applications
Strategic Roadmapping	Connects forecasting insights to strategy development	Can revert to 'strategic planning' obsolescence if not rigorously updated

School of Management & Business

Postgraduate Programmes



Aberystwyth

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(AMBA Accredited)

Masters in Management (MSc)

- MSc e-Business Management
- MSc International Business Management
- MSc Broadcast Media Management

Founded in 1872, UWA is the senior institution of the University of Wales of which HRH Prince Charles is Chancellor.
Aberystwyth is an ideal place to study. Located in beautiful surroundings, the University provides a comprehensive range of services and facilities. The University information services are among the best in the UK, and the library facilities include the use of one of the six copyright libraries of Britain, the National Library of Wales, which is adjacent to the University Campus. The University is at the heart of a relaxed, friendly, safe community which leads to a unique learning environment.

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School of Management & Business
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Penglais Campus
The University of Wales
Aberystwyth
Ceredigion
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Electronics and Technology Recruitment

Senior Appointment – Head of UMTS Development

Central London
£ Outstanding + Benefits

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

Ref : 4328

DSP Software Engineers

Hertfordshire
£ Market Leading + Benefits package

This outstanding organisation designs and manufactures a range of products that exploit wireless GSM technology. Due to there rapidly growing client base and respectability, they currently require DSP Software Engineers with ambition, self motivation and the hunger to rise to new challenges.

Experience in developing and debugging real-time systems is essential, along with atleast 1years practical use of DSP assembler language (not just using C compiler). 2 + years practical use of C++ is also essential, along with familiarity with DOS/Windows/scripting languages (e.g. PERL). Basic knowledge of digital hardware, good knowledge of Digital Signal Processing Theory (Nyquist sampling, GMSK Modulation, Channel Coding, etc.) and DSP algorithm design (preferably in communications systems) will be required too succeed. Market leading salaries and packages will be offered to the successful applicants.

Ref : 4424

Protocol Consultant

Cambridgeshire
£ 50 – 100K + Benefits

An excellent opportunity within a dynamic and fast moving company with a distinct vision of the future of mobile communications. An exceptional engineer is required, who has been exposed to the latest technologies such as GSM, GPRS, WAP, UMTS and Bluetooth. You will have atleast

10 years strong C coding experience in a product development environment, along with design / implementation using RTOS for multi-tasking applications, experience of GSM / GPRS / UMTS protocol type approval process, use of SDL and message sequence charts, direct experience of

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

L2 / L3 GSM / GPRS / UMTS terminal protocols.

Ref : SMRU

Audio / Video DSP Software Engineer

Avon
£ Excellent + Benefits

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

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

Ref: 3258

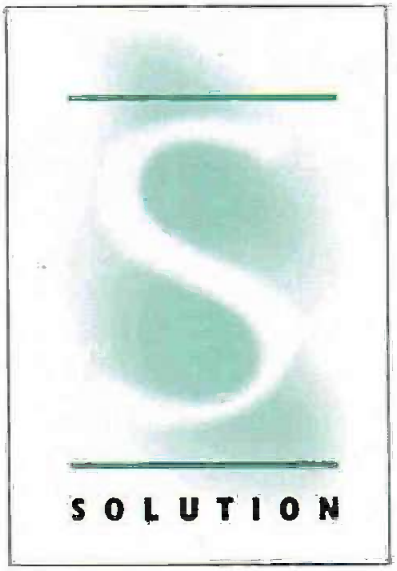
Technical Sales Engineer Frequency Control Products

South East
to£35K + Car + Benefits

A leading manufacturer with a global presence our client specialises in quartz based frequency control products. Following recent expansion in their European operations they are seeking to appoint a Technical Sales Engineer to further promote their product in both existing and potential clients in the UK and Eire.

Technically qualified to HNC or above you will have a proven background in sales and business development within the RF or EMS industries. You will be comfortable in the design-in selling process and capable of promoting the product offering to all levels of customer. You will need to be a tenacious self starter with a keen desire to develop business and achieve sales targets.

In return you will receive a very competitive package including company car and the opportunity to develop your career within a technologically advanced, leading edge manufacturer.



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Technical Sales Engineer Frequency Control Products

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In return you will receive a very competitive package including company car and the opportunity to develop your career within a technologically advanced, leading edge manufacturer.

Major Account Sales Managers Programmable Logic

North & South UK (2 Roles)
to £35K + Car + Benefits

Our client designs, develops and markets high performance programmable logic devices and related IP. They are the world's leading force in some innovative variants within this arena and have built their global reputation on technical excellence and customer focus.

Development within their UK sales structure has paved the way for the appointment of two Major Account Sales Managers. The roles will be geographically split and will focus on a number of major key account players. Ideal candidates will have a background in the semiconductor industry with a proven history of achievement and key design wins. You are likely to be educated to degree level and have a knowledge of PLD technology and the related UK market. You will be adept at developing and managing major accounts.

In return you can expect the support of a talented team of technical and applications professionals and a salary package reflecting the seniority of the role.

