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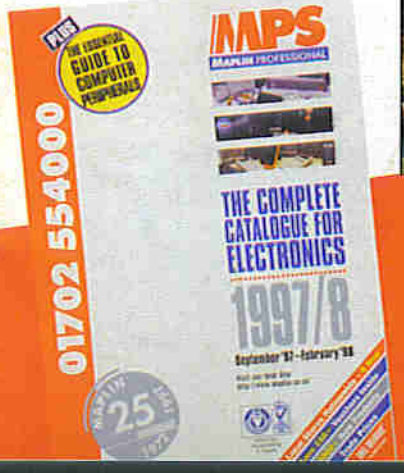

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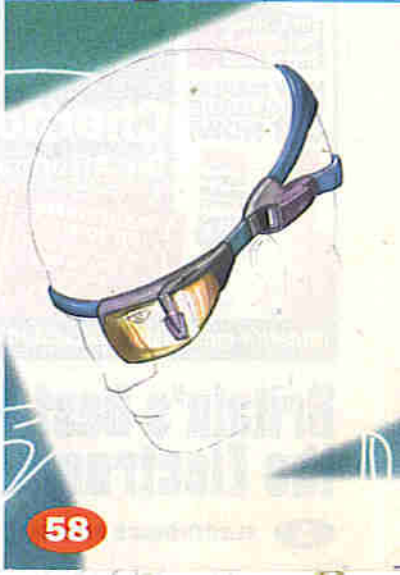

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ELECTRONICS and Beyond

It's that time of year when Maplin Electronics presents a new edition of its catalogue to the world. Packed with over 1400 pages and around 2000 new products it still represents excellent value at £3.45. Included with this issue of the magazine is a small selection of the new products in an extra 16 page bulletin.

It also contains a useful guide about Car audio, Networking, PC Audio, Computer peripherals and project kits. We hope you find it useful and if you want know more about our products please look in our latest catalogue. It is available by mail order or from any of our stores nationwide.

Skyshots - The Movie

With reference to the article that appeared on page 57 of our September edition, we would like to point out that the article and photographs were sold to Maplin Electronics as First British Serial Rights only. Maplin Electronics has no further claim to the article and photographs.

Paul Freeman-Sear, Publishing Manager

Britain's Best Magazine for the Electronics Enthusiast

NEWS REPORT

Philips Power Transistors for Radar Applications

Philips Semiconductors has introduced a family of silicon bipolar microwave power transistors targeted for use in S-band pulse radar, including a unique 100W transistor with the 400MHz bandwidth required to cover the entire 2·7 to 3·1GHz frequency range. Until now, transistors capable of handling such high powers were only capable of covering half the required frequency range – either 2·7 to 2·9GHz or 3·1GHz.
For further details, check: `www.semiconductors.philips.com`.
Contact: Philips Semiconductors, Tel: +31 40 272 20 91.

Samsung Establishes UK EMC Lab

Samsung Electronics has opened an electromagnetic compatibility (EMC) and quality assurance laboratory (QA-Lab) in London. In 1995, Samsung decided to build the US$ 7 million facility in order to improve the company's capability to design and manufacture products that satisfy a wide range of consumer demands and meet the CE mark directives for the European Union market.

The CE Mark is a set of harmonised standards which covers a wide range of items, including electric and electronic goods for all European Union member countries. Thus, the CE Mark is a standard required of all manufacturers exporting products to Europe.

Samsung Electronic's new laboratory is equipped with the latest in measuring electromagnetic emissions, product immunity to radiation, dark rooms, an outdoor testing facility and systems for various product evaluations. It will be mostly used extensively for basic research in order to improve product quality within the design stage.

For further details, check: `www.samsung.com`.
Contact: Samsung, Tel: (0181) 391 8213.

Cyrix Announces MediaGX Processors

Enabling PC manufacturers to offer a complete multimedia system including monitor for £650, Cyrix has announced 166 and 180MHz MediaGX processors. The MediaGX processor reduces system cost by incorporating multimedia and system functions right on the CPU – a first for the PC industry.

Since it first came on the scene earlier this year, the MediaGX architecture has gained support from a number of PC companies, including Compaq, IBM, Samsung and Tatung.

The MediaGX roadmap includes integrated Universal Serial Bus (USB) support and MPEG video acceleration. In addition, MediaGX processor speeds are expected to increase to 200MHz and beyond, and feature MMX instructions, by late this year.

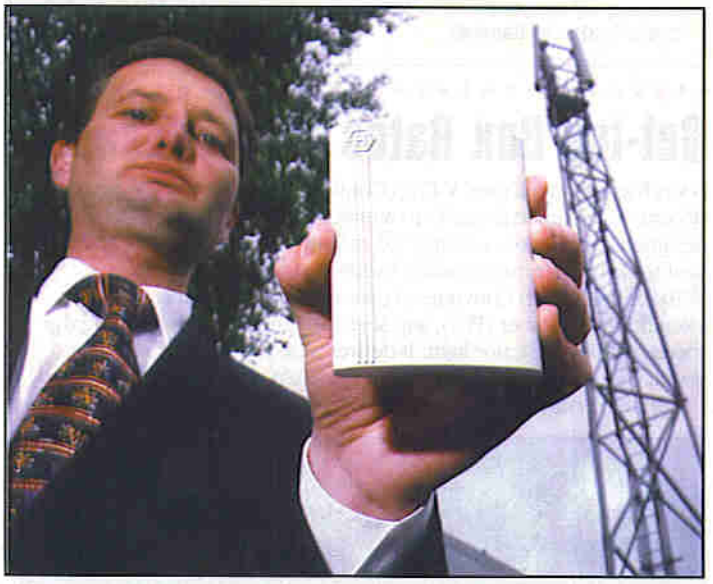
For further details, check: **www.cyrix.com.**
Contact: Cyrix, Tel: +1 800 777 9988.

Nintendo's Star Fox 64 Hits Industry High

Star Fox 64, the 3D-flight adventure for the Nintendo 64, is on track to become the hottest video game on any hardware platform in history. In the first five days the game was on sale, more than 300,000 copies were sold. This surpasses the prior record also held by two Nintendo 64 games – Mario Kart 64, and Super Mario 64.

Sales data from the PC entertainment business shows that Quake, currently the most popular PC game, has sold a mere 600,000 units in the 10 months since August 1996. Nintendo expects sales of Star Fox 64 to reach one million alone by the end of August.

For further details, check: **www.nintendo.de.**
Contact: Nintendo, Tel: (01703) 652222.



Passive Picocells Cut Need for Power

Researchers into short-range wireless communications at BT Laboratories at Martlesham Heath, near Ipswich, have developed a revolutionary approach to linking telecommunications and IT equipment to networks.

The BT researchers have built a prototype system which they call passive picocell, which eliminates active electronics in base stations and converts light signals into radio signals, but needs no power feed or batteries.

Passive picocell technology will find applications in numerous areas. The first applications are likely to be high-speed wireless networking in buildings such as offices and hospitals.
For further details, check: **www.bt.com.**
Contact: BT, Tel: (01473) 647588.

BT-MCI Deal Still On Despite Bad News from MCI

BT plans to proceed with its £12 billion merger with MCI, in spite of the news that MCI could lose £470 million as a result of US Government legislation relating to its expansion into the country's local phone service market. It is not yet clear whether BT might seek to renegotiate the terms of the deal, which includes a plan to form the world's first global telecom company to be called 'Concert', by the end of the year.

For further details, check: **www.bt.com.**
Contact: BT, Tel: (01473) 647588.

NEWS BYTES

Apple Crumbles

Apple Computer has announced the resignations of Chief Executive, Gilbert Amelio, and Chief Technology Officer, Ellen Hancock, and indicated that Apple co-founder and strategic advisor, Steve Jobs, will assume an expanded role as a key adviser to Apple's board and executive management team.

Jobs will continue as chief executive of Pixar, the computer animation company, and Apple will conduct an external search for a new leader able to help the struggling company find a way to make a comeback.

For further details, check: www.apple.com.
Contact: Apple, Tel: (0181) 569 1199.

Sony Licenses ARM Technology

Cambridge-based ARM has licensed its low-power RISC microprocessor technology to Sony. The partnership will enable Sony to incorporate ARM's 32-bit RISC CPU cores into its wide range of consumer and professional electronics products and recording media.

For further details, check: **www.arm.com.**
Contact: ARM, Tel: (01223) 400400.

Specialist Radio Catalogue

Waters & Stanton have released a 48-page catalogue covering specialist radio communications equipment. The new catalogue covers transceivers, kits, antennas, morse and data products. Check the Maplin Catalogue for a selection of Waters & Stanton products or call direct for a free copy of the latest catalogue.

Contact: Waters & Stanton, Tel: (01702) 206835.

Nat Semi Expands Silicon Valley Fab

National Semiconductor is sinking $100 million into the expansion of its existing 8-inch wafer facility in Santa Clara, California. The investment will add 15,000 square feet of Class 1 clean room space to National's Advanced Technology Group (ATG) wafer fab. The ATG facility, currently 25,000ft.2, serves as National's research and development fab where the company develops, evaluates and tests the latest manufacturing processes and tools.

For further details, check: **www.national.com.**
Contact: National Semiconductor, Tel: (01475) 633733.

Job Prospects in Electronics Remain High

Employment within the UK electronics industry continues to register high levels of optimism, according to the latest Manpower Quarterly Survey of Employment Prospects. Job opportunities are expected to increase by 39% in the three months from July to September, according to a poll of over 2,000 employers.

Contact: Manpower, Tel: (0171) 253 3300.

NEWS BYTES

Plasma Chips Promise Giga Speeds

Working together with colleagues at Russia's Ioffe Institute and the University of Virginia, a professor of solid-state electronics at Rensselaer Polytechnic Institute has developed a prototype chip that transmits signals as waves, rather than packets of electrons. The process is analogous to the way that sound travels through the air on waves rather than as clumps of sound-carrying molecules.

The so-called 'plasma-wave' technology could boost the speeds of microprocessors well into the Gigahertz range, and enable sensors of such extreme sensitivity that they could detect the molecular vibrations of specific substances, such as explosives.

For further details, check:
www.ioffe.rssi.ru.
Contact: Ioffe Institute, Tel: + 812 247 91 45.

Windows 98 to Have Web Browser Look and Feel

Microsoft's next version of its Windows operating system, Windows 98, to be launched early next year, will allow users to access information via a browser type environment wherever it is stored – whether on a PC, a corporate network, an online service, or the Internet. The new interface will be used to navigate through files by single-clicking on highlighted items. It will make it easier to install PC devices, make it easier for companies to manage PC networks, and let a user connect an interface card to allow a PC to run TV programming from cable and satellite companies.

For further details, check:
www.microsoft.com.
Contact: Microsoft, Tel: (0345) 002000.

Chips Are Down

A flurry of activity at the end of last month signalled consolidation within the chip industry. First came Intel, which slashed prices on its Pentium microprocessors and bought chip maker, Chips & Technologies. Advanced Micro Devices (AMD) responded with steep price cuts on its own family of processors, undercutting Intel by 25%, and finally, National Semiconductor announced it was buying Cyrix.

For further details, check:
www.intel.com, www.amd.com and **www.national.com.**
Contact: Intel, Tel: (01734) 403000, AMD, Tel: +1 800 222 9323, and National Semiconductor, Tel: (01475) 633733.

Compaq Announces Network PC and Questions Viability of NC

Compaq has announced a range of PCs that meet the new industry-standard Net PC specifications and are designed to offer companies the lowest possible cost of ownership. The Deskpro 4000N will complement Compaq's existing business PCs and use new manageability technologies that will eventually be incorporated across the whole Deskpro PC range.

Steve Torbe, product marketing manager at Compaq, told Electronics and Beyond, "The Network Computer promise is wearing thin and its proponents have failed to recognise the necessity to bring to market a standards-based product that can easily integrate into existing environments. Although the NC can bring a lower purchase price to the cost of ownership equation, what its backers fail to mention are the costs it adds to training, technical skills, the network, the server, and application re-development. For this reason, customers who adopt the NC will quickly realise they have gone down a dead end".

For further details, check:
www.compaq.com.
Contact: Compaq, Tel: (0990) 134456.

Set-top Box Rates TV Broadcasts

Soundview Technologies' V Chip Converter, using a new TV rating system, will soon be available to families in the US. The set-top unit is designed to equip the existing 200 million TVs in the US that will be deaf to the government backed V-chip signals.

To set the V Chip Converter, a parent enters a personal identification number (PIN), and selects a rating limit by pressing the corresponding indicator light. If desired, specific levels of violence, sexual content, language and suggestive dialogue can also be blocked.

Contact: Soundview Technologies, Tel: +1 203 661 3303.

Pace Launches 56k-bps Voice Modems

Pace has launched a new range of 56k-bps modems with a difference. Unlike other brands, Pace 56 Voice modems are designed and manufactured in the UK and have been specifically engineered for 56k-bps communications. The new designs provide more powerful performance not only at 56k-bps but at 33·6k-bps speeds too. All models in the range are flash upgradeable so that users can freely upgrade their modem when a worldwide standard is agreed.

Pace has focused on developing a 56k-bps product with features not found on other modems. Every modem in the range supports UK Caller Identification, giving access to a caller's number even before the telephone rings. The products have been uniquely designed to fully function as a stand-alone speakerphone. This means that users can make and receive telephone calls in speakerphone mode, at the touch of a button, without using their PC.

For further details, contact:
www.pacecom.co.uk.
Contact: Pace, (01274) 537035.

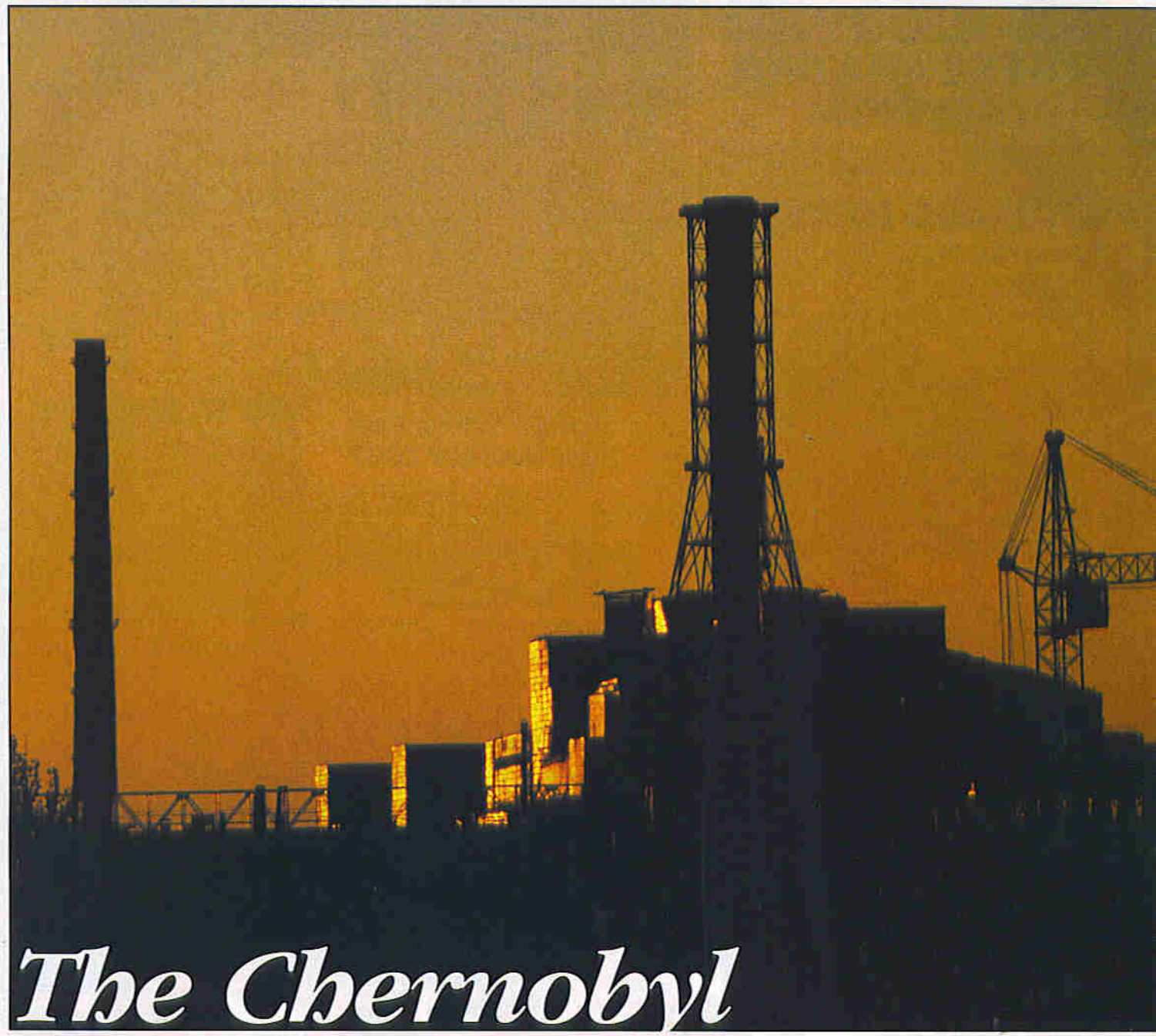
Silicon Graphics Process Mars Mysteries

Silicon Graphics, has announced that it is a major technology provider for NASA's Mars Pathfinder landing. The project is providing a wealth of new information about the relatively unknown red planet. The Mars Pathfinder project landed a variety of scientific instruments and a rover vehicle named 'Sojourner' on Mars' surface to gather data and images.

The information is being processed by Silicon Graphics computer systems installed at Jet Propulsion Laboratory (JPL) in Pasadena, California. The processed data and images are being published on the JPL Web site at **mpfwww.jpl.nasa.gov,** to link space enthusiast's worldwide with NASA scientists in this unique exploration of Mars.

The Silicon Graphics systems, which include Onyx2 visualisation supercomputers, and O2 and OCTANE desktop workstations, receive and process images and information from NASA's Deep Space Network. Silicon Graphics WebFORCE Origin200 servers host the interactive JPL Web site and a Silicon Graphics mirror site to chronicle the landing.

For further details, check:
www.sgi.com.
Contact: Silicon Graphics, (0118) 925 7697.



The Chernobyl INCIDENT

by Douglas Clarkson

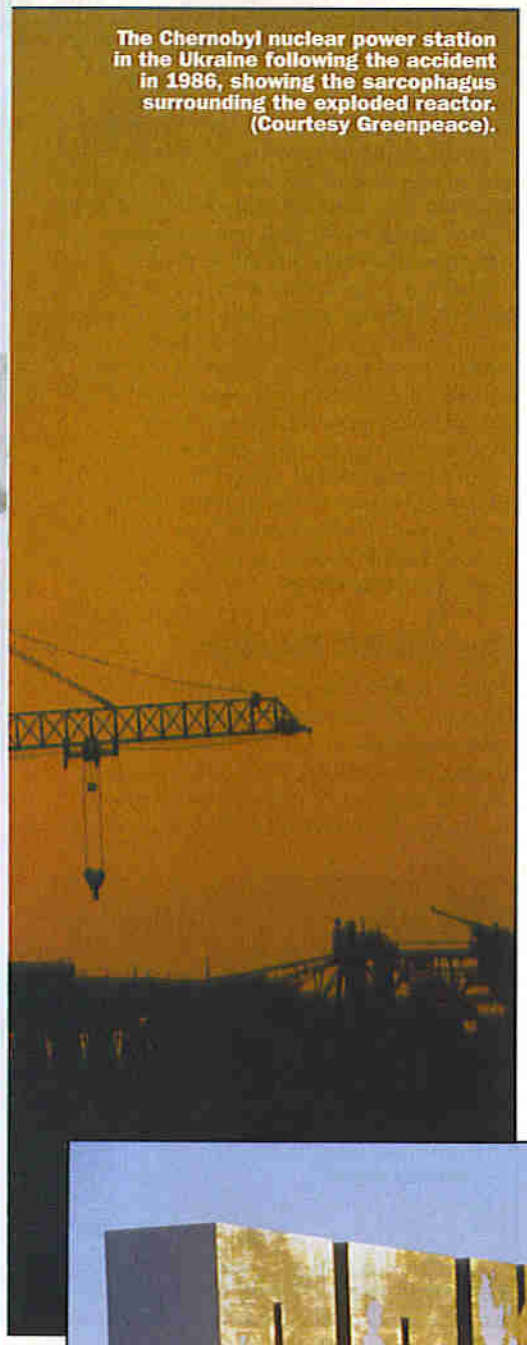
The story of the Chernobyl incident exists in many sources and contexts. It is only in the post perestyroika and glasnost phase following the dissolution of the Soviet Union that some missing elements of the saga have emerged. Whatever the exact scientific and technical framework of the incident, however, the accident remains a tragedy of immense proportions and one that has ongoing consequences for many thousands of people.

Initial Choices

As the Soviet Union came to use nuclear power for its expanding industrial base, there was a move to develop a pressurised water reactor (VVER type). The experience with early designs, provided doubt regarding the safety of the high pressure circuits required for such a design and also the additional cost of providing an adequate containment structure. The so-called high powered, boiling, channelled-type reactor of RBMK type didn't require expensive containment and as it operated at relatively low pressure in its cooling circuits, became the design of choice.

One of the historical strands of interest in the RBMK is that it is likely that its design evolved out of reactors whose key purpose was the generation of Plutonium for nuclear weapons. The prototype RBMK had been developed in the closed nuclear city of Obninsk. It was considered a relatively simple task to scale up the reactor to a 1,000MW generating capacity system.

As the design for the massive core structures was completed, some physicists



The Chernobyl nuclear power station in the Ukraine following the accident in 1986, showing the sarcophagus surrounding the exploded reactor. (Courtesy Greenpeace).

commented that the design could be rendered safer by incorporating additional control rods in the lower half of the reactor. Also, it was pointed out that the control rods should be able to be lowered in an emergency shutdown procedure in about 3 seconds. However, due to the highly bureaucratic nature of the State Sector complex, these recommendations were never implemented in the initial series of plants that were built.

As the Soviets announced their intention to develop RBMK systems, comments were made on the potential combustible nature of the thousands of tons of graphite in the core. The control rods act as a moderator to slow down and capture the neutrons emitted by the Uranium -235 atoms in the fuel.

Also, the reactor and its design – once completed – was identified with the achievements of the Soviet System. No one, in any sense of the word, would prosper through criticising it – even if the criticism could have acted to improve reliability and safety.

At the very outset of the project, the construction of the reactors at Chernobyl presented major difficulties. Various key and highly specialised components of the reactor design were difficult to source. With other RBMK reactors also being built at other locations and usually for more powerful and influential groups and ministries, it was often necessary to improvise by local manufacturing of various components. Also, at the very outset, before the construction of the attractive town of Pripyat, some 3km from the reactor complex, it was difficult to attract a skilled and dedicated workforce. In time, however, Pripyat would grow to a town of some 49,000 inhabitants. The longer established town of Chernobyl with a population of 12,500, is about 15km south east of the reactor complex.

Secret Problems

The first reactor at Chernobyl was commissioned on 26th September 1977, with the second unit on 21st December 1978. One of the problems, however, of the State System, was the flow of engineering data and experience between similar installations. In 1977, a meltdown of a fuel element had taken place at the Number One unit at Leningrad – now St. Petersburg. Soon after the commissioning of the second reactor at Chernobyl, a fire which burnt through cables at a reactor at Beloyansk, led to brief loss of control of the reactor.

In some ways, the most hazardous period of a reactor is when it is being run up for the first time or after maintenance. The commissioning of the number 3 reactor at Chernobyl gave an opportunity for shutting down number 1 reactor for essential maintenance. When the number 1 reactor was restarted, some of the control valves to the cooling system had been inadvertently closed. This resulted in the fuel assemblies overheating, leading to rupture of some fuel elements and the release of radiation into the reactor hall. A more major accident was averted by the emergency shutdown system, though it took 8 months to repair the damage. Even this incident at the number 1 reactor was apparently not officially reported to staff working on the other reactor sites at Chernobyl. Control of such information was very much with the State.

Also, during 1987, an explosion at a generator at Armyansk resulted in the turbine hall being burnt to the ground. In

Entrance sign to the city of Pripyat, Ukraine, with the Chernobyl nuclear power station behind. (Courtesy Greenpeace).

View of the deserted city of Pripyat, with Chernobyl power station in the background. (Courtesy Greenpeace).

June 1985, a fault on the pressurised water station at Balakovsky resulted in the fatal scalding of 14 engineers by superheated steam. It is the nature of all nuclear power programmes, however, to be secretive about mishaps. Presumably, employees in this sector in the west enter into non-disclosure agreements regarding operational procedures.

The Chernobyl Test

While nuclear power stations can feed significant amounts of power into the grid supply, there are times when they may be active but not generating. In this situation there is the danger that a local grid power supply can cripple reactor safety systems – especially pumps for cooling the reactor. While diesel generators can be engaged, in the vital seconds before they come on line, a core accident is possible.

The origin of the future fateful test at Chernobyl stemmed from a serious incident that had taken place at an RBMK station at Kursk in 1980, which suffered a total loss of electrical supply due to failure of the local grid. The level of water circulation at the Kursk facility had been sufficient to prevent an uncontrolled power surge before generators could trip in. It was essential to verify at the Chernobyl site that available power from the idling turbines could be sufficient to drive the main pumps and thus maintain a cooling flow as the reactor was shut down. These tests, however, were not undertaken at the time of final commissioning of unit number 3 due to pressure of work late in 1983.

While the object of the exercise on the number 4 reactor was to determine whether power derived from a local 'coasting turbine' could provide sufficient power to achieve a safe shutdown in event of failure of local grid supply, the test was highly irregular and represented conditions far removed form normal operation. It is relevant, however, to briefly discuss some aspects of nuclear technology and details of the unit's design before aspects of the incident are considered.

The RBMK Design

Figure 1 indicates a simplified design of the Chernobyl RBMK reactor. In the RBMK reactor, graphite acts as the moderator, slowing fast neutrons, while water acts as a neutron absorber. Some key parameters of the reactor are indicated in Table 1.

Parameter	Value
Thermal power	3,200MW
Electrical power	1,000MW
Active core	11·8m
Core height	7·0m
No. fuel channels	1,661
No. control rods	211
Uranium dioxide charge	204 tons
Uranium enrichment	2%
Maximum graphite temp	750°C
Input coolant temp	165°C
Steam temperature	284°C
Steam drum pressure	70kgf/cm2

Details of the actual reactor core are summarised in Figure 2.

Table 1. Parameters of Chernobyl number 4 reactor: RBMK design.

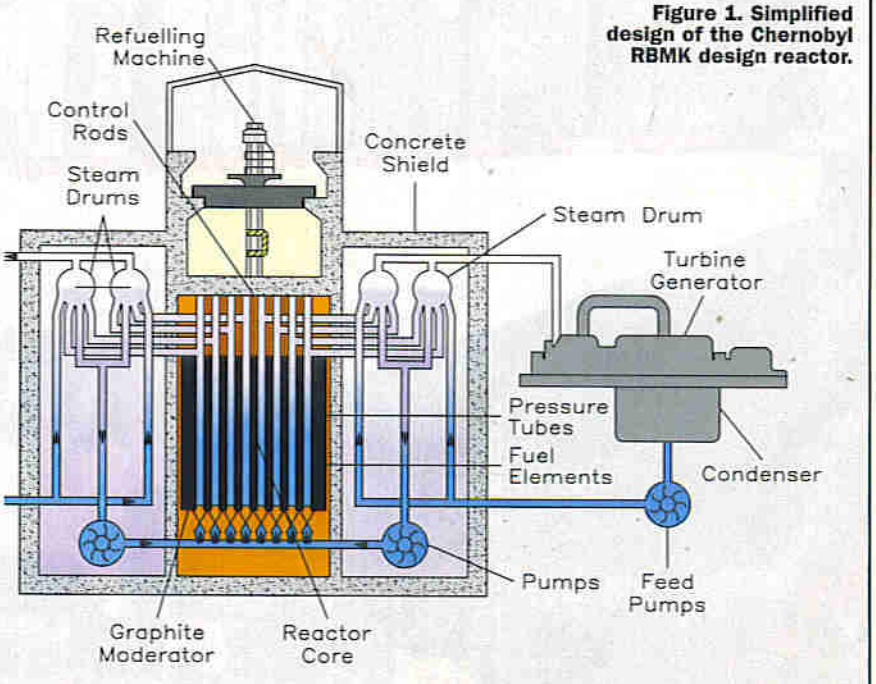


Figure 1. Simplified design of the Chernobyl RBMK design reactor.

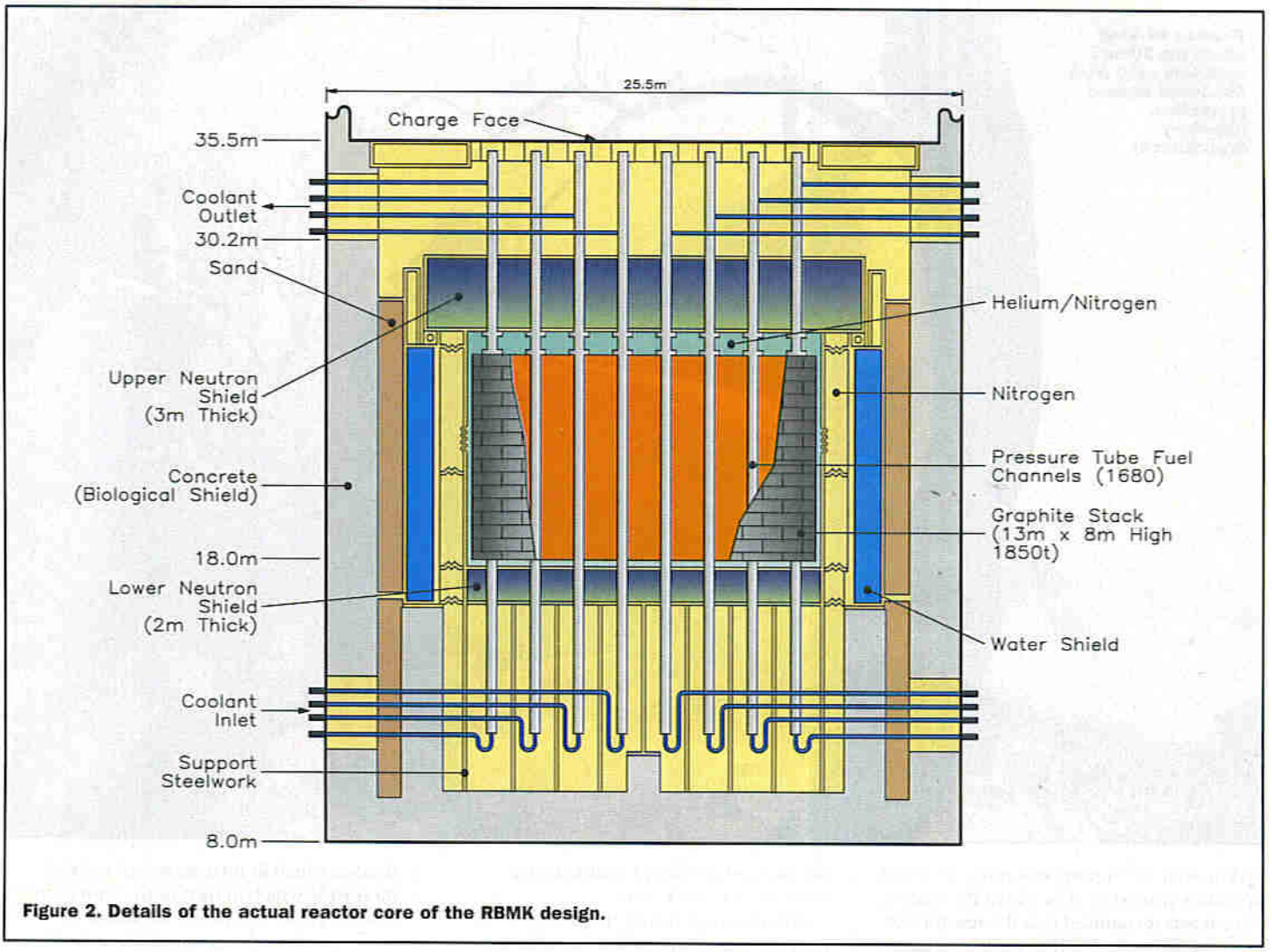


Figure 2. Details of the actual reactor core of the RBMK design.