Test and Manufacture

Project Engineers

Up to £20K
Buckinghamshire

Our client is a well established sub contract manufacturer to the electronic industry. They are currently looking to recruit 2 project engineers due to company expansion.

The candidate will have attained academic qualifications in higher education relevant to the electronics industry and have had experience working in an electronic manufacturing environment. The candidate will be self-motivated with a high degree of initiative.

Responsibilities include:

- Assisting the test department with fault finding and problem solving.
- Assessing the suitability of alternative electronic components for the manufacturing process.
- Liasing between the company and the customer during new product introduction and to gather all details of the project required for manufacturing.
- Providing sales with quote details by gathering labour estimates for manufacture and test.
- Progress internal sales orders, prepare information for documentation control, identify and procure tooling, jigs and fixtures.
- Assist in identifying and installing new manufacturing methods and processes and be effective in the training of supervisors and operators.
- Providing continuing product support for the life of the project.

Ref 5454

Production Engineer

£Negotiable
Bedfordshire

Our client has been involved in many UK defence programmes. Current products, capabilities and services are diverse, ranging from complex air force, army and naval weapon systems to the latest battlefield communication technologies and field electrical power generation and its distribution. A vacancy for a Production Engineer has arisen. You will have a mechanical/composite manufacturing background to be able to work as part of a multi-disciplinary team responsible for ensuring engineered solutions and systems are developed to meet our customer expectations.

Special requirements:

- Have a background in Defence / Aerospace /Automotive manufacturing programmes
- Goldratt's Theory of Constraint's
- CAD/CAM software Artisan Ideas and Autocad
- Have a reasonable working level in Microsoft Windows Word, Excel etc.

Ref 5549

Development Assurance Engineer

London
circa £25 - £34k

Our client specialises in:

- Advanced communications, multimedia and information systems
- Tactical radio, surveillance radar and optronics
- Satellite navigation and positioning, air traffic management and aircraft simulators
- E-solutions in transactions, security and contacts.

A vacancy has arisen for a proactive and dynamic individual with an interest in aviation, to work within the quality department to constantly improve the company's products, processes and people.

As an energetic, detail-oriented person, you would enjoy the challenge, variety and independence involved in adding value and exercising judgement for the whole company, including design/development, manufacturing, and procurement. Your ability to communicate and persuade contributes to the culture of high standards essential for the aerospace business sector. You have the motivation and resilience to plan work and meet promises without extensive supervision, and the flexibility to respond to a developing business environment.

Ref 5528

My client is one of the world's largest electronic component distributors, who have a large presence in virtually every single country world-wide.

Due to a large internal restructure programme, My client is now looking to recruit additional members to their team in the following vacancies: -

Catalogue Publications Manager

Essex

To evolve and develop the marketing positioning of my client's Catalogue business in order to maximise visibility by its customers and exposure as leader in its market niche.

The Successful candidate will be responsible for the creation and delivery of effective marketing programmes to include CD, product bulletins, and advertising, sales support materials and catalogue production.

Leadership of the Catalogue Team, Management of key suppliers (Sitbo, RSCR) and contract printers. Assess and report success criteria for Catalogue marketing against plan. Control existing Catalogue marketing assets (e.g. Database) whilst evolving marketing focus at a pace to lead market.

I am looking for candidates that have had prior experience in dealing with such a role, or a candidate that can identify themselves with at least 3 of the following:-

- Demonstrable capability to manage large projects.
- Budget management/cost control.
- Ability to operate successfully in a complex mail-order business.
- Track record of rapid innovation.

Ref 3875

Technical Account Managers.

Various Locations

The reason for them recruiting a large number is that they are currently creating two brand new teams to deliver an unrivalled level of technical expertise to the OEM market place.

Working alongside a number of leading edge suppliers the candidates will be pivotal in establishing demand creation activity, this will mean working in depth with customers and suppliers to achieve sustainable and profitable business. Candidates should have strong commercial acumen and experience of operating within an engineering environment.

Please note that these are sales roles dealing with Electronic Components, I am looking for candidates that have a minimum of 18 months experience within this industry.

Ref 3877

Programme Manager

Bedford/Swindon

The successful candidate will be employed to review the processes for managing existing and new customer engagements, looking at the efficiencies of the procedures, staffing levels and systems. Provide recommendations and drive through the resultant actions. Responsible for finance procedures through to invoice reconciliation, billing and collection. Recruit, coach and manage the performance and development of the team to fulfil business objectives and maximise service levels and profitability. Manage 'Make for Stock' audit trail. Investigate and resolve discrepancies (both pricing and stock).Invoice reconciliation and billing. Investigate and understand existing customer processes.

Ref 3824

These are just a few of our current opportunities for Sales & Marketing professionals. We currently have a wide range of permanent positions and we would welcome the opportunity of discussing the next step in advancing your career.