Reactor Stability

As part of the fission process, neutrons are either 'prompt' or 'delayed'. Most neutrons are 'prompt', i.e., they are released as soon as fission occurs. They interact with the graphite moderator and are absorbed by fissile fuel U-235, causing further fission in a few milliseconds. Some 0·5% of neutrons are however, 'delayed' and emitted at intervals up to 1 minute after initial fission. Reactors are inherently designed to avoid prompt criticality.

The so-called negative fuel Doppler coefficient operates so that fission becomes less likely as fuel temperatures increase. This is because Uranium -235 atoms in the fuel elements become more excited and more of a 'moving target' for interaction with thermal neutrons.

At sufficiently high core operating temperatures, increasing rate of fission will tend to drive fuel temperatures higher – resulting in a reduction in rate of fission due to this negative fuel doppler coefficient. The reactor, therefore, has a degree of stability at this operating level. In the RBMK reactor design, this factor is dominant above 20% of rated power. Standing operations were apparently that the reactor should not be operated below this 20% level.

Xe-135 is a decay product of I-135 within fuel elements, with a half life of 6·6 hours. Under steady-state conditions of power generation, an equilibrium level of Xe-135 builds up. Xe-135, however, is a strong neutron absorber – having a large cross-section for neutron capture.

When reactor power is reduced to a new and lower stable level, there is a short-lived increase in X-135 levels with reference to the neutron flux in the reactor. This tends to further reduce the level of core activity. Thus, in order to recover reactor power, control rods have to be removed to counteract the 'Xenon poisoning' effect.

A 'positive scram' effect is also considered to have played a party in the Chernobyl incident. The boron carbide containing control rods were typically driven through water filled channels in the graphite moderator. It could be possible, for example, in initial insertion of the control rods, for water – a net neutron absorber – to be displaced, which would have acted to increase neutron activity in the reactor.

Thus, before the rods were adequately displayed, a loss of moderating effect would have taken place. The final deployment of the control rods could have been the final trigger in the reactor to have produced an uncontrollable power surge.

A key factor also was the so-called 'positive void' effect. Where the core temperature increases and additional steam is generated, the net effect is to reduce neutron absorption due to the elimination of water. At powers below 20% rated capacity, the 'positive void' effect dominates over negative fuel doppler coefficient and brings about a potential instability. Also, the generation of more steam in turn tends to reduce the flow of coolant through the core.

Countdown to Disaster

It transpires, however, that the fateful manoeuvre on the RBMK reactor had been attempted in 1982 and 1984. The 1982 test had not involved the Chernobyl number 4 reactor.

As can be imagined, it has always been considered very important to determine the actual sequence of events. The scheduled shutdown of the reactor began early in the morning on the 25th of April. By 3:45am, the reactor power was reduced to half power of 1,600MW (thermal) and later, the emergency core cooling system was isolated and rendered inoperative in case it interfered with the test. At around 14:00, the reactor was due to have been reduced further, though in order to meet grid requirements, the system maintained power at 1,600MW (thermal) and the experiment was postponed. It was only at around 23:10 that main power reduction took place and at midnight, the shift changed and a new team came on duty.

The fateful day was now April 26th. The experiment had planned to reduce power to 25% of full power. A control rod sequence change was undertaken but this failed to reduce the power to the required level. Instead, a 30MW (thermal) level was achieved – far below the set level of around 700MW (thermal). Since this took the reactor into an unsafe operational area, the experiment should have been abandoned.

The initial collapse of power at 30MW was probably the result of falling into a so-called

Firemen working within the 30km exclusion zone from Chernobyl without protection. (Courtesy Greenpeace).

'Iodine well' or 'Xenon poisoning'. The shift operators wished to close down the reactor, since it was recognised that the reactor was in an unsafe condition. The specialist engineer in charge of the turbine check argued strongly against this and eventually overruled their caution. More control rods were raised to increase the reactor's output power.

Power was eventually stabilised at 200MW (thermal) though with Xenon poisoning, control rods had to be withdrawn to achieve this level. It is estimated that at this stage, less than 26 control rods were in place. With reactor power at an increased level of 200MW (thermal), additional pumps were added to the cooling circuits in line with the planned test procedure. Some manual control rods were raised to increase power and raise temperature and pressure in the steam separator. At this stage, the onset of instability began.

The flow of water through the core was reduced below normal to improve steam separator status. At this stage, spontaneous steam generation took place in the core as excess heat built up. The steam was now routed to the turbines and automatic control rods withdrawn from the core. This manoeuvre, which normally takes 10 seconds, usually would compensate for the reduction in steam in the core as the turbine feed valves were closed. The lower than normal flow through the core, however, did not bring about the expected reduction in core activity. As more steam was generated in the core by increased core temperature, the 'positive void' effect was to further increase the rate of fission and steam increased in the core uncontrollably. As a last resort, the AZ or emergency button was pressed to effect a shutdown by lowering of control rods.

Observers just before the accident had seen the heavy caps of the fuel chambers jump up and down in their sockets – indicating that the fuel elements were under acute stress. The reactor structure at this stage had probably been distorted so that control rods would have had difficulty penetrating to the base of the core. As the control rods begin to be inserted from the top, a possible 'positive scram' effect triggered more instability in the core. The reactor power then reached a peak of around 100 times its design value under condition of inadequate cooling. It is likely that the initial rupture of fuel elements would have been initiated by melting of fuel which expands to 110% of initial volume. As attempts were made to set the rods into free fall by disengaging their motor drive, the rods jammed and could not be used effectively.

The whole installation shook. In the control room, plaster fell and emergency lighting came on. There were frantic calls to flood the core with water and manually lower the control rods. At this stage, the fuel rods shattered and reacted with the cooling water, rupturing the fuel channels. Soon after, a massive explosion rocked the entire site and blew off the upper concrete cap of the reactor – which weighs 1,000 tons. A concrete wall a metre thick in the control room buckled under the force of the explosion.

Also, it will be later discovered that the lower base of the reactor was also disrupted. This would allow air in at the base of the damaged reactor. Air drawn into the red hot graphite moderator material in the superheated core generates carbon dioxide which in turn generates carbon monoxide which in turn burns with blue flames. There was no containment of molten fuel by the concrete base during the emergency.

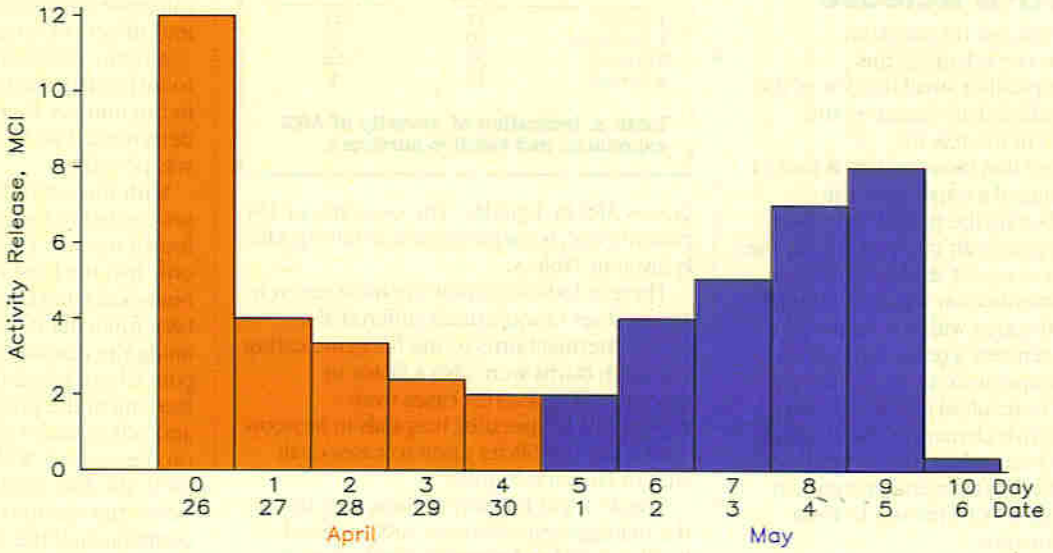
Emergency Measures

In the confusion and the darkness, it took some time to discover exactly what had taken place. At worst, it was feared that one or more fuel assemblies could have exploded. At this stage, with the reactor completely disabled, conventional methods to render it safe were futile. Various engineers, however, received fatal doses of radiation in carrying out orders to try to regain control. One of the initial measurement problems was that radiation monitors could not register the very high levels of radiation effectively, so the extreme danger of the accident was not initially apparent.

Highly radioactive fuel and fission products had been spread around the vicinity of the complex and incandescent lumps of graphite had started numerous fires. The roof of the main turbine hall, itself a kilometre long, caught fire. The number three reactor which was still on line, shared the same roof. By 5:00am, however, the minor fires had been contained or extinguished, though the crippled reactor core itself was still ablaze. The firemen were, however, exposed to severe doses of radiation. It took only about half an hour's exposure to bring on severe radiation sickness. Thus began a steady stream of casualties to the local hospital in Pripyat.

Many heroic effects of the engineering team of number 4 reactor were undertaken

Figure 3. Rate of emission of radioactivity from Chernobyl number 4 reactor.



to prevent further explosions. Hydrogen was, for example, replaced with nitrogen in the turbines of the number 4 unit.

Surprisingly, the number 3 reactor, was also at risk of catching fire and was only shut down at 5:00am. The remaining units number 1 and 2 continued to operate for some 24 hours after the accident. On the site was also a construction team building the number 5 and 6 reactors. There appeared, however, to be no emergency plan to evacuate non-essential personnel from the site. Workers, for example, waiting for transport to take them off site, sustained large doses of radiation.

Extinguishing the Graphite Fire

The efforts to control the ongoing release of radioisotopes and fuel were focused on seeking to try to extinguish the burning graphite and also to minimise release of radioactive material. With the core containing around 2,000 tons of graphite with an estimated combustion rate of 1 ton per hour, the reactor had the potential to remain on fire for months.

The reactor was then bombarded with around 5,000 tons of material by helicopter. This included some 40 tons of boron-containing compounds to absorb neutrons and some 2,400 tons of lead which, it was argued, could reduce heat through its high boiling point. Also, 1,800 tons of sand and clay and 400 tons of dolomite were dropped on the smoking ruin. The Dolomite (limestone) was used to generate carbon dioxide when subjected to the intense heat of the core. Trinatrum phosphate and polymerising liquids were used to suppress radioactive release. The dropping of material was also sought to fill channels round the areas of the core to prevent air from convecting upwards.

The initial process of dropping sand into the reactor appeared to work – with the amount of activity released gradually falling. It was noted, however, that the very act of dropping material into the core acted to release additional dust into the atmosphere.

There were, however, other anxieties. There was extreme concern that the molten fuel in the core could pass through the lower 2 metre concrete shield. If this came in contact with water lying below the reactor, then this could result in a massive explosion that would totally destroy the number 4 reactor and also damage the number three reactor. A key operation was undertaken in appalling difficulties to pump 200 cubic metres of highly contaminated water from the reactor basement. All the team members involved received high doses of radiation.

It was noted, however, that from May 1st onwards, the emissions began to increase and the core temperature began to rise. There was desperation to try and cool the remaining core. One scheme involved freezing the entire ground surface around the core to prevent oxygen from being drawn up into the burning core area. In a vast mobilisation, fleets of lorries brought liquid nitrogen to the site.

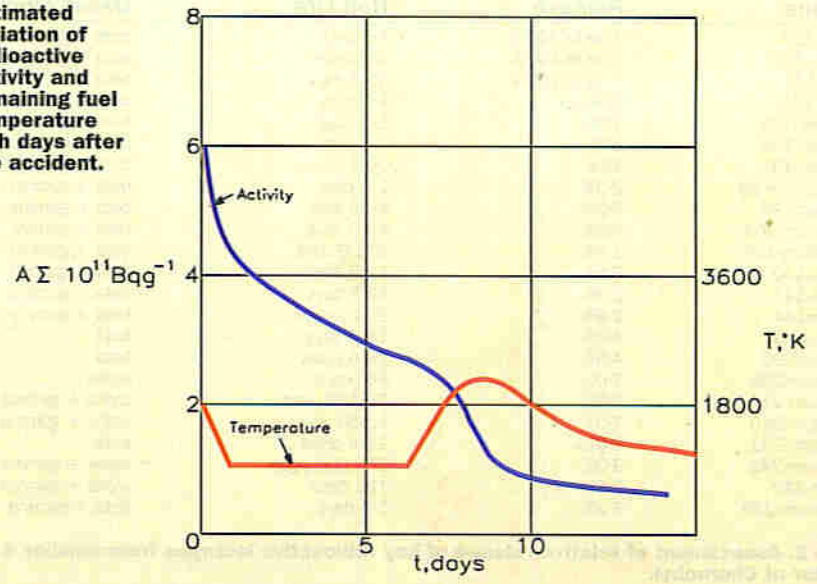
In the event, however, this was not needed when it was realised that even this would be ineffectual. Also, a tunnel was dug under the reactor to act as a heat exchanger. For no apparent reason, however, the reactor fire began to extinguish itself, with output levels falling dramatically on the 6th of May. The variation of estimated emissions from the reactor is indicated in Figure 3.

Some accounts, however, indicate that indeed, the use of Nitrogen was of value in cooling the reactor blaze. The immediate threat of a China Syndrome meltdown had apparently passed. Future investigations would reveal, however, what became of the core's remaining fuel.

The estimated variation of radioactive activity and remaining fuel temperature is indicated in Figure 4. While the radioactive decay is releasing energy at decreasing rates with time, the addition of insulating material dropped from the helicopters is acting to insulate the core with the result that the temperature increases.

It was only on the morning of Monday April 28th that western scientists in Sweden became aware of the possibility of an accident. This was confirmed later by a brief statement from TASS. The media circus had begun.

Figure 4. Estimated variation of radioactive activity and remaining fuel temperature with days after the accident.



Nature of the Radioactive Release

While the radioactive release from Chernobyl was considerable, this represented typically a small fraction of the overall core radioactivity based on the 'charge' of fuel in the reactor.

It is estimated that between 6 to 8 tons of radioactive material escaped into the atmosphere. During the period of leakage into the atmosphere, air currents spread the contamination over vast extents of Europe. The worst contamination was centred on the reactor site – the area within a 30km radius of the station remains a restricted zone.

The high temperature of the core – at around 2,000°C, resulted in the release of volatile radioactive elements from the fuel. Part of the fuel was released also in the form of fine dispersed components, ranging in size from a fraction of a micron to even hundreds of microns.

Table 2 summarises the estimate of releases of the various key isotopes with an uncertainty of around 50%.

With all the fuel elements effectively ruptured, the volatile elements such as Xenon and Krypton would totally escape from the core. The fraction released of high melting point elements would reflect the approximate fraction of non-volatile core material released – around 3·5%.

Thus, the initial fall off in activity would reflect the additive activity of a wide range of decaying radioisotopes. Years after the accident, most interest is now centred on the presence of Cs-137 with its half life of 30 years. The Iodine-131 isotope is taken up selectively by the thyroid gland. While doses of normal Iodine as Potassium Iodide is a well recognised means of reducing the absorption of I-131 from the environment, large number of susceptible children received significant doses.

Acute Radiation Exposures

A total of 237 individuals were suspected of being exposed to acute radiation syndrome (ARS). Science, in its way of classification, grades ARS in 4 grades. The outcome of 134 patients who were confirmed as having ARS is given in Table 3.

Grade	Number in Group	Number of Survivors
1 (mild)	41	41
2 (moderate)	50	50
3 (severe)	22	15
4 (chronic)	21	1

Table 3. Indication of severity of ARS exposures and relative survivors.

There is indication that the most severely exposed set of individuals suffered also severe thermal burns to the body, indicating that such burns were also a factor in mortality. The severest cases were transferred to specialist hospitals in Moscow – with most publicity given to cases dealt with in Hospital Number 6.

The accident has shown, however, that the management of severe ARS required highly specialised treatment with state-of-the-art medical facilities. The undertaking of bone marrow transplants for the most severely injured would certainly not now be attempted. Use would now be made of a group of agents known as cytophins or haemolytic growth factors, which act to stimulate the recovery of red cell production and also of the immune system.

Also, cells in the body that normally would replicate rapidly such as in the lungs and gastrointestinal tract, failed to do so in patients with severe doses of radiation. The suffering of these cases was appalling. In the days to follow, the toll of fatalities increased.

It became apparent that the fire crews and other emergency personnel were woefully ill-equipped to deal with such a severe emergency. In reality, such a severe accident had never been anticipated.

The Sarcophagus

The radiation monitoring activity of the clean up process was vast. In all, a total of some 260,000 men worked for months to decontaminate the damaged site. Doses were measured individually on a daily basis.

By November of 1986, however, a steel and concrete sarcophagus had been put in place around the crippled reactor to minimise any future release of radioactivity into the environment.

After its construction, it was determined to investigate the fate of the remaining fuel in the number four reactor – in order to determine that no future fission accident was possible.

With the sarcophagus in place, a team proceeded to explore the basement of the fourth reactor. They discovered that not only had the blast removed the upper biological shield, it had forced down the base foundation of the reactor, causing sand lining the reactor to fall to the bottom of the core where it had fused with molten fuel – forming in the process, a 'waterfall' of black and yellow and with strange crystal deposits on the surface. Without the presence of the sand, the fuel could well have penetrated below the reactor complex and contaminated the water table.

Ecological Damage

Direct radiation damage was evident within the 30km exclusion zone. In fact, the uptake of radioactive material varied due to differences in the pattern of fallout and the varied metabolism of eco systems. Water based eco systems tended to fare better than soil-based ones. Initially, conifers and small mammals were seen to be worst affected.

The remaining major contribution to radiation appears to be Caesium. While relatively high levels of Caesium can still be found within the 30km zone, there is the impression of eco systems returning to normal. Coniferous forests which had exhibited genetic mutations, appear to be exhibiting more normal growth patterns.

In the forest ecosystems, contamination tends to be located in the topsoil. Radioactive Caesium has come to be concentrated in new tree growth rings drawn from the soil through the roots. It remains to be seen if the levels of contamination restrict commercial exploitation of such timber. While 'wild foods' such as berries and mushrooms will continue to show elevated levels of Caesium over the next decades in Bellarus, Ukraine and Russia, slight levels of contamination will be in evidence in Nordic counties and in the UK. Forest fires in the evacuated area are known to spread contamination.

Health Effects of Chernobyl

The literature on the aftermath of the radioactive fallout from Chernobyl is very extensive but it is not conclusive. There are papers which show that in terms of childhood leukaemia and thyroid cancers, for example, levels of incidence are no higher than comparable non-contaminated areas. There are also papers that indicate the opposite.

Research published by international atomic energy concerns tends not to find any correlation between subsequent disease and radioactive contamination, while research undertaken by more independent groups tends to find such a link. The nature of these studies, however, is highly complex – requiring much specialist knowledge and expertise. Physicians in the affected areas,

Isotope	Release	Half Life	Decay Mode
Xenon-133	? up to 100%	5·3 days	beta + gamma
Krypton-85m	? up to 100%	4·4 hours	beta + gamma
Krypton 85	? up to 100%	10·7 days	beta
Iodine-131	20%	8·0 days	beta + gamma
Tellurium-132	15%	3·3 days	beta + gamma
Caesium-134	10%	2·1 years	beta + gamma
Caesium-137	13%	30·1 years	beta + gamma
Molybdenum-99	2·3%	2·8 days	beta + gamma
Zirconium-95	3·2%	64·8 days	beta + gamma
Ruthenium-103	2·9%	40·0 days	beta + gamma
Ruthenium-106	2·9%	371·6 days	beta + gamma
Barium-140	5·6%	12·8 days	beta + gamma
Cerium-141	2·3%	32·5 days	beta + gamma
Cerium-144	2·8%	284·9 days	beta + gamma
Strontium-89	4·0%	50·6 days	beta
Strontium-90	4·0%	28·6 years	beta
Plutonium-238	3·0%	86 years	alpha
Plutonium-239	3·0%	24,100 years	alpha + gamma
Plutonium-240	3·0%	6,560 years	alpha + gamma
Plutonium-241	3·0%	14·4 years	beta
Plutonium-242	3·0%	380,000 years	alpha + gamma
Curium-242	3·0%	163 days	alpha + gamma
Neptunium-239	3·2%	2·4 days	beta + gamma

Table 2. Assessment of relative release of key radioactive isotopes from number 4 reactor at Chernobyl.

however, are increasingly alarmed at the numbers of ill children they are having to cope with and also frustrated by their lack of resources to provide medical care. It has been estimated, however, that around 12,000 children received large doses to the thyroid and 9,000 children were irradiated in utero.

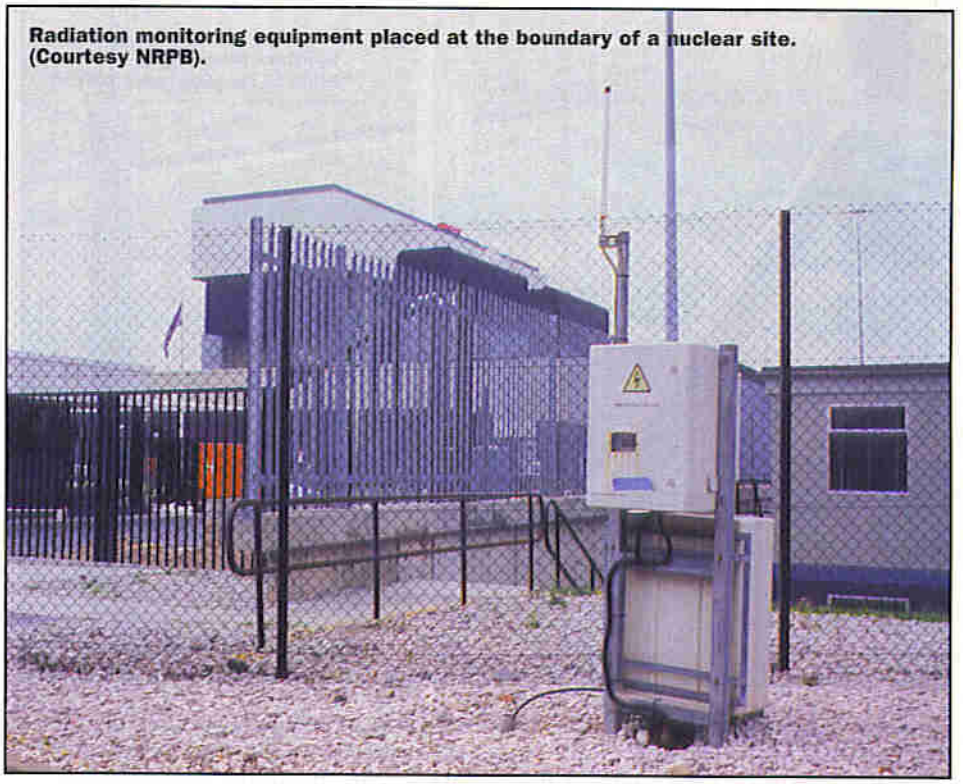
It would now seem apparent, however, that there is a significant increase in childhood thyroid carcinoma within the contaminated areas. Rates of childhood thyroid carcinoma were around 0·5 per million children per year before the accident. Rates in parts of Ukraine during 1990-94 were around 10·6 per million children per year and in the more highly contaminated Gomel region of Belarus, 92 per million children per year for the same period. There are indications that there is much less effect with in utero exposure and also decreasing effect with increasing age at contamination. The youngest babies would, therefore, be most vulnerable. The effects, however, take at least 4 years to manifest. These results are surprising the researchers.

Where other medical problems are attributed to radiation effects, these are described largely as gastrointestinal, being of an inflammatory nature initially and then developing into an ulcerated form. Also, respiratory problems such as primary chronic obstructive bronchitis have been identified. In addition, neurophysiological changes have been noted, manifesting as reduced mental capacity. There is also the impression that while the mortality is high in this group, referenced against an equivalent normal population, the reasons for deaths do not always have clear tendencies. It is also difficult to do meaningful studies where so many social, health provision and environmental changes have a direct effect.

Social and Psychological Effects

For a variety of reasons not directly related to the dose of radiation acquired, around 15,000 people have experienced health disability and are no longer able to work. In a way, the Chernobyl accident has set in train a vast social experiment where stress levels are suddenly raised. It is recognised that in addition to measuring the levels of contamination, the study of social and psychological effects is highly relevant.

The restriction on food available in the restricted zones acted to drive towards poor nutrition. Fresh food and vegetables were looked upon with suspicion and 'clean' supplies from outside the contaminated area were in short supply. Some children, for example, were prevented from consuming milk in any form, which subsequently resulted in cases of rickets from vitamin D deficiency. Vodka had for some time been identified as a 'purification agent' and began to be consumed in even greater quantities. The so-called 'coffin money' for purchase of 'clean' food supplies was largely used to buy alcohol of any type. Over many areas, the remaining population became increasingly stressed. Also, more mobile sectors of the population such as professionals tended to leave such areas with the result that a wide range of services tended to deteriorate.



Radiation monitoring equipment placed at the boundary of a nuclear site. (Courtesy NRPB).

A major four year project of study within this context has been funded by the European Commission and involved collaboration from researchers from the European Community and the Commonwealth of Independent States. A control group of individuals in non-radiologically affected areas was compared with individuals who either were living or who had been relocated from contaminated areas. In all, a total of 5,000 individuals were surveyed.

The study was typically a difficult one to have undertaken, around the time of the break up of the Soviet Union when severe stress levels were experienced due to the social and economic upheaval.

One of the points to emerge was the usefulness of an understanding of radiation in coping with 'invisible' risks and also coupled to the belief that actions could reduce radioactive uptake. In the sealed zone of 30km, a total of around 130,000 inhabitants had to be evacuated. Not surprisingly, those who anticipated a better outcome as a result of relocation showed less stress while those who were unhappy with the upheaval were more stressed.

Chernobyl Accident and Consequences

There have been many responses to the Chernobyl accident. Reactor specialists from Western countries have made extensive reports on the design weaknesses of the RBMK reactor design. Also, the isolation of many parts of the Soviet science and technology from mainstream global contacts, led to forms of reactor design that were not in line with internationally recognised safety guidelines. Very much to the credit of the Soviet scientists, however, is that information related to the incident was conveyed as rapidly as possible.

A major contribution of the West since this incident has been to improve safety standards of RBMK reactors in the CIS. This involves both upgrading of inherent reactor safety and improvement in training of operators of such systems. The speed of insertion of control rods has been increased. Additional absorbers were installed in the core to reduce the value of the void coefficient. A remedy for the improved reactor stability in RBMK designs was to use a fuel of higher enrichment of 2·4% rather than 2·0%.

Nuclear Power in the Ukraine Today

It is a curious paradox, that while various western industrialised countries subsequently sought to phase out nuclear power generation, the Ukraine – the site of the Chernobyl incident – is actively seeking to develop and expand its civilian nuclear power resources.

On paper, the officials of the Ukrainian State Committee for Nuclear Power Utilisation (Goscomatom) indicate that nuclear power is cheaper than costs of thermal plants. Revised calculations of costs in the UK, however, with consideration of expense of decommissioning, indicate that such cost estimates are optimistic. Between 1995 and 2000, a total of four new reactors are planned to be commissioned in the Ukraine – providing an anticipated 40% of total electricity production. This promotion of nuclear power, therefore, is taking place in spite of the bitter and on-going lessons of the Chernobyl accident.

Even in the midst of a major environmental disaster, the surviving reactors of the Chernobyl site were re-commissioned – with units 1 and 2 operational in October/November 1986 and unit 3 in 1987.

While the nuclear safety lobby was trying to improve procedures and safety, a fire in the turbine hall of the number 2 reactor at Chernobyl put further development of nuclear power on hold. A moratorium introduced on new developments was lifted late in 1993, which subsequently led to the expansion of the nuclear programme. While the exact damage to the number 2 reactor is

Part of the Radioactive Incident Monitoring Network (RIMNET II). (Courtesy NRPB).

unclear, it was scheduled to be re-opened during 1996.

The town of Pripyat, initially built for the workers of the Chernobyl complex, is a restricted area. A new town, 'Slavutich', completed in 1988, has been built and has experienced a range of social problems in the aftermath of the Chernobyl accident.

Managing Nuclear Emergencies in the UK

A highly structured emergency planning system is in place to cope with nuclear emergencies in the UK – see references. For the earlier series of Magnox reactors, an evacuation zone of up to 2·4km is anticipated and 1km for more modern plants. There is clearly no anticipation of an accident as devastating as that at Chernobyl with its 30km evacuation zone.

Monitoring of levels of gamma radiation is routinely monitored by means of the RIMNET network (Radioactive Incident Monitoring Network) which consists of 92 monitoring stations throughout the UK. This has both a role for UK-based accidents and also for detecting radioactivity from overseas.

In addition, UK nuclear power stations have various monitoring systems on their site periphery to detect any leakage from installations. Emergency services such as the fire service routinely carry radiation monitors to evaluate contamination risks.

Epitaph

Tragic as the Chernobyl incident was, it has provided an opportunity to take extreme measures for additional safety throughout the world's current stock of nuclear power stations.

The incident also served to indicate the utter futility of nuclear war. The vast might of the entire Soviet Union had been put under stress with a situation that had released the equivalent of a single low megaton nuclear weapon detonation. The arms race was exposed as an incredibly senseless waste of resources and one which, in the end, had left the Soviet Union bankrupt. In particular, the concept of a 'localised' theatre of nuclear war was demonstrated as a foolish deception by the rapid spread of contamination across Europe. The 'credibility' of nuclear weapons was, therefore, destroyed at a stroke.

While the accident had been devastating, a more serious event could have taken place. Molten fuel could have penetrated to flooded chambers under the reactor and resulted in an even more severe explosion. This could have resulted in the contamination of the groundwater under the reactor. Heavy rain or snow could have acted to cause contamination of a much more intense level in the vicinity of the reactor.

It is important to remember, also, that the story of Chernobyl is also an unfolding one. Social conditions have been put under severe strain. Worrying health trends in the region are being studied but inadequate resources are available to take remedial action.

A sense of perspective, however, is always useful in dealing with the aftermath of Chernobyl. The British Imperial Cancer Research Fund and the World Health Organisation estimated in May 1992 that 250 million people alive then in the developed world would die prematurely from diseases caused by smoking.

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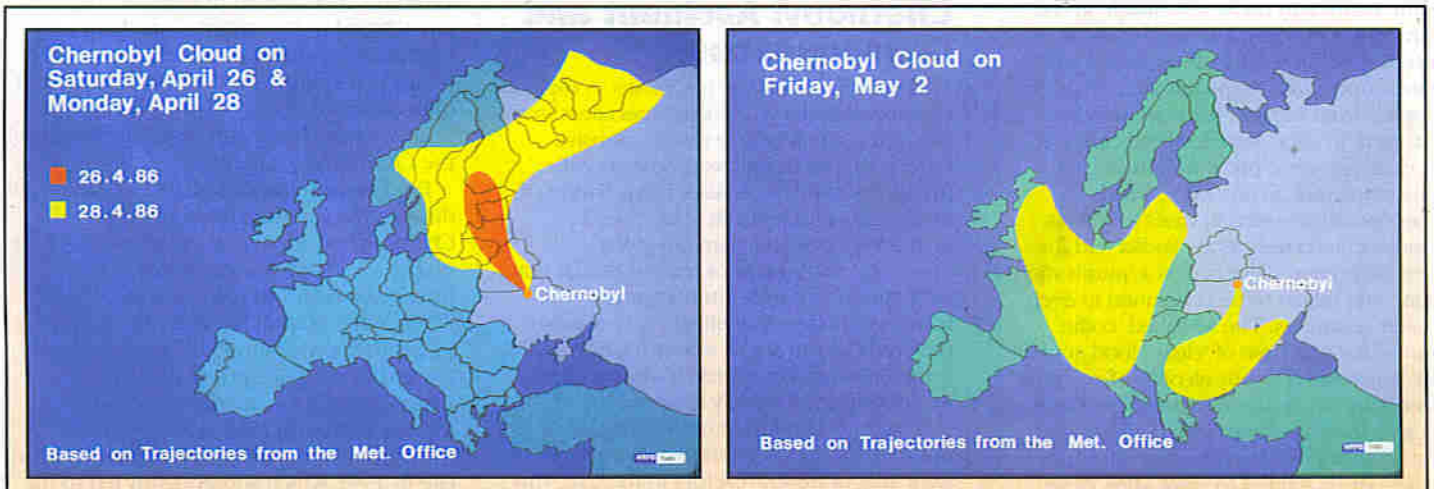
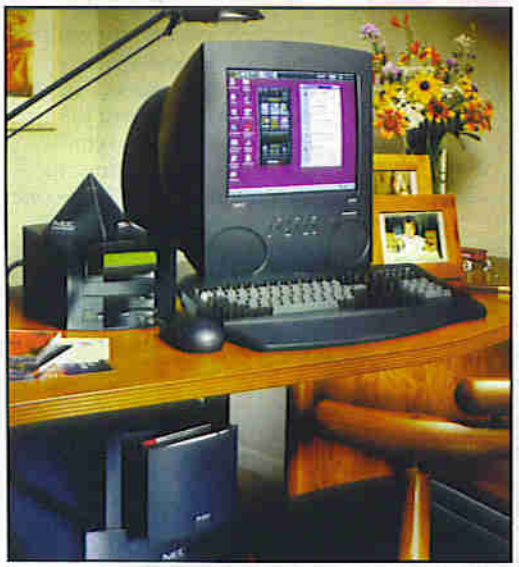
http://www.iaea.or.at/worldatom/in foresource/bulletin/bull383/willia ms.html



How the Chernobyl cloud spread in the days following the explosion. (Courtesy NRPB).