Test and Development

Facilities Manager

Salary £Excellent
Midlands

This rapidly expanding mobile communications company require a Facilities Manager. The main objective of the role is to provide internal support to the organisation. These responsibilities will include:

- Liaison with local building contractors to facilitate refurbishment's / repairs
- Responsibility for establishment of new premises in world-wide locations
- Organisation of facilities such as catering, security, maintenance etc
- Co-ordinating the supply of equipment, furniture, stationary etc
- Ensuring compliance with health and safety regulations
- Facilitating internal movement / relocation where necessary

Relevant Experience

- At least 5 years experience within a Facilities Management role
- Experience of project management of office relocation would be an advantage
- Good contract negotiation skills
- Experience of establishing new premises internationally

An ideal candidate would be based around the midlands although this is not essential

The successful candidate can expect an excellent salary and benefits such as pre-IPO stock options.

Software Test Engineer

Salary £Excellent
Leicestershire

Our Client who specialise in DSP (Digital Signal Processing) is looking for a Software Test Engineer. The role is to develop and evolve the software test strategy of their Telecomms products and to ensure that software testing is successfully executed on each software release. The successful applicant will have at least 3 years experience in software quality assurance for large, multi-platform software products. The candidate should have 3+ years experience of software quality assurance and test for large software systems on a variety of Operating Systems (to include at least one real time operating system, Linux, Solaris, Windows NT/2000) The candidate should have at least 3 years experience of creating software validation plans to cover all aspects of software quality assurance, including final release testing and regression testing Competent C/C++ skills required for analysis of software and for the creation of bespoke test software and test harnesses. The right candidate will receive an excellent Salary and Benefits package.

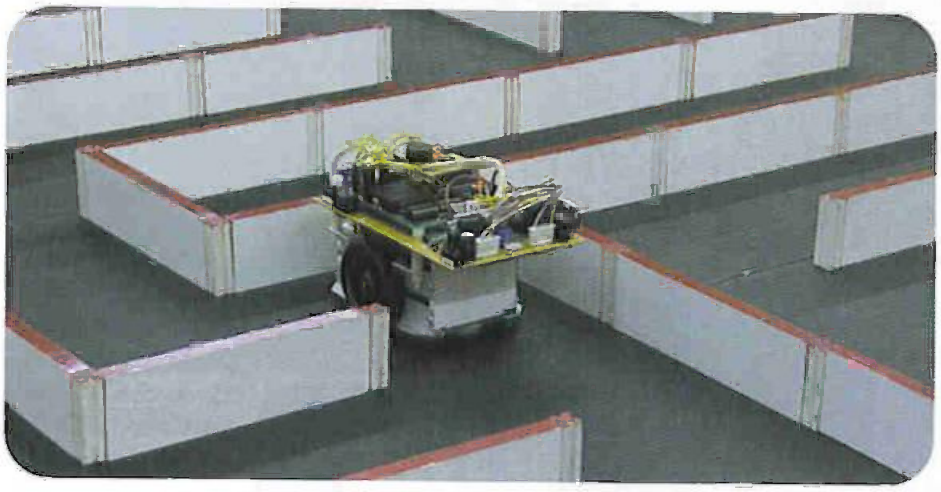
Technical Author

Salary: £24k
Midlands

Our Client, who specialises in the Aerospace Industry, is seeking a Technical Author. The role will involve preparing Technical documentation to a defined civil or Military Specifications, Ensuring Engineering Validity of all technical documents and Generating and revision of Maintenance Manual and In-Service Bulletins The candidate should be qualified to at least HND level or equivalent in Electronic Engineering or similar discipline. At least three year's experience of Technical Writing, Excellent Written Skills. Familiarisation of ATAI 00, AvP70, Simplified English, PC Literate, with experience of Adobe Framemaker Strong communication and interpersonal skills. The candidate should be able to contribute effectively in a team environment.

Ref: JF/5412

MICROMOUSE – a triumph for South West Wales



FOR SOME TIME THE INSTITUTION OF ELECTRICAL ENGINEERS (IEE) HAS BEEN RUNNING A COMPETITION FOR ROBOTS TO FIND THEIR WAY ROUND A MAZE.

This competition was aimed at students in further and higher education with the world finals being held annually at a British university. Two years ago it was decided to extend the competition to the 11-16-age range. Members of a local Science, Engineering and Technology group who meet regularly to co-ordinate science and technology activities in the area, decided that this competition had the potential to provide a stimulus to the teaching of Design and Technology in schools. We decided to organise a regional competition and seek support for a three-year programme, which would provide encouragement, and practical support for schools to take part. Sponsorship and support, notably from IEE, West Wales TEC and British Steel has allowed us so far to provide a number of in-service training days on electronics and control technology for the teachers from participating schools as well as providing kits of parts and control equipment to the schools. The Technology Enhancement Programme and the Neighbourhood Engineers Scheme have also provided support.

At the end of the first year of the programme about twelve schools took part in the finals which were held at Swansea University on March 16th, 1998. The winning team was from Bishop Gore comprehensive school, Swansea, but the runners-up from Aberaeron decided to try their luck at the world championships in Manchester. To everyone's delight and amazement they won and it became apparent that their success was due to having had experience in a regional final.