What's On?



Analyst Conference Reports Global PC Market to Surpass 150 Million

The worldwide personal computer market is forecast to grow 19% in 1997, with shipments surpassing 84·3 million units, and Dataquest reports the market will continue to post double-figure growth through the year 2001, with shipments reaching 151·6 million units.

To prepare vendors for this explosive market, Dataquest analysts and industry leaders will discuss opportunities in the marketplace during the Dataquest PC Trends conference from July 14 to 15 in Santa Clara, California.

"The PC war between Dell and the other vendors will change the industry landscape forever.", said Bill Schaub, Dataquest's computer group director. "Everyone dependent upon the PC industry needs to navigate this new terrain very carefully."

Dataquest analysts presented their outlook for the PC market, identified key growth trends, and provided insight for vendors to position their company for greater profitability. Some topics to be examined during the two-day conference are the worldwide PC market through the year 2005; multimedia strategies for consumer PCs, digital convergence, and mainstreaming the mobile computing market.

For further details, check: **www.dataquest.com.**
Contact: Dataquest, Tel: (0800) 716089.

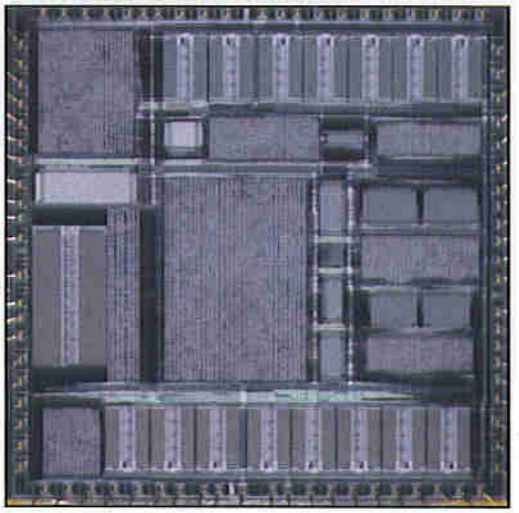
UK Conference Investigates Design Reuse

Intellectual Property in Electronics '97 to be held at Royal Ascot over the period 20 to 21 October will provide a platform for the European Electronics industry to come together and discuss the main business and technological issues surrounding the use of intellectual property and design re-use, and its likely impact on the electronics component and product industry.

The issues surrounding intellectual property are becoming increasingly important within the electronics industry as demand for consumer, communications and computer electronics products accelerates, and demand increases for faster end-product and component turnaround. Design teams face a combination of increases in design complexity and shrinking design times, challenging their abilities to keep up.

The electronics industry is also starting to see a structural shift in the market based around the move to systems-on-a-chip, and this could have a significant bearing on design re-use within electronics.

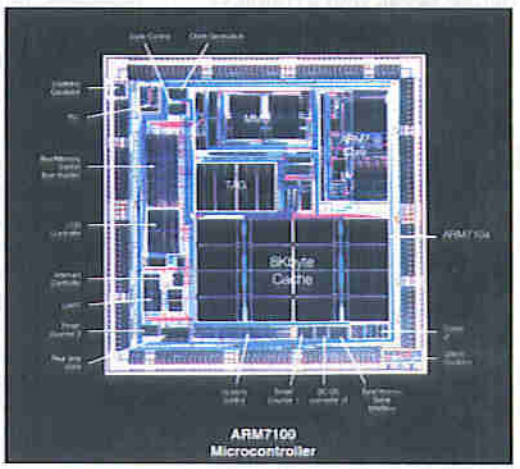
A recent survey published earlier this year by Dataquest suggests that Europe is well placed to take advantage of the changes occurring in design re-use. Huge engineering layoffs over the past 10 years have led to many more smaller design houses setting up on their own in Europe than any other part of the world. Dataquest's figures suggest that of the approximately 1,000 design houses in the world, more than 600 are based in Europe.



Moves to systems-on-a-chip are likely to benefit small design companies supplying intellectual property to the system chip designers, while handicapping manufacturers that cannot integrate memory devices on the same chip as logic gates.

Intellectual Property in Electronics '97 is organised by Miller Freeman and follows a successful inaugural event in Silicon Valley earlier this year.

For further details, check:
www.mf-exhibitions.co.uk.
Contact: Miller Freeman, Tel: (0181) 855 7777.



ARM7109 Microcontroller

Diary Dates

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

September 1997

1 to 3 September. Tenth International Conference on Electromagnetic Compatibility, University of Warwick, Tel: (0171) 344 5467.

2 to 4 September. International Conference on Genetic Algorithms in Engineering Systems: Innovations and Applications, University of Strathclyde, Tel: (0171) 344 5467.

7 September. Document 97, NEC, Birmingham. Tel: (0181) 742 2828.

7 September. GIS 97, NEC, Birmingham. Tel: (0181) 742 2828.

7 September. Voice Europe, Olympia 2, London. Tel: (01244) 378888.

8 September to 24 October. Amateur Radio Morse Workshop, Highbury College, Newbury. Tel: (01705) 383131.

17 September. InControl 97, Olympia Exhibition Centre, London. Tel: (01799) 528292.

17 September. OnBoard, Olympia Exhibition Centre, London. Tel: (01799) 528292.

17 September. Time 97, Earls Court Exhibition Centre, London. Tel: (01799) 582292.

22 September. European Exhibition on Optical Communications, Edinburgh International Conference Centre, Edinburgh. Tel: (01322) 660070.

22 to 25 September. 11th International Integrated Optical Fibre Communications Conference, ICC, Edinburgh. Tel: (0171) 344 5478.

22 to 25 September. 23rd European Optical Fibre Communications Conference, ICC, Edinburgh. Tel: (0171) 344 5478.

26 to 28 September. RSGB International HF Convention, Windsor, Berkshire. Tel: (01707) 659015.

27 September. The Internet 97 Show, NEC, Birmingham. Tel: (01923) 261663.

30 September. Microwaves, RF & Technologies 97, Wembley Conference & Exhibition Centre, Tel: (01322) 660070.

October 1997

7 to 9 October. World Power and Energy, NEC, Birmingham. Tel: (01322) 660070.

7 to 9 October. Voice Europe – Computer Telephony and Voice Processing, Olympia, London. Tel: (01244) 378888.

7 to 9 October. GIS '97 – Geographical Information Systems, NEC Birmingham. Tel: (0181) 742 2828.

7 October. Electronic Commerce 97, Wembley Conference and Exhibition Centre, London. Tel: (0181) 332 0044.

28 October. Instrumentation Harrogate, Harrogate International Centre, Harrogate: Tel: (01822) 614671.

21 to 22 October. Property Computer Show, New Connaught Rooms, London. Tel: (01273) 857800.

November 1997

1 to 2 November. Radio Rally, Llandudno, North Wales. Tel: (01707) 659015.

3 November to 19 December. Amateur Radio Morse Workshop, Highbury College, Newbury. Tel: (01705) 383131.

4 to 5 November. Software in Sales and Marketing, Wembley Centre, London. Tel: (0181) 541 5040.

18 November. Electronic Information Displays, Sandown Exhibitions Centre, Esher. Tel: (01822) 614671.

18 to 19 November. Workplace '97, Olympia, London. Tel: (0181) 910 7910.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 3, Rayleigh, Essex SS6 8LR or e-mail to swaddington@cix.compulink.co.uk.

Bob's Mini CIRCUITS

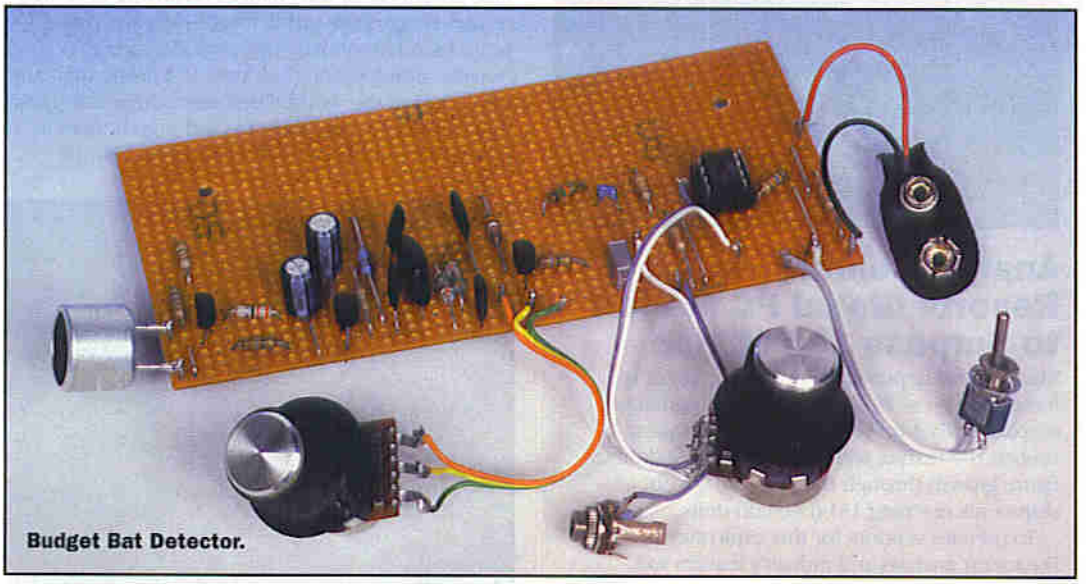
by Robert Penfold

Budget Bat Detector

Although relatively simple and inexpensive, this ultrasonic sound detector has good sensitivity from 20kHz to around 80kHz. It is fully portable, and the user listens to the detected sounds by way of a crystal earphone. Although units of this type tend to be associated with the study of wildlife, such as listening to bats' radar and the high frequency sounds produced by some insects, they can be used to detect any ultrasonic sounds within their operating range. Human hearing ceases to function properly at an upper limit of about 20kHz, but there are plenty of sounds at higher frequencies. With a unit of this type, it is possible to explore these normally unheard sounds.

Operating Principle

In order to make ultrasonic sound waves audible to a human, it is obviously necessary to reduce the pitches of the sounds so that they fall within the audio range. The only simple way of doing this is to use the heterodyne principle. This is basically just a matter of combining the input signal with the output from an oscillator using a special type of mixer. The mixing process produces new signals at the sum and difference frequencies. For example, suppose that there are input frequencies at 50 and 55kHz. If the oscillator is set at 49kHz, the sum frequencies will be 99kHz (49kHz + 50kHz) and 104kHz (49kHz + 55kHz). Of more importance in this application, the difference frequencies will be at 1kHz (50kHz – 49kHz) and 6kHz (55kHz – 49kHz), which are frequencies within the audio range.



Budget Bat Detector.

All that is happening is that the input frequencies are being reduced by an amount which is equal to the oscillator's frequency. In the simple example above, there were just two input frequencies, but this method works in exactly the same manner whether there is one input frequency or thousands. All the input frequencies are reduced by the same amount, and their relative strengths remain unaltered. The character of the ultrasound is therefore reflected in the audio output signal, with a couple of ultrasonic tones producing two audio tones, or a high frequency noise signal producing an audio noise signal. In use, this makes it easy to interpret what you are hearing.

The unit will also work if the oscillator is set higher than the input frequencies. With our previous example of input signals at 50kHz and 55kHz, output tones at 1kHz and 6kHz will also be produced if the oscillator is tuned to 56kHz (56kHz – 55kHz = 1kHz, and 56kHz – 49kHz = 6kHz). This method could be regarded as less authentic as it is inverting the signal, with high input frequencies producing low audio tones, and lower input frequencies producing high audio tones. However, in practice, the two types of output signal do not necessarily sound that much different, and results are generally satisfactory either way.

This ultrasonic detector has an alternative operating mode in which the signal is fed to a conventional AM demodulator, and no oscillator signal is used. With just a single input frequency, this produces no audio output. However, with two or more input frequencies, an audio output is produced at the difference frequencies. For instance, inputs at 50kHz and 55kHz would produce an output tone at 5kHz (55kHz – 50kHz = 5kHz). The advantage of this method is that there is no need to tune an oscillator to a suitable frequency before an audio output is produced. On the other hand, using the oscillator gives slightly better sensitivity, and what is generally perceived as a 'cleaner' output signal.

Circuit Operation

Figure 1 shows the full circuit diagram for the Bat Detector. The microphone (Mic1) must be capable of operating reasonably efficiently at ultrasonic frequencies, and this precludes the use of normal microphones. The only relatively low cost transducers that operate well over the appropriate frequency range are 40kHz transducers of the type intended for use in remote control units and ultrasonic intruder detectors. These offer optimum results at around 40kHz, but seem to work reasonably well over a much wider frequency range. This type of transducer is a Piezo-electric device, and is essentially a high frequency version of a crystal microphone. In common with most types of microphone, the output from the transducer will usually be quite weak, and will often be well under 1mV Pk-to-Pk. A large amount of amplification is therefore needed in order to bring the signal up to a usable level, and this is provided by a two-stage common emitter amplifier based on TR1 & TR2.

The output of the amplifier is coupled to a conventional AM detector which has volume control VR1 as its load resistance. From VR1 to audio signal is coupled to another common emitter amplifier, and this stage provides audio amplification that substantially boosts the sensitivity of the circuit. This gives plenty of volume from a crystal earphone, but note that the unit will not work using any other form of earphone or with headphones.

IC1 is used in the standard

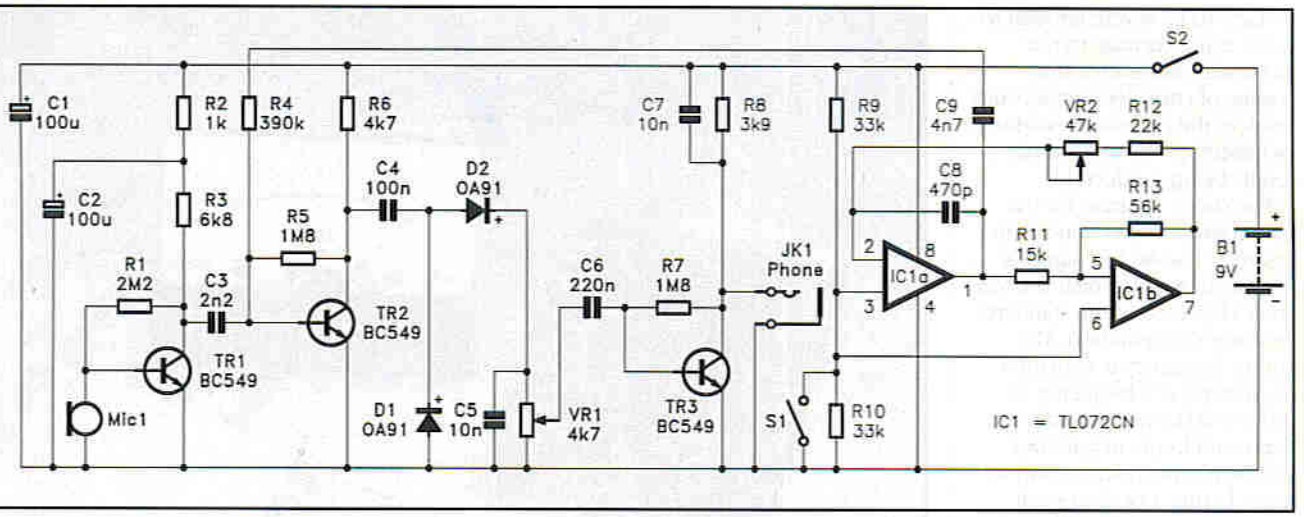


Figure 1. Budget Bat Detector circuit diagram.

triangular/squarewave oscillator configuration, and in this case, it is the triangular signal from the output of IC1a that is required. VR1 enables the oscillator's frequency to be tuned from about 25kHz to around 70kHz. The output of the oscillator is loosely coupled to the input of TR2 via C9 & R4, and the required mixing of the signals is provided when they reach the demodulator circuit. Closing S1 mutes the oscillator, and sets the unit into its straightforward AM demodulation mode. The current consumption of the circuit is about 5mA.

Construction

This circuit requires a well designed component layout if problems with instability due to stray feedback are to be avoided. The stripboard layout of Figure 2 is free from these problems, and the board is very simple to construct. The TL072CN used for IC1 is not a static sensitive component, but I would still recommend fitting it in a holder. Ultrasonic transducers are normally sold in pairs; one for use in the transmitter and the other for use in the receiver. In this case, it is obviously only the receiving transducer that is required, and the transmitting transducer should be stored for possible future use. The receiving unit is the one marked 'R40-16'.

To test the finished unit, set the volume control near to maximum and then try rubbing two fingers together just in front of the microphone. This should produce a very loud noise signal from the earphone. Dropping a pin or a small piece of wire onto a hard surface should produce high frequency sounds that can be tuned-in to produce loud 'clanking' sounds from the earphone. When using the unit, bear in mind that ultrasonic sound waves are highly directional, and that good results will only be obtained if the microphone is aimed quite accurately at the signal source.

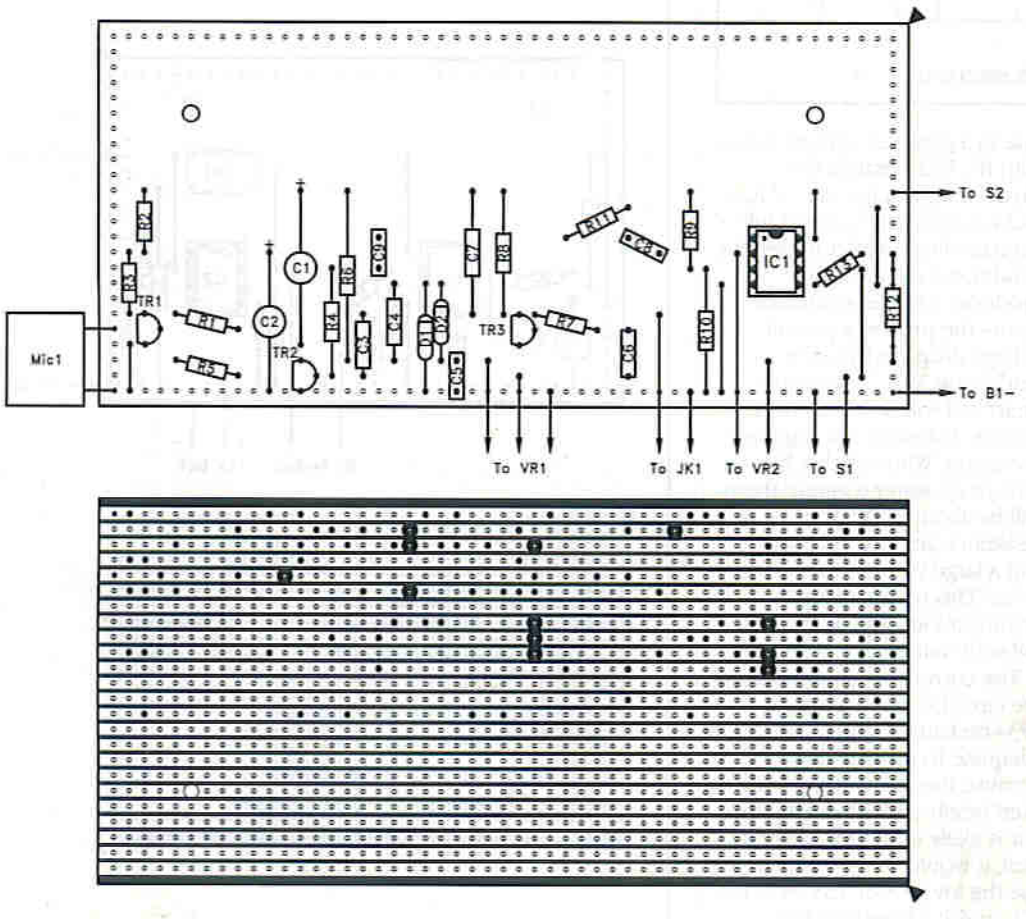


Figure 2. Stripboard layout for the Budget Bat Detector.

Soil Moisture Meter

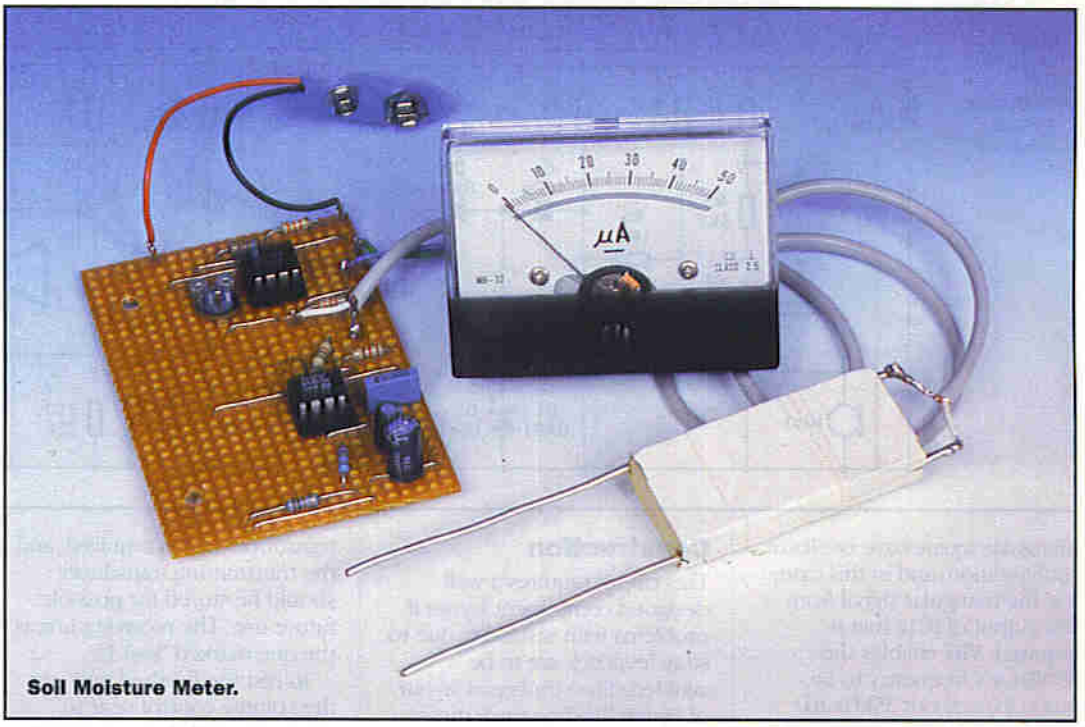
Owners of potted plants seem to worry a great deal about the moisture content of the soil in the pots, and with many plants, moisture level does have to be just right if the plants are to survive and thrive. If the soil dries out, the plants can rapidly wilt, but too much water can also be harmful. Fortunately, measurement of the moisture content is something that can be easily achieved electronically. Using a simple circuit and a home-made probe assembly, it is possible to test the soil up to a depth of 25mm or so with minimal disturbance of the soil. This unit uses a panel meter to indicate the relative water content of the soil, clearly differentiating between dry, moist, and wet soils.

The Circuit

Electronically testing the moisture content of soil is quite easy because the electrical resistance of soil is dependent on its water content. The higher the moisture content of the soil, the lower its resistance. Even the most basic of resistance measuring circuits can, therefore, act as a soil moisture meter if it is fitted with a suitable probe assembly. However, when detecting moisture electronically, it is better to use an AC signal rather than the DC signal normally used for resistance measurement. This is simply to avoid electrolysis causing corrosion of the electrodes. In this application, the erosion is

unlikely to be severe enough to cause major damage to the electrodes, but even a thin coating of corroded metal could result in the electrodes working inefficiently, with misleading results being produced.

The circuit diagram for the soil moisture meter appears in Figure 3. The AC test signal is produced by IC1, which is a 555 timer chip used in the standard oscillator configuration. The output frequency is virtually a squarewave at a frequency of about 6·8kHz, but the wave shape and frequency are not critical. IC1 provides an output signal having a peak-to-peak amplitude that is virtually equal to the supply voltage, which is far higher than is really necessary in this application. R3 & R4 form an attenuator which reduces the output signal to about 0·6V Pk-to-Pk. This signal



Soil Moisture Meter.

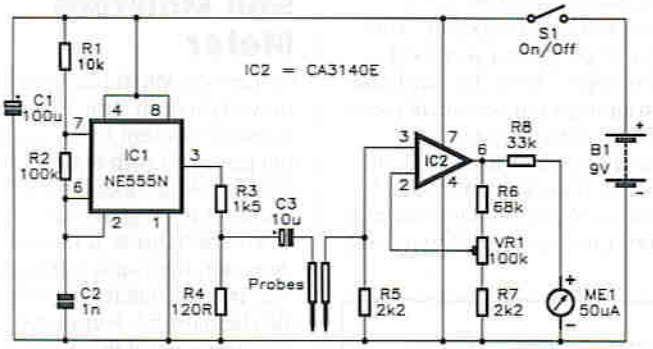


Figure 3. Soil Moisture Meter circuit diagram.

is coupled to one of the probes via DC blocking capacitor, C3.

The output from the second probe is coupled direct to the input of a non-inverting mode amplifier based on IC2. This is almost a standard inverting mode circuit, having R5 as the input bias resistor, and R6, VR1, and R7 as the negative feedback network. It differs from the standard arrangement only in that there is no negative supply. The circuit still operates normally on positive input half cycles, producing a train of amplified half cycles at its output. On negative input half cycles, the situation is different, and these fail to produce any output signal because the output of IC1 cannot go negative of the 0V supply rail. IC2 therefore acts as a simple but effective precision half-wave rectifier. The output of IC2 drives a simple voltmeter circuit comprised of R8 and ME1.

With the probes in very moist soil, there is a low resistance between them, and little voltage drop through this resistance due to a potential divider action with R5. VR1 controls the closed loop voltage gain of IC2, and it is adjusted to give a full scale reading on ME1 under this condition. Less moist soil produces a higher resistance across the probes, a greater voltage drop, and a lower reading on ME1. Reasonably moist soil will typically give a roughly half scale reading from the meter. With soil that has little or no water content, there will be about 20kΩ or more of resistance across the probes, and a large voltage drop across them. This results in ME1 reading about 10% or less of the full scale value.

The current consumption of the circuit is about 10mA. A PP3-size battery should be adequate to provide this, because the unit is likely to be used briefly and intermittently. If it is likely to be used a great deal, it would be advisable to use the low power TS555CN for IC1, which will reduce the current consumption to about 4·5mA.

Construction

Figure 4 shows the stripboard layout for the soil moisture meter, and this is based on a board which has 30 holes by 20 copper strips. Construction of the board is reasonably straightforward, but note that the CA3140E used for IC2 has a PMOS input stage, and that it therefore requires the usual anti-static handling precautions. Note also that IC1 has the opposite orientation to normal (i.e., pin 1 is at the bottom right not the top left).

The probe assembly can consist of nothing more than

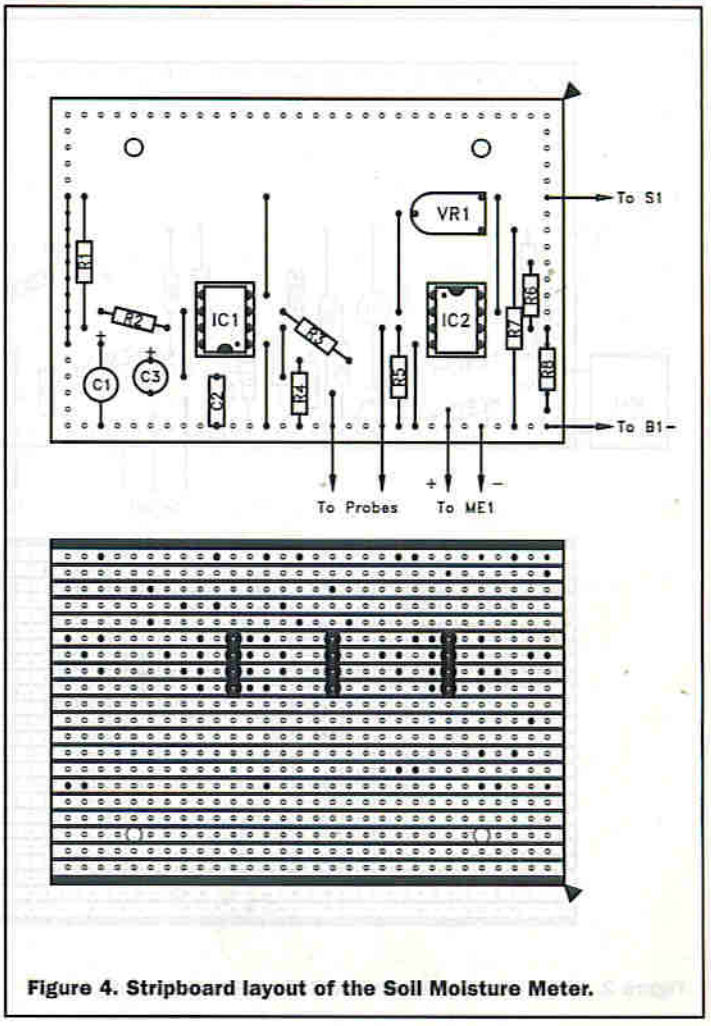


Figure 4. Stripboard layout of the Soil Moisture Meter.

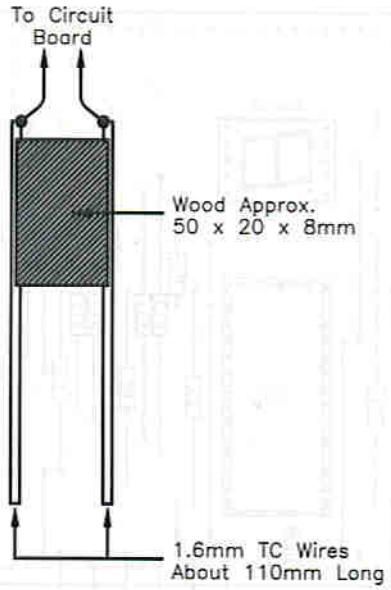


Figure 5. Soil Moisture Meter probe assembly.

two pieces of 1·6mm diameter (16 s.w.g.) tinned copper wire about 110mm long, plus a small block of wood to hold them about 20mm apart (see Figure 5). A miniature round file is used to groove the sides of the wooden block so that the two pieces of wire are easily glued securely in place. Once the wires are in place, placing some bands of insulation tape around the block of wood will help to keep everything in place and will provide a neater appearance. The wires are connected to the circuit board via a screened lead about 0·5m long.

When the completed unit is switched on, there should be no deflection of the meter's pointer. If the bottom 25 to 30mm of the probes are immersed in ordinary tap water, there should be a strong deflection of the pointer, and VR1 is then adjusted to give a full scale reading on the meter. The unit should then have the correct sensitivity, with very moist soils giving high readings, moderately moist soil giving readings of around half full scale, and dry soil giving a low reading. If even slightly moist soil gives quite high readings, reducing the value of R5 to about 1kΩ should cure the problem. In use, the probes should always be inserted about the same distance into the soil, and it might be worthwhile marking them with lines to indicate a suitable depth. The wire probes must be kept reasonably clean if the unit is to continue functioning well.