Our regional finals at the end of the second year saw more than twenty schools taking part and as well as greater confidence and enthusiasm there was also a significant improvement in the technology, reflecting the effects of the training and support given to the teachers. Swallow Systems, which are significant sponsors of the national competition, provided a web-site so that results and pictures could be displayed on the Internet. Members of the Swansea University Computer Society provided technical support and arranged for a web-camera to broadcast video images of the finals.

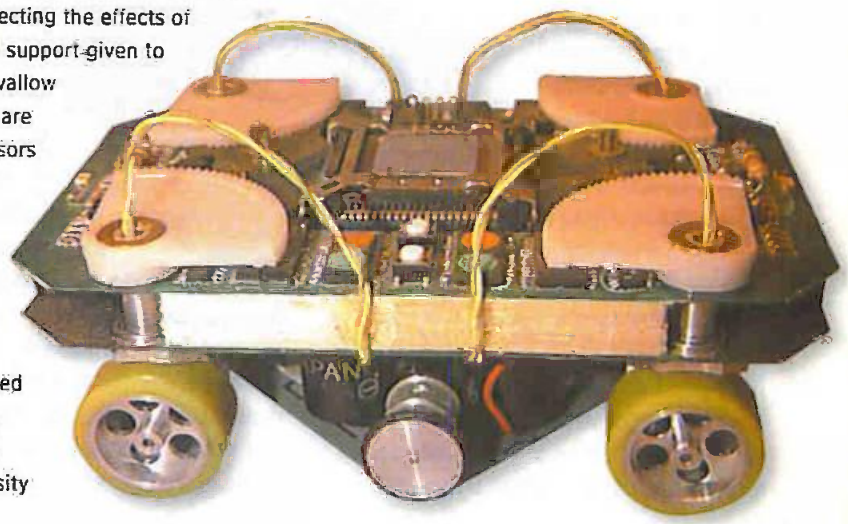
The South West Wales regional competition has provided a model for other regions in both England and Wales and the IEE may well be modifying the world competition in the light of our local achievements. At the outset, the aim was to use Micromouse as a means of encouraging and developing the teaching of 'systems and control' and to stimulate interest in this aspect of technology.

We feel confident that both aims have been achieved and we look forward to continuing success.

If you would like to find out more visit the Swallow Systems web-site at www.swallow.co.uk or contact the IEE on their web site - www.iee.org.uk

West Wales Organising Team:

John Jones - Regional Hon. Sec. IEE.
Jason Williams - Engineer in Residence - The Careers Business Co., Swansea.
Simon Morgan - Dyfed Education Business Partnership.
Dr. Chris Young - WDA.
Mike Auckland - Teacher and former seconded D&T Adviser, Swansea.



Event Review: E3 2001

THE ELECTRONIC ENTERTAINMENT EXPO – BETTER KNOWN BY ITS ABBREVIATION E3 – IS THE MOST HIGH PROFILE AND IMPORTANT OF ALL THE EVENTS IN THE VIDEO-GAMING INDUSTRY.

Held in Los Angeles every year, with three days of conferences overlapping three days of expositions, E3 is where software developers unveil and announce new games, and hardware developers show off their new hardware in an attempt to try and convince journalists and the rest of the industry that their peripheral or platform is the best. With Microsoft joining the big three established console developers, and all four showing off their latest creations and developments, E3 was always bound to attract more attention this year than ever before. Here Electronics And Beyond presents its own review of the 'big four' consoles, and picks out a couple of the best peripheral devices on display at the event.

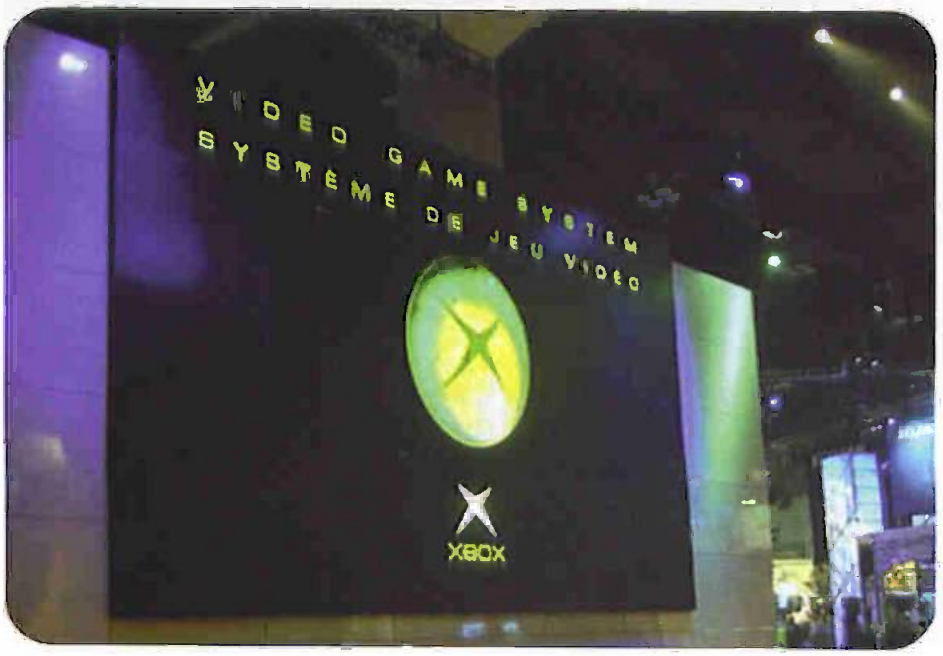
Nintendo GameCube

Many industry journalists felt that, because of its cartridge-based format, Nintendo's N64 never really realised its full potential. It remained popular, however, partially because of Pokémon spin-offs but mainly due to the quality and originality of its games. There is general agreement that the way in which Nintendo and its developers used the cartridges for storing game data did indeed add to the quality of the games available for the system. It did, however, place limitations on game design that would not have arisen had the console used compact discs as its media.

For its successor – the GameCube – you would be forgiven for thinking Nintendo would switch to a DVD-based format. Not so. Instead, they have opted for 8cm optical discs which will be able to hold 1.5 Gigabytes of readable data and allow an extra level of counterfeit protection not available on standard DVDs. This also rules out the GameCube being used as a DVD player – but in the long run this may turn out to be a good move, as it allows Nintendo to market it purely as a video gaming console without muddying the waters by trying to be all things to all people in the same way as the Playstation 2 has done.

The GameBoy was one of the success stories of the last decade, with over 110 million sales since 1989. Its soon-to-be-released 32-bit successor – the GameBoy Advance (GBA) – was also on show at E3. The GBA has a 50% larger screen size, more than 500 times as many on-screen colours, 15 hour battery life, and backwards compatibility with all previous GameBoy titles. A couple of years ago, Nintendo introduced special connectors and cables so as to allow certain N64 and GameBoy titles to interact with each other. This helped sales of both the N64 and the Pokémon titles that utilised it. Nintendo plans on keeping this arrangement for their two replacements, but with the additional feature that GBA consoles will eventually be able to be used as controllers for the GameCube.

The GameCube may face steep competition from the Playstation 2 and Microsoft's Xbox, but you wouldn't know it from the huge crowd at E3 who were completely blocking up entry and exit to Nintendo's exhibition area. Interest in the GameCube and its preliminary game line up was so intense, in fact, that traffic through the booth was stopped completely at various times during the first day. Enthusiasm did become slightly muted, however, when journalists began to realise that Nintendo was not going to announce a price for the console at the event. In addition, European journalists were disappointed to hear that despite the North American release date being announced as November 5th, a European release date would not be announced for a while yet – the most specific they could be being sometime in 2002.



Microsoft X-Box

It wasn't all that long ago that Microsoft only had one game associated with it – Flight Simulator (if you could call Flight Simulator a game). But when Microsoft decide that they want to capture a market, they go about it in a really big way, and anyone coming to E3 would be forgiven for thinking they had come to a Microsoft convention.

Due to go on sale in the US on November 8th (oddly enough, three days later than the GameCube), at an initial price of $299, the Xbox will be driven by an NVIDIA graphics processing unit and an Intel 733MHz processor – the most powerful CPU of any console announced so far. Its internal hard drive will allow massive storage of game information, allowing N64-style customisation and modification of game data, but on a much larger scale.

Emblazoned with a large 'X' and a signature green Xbox 'jewel' positioned in its centre, the Xbox, like the PS2 and the upcoming GameCube, is far from the bland and conventional console designs of old. Its media format will be DVD, and it will come with an Ethernet port for fast online gaming.

According to analysts, Microsoft will be spending an estimated $500 million in marketing its new system – more than it spent promoting Windows 95. Despite initial hostility from certain quarters, lodged firmly in the anti-Microsoft brigade, there has been enormous media interest in the Xbox, and that can only increase as the date gets ever closer to its launch.

Sony Playstation 2

The Playstation 2 (PS2) may not be new in the same sense as the Xbox or GameCube, but Sony were still eager to plug their fledgling machine as much as possible. Under pressure to compete with Nintendo and Microsoft, who had presented earlier in the day, Sony Computer Entertainment of America announced several new partnerships and set out details of its plans for building an Internet access system around the PS2 machine.

The Macromedia Flash Player will be brought to the console, as will RealPlayer, and Sony will release a network adapter offering a combination of analogue connectivity with high-speed broadband access. The network adapter combines high-speed Ethernet connection with a V90 analogue modem that will allow consumers network access and connection to multiple devices in the home through the Playstation 2.

Through a strategic alliance with AOL, Sony also plans to release the network adapter along with a hard disc drive giving consumers access to AOL features such as instant messaging, e-mail and chat, as well as Web access through a Netscape browser.