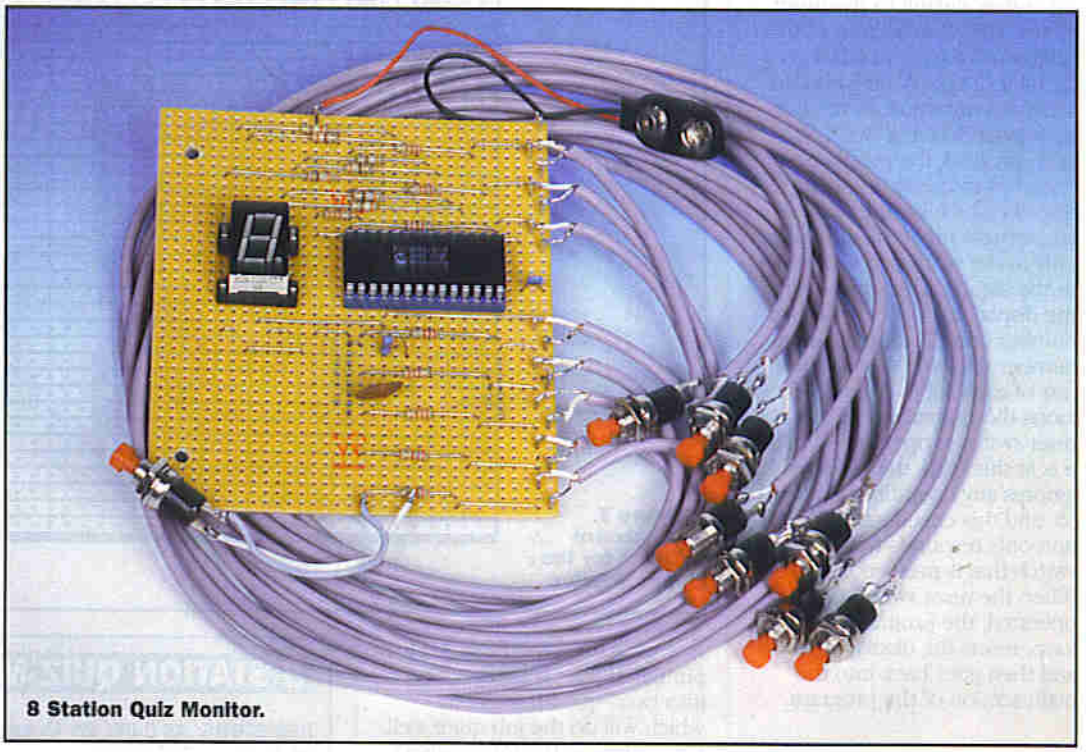
8 Station Quiz Monitor

This unit is an eight station quiz monitor for television style quizzes, where the first person to press his or her button gets the opportunity to answer the question. Rather than an individual indicator light for each contestant, a single seven-segment LED display is used. This displays '0' at switch-on or after the unit has been reset, but it shows the number of the appropriate contestant ('1' to '8') when one of the pushbutton switches is operated. Although a quiz monitor is a fairly simple application, units of this type often end up rather more complex than one would expect. In this case, the circuit has been kept very simple by basing the unit on a PIC16C55 microcontroller.

The Circuit

Figure 6 shows the full circuit diagram for the eight station quiz monitor. The 16C55 has three input/output ports which provide a total of 20 input/output lines. Port A has only four lines, and in this case, only one of them (RA0) is actually used. This is used as an input which monitors reset switch S9, and it is taken high when S9 is operated. The eight lines of Port B are also set as inputs, and these monitor the contestants pushbutton switches (S1 to S8). Operating one of these switches pulls the appropriate input of IC1 low. Port C is used as output lines which drive the seven-segment display via current limiting resistors R10 to R16. Obviously, only seven lines are needed to drive the display, and RC7 is therefore left unused.

The clock speed used is not



8 Station Quiz Monitor.

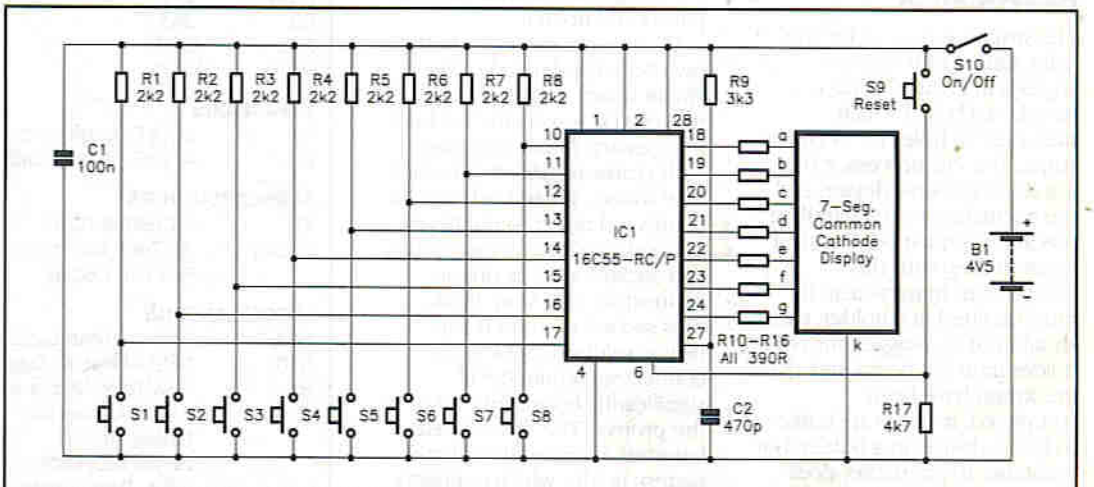


Figure 6. Quiz Monitor circuit diagram.

critical, but it needs to be quite high so that the unit can tell which competitor operated their switch first when two or more switches are operated almost simultaneously. An RC clock circuit together with an RC-P version of the PIC chip are therefore used, with the clock frequency set at about 500kHz by timing components R9 and C2. Power is provided by a 4·5V battery. Even with a fresh battery fitted, the actual supply voltage is well within the 6V maximum for the PIC processor. The current consumption of the circuit depends on the number of display segments that are switched on, but it is in the region of 10 to 35mA.

Software

The initial section of the program (see Listing 1) sets Port C as outputs, and sets the display to read '0'. Port A and Port B do not need any setting up as they default to the input mode. The main section of the program is a loop which tests each bit of Port B, bit-by-bit, to see if a pushbutton switch has been operated. If a switch has been pressed, the program branches to the appropriate one of eight subroutines. These are virtually identical, and differ only in the value that is output to the display. This value sets the display to '1' for contestant number one, '2' for contestant number two, and so on. The rest of each subroutine simply loops the program until the reset switch is operated. While it is in this loop, the program ignores any operations on S1 to S8, and this ensures that the unit only responds to the switch that is pressed first. When the reset switch is operated, the program exits the loop, resets the display to '0', and then goes back into the main section of the program.

Construction

The stripboard layout for the eight station quiz monitor appears in Figure 7. This is based on a board which measures 40 holes by 34 copper strips. The PIC processor (IC1) is a static sensitive device, and the normal anti-static handling precautions must be observed when dealing with this component. In particular, it must be fitted in a holder, and it should not be plugged into the holder until the board and all the wiring have been completed. It is also advisable to fit the display in a holder, but a suitable 10-pin socket does not seem to be available. However, it is not too difficult to improvise something. A 14-pin DIL holder is easily split into two 7-pin SIL holders which will do the job quite well. Simply ignore the four unused pins of the holder.

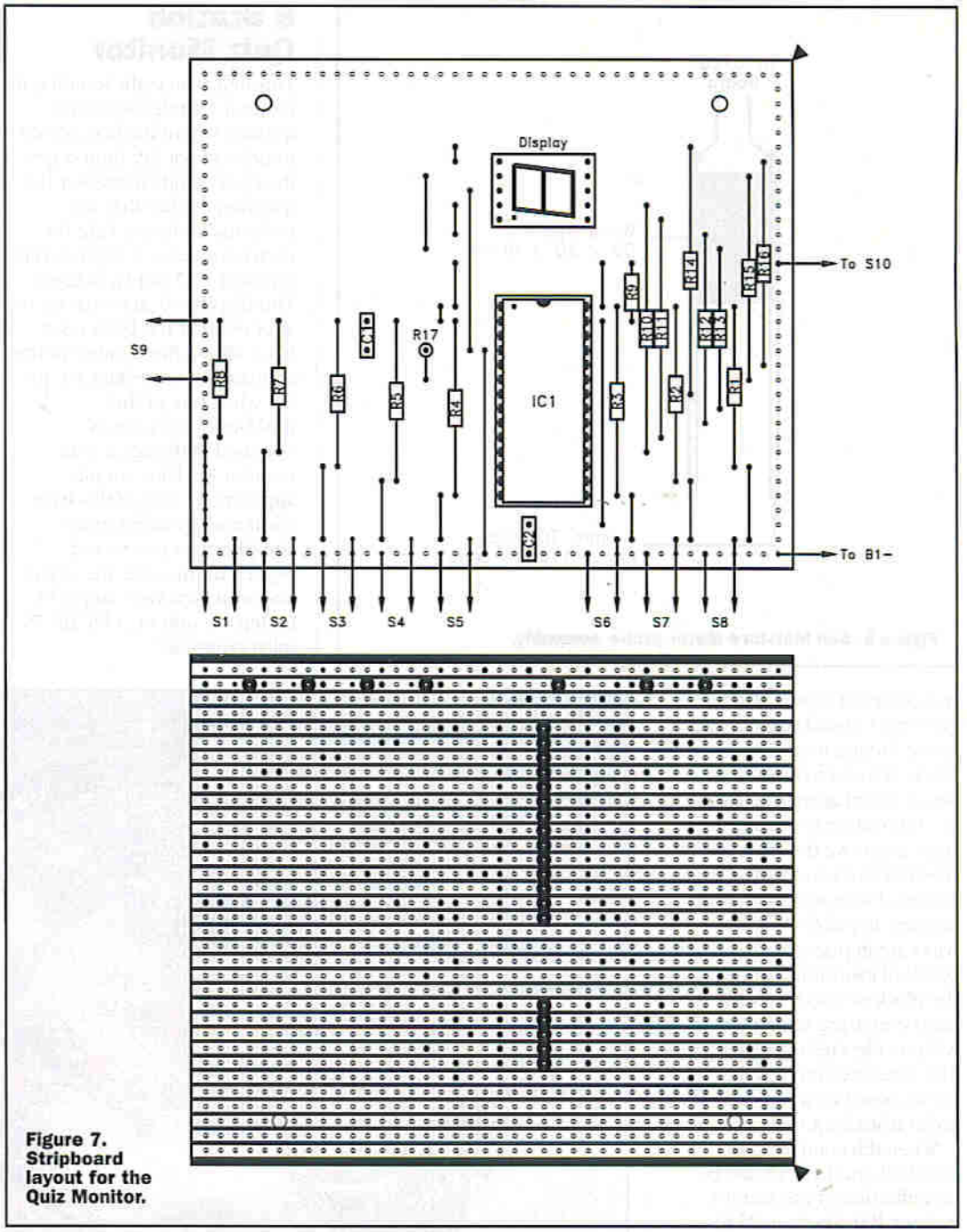


Figure 7. Stripboard layout for the Quiz Monitor.

S1 to S8 are mounted in their own boxes and wired to the circuit board via screened leads that can be several metres long if necessary. A thin screened audio cable is probably the best type to use. These leads can be connected direct to the board, or connected via two way plugs and sockets such as phono connectors or 3·5mm jacks. This second method is the neater solution, but the 16 connectors required will significantly boost the cost of the project. The three AA-size batteries are fitted in a plastic battery holder which connects to S1 and the circuit board via a standard PP3 style battery clip.

8 STATION QUIZ MONITOR PARTS LIST

RESISTORS: All 0·6W 1% Metal Film			
R1-8	2k2	8	(M2K2)
R9	3k3	1	(M3K3)
R10-16	390Ω	7	(M390R)
R17	4k7	1	(M4K7)
CAPACITORS			
C1	100nF Ceramic Disc	1	(YR75S)
C2	470pF Resin-dipped	1	(RA38R)
SEMICONDUCTORS			
IC1	PIC16C55-RC-P	1	(CR18U)
Display	12·7mm Common Cathode Red LED Display	1	(FR41U)
MISCELLANEOUS			
S1-9	Push-to-make Switch	9	(FH59P)
S10	SPST Miniature Toggle Switch	1	(FH97F)
B1	4·5V (3 × AA-size cells)	3	(JY48C)
	Battery Connector	1	(HF28F)
	Battery Holder	1	(YR61R)
	28-pin DIL Holder	1	(BL21X)
	0·1in. Pitch Stripboard, Wire, Solder, Etc.		

```
PORTAEQU        05
PORTBEQU        06
PORTCEQU        07
          CLRW
          TRIS      07          ;Sets Port C as out-
puts
          MOVLW3F
          MOVWFPORTC;Sets display at "0" initially
LOOP      BTFSSPORTB,0    ;Test S1
          CALL      CONT1
          BTFSSPORTB,1    ;Test S2
          CALL      CONT2
          BTFSSPORTB,2    ;Test S3
          CALL      CONT3
          BTFSSPORTB,3    ;Test S4
          CALL      CONT4
          BTFSSPORTB,4    ;Test S5
          CALL      CONT5
          BTFSSPORTB,5    ;Test S6
          CALL      CONT6
          BTFSSPORTB,6    ;Test S7
          CALL      CONT7
          BTFSSPORTB,7    ;Test S8
          CALL      CONT8
          GOTO LOOP       ;Read switches indefinitely
CONT1MOVLW06
          MOVWFPORTC;Set display at "1"
RESET1    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET1
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT2MOVLW5B
          MOVWFPORTC;Set display at "2"
RESET2    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET2
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT3MOVLW4F
          MOVWFPORTC;Set display at "3"
RESET3    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET3
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT4MOVLW66
          MOVWFPORTC;Set display at "4"
RESET4    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET4
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT5MOVLW6D
          MOVWFPORTC;Set display at "5"
RESET5    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET5
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT6MOVLW7D
          MOVWFPORTC;Set display at "6"
RESET6    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET6
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT7MOVLW07
          MOVWFPORTC;Set display at "7"
RESET7    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET7
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
CONT8MOVLW7F
          MOVWFPORTC;Set display at "8"
RESET8    BTFSSPORTA,0    ;Wait for reset
          GOTO RESET8
          MOVLW3F
          MOVWFPORTC;Set display at "0"
          RETLW00
          END
```

Listing 1. PIC Assembly Language Program.

```
:10000000400007003F0C27000607150926071C09BA
:1000100046072309660 72A0986073109A607380912
:10002000C6073F09E6074609040A060C270005072C
:10003000170A3F0C270000085B0C270005071E0A63
:100040003F0C270000084F0C27000507250A3F0C2E
:1000500027000008660C270005072C0A3F0C270024
:1006000000086D0C27000507330A3F0C2700000825
:100070007D0C270005073A0A3F0C27000008070CF3
:1008000027000507410A3F0C270000087F0C2700C6
:0A0090000507480A3F0C270000088E
:00000001FF
```

Listing 2. PIC Object Code.

BUDGET BAT DETECTOR PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (Unless Stated)

R1	2M2	1	(M2M2)
R2	1k	1	(M1K)
R3	6k8	1	(M6K8)
R4	390k	1	(M390K)
R5,7	1M8	2	(M1M8)
R6	4k7	1	(M4K7)
R8	3k9	1	(M3K9)
R9,10	33k	2	(M33K)
R11	15k	1	(M15K)
R12	22k	1	(M22K)
R13	56k	1	(M56K)
VR1	4k7 Logarithmic Rotary Potentiometer	1	(FW21X)
VR2	47k Linear Rotary Potentiometer	1	(FW04E)

CAPACITORS

C1,2	100µF 10V Radial Electrolytic	2	(FF10L)
C3	2n2F Mylar	1	(WW16S)
C4	100nF Mylar	1	(WW21X)
C5,7	10nF Mylar	2	(WW18U)
C6	220nF Mylar	1	(WW83E)
C8	470pF Ceramic Plate	1	(WX64U)
C9	4n7F Mylar	1	(WW17T)

SEMICONDUCTORS

IC1	TL072CN	1	(RA67X)
TR1,2,3	BC549	3	(QQ15R)
D1,2	OA91	2	(QH72P)

MISCELLANEOUS

Mic1	40kHz Ultrasonic Transducer	1	(HY12N)
S1,2	SPST Miniature Toggle Switch	2	(FH97F)
B1	9V (PP3 size)	1	(JY49D)
JK1	3·5mm Jack Socket	1	(HF82D)
	Battery Connector	1	(HF28F)
	Crystal Earphone	1	(LB25C)
	8-pin DIL Holder	1	(BL17T)
	0·1in. Pitch Stripboard, Control Knobs, Wire, Solder, Etc.		

SOIL MOISTURE METER PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (Unless Stated)

R1	10k	1	(M10K)
R2	100k	1	(M100K)
R3	1k5	1	(M1K5)
R4	120Ω	1	(M120R)
R5,7	2k2	2	(M2K2)
R6	68k	1	(M68K)
R8	33k	1	(M33K)
VR1	100k Miniature Horizontal Preset Potentiometer	1	(UH06G)

CAPACITORS

C1	100µF 10V Radial Electrolytic	1	(FF10L)
C2	1nF Polyester Layer	1	(WW22Y)
C3	10µF 50V Radial Electrolytic	1	(FF04E)

SEMICONDUCTORS

IC1	NE555CN	1	(QH66W)
IC2	CA3140E	1	(QH29G)

MISCELLANEOUS

S1	SPST Miniature Toggle	1	(FH97F)
B1	9V (PP3 Size)	1	(JY49D)
ME1	50µA Moving Coil Panel Meter	1	(FM98G)
	Battery Connector	1	(HF28F)
	8-pin DIL Holder	2	(BL17T)
	0·1in. Stripboard, Materials For Probes, Wire, Solder, Etc.		

PROJECT

Catching Data VIA THE GAME PORT

PART 1

Hardware

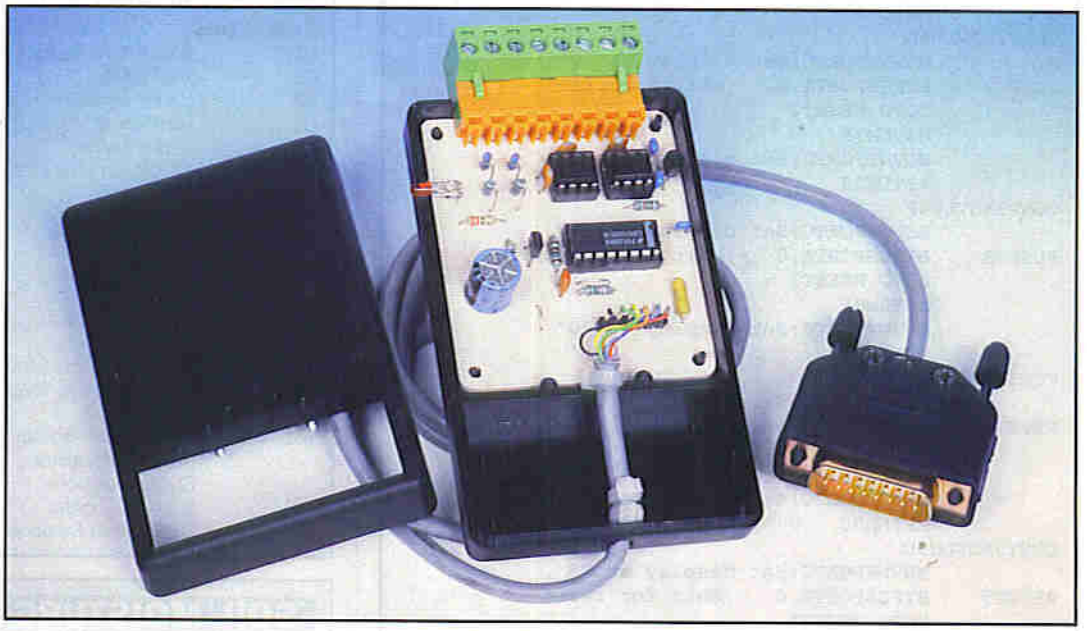
by Dr Pei An

A data logger is a device which enables a computer to catch analogue information from the real world into the computer world. A typical data logging system consists of sensors, A/D converters and computer interfacing circuits.

The sensors convert physical quantities such as temperature, pressure, sound level, light intensity, etc., into voltages; the A/D converters convert voltages into digital numbers and the interfacing circuits allow computers to read these numbers. Data loggers may be in the form of a card which is inserted into the computer's expansion slot. They may also be external devices which are connected to a computer via the Centronic port, the RS232 port or other types of interfaces.

Most desktop PCs have a game port to which a joystick is connected. The game port provides two digital input lines and two analogue input lines. The digital input lines read digital data and the analogue ones measure resistance. Although the port is designed originally for joysticks, it can be used also for other purposes. This article shows a data logger design which utilises the game port. This is illustrated in Figure 1.

This article has two parts. The first part concerns the game port and the hardware design of the data logger. The next part deals with programming the data logger and applications.



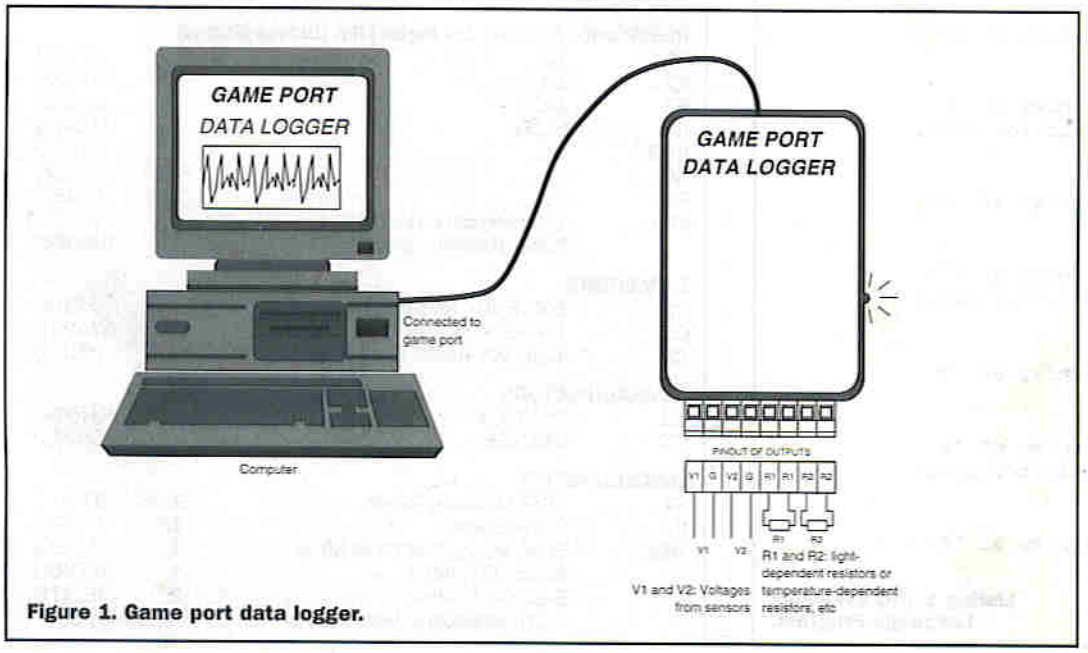


Figure 1. Game port data logger.

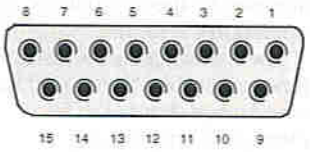
Game Port and Joystick

The game port is housed in a 15-way female 'D' type connector. The pin-out, functions and typical connection are given in Figure 2. Some game ports can support two joysticks. However, most game ports that come with multi-function I/O cards can only support one joystick. Figure 2 shows a game port which drives two joysticks. If the port supports one joystick, pins associated with the second joystick have no function at all.

A joystick has two 100kΩ potentiometers arranged perpendicular to each other to indicate the X and Y positions of the joystick. It also has two normally-open buttons.

Internal Hardware Structure

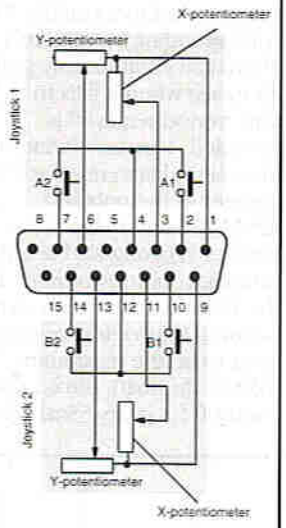
The internal circuit diagram of the generic game port inside a PC is given in Figure 3. The circuit is for connecting two joysticks. The logic structure of the game port is given in Figure 4. We can see that the 8-bit internal data bus consists of 4



(a) Game port connector viewed from the back of a pc
Connector type: 15 pin female D-type

Pin functions of the game port

Pins	Name	Description
1,8,9,15	+5V	VCC from the pc
4,5,12	GND	Ground
2	BA1	1st botton of joystick A
3	AX	X-potentiometer of joystick A
6	AY	Y-potentiometer of joystick A
7	BA2	1st botton of joystick A
10	BB1	1st botton of joystick B
11	BX	X-potentiometer of joystick B
13	BY	Y-potentiometer of joystick B
14	BB2	1st botton of joystick B



(b) Connection of the port pins to external resistors and switches

Figure 2. Pinout, pin functions and the typical connection of the game port.

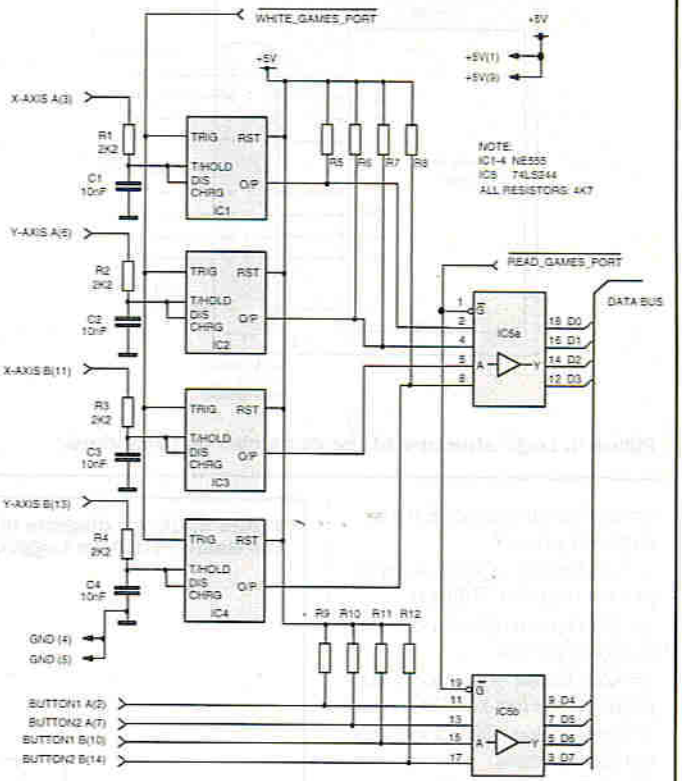


Figure 3. Circuit diagram of the generic game port.

bits from four NE555s via IC5a and 4 bits from the button inputs via IC5b. The four button status inputs are pulled to +5V by four pull-up resistors. The game port is controlled by a CPU I/O port with an address of 201h. Bit functions from bit 7 to bit 0 of the port are shown below.

BB2 BB1 BA2 BA1 BY BX AY AX

BB2: Button 2 of joystick B
BB1: Button 1 of joystick B
BA2: Button 2 of joystick A
BA1: Button 1 of joystick A
BY: 555 monostable of Y potentiometer of joystick B
BX: 555 monostable of X potentiometer of joystick B
AY: 555 monostable of Y potentiometer of joystick A
AX: 555 monostable of X potentiometer of joystick A

The 4 MSB bits (BB2, BB1, BA2 and BA1) can be polled for checking the status of the input lines. The measurement of resistance has a different approach. Monostable circuits based on 555s are applied. The outputs of the 555s are normally low. When writing a byte to the port 201h, –WRITE_GAME_ PORT goes low for a short period of time. The low going edge of the signal triggers the four monostables and BY, BX, AY and AX lines become 1. The 555 monostable has a 10nF capacitor, which is charged via a 2·2kΩ resistor on the game port I/O board and an external resistor which is the potentiometer inside the joystick. If the voltage across the capacitor increases above a threshold level, the output of the monostable outputs 0 instead of 1. The length of the time period at which the output is 1 is solely determined by the external resistance value, assuming that the values of the internal capacitor and resistance are fixed. The time interval and the external resistance are related by the following equation:

The time interval may vary in a range 24·2Ωs for a zero external resistance and 1,124μs for an 100kΩ resistor. However, uncertainties in the internal capacitors and resistors make the equation impossible to use. In practice, a calibration is carried out which involves measurements of one-shot periods when the input resistance is zero and when the input resistance is precisely 100kΩ. A 1% 100kΩ resistor can be used for the purpose.

If a game port only supports one joystick, only two resistance channels and two digital input channels are available from the port.

Software Control

In the QBASIC programming language, there are two instructions which are specific to the game port. One is the 'STICK(x)' function and the other is the 'STRIG(x)' function.

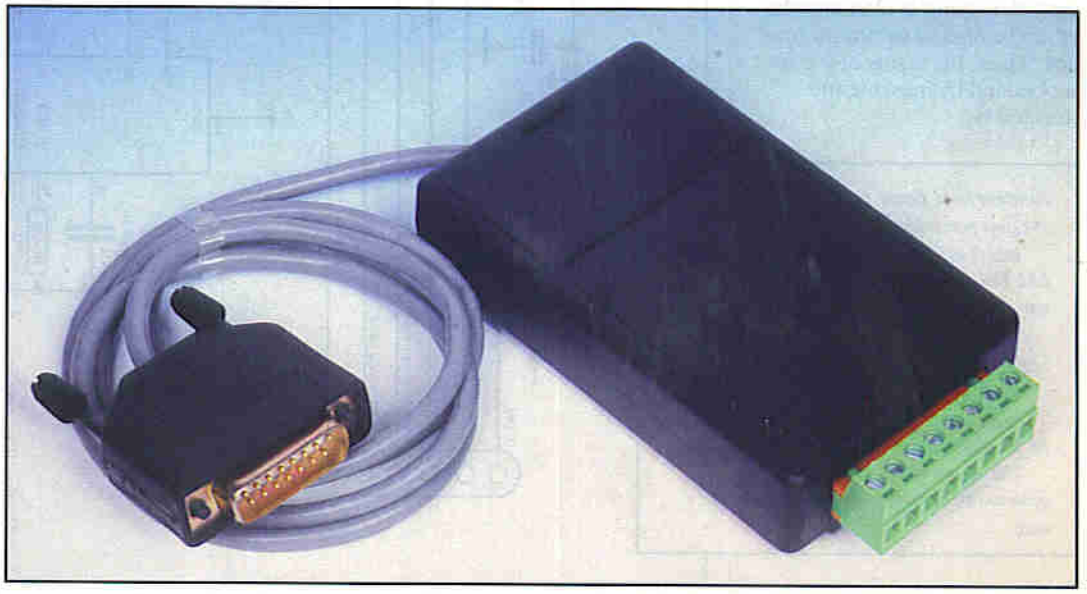
For the STICK function, x can be a value of 0, 1, 2 or 3, and is used to read X and Y potentiometers of joystick A and B.

x=0 read X coordinate of joystick A
x=1 read Y coordinate of joystick B
x=2 read X coordinate of joystick A
x=3 read Y coordinate of joystick B

When using the instruction, you must call STICK(0) first before you call STICK(1), STICK(2) or STICK(3). STICK function returns a coordinate value which varies from 6 for zero resistance to about 150 for 100kΩ resistance.

STRIG(x) returns -1 if the condition is true. It returns 0 if the condition is not true; x can be a value of 0 to 7 and is used to select a specific joystick button status condition.

x=0 1st button of joystick A was pressed since last STRIG(0)
x=1 1th button of joystick A was currently pressed
x=2 1st button of joystick B was pressed since last STRIG(2)



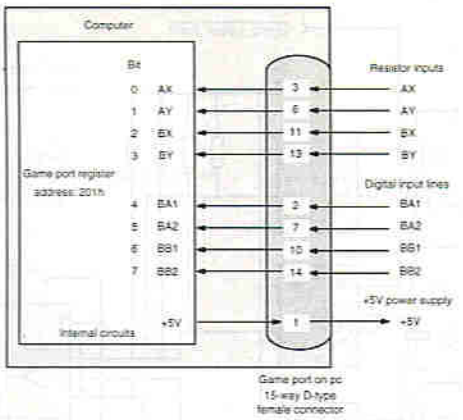


Figure 4. Logic structure of the game port on computers.

To determine the resistance value, firstly, you output a byte to the 201h port so as to start the one-shot monostable. The corresponding bit rises to 1. Then, you continuously poll the bit to see when it falls to 0. The time period required is recorded. The way to find the time period is to use the third counter of the onboard 8253/8254 timer chip. This counter is configured as a free-running countdown timer. If the 16-bit time constant (which is stored in two 8-bit registers) is set to be the maximum (65,536 decimal), the counter counts 0 for every 55ms. The time interval associated with the joystick port is always smaller. Only counter 3 can be used for this purpose. Counters 1 and 2 are used by the computer's operational system.

The following Turbo Pascal 6 function enables the period for a resistance channel to be measured. The channel is specified by x. The function issues a port write operation to the game port using port [$201]:=0 to start the monostables. Immediately following this, the value in the 3rd 8254 counter is read and is assigned to a variable, Time1. Next, a looped procedure

x=31st button of joystick B was currently pressed
x=42nd button of joystick A was pressed since last STRIG(4)
x=52nd button of joystick A was currently pressed
x=62nd button of joystick B was pressed since last STRIG(6)
x=72nd button of joystick B was currently pressed

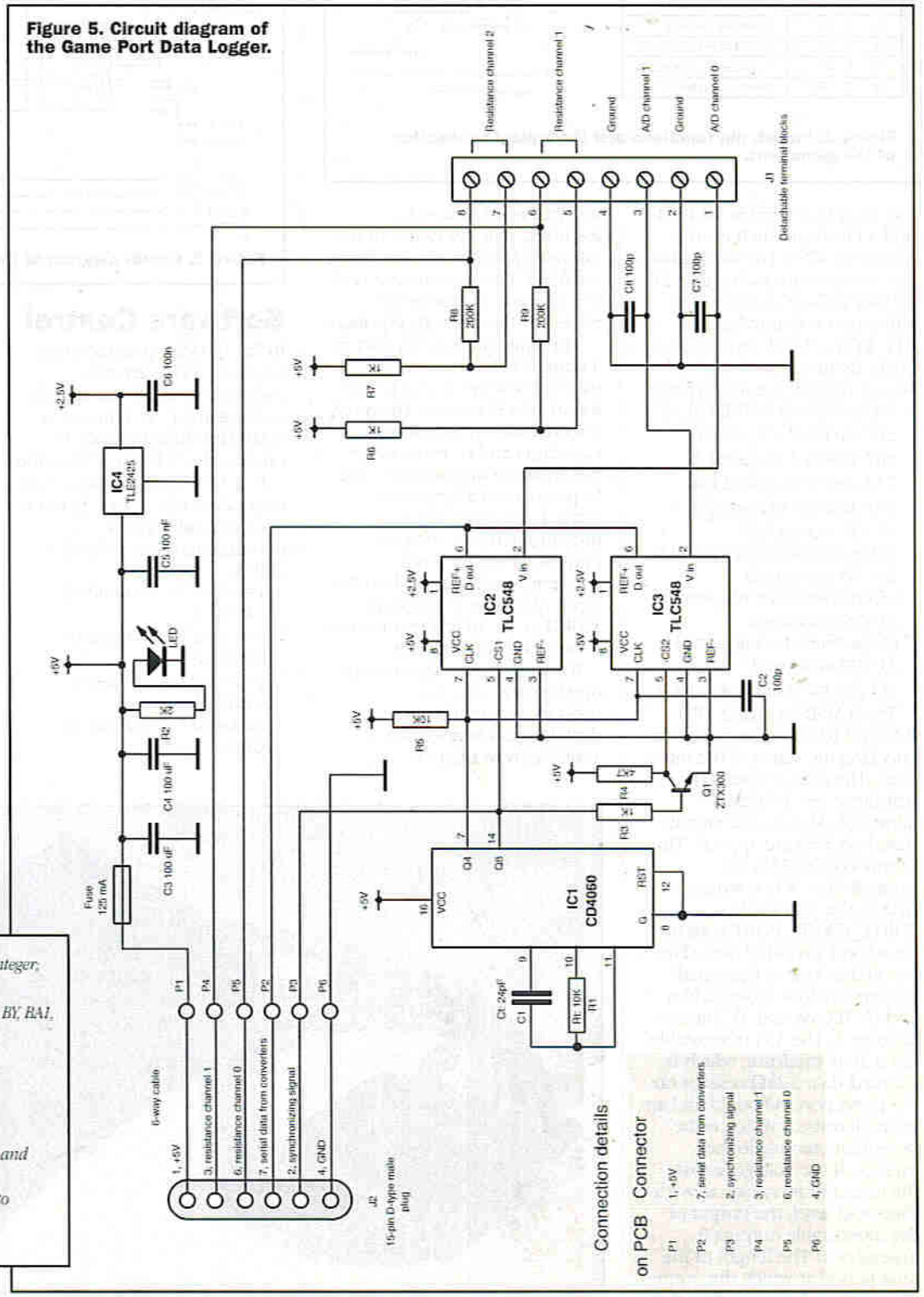
The following QBASIC program prints the X and Y coordinate values of joystick A on the screen and shows the status of the two buttons:

```
10 dummy=STICK(0)
20 print "Coordinate of X: ", STICK(0)
30 print "Coordinate of Y: ", STICK(1)
40 print "Current status of 1st button: ", STRIG(1)
50 print "Current status of 2nd button: ", STRIG(5)
60 end
```

In the Turbo Pascal 6 programming language, there are no special instructions to the game port. A PORT instruction is used instead. The following TP6 function returns the status of a particular bit of the game I/O port specified by a variable Bitx. The content of the joystick register is read into the PC and assigned to "Input_byte" first. Then, the status of the bit is obtained by masking the selected bit.

```
Function Read_Game_port(Bitx:integer):integer;
(* Game port address: 201H
   Bitx (1 to 8) selects status of AX, AY, BX, BY, BA1, BA2, BB1 and BB2 *)
var
   input_byte:byte;
begin
   input_byte:=port[$201];
   Read_game_port:=round((input_byte and bit_weight(bitx))/bit_weight(bitx));
   {bit_weight is a user-defined function to generate the bit weight of a bit}
end;
```

Figure 5. Circuit diagram of the Game Port Data Logger.



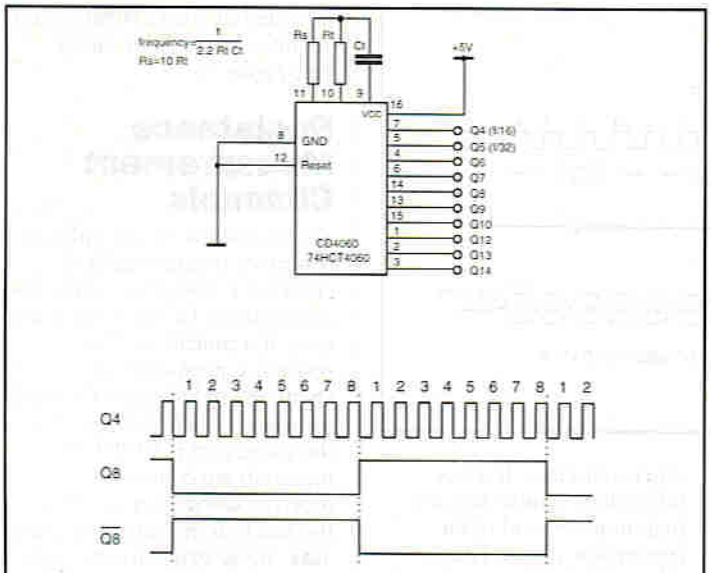


Figure 6. 4060 basic circuit and timing sequence of Q4 & Q8.

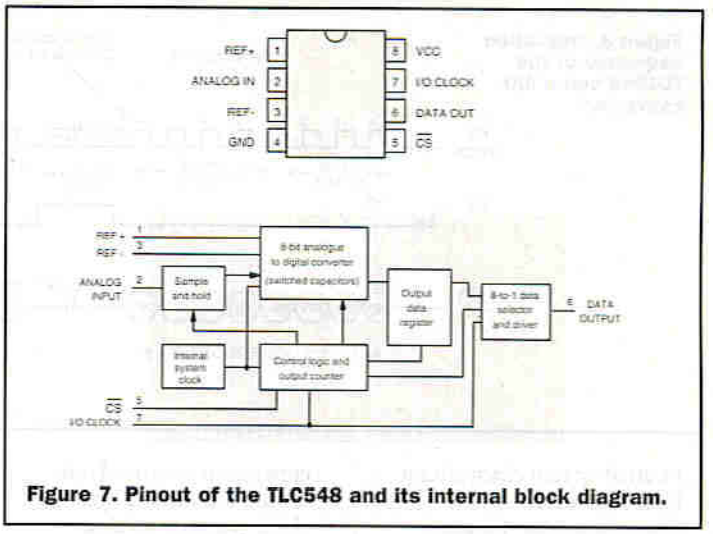


Figure 7. Pinout of the TLC548 and its internal block diagram.

continuously checks if the associated register bit goes low. As soon as it goes low, the 8254 counter is read again and the value is assigned to another variable, Time 2. The time interval is then calculated. The function uses two other function/procedures. One is the Procedure init_8254. It writes the timer constant to the 3rd counter of the 8254 and configures it as a free-running counter. 'Read_8253' is a function to read the high- and low-order bytes of the counter and to combine the two bytes into a single value.

```
Function Interval_Game_port(x:integer):integer;
(* x selects AX (x=1), AY (x=2), BX (x=3), BY (x=4) *)
var
    Time1, Time2, dummy: integer;
Procedure init_8253;
(* Initialize 8253 *)
begin
(* Control word= b6H = 10110111b
    10 = select counter 2
    11 = read/write low count byte first then high byte
    011 = mode 3
    0 = binary counting with 16-bit *)
    Port[$43]:=$b6; (* load control word to the control register of 8253 *)
    Port[$42]:=255; (* load low count byte *)
    port[$42]:=255; (* load high count byte *)
    port[$61]:=port[$61] or 1; (* disable speaker *)
    port[$43]:=$80; (* 80H is the counter latch command for counter 3 *)
end;
Function read_8253:integer;
(* read low order and high order bytes of the counters *)
var
    low_byte, high_byte:byte;
begin
    low_byte:=port[$42];
    high_byte:=port[$42];
    read_8253:=low_byte + 256* high_byte;
end;
Var
    i:integer;
begin
    init_8253;
    for i:=1 to 100 do i:=i;
    i:=0;
    dummy:=bit_weight(x);
    port[$201]:=0;
    Time1:=read_8253;
    repeat i:=i+1 until (port[$201] and dummy=0) or (i>=5000);
    Time2:=read_8253;
    Interval_game_port:=time1-time2;
    if i>=5000 then Interval_game_port:=0;
end;
```

Game Port Data Logger

The game port data logger consists of a timing unit which is based on a CD4060 ripple counter (IC1), an A/D converter unit which consists of two TLC548 8-bit serial I/O A/D converters (IC2 & IC3) and a resistance input unit. The complete circuit diagram is given in Figure 5.

The Timing Circuit

The timing circuit uses a CD4060 14-stage ripple counter. It has an R-C oscillation configuration. The CD4060 has an onboard oscillator which requires a timing capacitor, Ct, and a resistor, Rt. The capacitor is 24pF and the resistor is 10kΩ. A 40kHz signal is generated at pin 7 (Q4 output) and a 2·5kHz signal is generated at pin 14 (Q8 output). For every 8 pulses generated at pin 7, the output at pin 14 change status. The pinout of the CD4060 and the output timing sequences of Q4 & Q8 are given in Figure 6. Q4 drives the CLK inputs of the two A/D converters (ICs 2 & 3). Q8 is connected to the -CS input of the 1st TLC548 (IC2). It is inverted by the ZTX300 (Q1) and is connected to -CS of the 2nd TLC548 (IC3). For each converter, the falling edge of the -CS initiates an A/D conversion. This arrangement therefore enables the two A/D converters to work in turns. The Q8 is also fed into the computer via one digital input line of the game port. This allows the computer to synchronise its reading procedure with the operation of A/D converters so as to make the data reading in tune with the serial data output from the A/D converters.

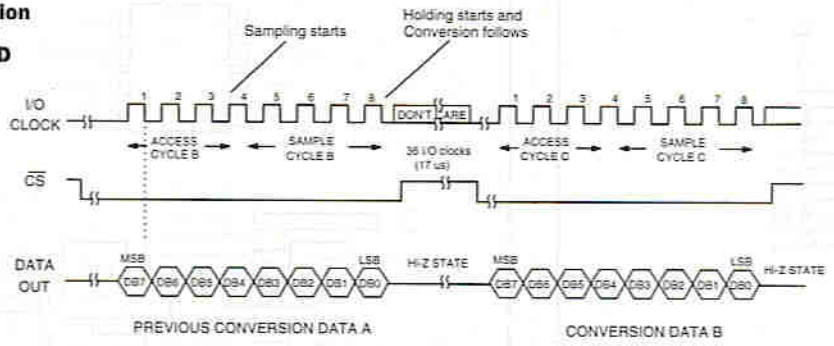
TLC548 A/D Converter

The TLC548 A/D converter is a LinCMOS 8-bit switched-capacitor successive-approximation A/D converter. It has an onboard sample-and-hold circuit, an onboard 4MHz system clock generator and a serial I/O interface. The TLC548 is able to sample 45,500 times per second. The pinout of the IC has been shown in Figure 7. Pin 8 (VCC) and Pin 4 (GND) are connected to the positive and negative rails of the power supply. The range of the power supply voltage is between 3 to 6V with a typical current assumption of 1·9mA. Pins 1 and 3 (REF+ and REF-) are connected to an external band-gap voltage reference. REF- and GND are normally wired together.

The serial I/O interface of the converter consists of two TTL-compatible control lines, the I/O Clock input (I/O CK, Pin 7) and Chip select input (-CS, Pin 5) and one 3-state data output line (DATA OUT, Pin 6). The system clock and the I/O clock operate independently and do not require any special speed or phase relationships between them. This simplifies the interfacing with other circuits. The interfacing hardware and software need only to concern with initiating the conversion and reading the data by using the I/O CLK and -CS. The operational sequence is explained below and is shown in Figure 8.

1. When -CS is high, the data output line is at high impedance state. It also disables the clock input, I/O CLK. -CS goes low to start a read cycle. To minimise errors caused by noise at the input, the internal circuitry waits for two rising edges and then a falling edge of the

Figure 8. Operation sequence of the TLC548 serial A/D converter.



internal system clock after a high-to-low transition is detected on the -CS pin, before it is accepted. The MSB of the previous conversion result (DB7) automatically appears on the DATA OUT pin.

2. The falling edges of the first four I/O CLK shift out DB6, DB5, DB4 and DB3 of the previous conversion result on the DATA OUT pin. The on-chip sample-and-hold begins sampling an analogue input after the 4th falling edge of the I/O CLK.

conversion is carried out during the next 32 system clock cycles. In total, a complete A-to-D conversion takes 36 internal system clock cycles. During the conversion, either -CS must go high or the I/O CLK remains low for at least 36 system clock cycles. -CS can be kept low during multiple conversion, however, special care must be taken to prevent noise from getting into the I/O CLK, which otherwise causes the device and the external interface circuit to lose synchronisation. If -CS is taken high, it must remain high until the end of the conversion. A valid falling edge of -CS will cause the device to reset and to abort the conversion in progress.

It can be seen that the timing sequences of CLK and -CS required by the TLC548 can be provided by the CD4060 timing circuit as mentioned earlier (see Figure 6).

Resistance Measurement Channels

The circuit associated with the resistance measurement channels is designed so that the channels can be calibrated with ease. If terminals for the resistance measurement channels are left open, the total external resistance applied to the game port is 101kΩ. If terminals are connected together using a copper wire, the external resistance becomes 1kΩ. These two extreme cases are used for calibrating the resistance measurement channels. After the calibration, resistance can be measured.

If an unknown resistor (R) is connected to the terminals, it is

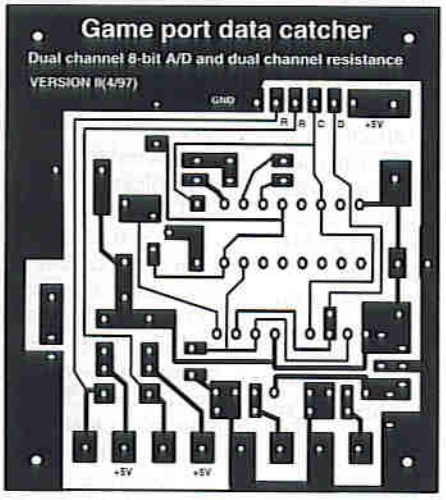


Figure 9. PCB artwork.

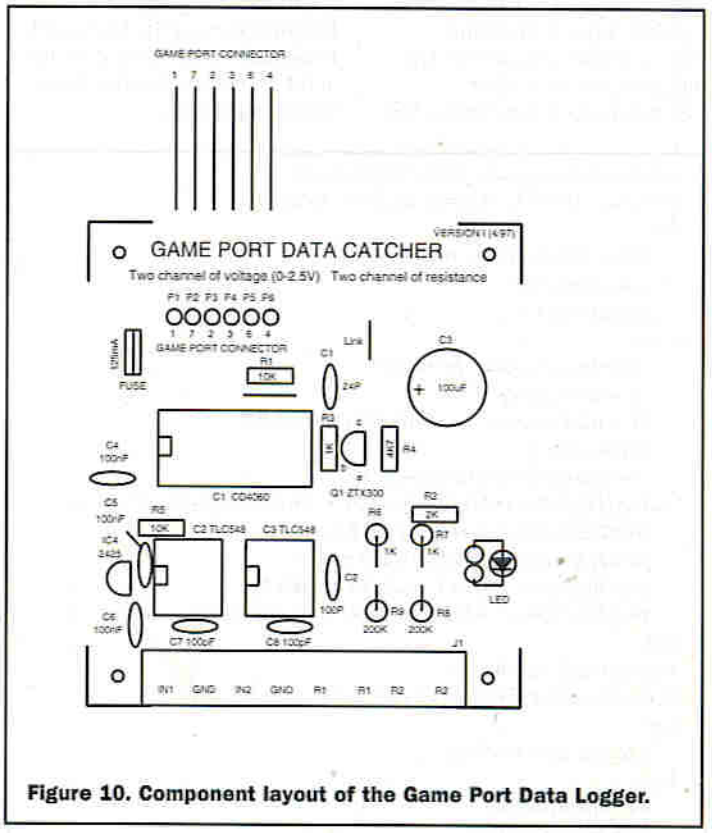
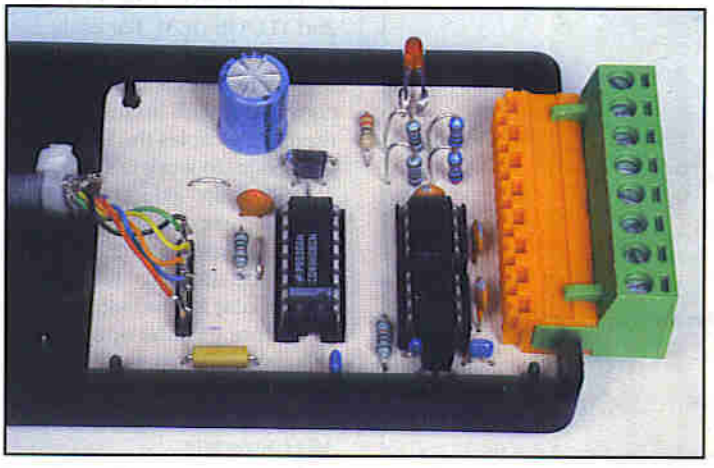


Figure 10. Component layout of the Game Port Data Logger.

3. Three more clock cycles are applied to the I/O CLK, DB2, DB1 and DB0 of the previous conversion result are shifted out at each falling edge of the I/O CLK.

4. The final (8th) clock cycle is applied to the I/O CLK. The falling edge of this clock terminates the sample process and initiates the hold function. The hold function continues for the next four internal system clock cycles. After that, the hold function terminates and A-to-D



in parallel with the 200kΩ resistor first. Then they are connected to the 1kΩ resistor in series. The total external resistance is measured by the computer first. Then it calculates the actual resistance value of the resistor which is connected between the two terminals.

Power Supply System

The power supply to the data logger comes directly from the +5V power supply within the PC and is available at the port

connector. The maximum current available is not high. An excessive current drawn from the port may cause the PCB tracks on the internal I/O card to be overheated and may result in a permanent damage to the I/O card. To prevent this, a 100mA resettable fuse is used to limit the current usage. The +5V DC is converted to 2·5V (±0·8%) using a TLE2425 voltage reference (IC4). The voltage is the reference voltage to the A/D converters.

All the inputs are connected to an 8-way detachable terminal block. This provides a convenient way for connecting or disconnecting leads to the data logger. The connection to the game port of PCs is a 15-way male D-type connector which comes from the data logger via a 6-core screened cable.

Construction

The artwork of the PCB board is given in Figure 9 and the component layout is given in Figure 10. The PCB board is housed in a slim size ABS box. The suggested cutting of the box is shown in Figure 11. There are no adjustments needed for the assembled board. Once all the components are properly mounted, the logger will work.

Next Issue

The next issue deals with software programming of the game port data logger and some application ideas using the logger.

Technical Support

The designer's kit is available from the author. The kit consists of all the hardware for readers to construct. Source code and EXE file in Turbo Pascal 6 are provided on a 3½in. floppy diskette. The price of kit is £39 including postage and packing. The assembled and tested units are £48 each. Please direct your enquiry to Dr. Pei An, 11 Sandpiper Drive, Stockport, Manchester SK3 8UL. U.K. Tel/Fax/Answer: +44-(0)161-477-9583. E-mail: **pan@fs1.eng.man.ac.ik.**

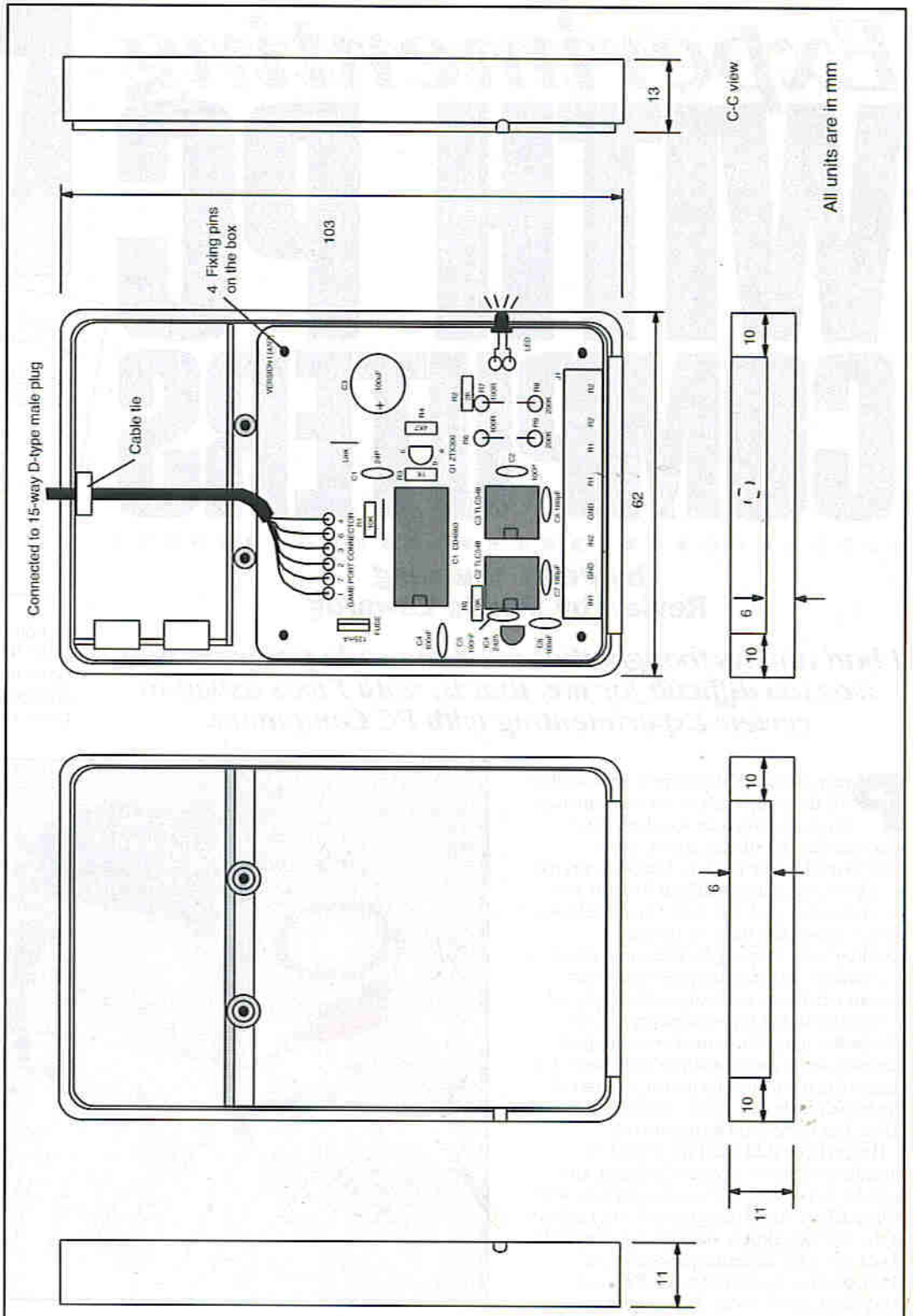


Figure 11. Cutting details of the case and the assembly of the logger.

PROJECT PARTS LIST

RESISTORS (All 0·6W, 1% Metal Film)

R1,5	10k	2	(M10K)
R2	2k	1	(M2K)
R3,6,7	1k	3	(M1K)
R4	4k7	1	(M4K7)
R8,9	200k	2	(M200K)

CAPACITORS

C1	24pF Ceramic Disc	1	
C2,7,8	100pF Ceramic Disc	3	(WX56L)
C3,5,6	100nF Ceramic Disc	3	(YR75S)
C4	100µF 16V Radial Electrolytic	1	(AT40T)

SEMICONDUCTORS

Q1	ZTX300	1	(QL46A)
IC1	CD4060	1	(QW40T)
IC2,3	TLC548	2	(GX06G)
IC4	TLE2425CLP	1	(CR12N)

MISCELLANEOUS

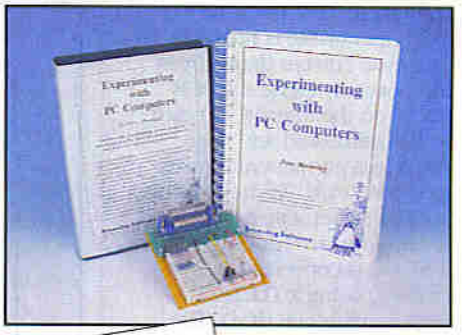
Fuse	125mA Resettable Fuse	1	(DA50E)
J1	8-way Detachable Screw Terminal	1	(CP48C and KC27E)
J2	15-way D-type Male Plug	1	(BK58N)
Cable	6-way Screened Data Cable	As Req.	(XR26D)
Box	Pocket-size ABS box	1	(KC95D)
	Software Disk	1	* See Text *

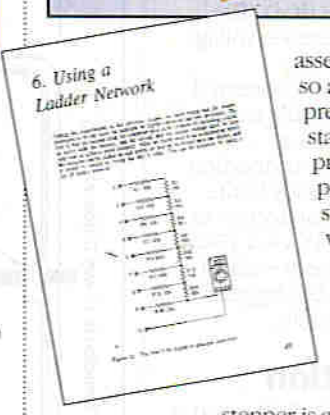
For kit details, see text.

Experimenting WITH PC COMPUTERS

by Peter Brunning
Review by Martin Edwards

I had always thought that machine code programming was too difficult for me, that is, until I was asked to review Experimenting with PC Computers.





Peter Brunning, the author, reckons that the usual approach to assembly language programming is far too theoretical, which makes the subject appear more complicated than it really is. English grammar, he says, is much more difficult to learn and yet children as young as 2 or 3 years old have quite a reasonable grasp of the basics. Children learn to speak by being immersed in the subject, and are only given grammar lessons when they are really quite advanced.

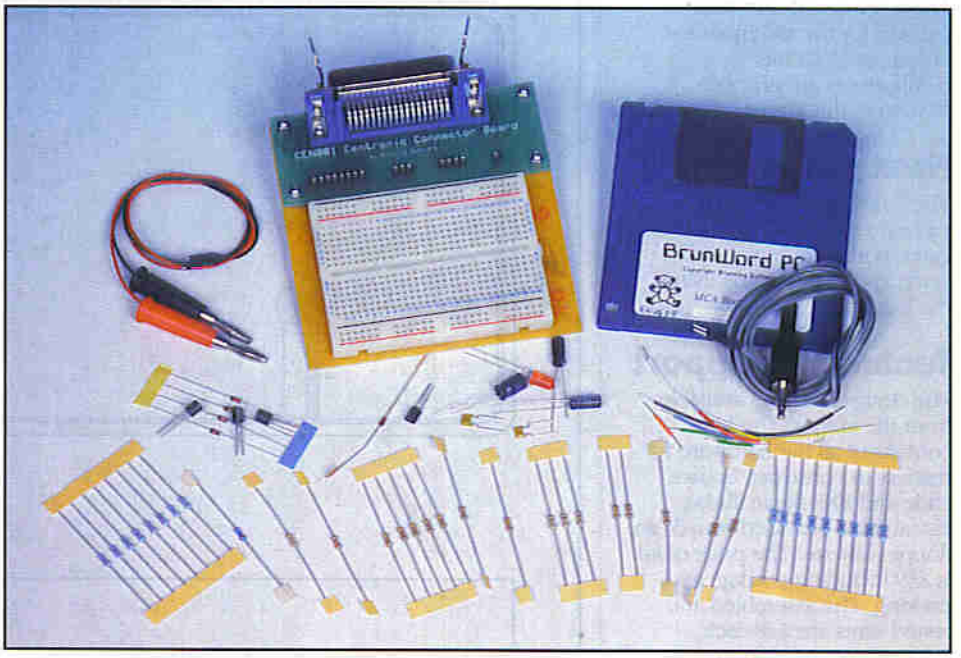
The idea is that *Experimenting with PC Computers* applies this natural technique to teaching about programming. There are a few pages of general introduction at the start of the book which give a hint of what it is all about, but there is no formal theory.

Having been told that I must read the introduction before I begin, I did that, and found it to be written in an easy, friendly style which did not stretch my grey cells. So, I arrived at the first experiment still knowing very little about assembly language programming although I had gained a feeling for what computers are all about. Experiment 1 uses a very simple circuit of one resistor and one light emitting diode (LED). The book leaves no room for misinterpreting the construction instructions. There is a circuit diagram, a layout diagram and a list of written instructions.

I bent and trimmed the resistor, copying the diagram in the book, and pressed it into the correct sockets with the help of a small pair of pliers. I fitted the LED and the white link as instructed, and the circuit was ready for the first experiment. I found it a particularly neat idea that the links are colour coded according to their lengths.

The next stage is to type in the programme to turn the LED on, which is a simple four line programme:

```
mov dx,378h
mov al,1
out dx,al
int 20h
```



As instructed, I typed the second line using 601 instead of 1 and on pressing RETURN, the computer gave a two tone beep. The book tells us this is because the number is too big for the register but that we must not worry about why it is too big. Normally, following a beep, we would check our typing and correct the error immediately, but we are told to leave the error in this first programme.

When I had typed the four lines, I pressed ESC A then C to assemble the *Current* text into machine code. An error box immediately popped up, saying *Number too big* and the cursor was positioned in the second line on the 6 of 601. The assembler and the text editor are the same programme, so there is no messing about. To correct the error, I simply had to press the DEL key twice.