Sega Dreamcast

Sega's announcement that it was to move away from single-platform games and develop for other consoles, was probably the most astonishing piece of news to hit the gaming industry in the interval between last years E3 and this. Sega intends to become the world's largest third-party publisher over the course of the next few years, but at this years event, the focus was still firmly on their own titles for the Dreamcast. Titles destined for other platforms did, however, include Sonic The Hedgehog for the GBA and a new version of Jet Set Radio for the Xbox.

Peripherals

Of course, games developers took up the vast majority of stands, but there were several interesting devices on show from third party peripheral developers as well.

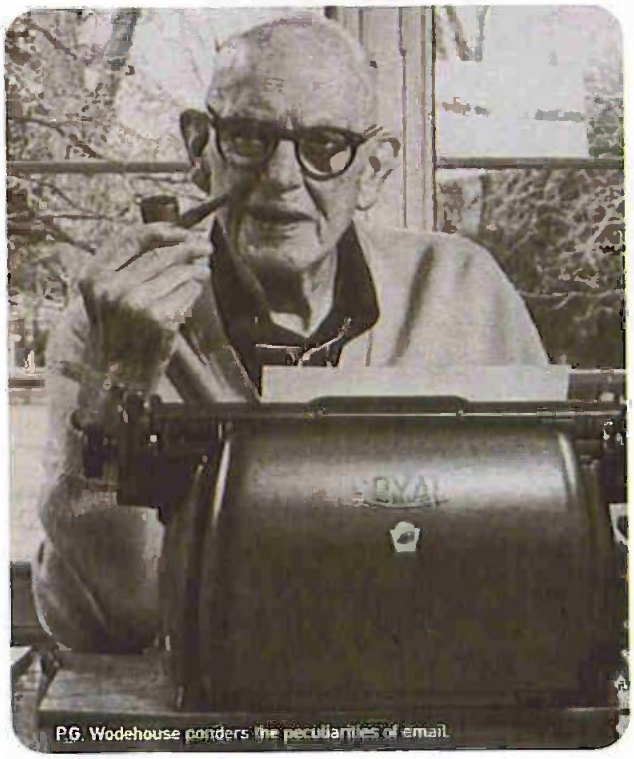
InterSense had one of the 'must-try-that' stands of the exhibition, with its InterTrax2 glasses, which display the game right in front of your eyes and allow the in-game view to be controlled by moving your head. The glasses have no noticeable lag (with an internal latency of 4 milliseconds), and are available with either serial or USB interfaces. Intended primarily for games designers, the glasses can connect to PCs and workstations running Windows 98 or 2000, as well as to the PlayStation 2. Game-designer toolkits featuring the InterTrax2 glasses are on sale for around $799.

Another popular destination for journalists was Essential Reality's P5 three-dimensional control glove. Compatible with Macs, PCs, and next-gen consoles, this frame-style device allows real time manipulation of virtual environments through simple movements of the hand and fingers. The finger sensors allow for movements of all the fingers and the thumb and have a 60 Hz refresh rate. The tracking system allows for yaw, pitch, and roll (1 degree resolution, 1 degree accuracy), x, y, and z (0.125 inch resolution, 0.5 inch accuracy, 3 foot range). Wearers of the glove will be able to do such diverse things as shoot a gun by pulling the trigger finger, throw an object or swing a baseball bat.

Beyond Belief

Internet Chat Rooms – 1930s Style

Chap magazine is a small publication with a mission to get us all to return to the styles and attitudes of the 1930s. Earlier this year they held a party aboard a riverboat on the Thames. One of the attractions, oddly enough, was an Internet chat room. This sounds seriously out of step with their aforementioned policy, but there is a punchline – the whole thing was done completely without the use of computers.



P.G. Wodehouse ponders the peculiarities of email

Instead, there was a room fitted out with several examples of that word-processor of the day – the mechanical typewriter. Several of these were available for guests to write their messages on and, when they had done so, there was a butler waiting patently to deliver their letter by hand to whoever in the room it was addressed to. P.G. Wodehouse would have been proud.

The Transistor's In The Rabbit

If you've ever lost tiny electronic components and then looked at your pet in suspicion, it is now official – you are not alone. A recent survey of electronics hobbyists carried out by the manufacturer of a components storage box asked the question: 'When you can't find your components and you know you haven't moved them, who is the first person you suspect of taking them'.

The results showed that a massive 29% of those who had regularly had components go missing had often suspected their household pet of swallowing them. 34% blamed friends or colleagues, 22% blamed their wives or girlfriends, perhaps quite surprisingly only 11% suspected their children, and as for the other 4%... Well they put all the blame down to 'No-one'. Incidentally, blaming yourself was not one of the options. Do they think all electronics hobbyists automatically blame other people when they lose their components? Surely not...