The second time the programme assembled correctly, so as instructed, I pressed ESC O to start the *Operate* process. A box popped up showing the values in the registers and a long cursor spanned across the first line of programme text (the single stepper is also part of the editor/assembler). I pressed the F1 key three times to single-step the new programme and watched the numbers change in the register box. And on the third press, the LED lit up.

The next four experiments use the same circuit but expand the software to show us how to programme a simple timer loop to make the LED flash, and how to use subroutines. At the end of the fifth experiment, I felt that I had become a programmer! This is a gross exaggeration, but the system does create a feel-good factor. When you do it in such a practical way, it all seems so very obvious.

In the third chapter, we experiment with a simple Digital-to-Analogue convertor, and again I found it very easy to follow the reasoning. Admittedly, the arguments are kept fairly brief, but there is enough explanation to understand how the circuit works. The software starts to look more involved, although it is not too difficult to follow the general idea, and that is all we beginners are

expected to do.

In chapters 4, 5 and 6, we try out various improved circuits for the D/A convertor until almost perfect results are obtained. While I cannot say that I fully understand why the final circuit should be better, there is no doubt from the experiments that we did arrive at a really good circuit.

Chapter 7 dives off into some circuit design theory which we are told to read through without trying too hard. We add three transistors and a few resistors, and our circuit becomes an Analogue-to-Digital convertor. A few more experiments and then in chapter 8, we type in very basic software for vertical and horizontal scanning.

At this point, our PC effectively becomes a simple oscilloscope and we use it to display various charging curves of a capacitor. I found the experiment with the constant current generator particularly interesting. If the Analogue-to-Digital converter is linear, as mine was, then a perfectly straight line is displayed diagonally across the screen.

Chapter 9 explains how successive approximation can be used to speed up the conversion rate of our A/D convertor, and adds software so that our oscilloscope is automatically triggered. In chapters 10, 11 and 12, we find out how to use a thermistor to measure temperatures and how to use our circuit to plot temperature graphs. I am sure this would be suitable for experienced engineers. We beginners are reminded that we are only expected to follow the general idea. The final system uses the VGA mode of our PC, with graticule lines in blue, dark blue and with a red zero line. The actual temperature graph is bright yellow, making the overall appearance very professional. By the end of chapter 12, I felt a real sense of achievement.

The last three chapters take us into the world of audio manipulation. Admittedly, we do not get very far into this very involved subject, but certainly, all the basics are covered. We start by using our PC oscilloscope to display the audio signal from a cassette recorder or radio. Then we are introduced to waveform analysis by adding different frequencies together to create waveforms such as a square wave. Finally, we look at how to analyse waveforms using a mathematical approach, and although this might sound rather too complex, it is done in a way that I found very interesting. We are not expected to understand how the system works but simply to apply the system.

For the purpose of this review, I went through the experiments rather faster than I should have, bearing in mind that I was a complete beginner. There was no problem with the first 8 chapters, but I should have stopped for a few days at that point to allow my brain to catch up, and then proceeded more slowly. From chapter 9 onwards, brain straining new concepts seem to be on every second page. I know that really it was not like that, but we are certainly taken to a very high level from a zero beginning. The explanation at the start tells us that this will happen and that we must just let the ideas flow through our minds rather than trying to understand everything that we do.

If you are a complete beginner, you will need to take it much more slowly than I did. As the author says, "My explanations will always be fundamentally simple to understand, but new concepts are notoriously difficult to grasp. Time is the only weapon to combat this, so use it to the full."

Yes! *Experimenting with PC Computers* gets my seal of approval. Even at the pace that I hurtled through the book, I have gained an incredible insight into programming, and I found the Analogue-to-Digital converter design little short of brilliant in its simplicity. I can only repeat that I wish that I could have taken three or four months rather than my quick burst of just 4 weeks.

Overview

The book *Experimenting with PC Computers* is £24 and as well as teaching you how to programme, it is a mine of information on programming techniques, and there is a 100-page programmers' reference section at the back containing everything you need to know to write your own programmes. The book is printed on quality paper and finished with wirobinding so that it always opens flat. This is a book that you will not regret buying, and you will use it for reference for many years to come.

The kit of parts can be purchased for £39.99. The kit needs the plugboard and the leads to be assembled and soldered before you can start. The kit includes the BrunWord Machine Code Assembler which I found to be an excellent programme, particularly as the editor, assembler and single stepper are all combined into one programme.

The book (Order Code NV68Y; £24.00) and the kit (Order Code NV67X; £39.99) can be ordered from Maplin from September 1997, but do take note that the kit does not include the book, so you will need to order the book and the kit.

The Information ECONOMY

PART 2

The Publishing Industry

by Stephen Waddington

Ever since the emergence of the Internet as a business tool, analysts have predicted the demise of the publishing industry. The counter claim is that technology is in fact set to drive the sector into new markets, creating new revenue and employment opportunities. Here, Stephen Waddington examines both sides of the argument and takes a look into the future.

It's three o'clock in the afternoon. I have just logged off from my AOL account, having spent the last hour or so browsing the Web. During my time online, I've visited servers in Boston, Palo Alto, Sydney and London. Amongst the three megabytes of data I've downloaded is the script of the movie *Silent Witness*, Pi to a million digits, a complete copy of the bible and the last months' worth of Hansard – the daily record of debate in the UK parliament.

You could be forgiven for thinking that I'm a hacker trying to exploit the copyright laws. In fact, this is the brave new world of electronic publishing, where a PC user equipped with a modem can access many of the national newspapers online moments after they hit the press, where pictures of Mars from the Pathfinder Rover – as shown in Photo 1 – can be browsed with the same familiarity as an album of family snaps, and where individuals can read about international events as they happen by logging onto a newswire service located at the other side of the globe.

Photo 1. Photos from the Mars Pathfinder Rover can be viewed with the familiarity of family snaps using the Web.

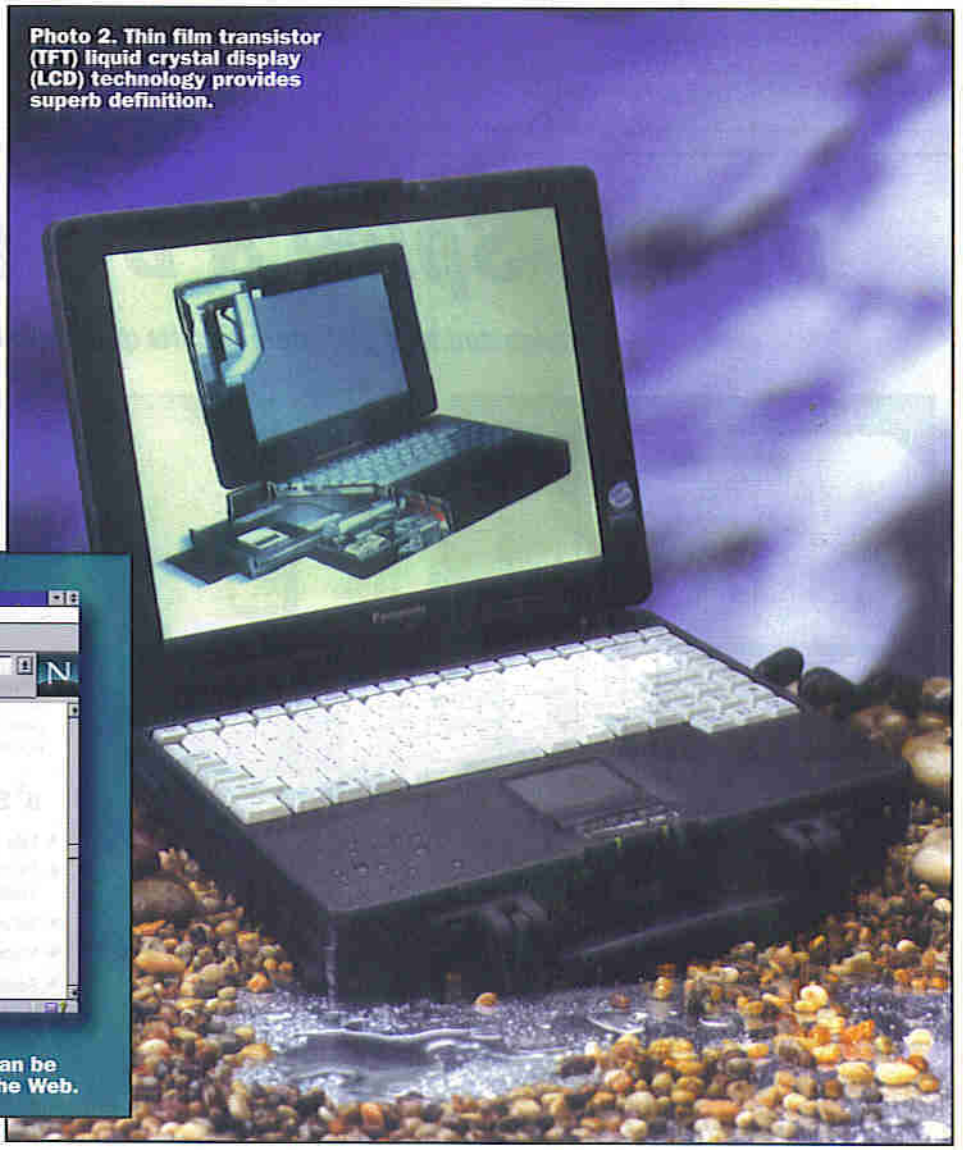


Photo 2. Thin film transistor (TFT) liquid crystal display (LCD) technology provides superb definition.

Immediacy and Interaction

The big shift we're observing in the media as we head towards the end of the century centres around the immediacy of information and the interaction between individuals and organisations that Internet allows. Information published on paper is, by its nature, static. It stays constant through time. By contrast, digital information is dynamic, can be delivered in real time and enables user interaction. It can be recognised by other software applications and can be reused or manipulated in as many forms as creativity allows.

Although the union of electronics and publishing is not a recent development, it has previously been mutually beneficial. Computers were used to desktop publish newsletters and magazines which were eventually delivered to the reader on paper. Computers were used to search lists of documents by researchers, but eventually, the physical document arrived in the readers hands.

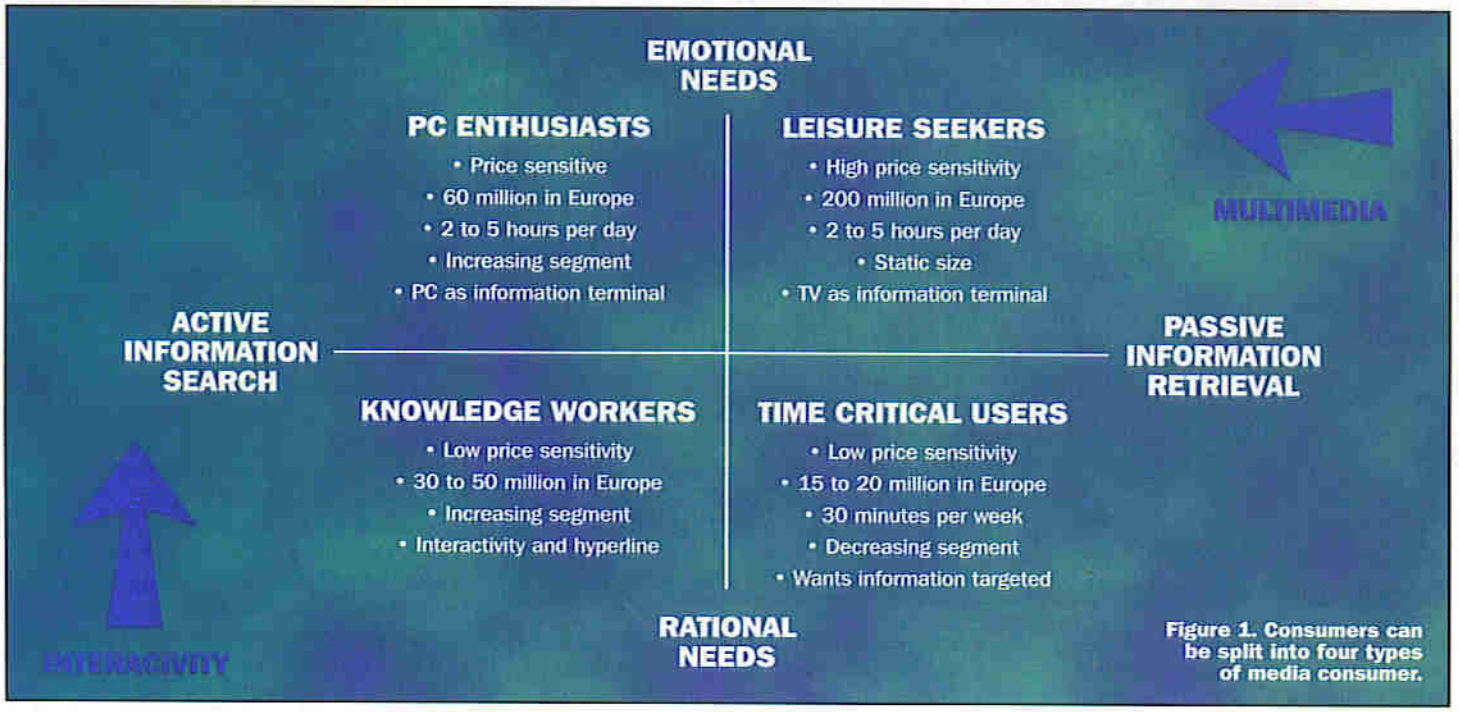


Figure 1. Consumers can be split into four types of media consumer.

Technological Advances

Previously, no-one wanted to read information on computers. Bulky, low quality monitors gave readers eye strain after a couple of hours use and were no replacement for the mobility and flexibility of newspapers or magazines. Rigid search techniques meant it was difficult to locate documents unless you knew either the exact title or author. Free form or themed searching was simply not an option.

Of course, this has all changed. Notebook Computers typically weigh in at under five pounds and thin-film transistor (TFT) liquid crystal display (LCD) technology provides superb definition, as shown in Photo 2. Users connected online via the Internet are able to use sophisticated search engines to locate information using keywords or search themes.

Publishing Study

As a first step to predicting the dynamics of the publishing sector into the next century, let's examine the audience which it addresses. A European Union report on electronic publishing, published in October 1996, split consumers into four groups, as shown in Figure 1. These groups can be broadly categorised as follows:

Knowledge Workers

There are 31 million of these types of individual in Europe. Knowledge workers use all types of media as a tool to make judgments and form opinions. These individuals are typically opinion formers such as brokers, analysts, journalists and academics.

PC Enthusiasts

The majority of the readers of *Electronics and Beyond* probably fall into this group of 24 million individuals across Europe. PC Enthusiasts live and breathe technology for technology's sake. They are driven by curiosity and are highly innovative. Their news sources include the Internet, trade publications and possibly satellite.

Time Constrained

Business users fall into this category of 16 million individuals in Europe. They are heavy users of mobile PC technology and need information packaged and filtered. These individuals typically have an international perspective.

Leisure Seekers

This is the largest and most important media segment, which comprises an audience of over 183 million individuals. The Leisure Seekers category takes in the majority of consumers. These individuals seek rich, inexpensive, television-centric services, interactive games, audio entertainment and localised media.

Figure 1 acknowledges the critical issues for the publishing sector as we look to 2002: firstly, the increase of knowledge workers, driven by a desire to access and search greater amounts of data; and secondly, the trend of leisure seekers towards a PC-enthusiast behaviour as technology becomes increasingly consumer focused and accelerates its march into the home.

Inconsistent Audiences?

This model of the media audience also throws up some interesting anomalies. According to Rick Smith, editor-in-chief and president of the US publication *Newsweek*, the single, strongest indicator of whether somebody will subscribe to a magazine, is the amount of time that individual spends exposed to television and radio news in all its forms during the week.

This would seem like a total contradiction. If an individual is getting a lot of news from television and radio, then why do they want even more in a printed form. The fact is that the audience of *Newsweek* is comprised predominantly of knowledge workers who crave news whatever its form.

Critical Juncture

The European Union report entitled 'Strategic Developments For The European Publishing Industry Towards The Year 2000' was presented at a meeting of European publishers held during October at the Frankfurt Book Fair. Its key conclusion is that the industry in Europe is rapidly approaching a critical junction as new developments in the area of new media spur the emergence of fresh players.

But this need not be the case. Prior experience in creating a sense of a shared communities of interest, in segmenting audiences, in tailoring content to meet and drive demand, and in building brands, will give the publishing industry an edge over other emerging content providers. Indeed, if these skills are not applied to the Web and other emerging technologies, problems of information overload and disorientation will increase.

New online communities based on interests, needs and lifestyles are emerging, and audiences are defining themselves as groups of individuals with similar interests, able to interact online. Today's publishers see their businesses as formulating and distributing fixed content to preset deadlines. In the future, the European Union study claims, electronic publishers must focus on integrating their content with services, customer-driven product tailoring, the brokering of information, and retail transaction facilities.

Competitive Opportunities

To regain advertising share from television, publishers are already establishing electronic interest communities, which will offer them the chance to gain unprecedented contact with end-users and in turn, bring higher advertising revenue and commissions for the publisher.

The European Union study sees electronic publishers becoming a threat to traditional broadcasters. Digital television will bring more targeted programming channels. However, it will not be able to provide the levels of value offered by electronic publishing to end-users due to its mass-market economics and starkly limited

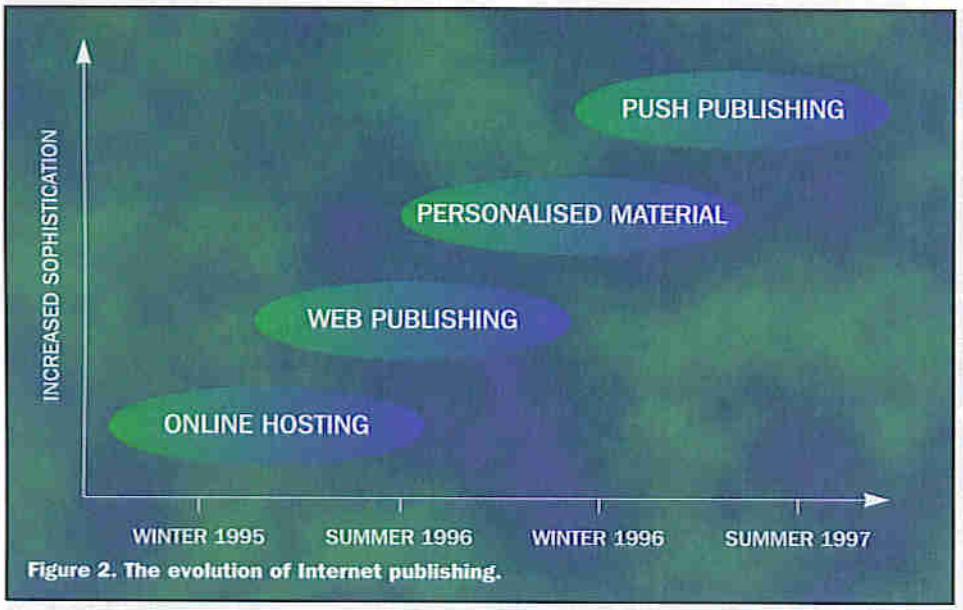


Figure 2. The evolution of Internet publishing.

interactivity. As electronic publishers leverage their brands to create focused online communities of high value to advertisers and users, the study predicts a gradually increasing market share of electronic advertising versus TV.

But the fundamental rules of advertising do not necessarily map well onto the online sector. Publishers have yet to determine a model which will work in this new medium. According to Newsweek's Smith, "We're going to have to think differently about advertising in the new media environment. The beautiful thing about a magazine is that you can flip through; an ad will catch your eye. And you'll say, "Hmm, I didn't know I was interested in that product"."

"In the online service, you'll have to be in the market for a car, or at least interested in a car, or in the market for a new piece of computer equipment. Once you have shown that interest, then, online, we can deliver you much more information than can be packed on one printed page", adds Smith.

Payment Models

The European Union study shows a high level of agreement that consumers will not pay for basic online content such as general news, local newsgroups, or classified services. The majority of services for the mass market will, therefore, need to be advertising-financed. By contrast, premium services for professional and special interest users are expected to generate substantial subscription fees.

Commissions from online transactions are expected to become a second important revenue stream. For the mass market, subscriptions will play only a minor role. However, premium services for professional and special interest users will generate significant subscription fees and be less advertising-dependent.

Early Adopters

The report claims that there is a potential strategic gain in taking early advantage of recent technological developments. Terrestrial broadband infrastructures will not be widely available until 2005, due to the enormous investments required for services such as video-on-demand. Publishers must therefore use hybrid broadcasting and online systems as well as the Internet to offer personalised content and services.

Early entrants will benefit not only from decreasing operational costs, but also a head start on their competitors in building customer loyalty and the necessary technical sophistication to offer advanced electronic publishing services. Electronic publishing is likely to become a strategic cornerstone for economic survival within the next 5 to 8 years. Players that make no effort to get involved will see the window of opportunity closing.

Market Share

According to the European Union report, by 2002, the electronic publishing share of the print market will range between 5 and 15%, and be worth up to £60 billion, depending on the type of publication and user acceptance patterns. A more accurate estimate of the future market size is very difficult – if not impossible – given the many foreseeable developments and the often unpredictable behaviour of users. A justifiable estimation therefore takes a best and worst case scenario to forecast market sizes for different types of electronic publications.

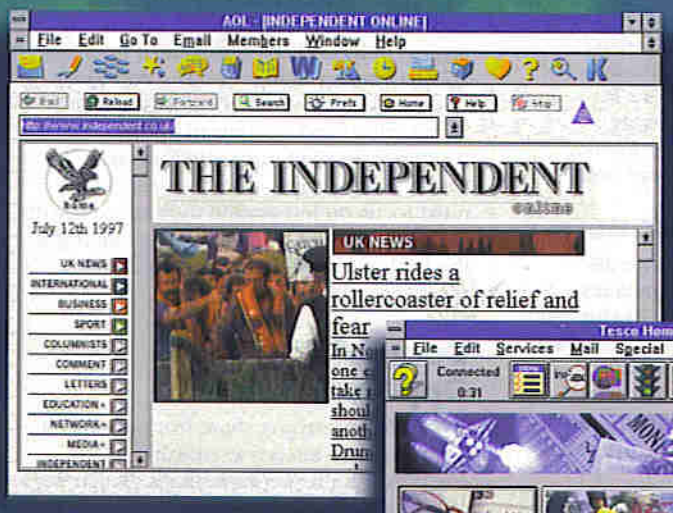


Photo 3. AOL hosts *The Independent* online.

Photo 4. CompuServe hosts *The Daily Telegraph* online.

Photo 5. A subset of the material published in *Computer Weekly* is available online from its Web site.

Photo 6. *The Wall Street Journal* charges an annual subscription of $49 (approximately £29) for access to its Web site.

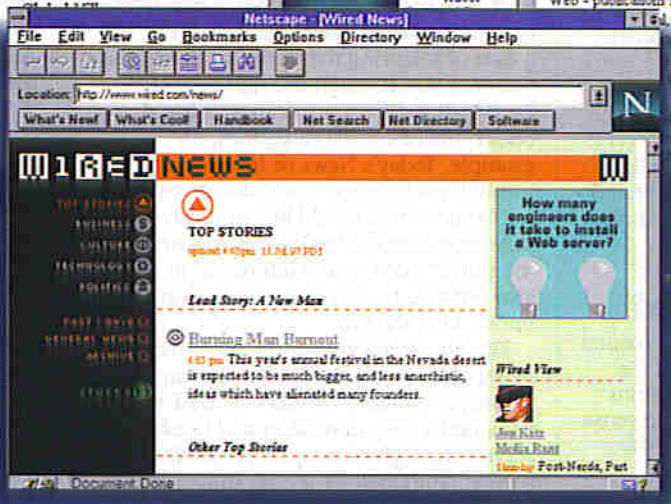


Photo 7. *Wired* News makes full use of the interactive capabilities of the Web.

Photo 8. Select publications to be delivered to your e-mail in-box with Netscape's In-Box service.

Revolution

According to *Newsweek's* Smith, there is no doubt that we are observing the beginning of a huge upheaval in the publishing sector. "I think there's no doubt that we're on the brink of an information revolution. In fact, we're in the early stages of it right now. But anybody who looks you straight in the eye and says "I know exactly where this revolution is heading" is either a man or woman of much greater insight than I am, or they're smoking something", says Smith.

Inevitably, as the electronic publishing sector gains greater market share, it will become an important employment market. It is predicted that approximately a million new multimedia-related jobs will be created across Europe within the next ten years. The demand for content creators and developers is expected to show the highest growth rates of over 95% until 2005. It's not hard to see how these figure arise. For example, national newspapers maintaining an online service are already starting to employ between 3 and 20 people extra, depending on the scope of the service.

Internet Generations

In only the last two years, we've observed the passage of four generations of Internet publishing technology, as shown in Figure 2. These consist of online hosting of publications; web publishing; personalised material; and push publishing. Let's examine each topic area in detail.

Online Hosting

Initially, news content was published by online service providers such as CompuServe and AOL. Typically, a publication such as *The Independent* on AOL as shown in Photo 3 or *The Daily Telegraph* on CompuServe as shown in Photo 4, paid the online service provider to host their content.

But the look and feel of publications hosted by an online provider is constrained by the features of the service's software. An additional issue is the limited size of the audience. By default, the content is only available to account subscribers. And while AOL is struggling to handle its 9 million users, there are already 40 million people connected to the Internet in remote locations around the world. The Web represents a far larger opportunity.

Marc Andreessen, co-founder of Netscape, is one of many industry players who has gone on record as saying that if these services fail to adopt an Internet infrastructure, they will soon be in trouble. The majority of online service providers have already developed gateways to the Internet and it is rumoured that both CompuServe and AOL are set to scrap their proprietary client software and intend to switch to a Web browser interface.

Publication/ News Service	Web Address
BBC	www.bbc.co.uk
Business & Technology Online	www.cromwellmedia.co.uk
Business Wire	www.businesswire.com
CNN	www.cnn.com
Computer Business Review	www.computerwire.com/cbr
Computer Weekly	www.computerweekly.co.uk
Computergram International	www.computerwire.com/computergram
EMAP	www.emap.com
Financial Times	www.ft.com
FutureNet	www.futurenet.com
IBM System User	www.computerwire.com/ibmsu
Internet Magazine	www.emap.com/internet
Multimedia Futures	www.computerwire.com/mf
Network Briefing	www.computerwire.com/nwb
Newsbytes	www.newsbytes.com
Software Futures	www.computerwire.com/sf
The Electronic Telegraph	www.telegraph.co.uk
The Guardian Online	www.guardian.co.uk
Unigram.X	www.computerwire.com/unigramx
UNIX & NT News	www.computerwire.com/uns
VNU Business Communication	www.vnu.co.uk

Table 1. Selection of UK publications that have an Internet presence.

Web Publishing

It's fair to say that newspaper publishers were initially unsure about the Internet and even today, are not completely sure about where it fits within their business model. After recognising that joining up with a service provider limited their potential audience, many publishers have created bespoke Web sites for their individual publications, such as *Computer Weekly* at `www.computerweekly.co.uk`, as shown in Photo 5.

Typically, these online publications provide a subset of the more traditional print version – or in the case of more adventurous newspapers such as *The Financial Times*, published the complete paper. In these cases, the Web site is password protected with access provided to individuals that register with the newspaper. Table 1 details a selection of UK based publications which have an Internet presence.

Web Subscriptions

The extension of this model has been for online publications to charge a subscription for access to the publication's Web site, such as *The Wall Street Journal* at `www.wsj.com` shown in Photo 6, which charges $49 (approximately £29) for an annual subscription. The online version, in addition to coverage from the main newspaper, carries news material updated throughout the day.

Publishers are guarded about how successful this activity has been. This could be a sign that it is not generating a great deal of interest and income. If this premise is correct, it is not difficult to see why. For every subscription-based newspaper Web

site, there are literally thousands of free newspaper, trade magazine and newswire sites, not to mention the number of pure online publications that have emerged during the last 18 months. Examples of the latter include Jeff Pulver's specialist 'Voice on the Net Digest' at `www.pulver.com` and 'Edupage', a review of technology coverage from the international media at `www.gene.cinvestav.mx/mail/edupage.`

But while the number of online publications continues to grow daily, only a select number, like *Wired News,* the online service of *Wired* magazine at `www.wired.com/news` as shown in Photo 7, have made full use of the possibilities of the media. *Wired News* has an interesting service as well. The full issues of *Wired* are online. Each article allows readers to comment and discuss issues raised within a hypertext chat area at the bottom of the document.

Personalised Material

Personalised, filtered information is a natural evolution of the online publication. If it's possible to access a variety of publications across the Internet, it makes complete sense to use a computer to filter and select the information that is of interest to the individual. Jeff Boulter, a student at Bucknell University in the US, has created a Web service that lets you put together your own online newspaper.

CRAYON consists of an online form that allows you to select from a variety of free news and information services available on the Web, such as daily newspapers and industry newsletters. You choose the types of news and sources you want, then CRAYON creates a personalised Web document that can be saved locally for subsequent access. CRAYON can be accessed at `www.sun.bucknell.edu/~boulter/crayon.`

Personalised news services such as Jeff Boulter's CRAYON are already plotting the future of Internet agents. These will continue to become increasingly sophisticated with time, providing the Internet user with targeted information on demand. But the final development to date amongst the online publishing community has been the emergence of new sectors called 'push technology', which combine user interaction with filtering and information delivery to the user.

Push Publishing

Push technology is a technique whereby an Internet publisher will send requested information via e-mail to a subscriber as it becomes available. This turns the conventional Internet model on its head, whereby an individual has previously had to visit a Web site on a daily basis to review content or search for information on and ongoing basis.

Netscape's In-Box direct service is possibly one of the most sophisticated examples of a push service available. The free e-mail service builds on the core mail functionality and is unique to Netscape Navigator. Working with Netscape, some of the highest-profile providers of Internet content are delivering feature-rich Internet content directly to an individual's mailbox. The content providers offer a wide variety of information, from a daily version of *PC Week* to analyst reports from Gartner and from daily versions of *The Mirror* newspaper to the *Sony Music* newsletter, providing details of new music titles and showcase of its audio library.

Netscape In-Box

To sign up for Netscape's In-Box Direct service, visit the Netscape site at: `form.netscape.com/ibd/html/ibd.html` as shown in Photo 8, or jump across from the link on the home page. From here, it is a case of following the dozen or so screens that take you through the sign-up process. Each In-Box Direct publication is listed under one of several categories, for example, Today's News or International. Go through each category and decide which publications you would like to receive. To subscribe, simply check the boxes next to the publications you're interested in. It is also possible to cancel a subscription by unchecking the box.

The Financial Times is the most recent newspaper to join the growing group of Netscape content providers. The FT has launched a daily news alert and briefing service through Netscape's In-Box Direct service. The briefings are produced by the Broadcast Monitoring Company (BMC), part of *Financial Times* Information. BMC News Review continuously identifies and summarises the day's most important developments and lists the best sources of further information for each. The service delivered to the user's desktop separates global news and UK news along with UK business news briefings.

User-defined Push Technology

Push technology is not necessarily dependent on the publisher to deliver information to the user. Using the latest software applications, it is possible to configure agents or assistants that will retrieve information from the Internet automatically in real time or over time, as predefined by the user. Highlights2, from Cross Atlantic software, automatically downloads and stashes Web pages to your hard disk. Like the morning newspapers, Highlights2 delivers the latest news to your virtual doorstep overnight, ready for review in your own time.

Internet Predictions

It is incredibly difficult to predict the ultimate impact of Internet technology on the publishing industry in business terms. Ultimately, these are two unhappy bedfellows. The Internet does not lie happily next to the publishing sector, which is typically very slow to innovate.

At a technological level, we are likely to see information become even more personalised through the use of agent technologies. The sheer size of the Web – which is claimed to be doubling every six months – will mean that conventional search engines are likely to run out of steam, unable to keep pace with the constant indexing and re-indexing required. Already, even the most obscure character string returns hundreds of hits using search engines such as Alta Vista and Yahoo. This information overload will drive publishers to create digital libraries that mirror traditional libraries in terms of structure and common content. The format of documents will be standardised and individuals' libraries will focus on specific topic area, enabling greater levels of document manipulation.

If nothing else, the Internet has forged a new path through which publishers and consumers can communicate. By keeping in closer contact with their readers, publications can get a better idea of what their readers are most interested in. The majority of the letters which *Electronics and Beyond* receives each month now reach us via e-mail. But having easy access to media also has its drawbacks. Over-zealous readers frequently blast their unsolicited opinions to hundreds of media outlets with one message. Junk mail is far from unique to the postal system.