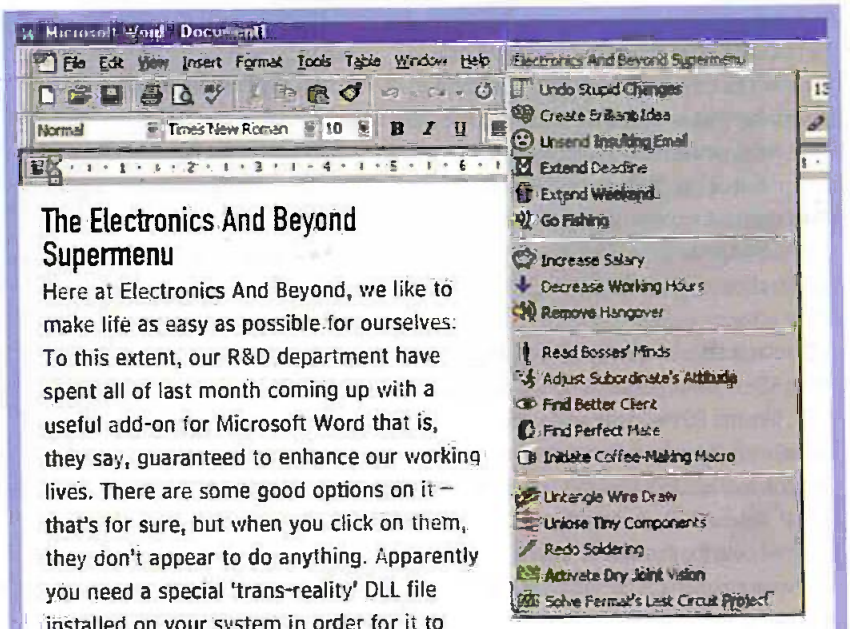
Oh Deer...

We get a lot of press releases coming in to the E&B offices, many of them by email. The following is a section from a real press release that arrived in our in-box. It has absolutely nothing to do with electronics but it is extremely funny, nevertheless.

Deer absolutely adore chewing on tobacco plants. In fact, they will chew up an entire tobacco plant and even a complete field of tobacco plants. Thousands of tobacco chewing deer are devastating tobacco crops in major tobacco growing regions of North Carolina, Virginia and South Carolina.

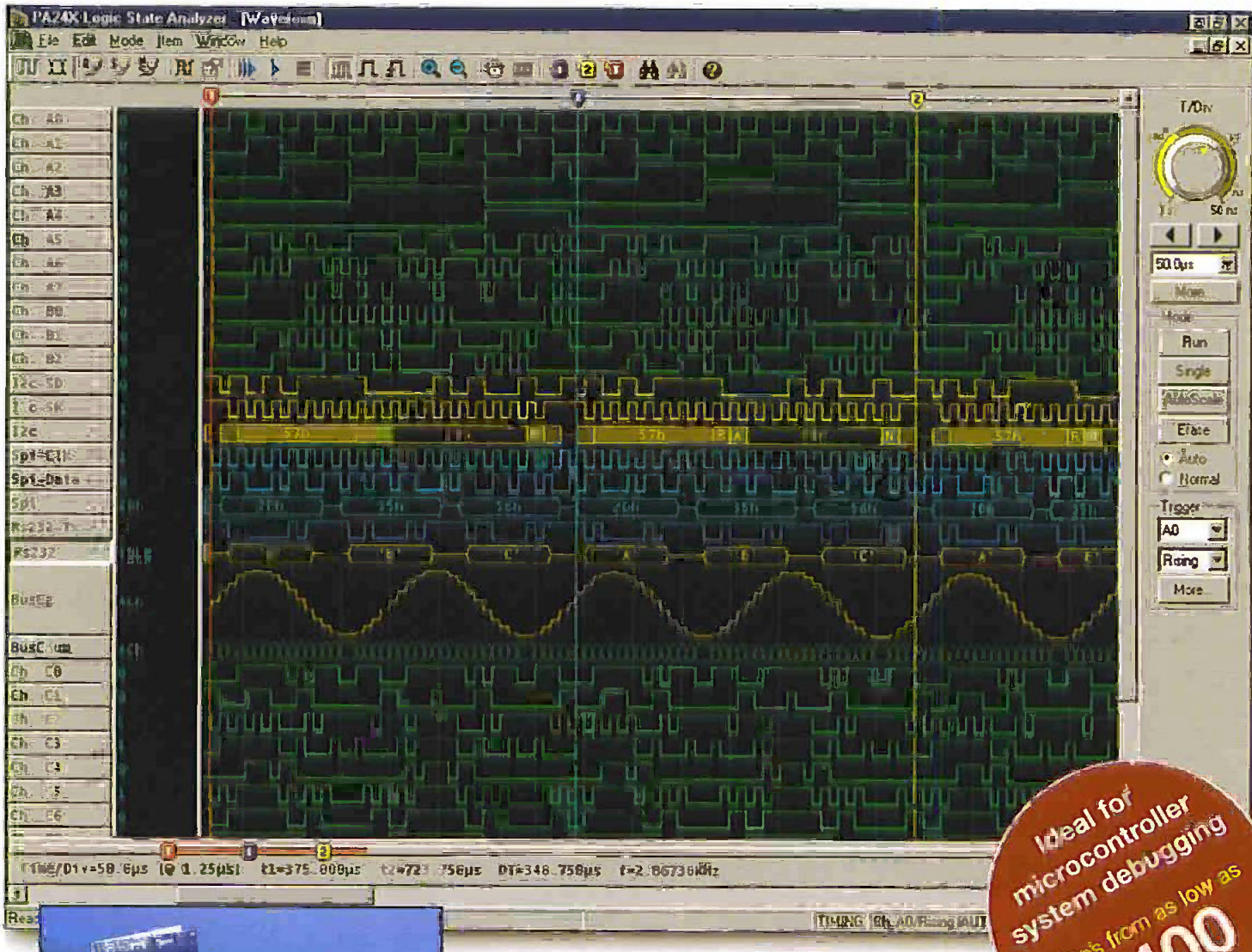
Robert Lawrence of Lawrence Brothers Farms in Creedmoor, North Carolina and his two brothers are up almost every night driving pick-up trucks through the tobacco fields, shooting guns and making loud noises to chase the deer from the tobacco plants. 'Sleep is very hard to get anymore since the deer invasion,' reports Robert. 'All this has only happened in the past three or four years and it's hard to live with. We put up electric fences, but they jump over them. Electric fences don't keep out the fawns that are small enough to get through the wire strands'.