Traditional Publishing Sector

Let's try to forget the Internet for a moment, and look at the way the computing industry is forcing the publishing sector to re-examine itself and constantly refine the procedures which contribute to the development of a publication. Historically, the production of a newspaper or magazine has been a tortuous process. However, technology in the form of newswires, ISDN, electronic images, word processors and desktop publishing, to name but a few, is enabling publications to work with fewer and fewer staff and slash deadlines from weeks to days and even hours. Figure 3 shows the seven processes which currently contribute to a development of *Electronics and Beyond.* If we had reviewed this model even five years ago, the entire process would be far more layout-intensive and would have stretched for several months from start to finish.

There are still areas of the publication process which are constantly being refined. The advent of digital photography has meant that many companies now distribute photographs electronically with press releases in a bitmap or JPEG format. And newswires such as Businesswire distribute photography electronically. This has enabled us to sharpen the content of the News Report in *Electronics and Beyond.* Stories are prepared throughout the month and photography sourced, but the copy and illustrations are not put to bed until a week before the magazine goes to print. This means we are able to keep our content fresh and topical.

Digital Photography

Digital photography captures photos using a digital camera as shown in Photo 9, and enables them to be assembled or edited on a PC and exchanged electronically or printed using a colour printer. The immediacy and user control over the photo process makes digital photography attractive, not only to photo journalists but also consumers.

For the consumer, broad support of interoperability and connectivity specifications will make it easy to download images to their PC, transmit their images via the Internet and print the images without compatibility concerns. For business applications such as publishing, the same specifications simplify the production process.

Photo 9. Digital photography will offer the publisher and photo-journalist greater flexibility in the future.

Together, HP, Eastman Kodak, Microsoft, and Live Picture has developed a resolution-independent file format called FlashPix, which maintains image quality as the images are exchanged across multiple software applications. The FlashPix industry file format is enhanced by the speed of Intel's MMX technology, using host sharing to accelerate image manipulation and processing.

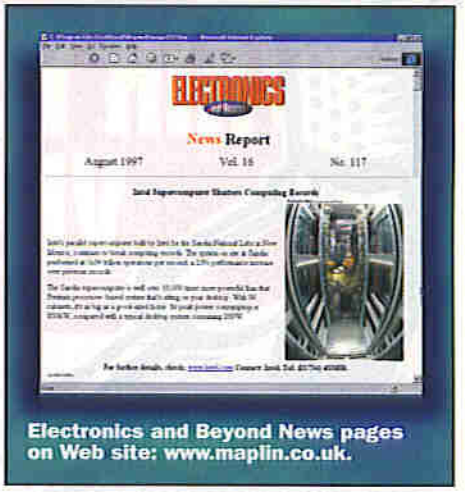
Colour Separation

The other area of major change occurs at the other end of the printing process. Once a magazine has been laid out by the designer and signed off by the editor, the electronic images are dispatched to the repro house physically by Syquest cartridge or optical disk, or electronically by modem or ISDN line. Film is then sent to the printer. The current offset printing process requires a separate photographic plate of the amounts of each of the four process colours (Cyan, Magenta, Yellow and Black) to be made for each page. From here, the printer produces a smallquantity of colour proofs which are sent to the editor together with the four colour films for approval and final sign-off. Once the editor gives the green light, the four colour plates are loaded into the printing press and the publication is printed.

This process is set to change over the next three years. The colour separation process will be replaced by direct to print publishing. Here, it is claimed no film or plates will be required, with electronic data fed directly to the digital printing system from the desktop application. This means that the printing process will be immediate. Potentially, it will remove the requirement for a final print proof. Instead, the editor will have to sign off the publication at the desktop publishing stage.

Creating Web Pages

Time to return to the Internet. One of the major technological challenges of going online for a magazine such as *Electronics and Beyond* or a newspaper such as *The Guardian* is the problem of converting their print publication to HTML for the web. Most publishers use popular pagination software such as Adobe PageMaker or Quark XPress for their print layouts, so naturally, the easiest solution would be simply to convert documents from those applications to HTML, the language of the Web.



Electronics and Beyond News pages on Web site: www.maplin.co.uk.

The problem is that desktop publishing applications like Adobe PageMaker and Quark XPress have been around much longer than HTML. PageMaker made its debut shortly after the Macintosh computer was introduced in 1984. HTML has only had four years to develop.

With this obvious generation gap between technologies, one would expect HTML to be more simple than a pagination program. PageMaker and XPress give designers complete control over the placement of text and pictures and is focused on producing high-quality printer output. HTML is designed mainly to be viewed on a monitor, and never be printed at all, although most browsers have simple print capabilities. The ideal converter would maintain the look of a document and would convert an entire page automatically, adding hypertext links where appropriate.

Closing Word

Will the computing industry and the publishing sector ever rest easy together? If publishers are smart, they will not be bypassed. Ultimately, social issues such as the need to exchange documents and the desire to read a newspaper will come to bear.

According to Paul Sagan, senior vice-president of new media with the US periodical *Time*, speaking at the Judd Publishing, In The Age Of New Media seminar, "The printed word is not going to go away, in the near term, probably ever. And certainly, not in our lifetime; not even as a generational effect, I don't think people are going to stop writing, and I really hope they don't stop reading".

"There are experiences that you can have with the printed word, that you can't have, online or on TV. Some of those are just real lifestyle; you can't take the computer on the train very easily. You don't curl up in bed with your computer; most people don't. You don't tear off a sheet on a computer and stick it to the refrigerator, to remember to do something, or to get a coupon and save, or to put up a recipe. The best you can do online now is print it out. You still want that paper copy, and that's going to be important, I think, for a very, very long time", added Sagan.

EDITOR DEVISES MAGAZINE CONTENT
The content for each magazine is defined by the editor typically on a three month rolling cycle.

↓

STAFF WRITER/FREELANCERS DEVELOP CONTENT
Articles are features including photography are developed by staff writer and freelance journalists. Completed articles are submitted five weeks prior to the publications date. By comparison, news material is typically submitted one week prior to the publication date.

↓

COPY FROM STAFF WRITER/FREELANCE WRITERS SUB-EDITED
Editorial staff review all content for errors and house style.

↓

PHOTOGRAPHY SCANNED IN-HOUSE USING LOW AND HIGH RESOLUTION TECHNIQUES
Many companies now provide photography in an electronic format. Where this is not available conventional photgraphs are used which need to be scanned at low resolution so that they can be included in initial page layouts.

↓

PAGE LAYOUT
Copy and photography laid out by designers using a desktop publishing application. Layouts signed off for editorial and layout style by editor.

↓

COLOUR PROOF
Publication sent to reproduction house to produce positive film separations of cyan, magenta, yellow and black. Some photos are scanned using high resolution laser scan technique and creates colour plates. Proof copies and colour film separations are provided to editor for final review and proof reading.

↓

PUBLICATIONS SENT TO PRINT
Final modifications made and publication sent to press. Following publication magazine dispatched directly to subscriber and news stand.

Figure 3. The production process for *Electronics and Beyond*.

AIR YOUR VIEWS

E-mail your views and comments to: AYV@maplin.demon.co.uk

Write to: *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 8LU

In this issue, M. Perry, Kidderminster, Worcs., wins the Star Letter Award of a Maplin £5 Gift Token for his 'variac'tive letter writing!

£5 MAPLIN GIFT VOUCHER

Star Letter

Dear Sir,

Further to the request for information on controlling a model train (*Air Your Views*, Issue 116), I understand from the original letter (from Peter Smith of Anglesey, N. Wales – Ed.) that the train motors run on AC not DC. Therefore, the need is for an AC supply that can be varied between say, 0 and 30V. I presume the supplies for ancillary lighting, signalling and other trackside items simply needs a fixed voltage, so can be fed from a normal transformer without the need for control other than ON/OFF switching. This would reduce the current requirement of the variable supply. One suggestion I was surprised has not been mentioned and personally for such a LV supply, I would consider using, is a variac transformer feeding the PRIMARY of a 240V in 30V out double-wound transformer. This would then provide the necessary 0 to 30V output that is fully isolated from the mains, smoothly variable and undistorted sine wave. The variac must not be used on its own, as it is auto wound and so 'live' to the mains. The bonus of this method is that the transformer also provides a current step-up ratio in that a 1A variac would only be needed with say, a 24V transformer giving an output of 10A, or say, using the Maplin 0·75A with a 30V transformer would supply a load of around 6A. While the new cost of such variacs may seem a bit high, they are extremely robust, reliable and virtually trouble-free, run cool and often compare favourably cost-wise with 'electronic' controllers. They can often be obtained second-hand at a fraction of the new cost at electronic/radio shows. Any fixed voltage supplies needed are then obtained from a separate transformer in the normal way.

It sounds as though the 'Velleman speed controller' referred to in the original letter from Peter Smith must either consist of a variac or at least operate like one, since it is (as described) connected in the same way you mention. However, this method was deemed to be unsafe due to the possibility of a short circuit causing the rail track to become directly connected to live mains! Perhaps what is required is an additional circuit to constantly monitor the track voltage and immediately cut the power should this exceed a set limit, perhaps used in conjunction with additional mains safety precautions.

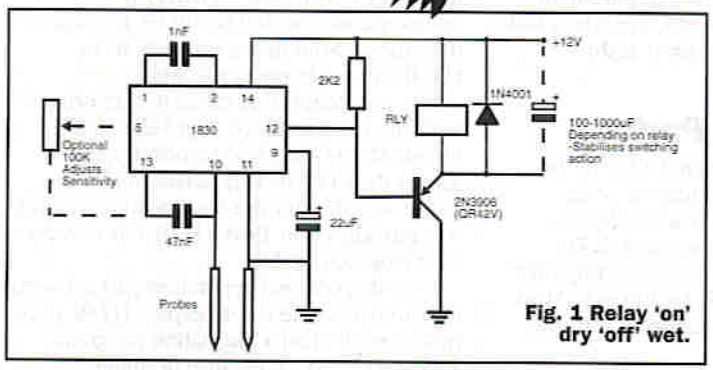


Fig. 1 Relay 'on' dry 'off' wet.

Low Level Solution

Dear Sir,

Regarding Dr. R. D. Beauchamp's letter (Issue 117), circuits as shown based on the LM1830N Fluid Level Detector IC have been used successfully by me over the last 6-7 years in similar application. Suitable relays are Maplin's JM18U/HY20W/YX99H, depending on the load current. Alternatively, a very basic approach could use a float switch, e.g., CL25C CL26D either switching a relay or switching direct if the load is low enough (e.g. 50W maximum).

I. M. Tasker, Grantham, Lincs.

Thank you for sending in these diagrams, which more-or-less agree with our written solution to the problem printed last issue!

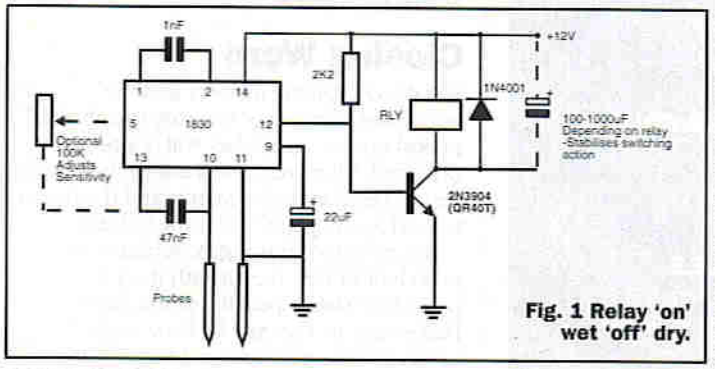


Fig. 1 Relay 'on' wet 'off' dry.

Jumping the Gun?

Dear Sir,

Regarding the article *Time Measurement* by Douglas Clarkson in Issue 114, I feel sure that the 1,000-day countdown to the new millennium has started 367 days early! If, as previously, the clockers engaged a carpenter, he/she would measure a 10-foot stick with a mark at 10 on the tape, not at 9. That's to say, the end of the 20th century occurs at the end of the year 2000 and not at the start. Thus, there are 366 days in year 2000, 365 in 1999 and 269 in 1998 to make up the 1,000 days before the new millennium, with the countdown commencing on 6th April 1998. It seems to me that Accurist/Greenwich may be in error by 1 part in 3·72 in their measurements for the start of the 21st century. Other readers closer to Greenwich may have pointed this out by now. Beware the 'eleven other contenders'!

J. L. Moloney, Bowen, Australia.

Time being an abstract concept anyway, does it really matter when the countdown began? Looking at it from the other direction, surely the new millennium would commence immediately after year 2000 rolls around, and not at the end of that year; therefore, the countdown to the new millennium would be up until that point?

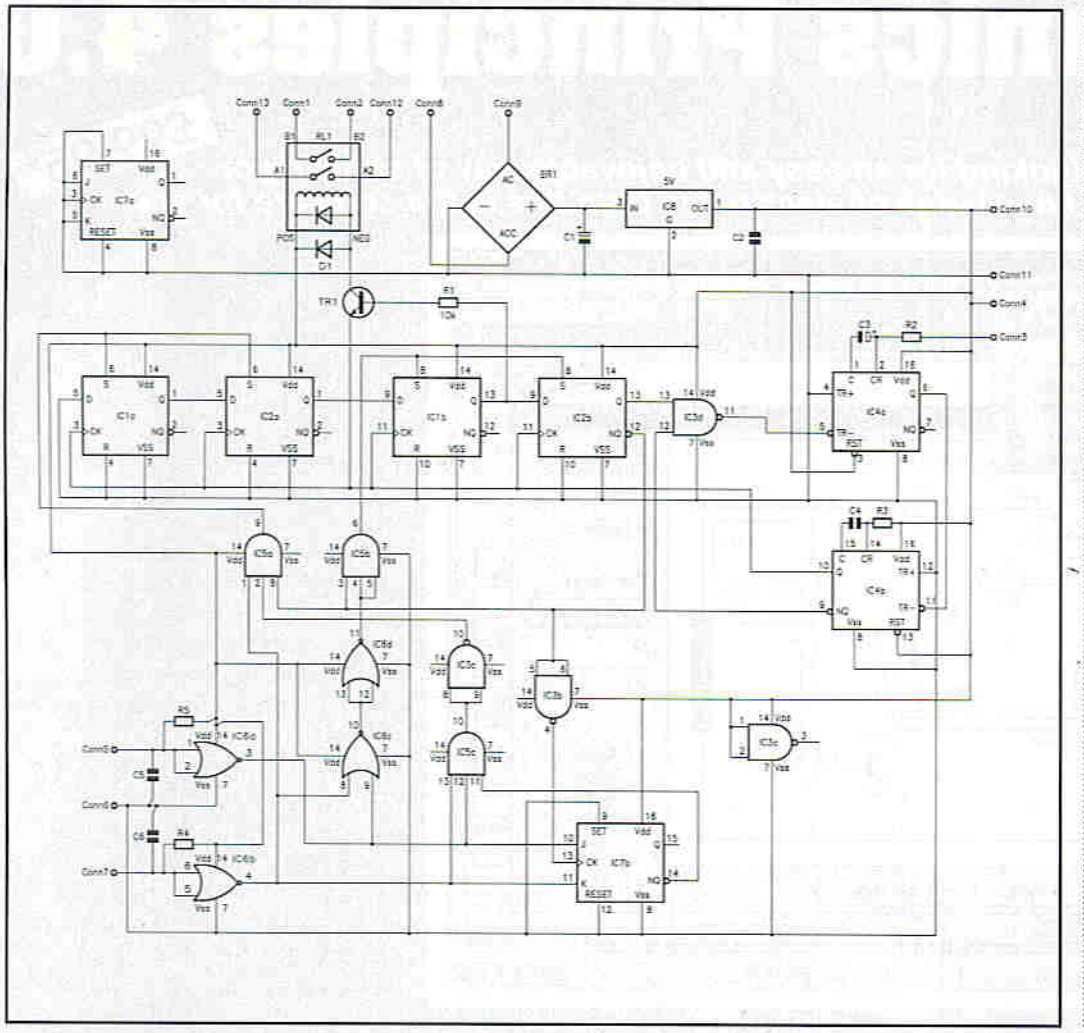
Low Profile Electrolytics

Dear Sir,

I am interested in using surface-mount components in some of my projects and intend to build at least one of your published projects using them, but I also want to use them in my own designs or experimental projects but I notice your catalogue only has a relatively small range of components in stock. Any chance of improving the range to include electrolytic capacitors, tantalum capacitors and RF coils? Also, I notice you have a kit for a TV Test Pattern Generator and an RS232 Test Generator. Is there any chance of you publishing a project for a computer monitor 'SVGA' Test Pattern Generator? Commercial units are available but are expensive. Your magazine is very good – I've been reading it for at least 10 years and I like the way you publish a wide range of projects.

Mark Garton, Bromsgrove, Worcs.

A detailed article about surface-mount devices (SMDs) by Ian Davidson was featured in Issue 115 (July 1997) of the magazine. It states that, as yet, electrolytic capacitors are not available in SMD form because they would be damaged by the heat from soldering – most SMD parts being used for production line assembly which employs automated reflow soldering methods. Tantalum ones are available for higher capacitance values, but are comparatively expensive, so the cheaper ceramic type (listed in the catalogue) are more often used. Only a limited range of inductors are available in SMD form because the small package size restricts the inductance value severely. Consequently, many RF designs aim to use the smallest possible values of capacitors and inductors. Our new catalogue due out at the same time this magazine reaches the newsagents will feature an extended range of surface mount products. Your project suggestion has been noted, and thank you for your comments on the magazine.



ELECTRONICS CORRIGENDA

September 97 Issue 117

Iambic Keyer

Figure 2 (page 17), showing the circuit diagram for the relay version, is incorrect. It should be as per the transistorised version shown in Figure 5 (page 20), but with TR1, TR2 & R6 omitted, and replaced instead by RL1, D1, TR1 and R1. We reproduce the corrected version opposite.

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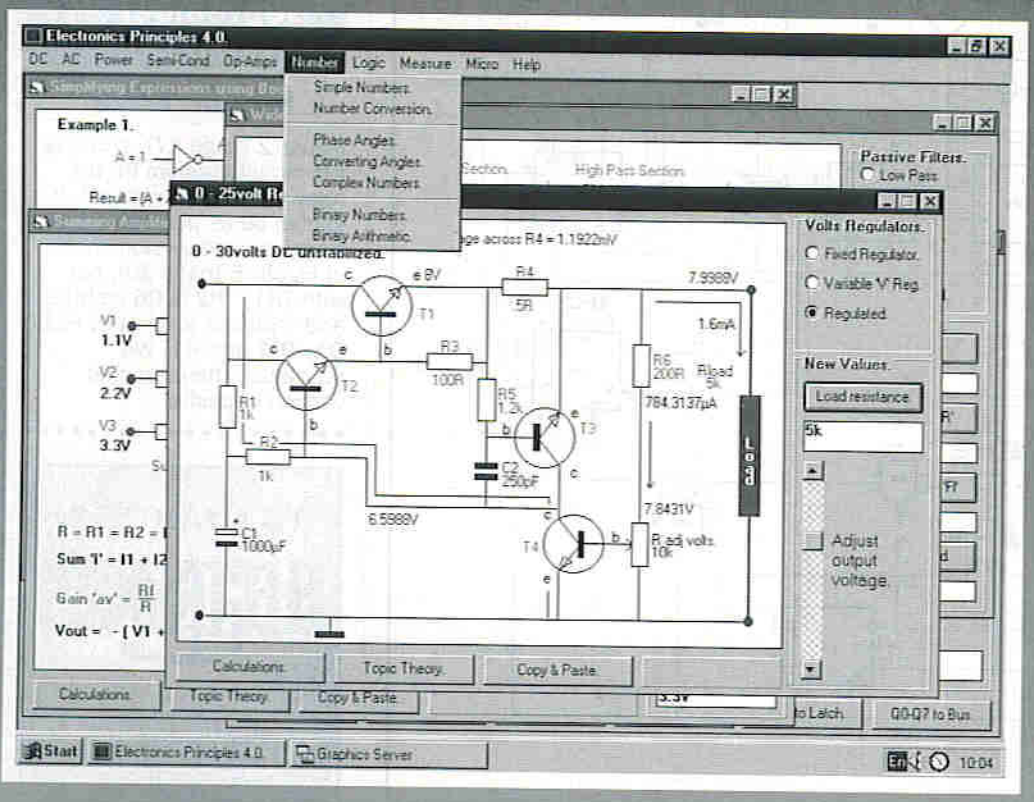

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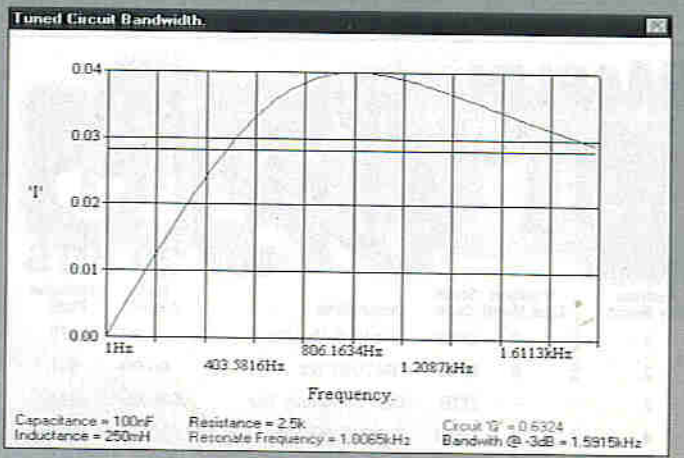

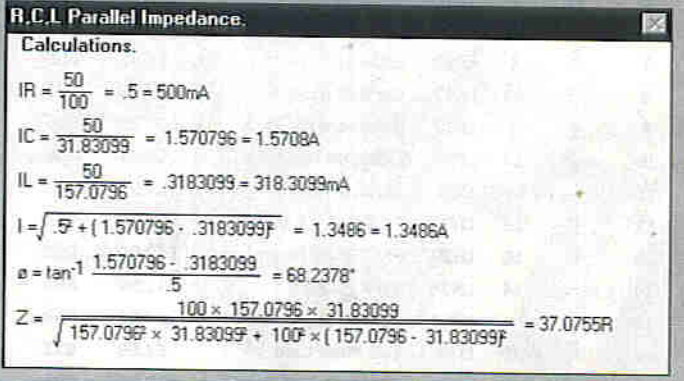

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COMMENT

by Keith Brindley

Sleepless in Seattle?

There's trouble brewing in the computer world which will be very interesting to watch over the coming year or so. The great majority of the world's personal computers have two things in common. First, they are mostly powered by a microprocessor made by Intel. Second, the operating system used to run them is made by Microsoft. True, you can have several flavours of operating system: DOS (versions 1 to 6 – or is it 7, I lost track a while ago), or Windows (versions 3, 95, NT3, NT 4, CE), but they're all made by Microsoft nevertheless.

Until now, the Wintel stranglehold on the personal computing market has been almost complete – but not quite! There have always been a few other microprocessors around, and there have always been a few other operating systems around. The Motorola 68000 series, for example (later the PowerPC series), has been used to drive other computers – most notably, Apple's Macintosh range, while other operating systems are available for all microprocessor variants. But Microsoft's impressive marketing ability and the corporate business world's reluctance to accept anything other than so-called IBM-compatible computers (read Wintel) has kept the ball very firmly in Intel's and Microsoft's court.

But things are happening. The seemingly unbreakable Wintel union may be about to suffer a fracture. For a start, Intel is having problems because other microprocessor manufacturers are supplying microprocessors which can do the same job – that is, run Windows. Many personal computers are sold with the 'Intel Inside' logo emblazoned on them, but a slowly increasing number of them have microprocessors made by other companies.

This has caused Intel to change its marketing policy in two main ways. First, its prices have been forced down. Competitors sell their microprocessors at much lower prices than Intel. True, presence of an Intel microprocessor sells computers at a premium price (remember the corporate business world's reluctance), but when alternative computers are available for a lot less (around £200 currently), customer loyalty to the Intel name – particularly the non-business user – becomes doubtful and the premium becomes less acceptable. As a result, Intel's prices will tumble by 50% or so over the coming months (it will already have started as you read this).

Second, Intel is looking elsewhere to supply its microprocessors. The network computer (NC) was initially proposed as an open-architectured computer – in other words, it is a computer that doesn't rely on hardware or software from any particular suppliers. No longer would customers have to rely on a hardware manufacturer like Intel, or a software manufacturer like Microsoft in what is effectively the closed architecture of a Wintel personal computer. As such, while Microsoft is dead-set against network computers, deriding them at every opportunity, Intel simply sees sales of microprocessors. Network computers, because of their very principle of being built around the Java programming language, are highly processor-intensive, so Intel is in with a good bet to sell its devices to network computer manufacturers. The outcome of both these factors is that Intel is looking elsewhere from Microsoft.

As you can expect, Microsoft is none too happy about this. Its Windows operating system products have been very carefully maintained as PC only operating systems. You can't run Windows on anything other than an Intel (or clone) microprocessor. Actually, at one stage, Microsoft was developing a version of its Windows NT operating system for the PowerPC, but took cold feet prior to completion. As such, to see its long-time cohort looking to the enemy camps to supply devices must be very annoying.

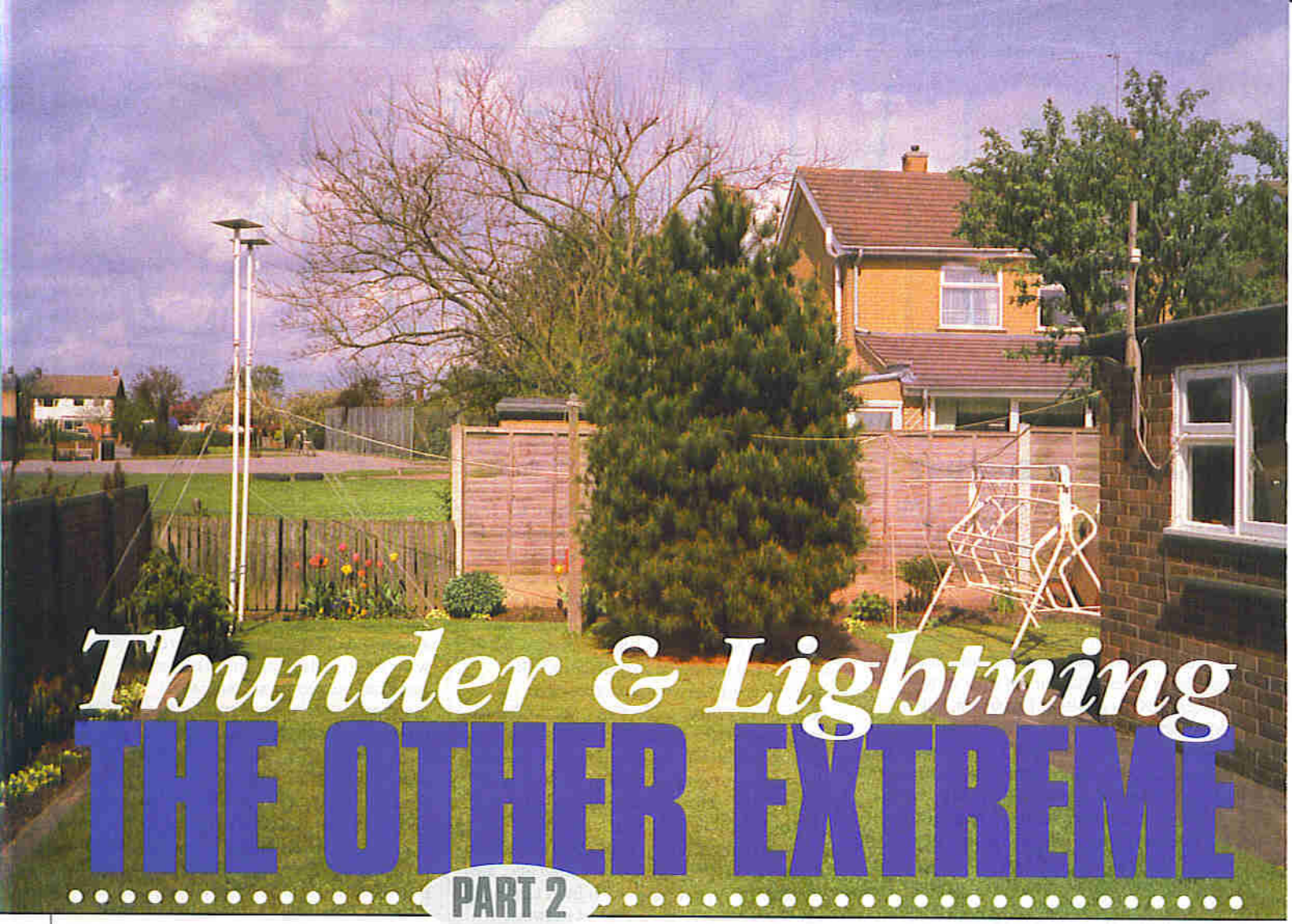
Taking matters into its own hands, Microsoft is pondering the use of Windows terminals as a counter to network computers. Basically, these are dumb terminals (without significant amounts of processing power) that are networked to a central computers. While the idea is similar to network computers, dumb terminals are significantly trimmed down devices – so Intel will not find much of a profitable market.

On the other hand, Microsoft is doing very little to help itself. By stopping the port of Windows NT to the PowerPC, it has cut itself adrift from users of PowerPC personal computers. And while PowerPC personal computers represent less than 10% of the market share, it's still a significant market (six or seven million computers a year). Further, by producing so many variations of its operating software, its customers are widely varying in their usages and capabilities. To move from one operating system flavour to another is a very big step for the average punter.

Finally, its modern operating systems (Windows 95 and Windows NT 4) are so complex they are often beyond the ability of many users to maintain – something not advertised along with the "Where do you want to go today?" slogan. This can be partly addressed by working with microprocessor manufacturers (particularly Intel, of course, as it still holds the lion's share of the microprocessor market) to ensure that future hardware is more closely specified than past hardware traditionally was. But Windows is still a pig of an operating system which requires far more maintenance (read expensive service contracts) compared with Apple's MacOS, say, or Acorn's RiscOS.

In the end, all these reasons for a split between Intel and Microsoft can, and will no doubt, be addressed. Because of their past relationship, the current Microsoft and Intel relationship is quite symbiotic. True, Microsoft can exist without Intel, simply because Windows *does* run on an Intel clone microprocessor-based personal computer. And true, Intel can always make microprocessors for another operating system, although it will see its trade radically cut for a while if it tries to do without Microsoft *too* soon. Nevertheless, in Andy Grove's (the head of Intel) own words in a recent Fortune magazine interview, "The world is filled with the cadavers of dead software companies – far more than the cadavers of dead semiconductor companies. Software companies can disappear almost overnight. Semiconductor companies undulate and fluctuate, but they don't go away." It will be interesting to see if he's prepared to take his stance to the extent that it's tested out on Microsoft.

But, Microsoft won't want the situation to develop where this might occur, because its own future lies in the user base being content to stay with future generations of its software. There is a relationship between the two companies which, no doubt, will continue in the long-term, even if there is a temporary rift.



Thunder & Lightning
THE OTHER EXTREME
PART 2

by Keith Garwell

Keith continues his quest to search for atmospheric electricity.

The Plate – Its Connections

TV aerial co-ax is used to connect the plate to the electronics, and is chosen for two reasons. Firstly, the screening, particularly to screen the inner conductor from mains 50Hz and secondly the very high insulation resistance achieved between the central conductor and the screen.

To maintain the insulation, the plate end (the weather end) must be suitably protected and Figure 16 shows a method which seems to have been successful over long periods.

A small plastic bottle is needed, the sort that has tablets in. These can be obtained from a chemist in various sizes. Mine was about 3 × 2in. (A chemist will dump them when they are empty). Make two holes in the base, one that will fit a grommet which in turn is a firm fit on the co-ax and the second that is a firm fit on the centre conductor. Figure 16 shows how the co-ax should be bent back into a 'U' inside the bottle, then the cap put on. This arrangement ensures that water cannot get into the co-ax.

Two connections come from the plate and support. The co-ax inner is connected to the plate and a second wire (ordinary plastic covered 7/0·2) is connected to an aluminium band fastened round the support pipe just above the guy ropes. This band acts as a guard ring and prevents any potentials from metal guy rope spikes, etc., from reaching the plate under moist conditions. It is connected to 0V back at the electronics via this second wire.