'We looked everywhere for help, something to put on the tobacco that the deer wouldn't like, and we found this garlic juice that was being used by cotton farmers down in Texas? it's called Garlic Barrier and is for sale on the internet at www.GarlicBarrier.com and made by Garlic Research Labs, Inc. in Glendale, California. We started spraying this garlic juice two weeks ago, now there are no deer in the fields at night, not even the fawns. It's been a life saver and for the first time this year I have been able to get a good night's sleep'..



The Electronics And Beyond Supermenu

Here at Electronics And Beyond, we like to make life as easy as possible for ourselves. To this extent, our R&D department have spent all of last month coming up with a useful add-on for Microsoft Word that is, they say, guaranteed to enhance our working lives. There are some good options on it – that's for sure, but when you click on them, they don't appear to do anything. Apparently you need a special 'trans-reality' DLL file installed on your system in order for it to work. We rang Microsoft to enquire about this, but they didn't seem to know what we were talking about



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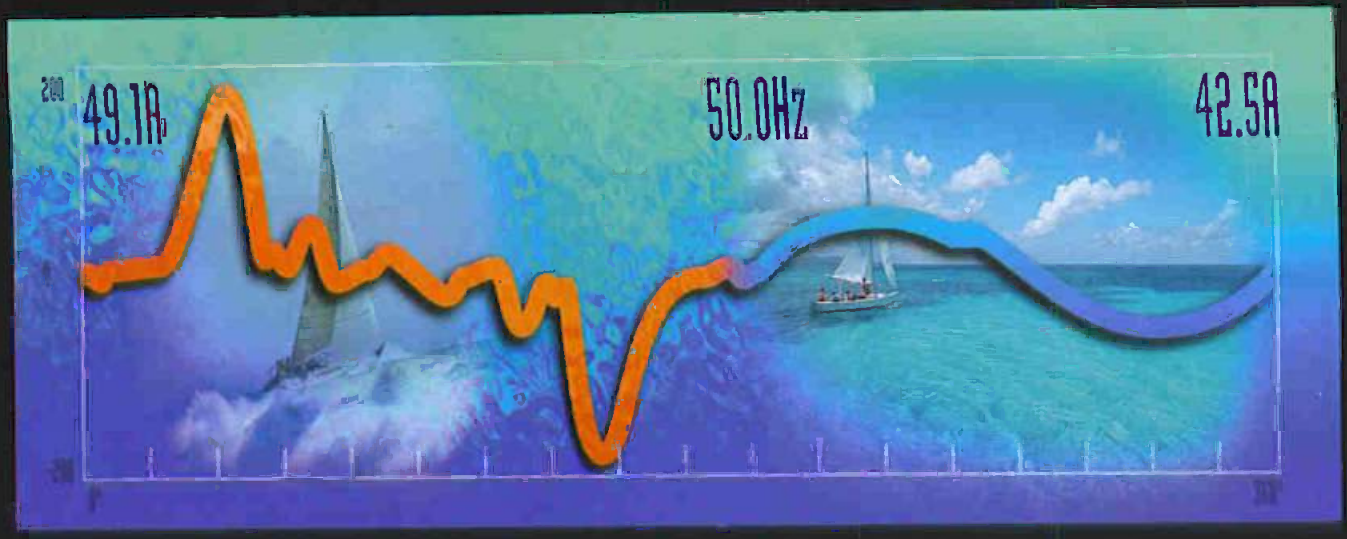
Handling harmonic distortion is now plain sailing... Sinewave



No modern business environment, with its computers, lighting, communications, air conditioning and pumping systems can weather this electrical storm indefinitely and inevitably, traditional solutions are costly and difficult to implement.

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