The co-ax is supported at the side of the pipe by means of two stand-offs and a couple of cable ties. Figure 17 shows the general arrangement.

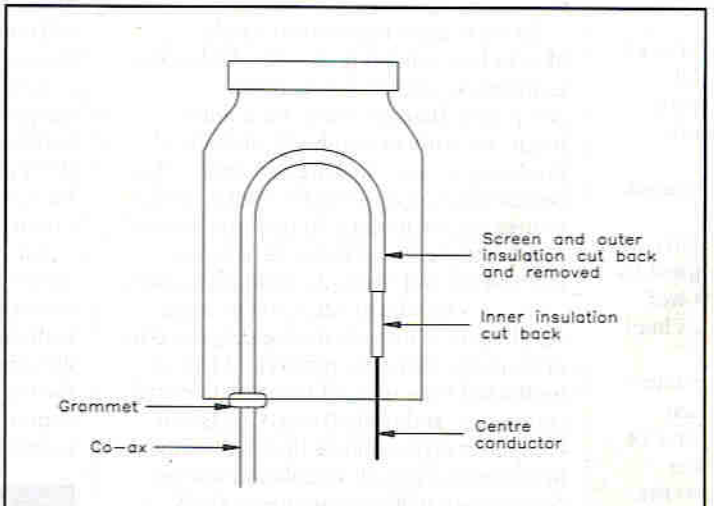


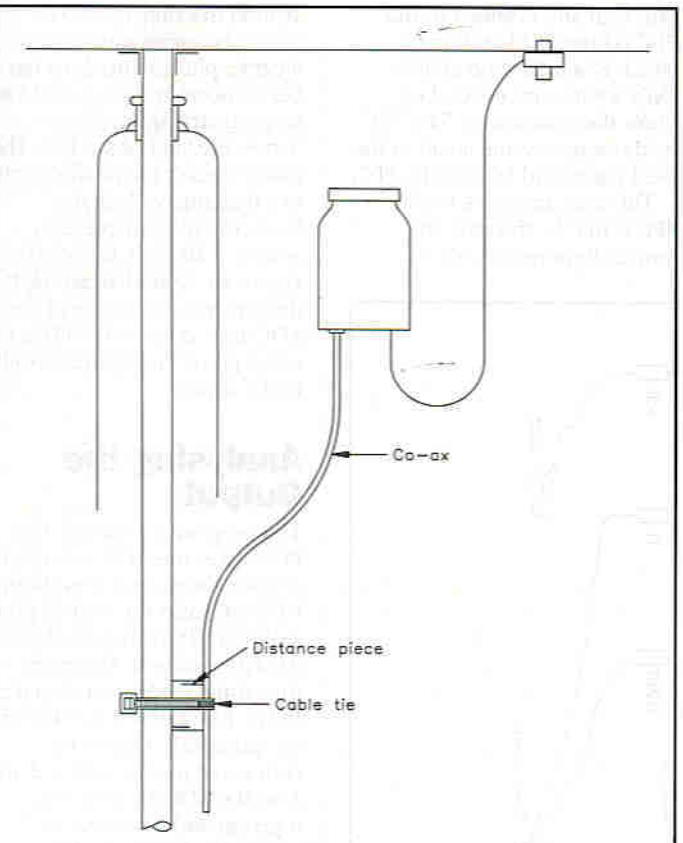
Figure 16. Termination of co-ax inside plastic bottle.

The stand-offs can be made by cutting two pieces of the support pipe about an inch wide and heating them until soft. Lay a piece on its side and press down on the top with a screwdriver blade until a shallow dip forms. Turn the piece over onto its dip and press again until a second dip forms. Figure 18, 1 to 4, shows the steps in the forming process. This ends up as a not very well made figure of eight. Put this between mast and cable and hold together with a cable tie – see Figure 18, 5.

Commissioning

All quite straightforward. Do the electronics first. Take a quick look over the wiring if you prefer to and then connect the power +12, -12V and earth or 0V. If one is available, connect a digital voltmeter to the output. Connect the input to 0V. It should then be possible to zero the output within 10mV using the 18-turn trimmer.

Put the lid on and remove the connection from the input. Move your hand around close to the input terminal without touching it and the meter



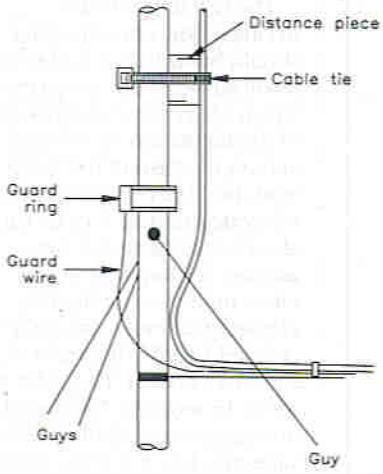


Figure 17. Pipe and plate layout, top and at guard ring.

Closer view showing arrangement of the guy ropes, etc.

should show output. A moving coil meter is better for this. If you have such a thing, place a small tin (the old original aluminium tins which 135mm films came in is ideal) over the input terminal so that the tin is touching the instrument case but not the input terminal. If there is much of a reading, try altering the trimmer. The best way is to slide the lid back so that the trimmer can just be adjusted to give zero and then slide the lid fully on again. This should not take more than a few tries. If you have the necessary equipment to set up 40mV which is isolated from the instrument, e.g., resistors, a variable, a millivoltmeter and a single cell, connect the 40mV between the case and the input terminal. This should give approximately 5V output. Reverse the connections and check the output reverses.

Now for the plate. Choose a position at least 3m away from any object which is as high or higher than the plate – house, trees, etc. – preferably as far as it is high seems to be a good rule. Items less than 2 to 3m high don't matter. **If the site is very open or on a hill then remember it may be subject to a lightning strike and precautions must be taken.** Normally, houses with their TV aerials nearby give adequate protection. This is a subject outside my knowledge and as a consequence, I cannot offer advice. Nor can I accept any responsibility or liability.

Erect the system with guys and connecting leads. Run connecting leads (co-ax and guard wire) to the home of the electronics. It is best to keep these leads above ground, otherwise they are a real target for rodents and other hungry animals! They only need support about every 6m. A pole with a hook will do, providing the hook does not tend to cut the plastic sheaths.

Since only 80mV is enough to

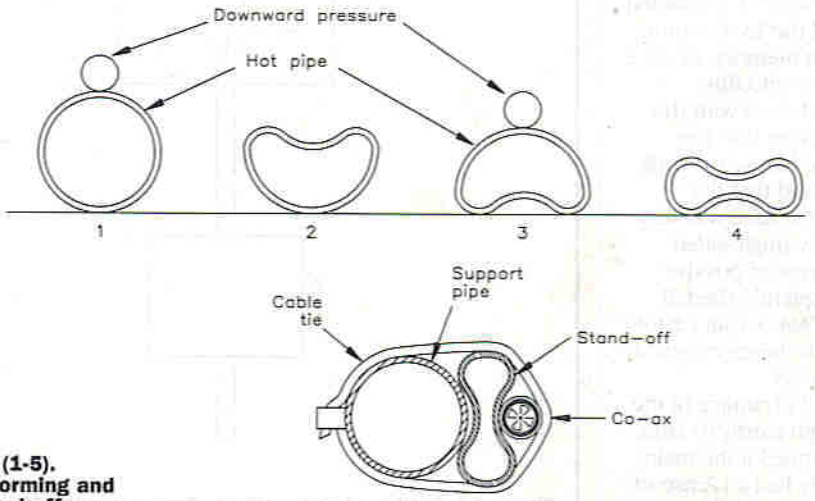


Figure 18 (1-5). Steps in forming and fitting stand-off.

saturate the input of the ammeter, earthing arrangements are quite important. The best arrangement is that which makes use of a star-point. In other words, all earth/0V connections made to one point. Figure 19 shows the general arrangement. Ideally, if it is possible to isolate the power supply outputs from the mains earth, then the star-point should be connected to a real earth, i.e., one or more copper rods buried in the ground. **All touchable metalwork on the power supplies should be connected to mains earth. For additional safety, an RCB can be used in the mains connection.**

Ancilliaries

Although commissioning completes the 'PAM' exercise in the sense that it's up and running and the output is available, I think it worthwhile to discuss the add-ons which I use as this may be helpful to those just making a start in this atmospheric electricity caper. They are intended for the DIY man, although in point of fact, all the items are available ready built. In three categories, they are: Recording the Output; Analysing the Output; Power Supplies.

Recording the Output

I started out using a 'Dragon' micro. (I had acquired it when they first came out). This was similar in many respects to the BBC micros and appeared at about the same time. It had four analogue-to-digital convertors (ADCs) built-in and used a standard BASIC (language). As a consequence, this was the easy thing to use. The program which I concocted for it sampled the PAM output and saved it in memory, whence it was dumped onto disc.

The disadvantages with this arrangement were that the Dragon had to be used to look at the results and that the resolution of the ADC was very low. It was only single-sided. i.e., it only accepted positive values, consequently, the full range of the PAM output (±10V, i.e., 20V) had to be expressed in 6 bits, i.e., 0 to 63.

The third disadvantage of the Dragon, though hardly its fault, was that it stopped if the mains failed! I already had an Amstrad 1640, an IBM PC look-alike, and remembered that they had also done a portable version (PPC1640) which ran off 12V. So, bright idea – use a PPC running off a battery. Instant mains failure proofing!

The next acquisition was an ADC-16 from Pico Technology at Cambridge (Ref 1). This is an 8-channel ADC which gives from 8- to 16-bits resolution plus sign and is linked to the PPC via the RS232 interface which is standard on all PCs. Only 5 wires are needed to make the connection. The PPC, by the way, cost me an ad in the local paper and £60 for the PPC.

The only drawback to the PPC is that by the time the temperature gets down to around freezing, the LCD screen becomes just about illegible plus the machine has been known to hiccup and lose its program. Again, that is hardly the fault of the PPC. The makers never intended it to run in a freezing cold garage! Consequently, my present system is laid out as shown in Figure 20. Note that although the temperature range of the ADC-16 is given as 0-70°C, it has never given the slightest trouble in the garage.

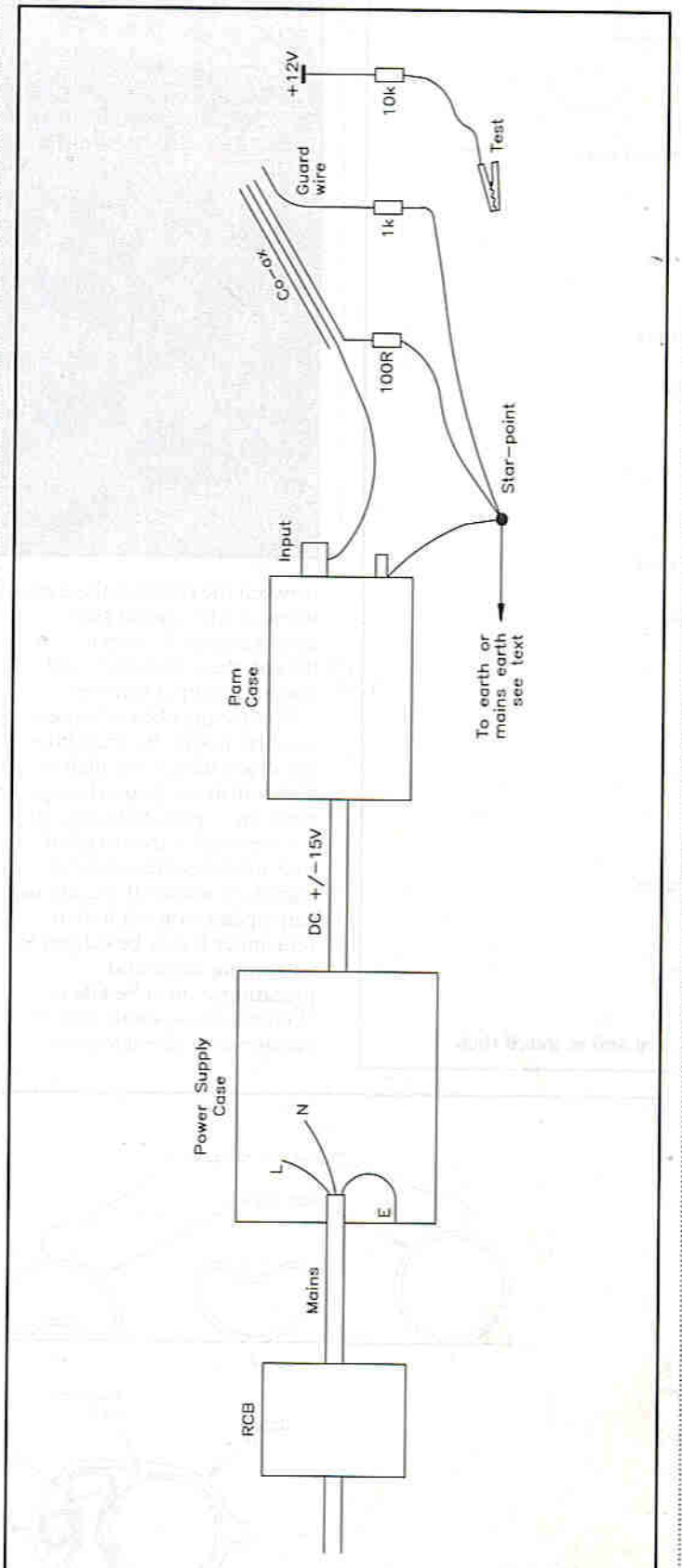


Figure 19. Outline of connections. Power supply PAM and co-ax.

Analysing the Output

The program running in the PPC drives the ADC convertor. It reads the output from both PAMs and also the output from a photocell which indicates the daylight strength. There are thus three readings to be taken; PAM1, PAM2 which is ×100 and the photocell. These are connected to channels 1, 2 and 3 on the ADC-16. This data, together with the time, is written to disc by the PPC.

The real difficulty was deciding how often the data should be written, and this was resolved in the PPC program which offers some options. One of the inputs can be selected and on the basis of the value read, the data may or may not be written to disc. A delay can also be set which prevents another reading from being taken until the set time has elapsed. Currently, this is set to channel 1 PAM1 (the most sensitive) value 4. The delay is set to 15 seconds. Translating, nothing is saved until the ADC value reaches ±4. Then nothing further is saved until 15 seconds have elapsed. The inputs are being read continuously – about every half second – it is only when data is saved to disc that there is a delay before reading (sampling) continues.

This seems to be a reasonable compromise. The current disc which has just filled up runs from 18th January 97 to 5th May 97. On 14th April, the days record was 374 bytes, whilst the 4th May took over 20k-bytes and the 5th, over 30k-bytes. The latter two huge figures were due to the very heavy rain which was coming from highly charged clouds. Are these two characteristics synonymous?

In passing, I should make the point that data logging software can be obtained with the ADC-16 but I wrote my own. Copies available (Ref. 2).

I also wrote my own display program, i.e., the program

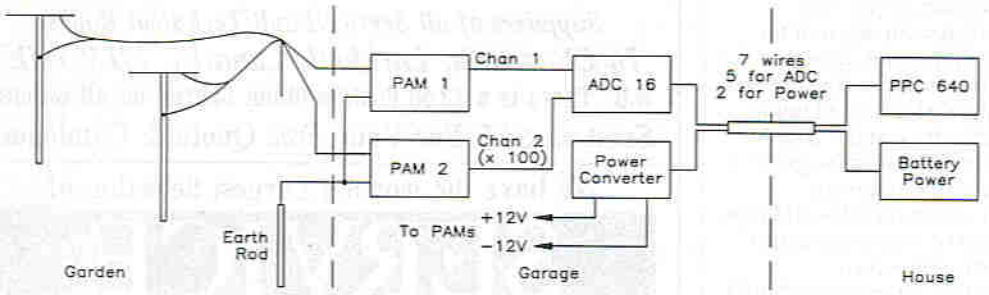


Figure 20. Outline of system layout and connections.

which reads the data off the disc and displays it on screen. The charts which are generated are in text format, i.e., they use standard computer and printer characters so that no special programs are required to look at them. They can so easily be sent via e-mail or the Internet. It is from this source that the various figures in this article were obtained (Ref. 2 again). A data logging program will normally include its own display program – I know the Pico logger does. I also know it will run on early PCs, i.e., without Windows in monochrome or colour, depending on the computer used.

Power Supplies

Having acquired the PPC, the next move was to replace the mains power supply that came with it with a battery backed supply. It's not quite as straightforward as one might imagine because both the PPC and PAM have to be supplied and the PAM system requires ±12V regulated.

The PPC can be connected direct to a 12V lead-acid battery and is designed to accommodate voltages which vary over the range between fully charged on charge to flat (well, nearly). This is around 11·5 to 13·8V or more.

To accommodate PAM, a power converter which will convert a range of from 11·5 to 13·8V to ±12V regulated is needed.

The one thing that cannot be done is convert both up and down voltage-wise in the same unit (as far as I am aware). If the current battery voltage was 11·5V, it would have to be converted up, whilst if it were 13·8V, it would have to be converted down. So, there is no situation where an ordinary series regulator would do the job.

However, it is possible to cheat, and Figure 21 shows how this may be done using an LM78S40. Putting four diodes in series with the input as shown drops 2·4V so the input range is now 9·1 to 11·4V, which can always be converted up to 12V.

The data sheet for the device gives all the details necessary. The current to be supplied is small, only 3mA for IC1 plus its output current. Add on any extras, e.g., the photocell in my system reading daylight, and it's not likely to come to more than 15mA.

There is one more cheat which can be done, and that is to obtain the negative supply by tapping off from the drive to the internal diode generating the positive supply (pin 2) with two diodes and two capacitors, as shown in Figure 21.

Actually, I have arranged mine so that it converts up to about 13·3V, then the additional rectifiers and capacitors can be added to produce about -12·4V. The supplies don't have to be set to 12V accurately; the important thing is that they are regulated. It is preferable to have a little more than 12V so that there is plenty of headroom for the PAM output to reach 10V.

Using one of the modern maintenance-free 'sealed' lead-acid batteries does require the use of a special charger designed for the purpose as both the output voltage must be regulated and the output current limited. The usual figures are 13·4-13·8V and current limited to a quarter of the Ah capacity.

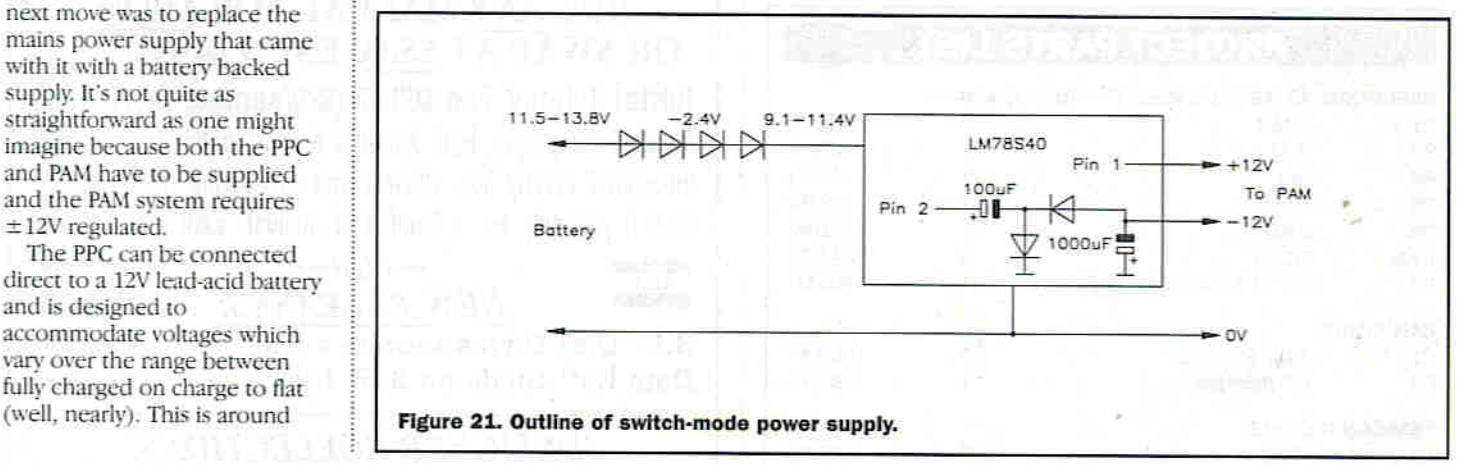


Figure 21. Outline of switch-mode power supply.

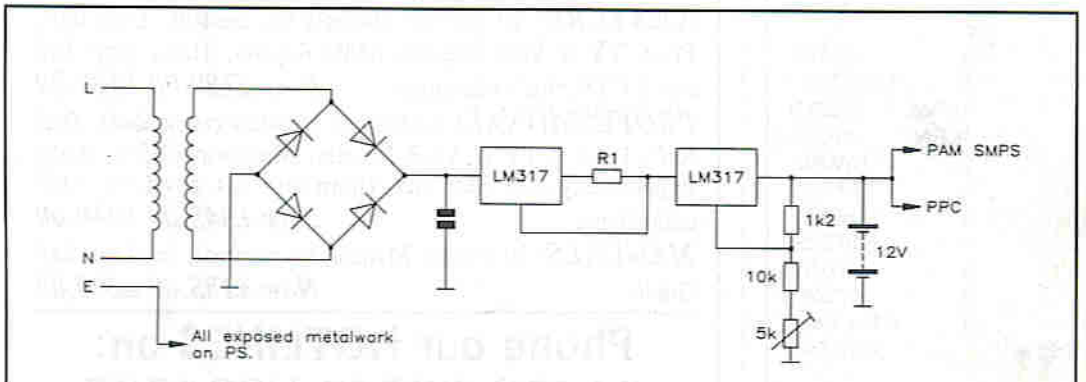


Figure 22. Outline of LM317s used as a battery charger.

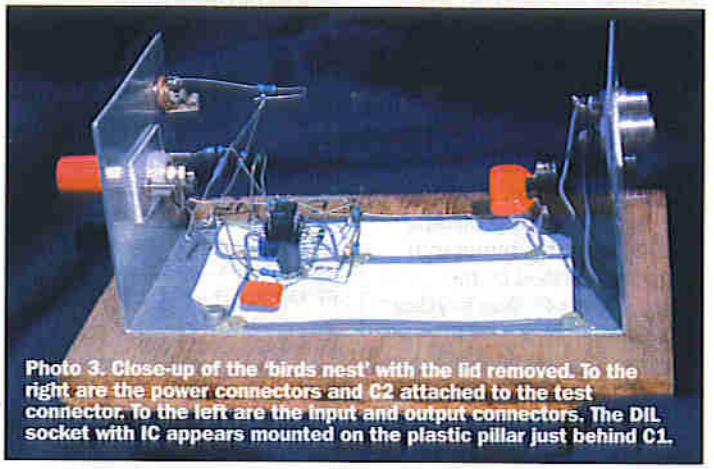


Photo 3. Close-up of the 'birds nest' with the lid removed. To the right are the power connectors and C2 attached to the test connector. To the left are the input and output connectors. The DIL socket with IC appears mounted on the plastic pillar just behind C1.

The complete system will probably consume about 0·25A and I would think that a battery of 2AH capacity would be sufficient. This will give about 4 hours use without the mains.

For the fully-fledged DIY person, Figure 22 suggests how such a charger might be constructed. This arrangement is untried by me. At the time of building mine, it hadn't occurred to me to use LM317s! The LM317, which can be obtained in various versions depending upon the rated current, can be used either as a current regulator or a voltage regulator.

In effect, it adjusts its output until there is 1·2V at the third terminal with respect to the output terminal. Thus, for the 2Ah battery, R1 would be 1·2/0·25 = 4·8Ω, call it 5Ω. The 5kΩ potentiometer should be adjusted until the output is in the range specified by the battery supplier for float working.

Assuming that the total requirement is about 0·25A, the 0·5A version of the LM317 is needed. The other power supply components must be similarly rated. The on load voltage across the reservoir capacitor should be at least 4·6V more than the maximum output voltage to allow sufficient headroom for the LM317s.

Maintenance

This is quite simple – an occasional wash down of the support pipe with detergent and warm water, as the pipe will slowly gather a layer of grime. Any deflection on the guard and screen line tests suggests a wash down is required.

This condition is tested for at any time by touching the test lead onto the screen connection, when there should only be a momentary change in output as the co-ax charges up – see Figure 19. The same applies when touching the test lead to the guard wire.

Components

At the time of writing, all components are available from Maplin, with the exception of the ADC-16 and Picolog.

All fixed resistors are metal film 0·6W. The preset trimmer is an 18-turn cermet. Capacitors C1 & C2 are metallised polyester film.

References

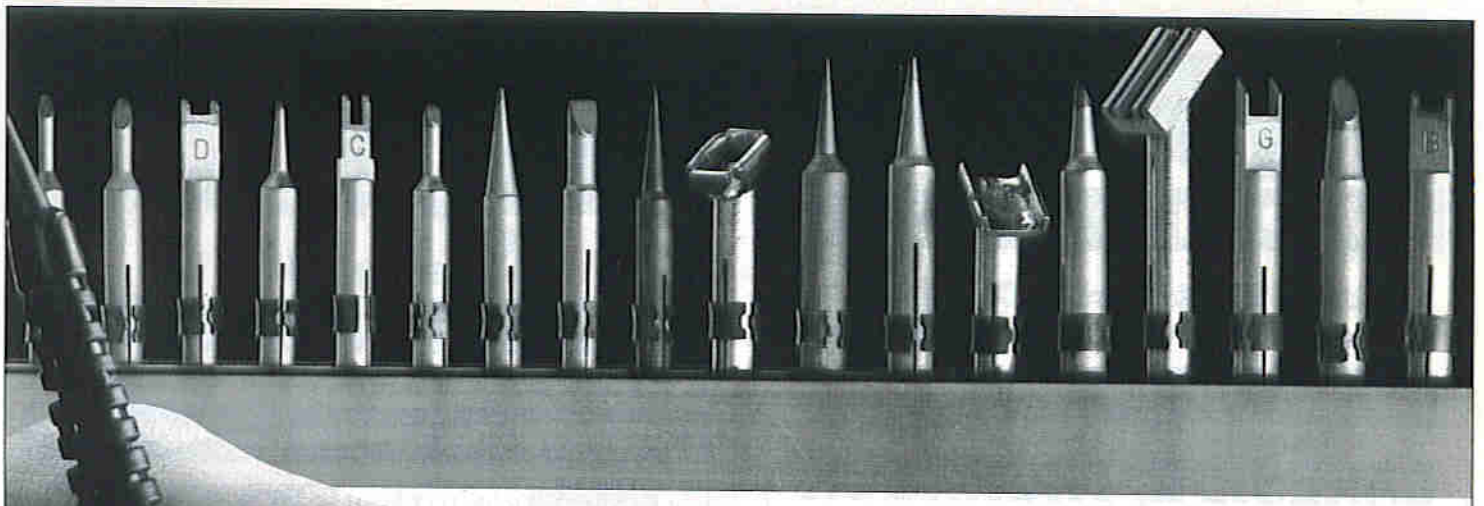
Ref 1. For ADC-16 and Picolog: Pico Technology Ltd., Broadway House, 149 – 151 St. Neots Road, Hardwick, Cambridge CB3 7QJ. Tel: (01954) 211716.

Ref 2. For programs and help: K. Garwell, 5 College Road, Alsager, Stoke-on-Trent ST7 2SS. Tel: (01270) 875159.

PROJECT PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (Unless stated)			
R1,2	10MΩ	2	(M10M)
R3	1MΩ	1	(M1M)
R4	4kΩ	1	(M4K7)
R5	24kΩ	1	(M24K)
R6	10kΩ	1	(M10K)
R7,8	470kΩ	2	(M470K)
R9	100kΩ 18-turn Cermet Potentiometer	1	(WR51F)
CAPACITORS			
C1	0·1μF Polyester	1	(BX76H)
C2	1μF Polyester	1	(BX82D)
SEMICONDUCTORS			
IC1	LF411	1	(QY27E)
MISCELLANEOUS			
8-pin DIL Socket		1	(BL17T)
	Aluminium Box	1	* See Text *
	Co-axial Cable	As Req.	(XR29G)
	7/0·2 Cable	As Req.	(BL00A)
	Phono Sockets	2	(YW06G)
	3·5mm Jack Socket	1	(HF82D)
	4mm Socket Black	1	(HF69A)
	4mm Plug Black	1	(HF62S)
	Screw Terminal Red	1	(HF07H)
	Screw Terminal Black	1	(HF02C)
	Power Supply	1	* See Text *
	Glue, Screws, Plastic Sheeting, etc.		(See Text)

The Maplin 'Get You Working' Service is not available for this project.
The above items are not available as a kit.



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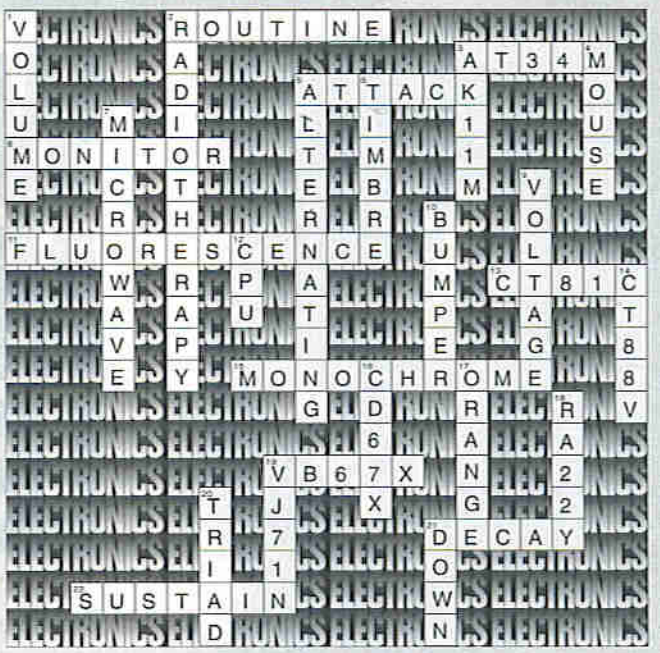
CROSSWORD No. 5 *Solution* **August 1997**



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Handbook for Samsung Penmaster 386L/20 laptop. Please contact John Lawson, Tel: (0181) 368 5438.

Club Corner

ARS (Aberdeen Amateur Radio Society) meets on Friday evenings in the RC Hall, 70 Cairngorm Crescent, Kincorth. For details contact: Martin, (CMOJCN), Tel: (01569) 731177.

The British Amateur Electronics Club (founded in 1966), for all interested in electronics. Four newsletters a year, help for members and more! UK subscription £8 a year (Junior members £4, overseas members £13.50). For further details send S.A.E. to: The Secretary, Mr. J. F. Davies, 70 Ash Road, Cuddington, Northwich, Cheshire CW8 2PB.

Bury St. Edmunds Amateur Radio Society. Meetings held at Culford School, 7.30pm for 8.00pm on the third Tuesday of each month, unless otherwise stated. Further details from Kevin Waterson, (G1GVI), 20 Cadogan Road, Bury St. Edmunds, Suffolk IP33 3QJ. Tel: (01284) 764804.

Crystal Palace and District Radio Society meets on the third Saturday of each month at All Saints Church Parish Rooms, Beulah Hill, London SE19. Details from Wilf Taylor, (G3DSC), Tel: (0181) 699 5732.

Derby and District Amateur Radio Society meets every Wednesday at 7.30pm, at 119 Green Lane, Derby. Further details from: Richard Buckby, (G3VGW), 20 Eden Bank, Ambergate DE56 2GG. Tel: (01773) 852475.

Electronic Organ Constructor's Society. Details of programme magazine and membership from: Don Bray (Hon. Sec.), 34 Etherton Way, Seaford, Sussex BN25 3QB. Tel: (01323) 894909.

E.U.G. User group for all 8-bit Acorn Micros, since 1991. Still going strong. Programming, news, information, sales. Contact: E.U.G., 25 Bertie Road, Southsea, Hants. PO4 8JX. Tel: (01705) 781168.

The Lincoln Short Wave Club meets every Wednesday night at the City Engineers' Club, Waterside South, Lincoln at 8pm. All welcome. For further details contact Pam, (G4STO) (Secretary). Tel: (01427) 788356.

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Science At Your Fingertips. Want to meet friends interested in Science? Send an SAE to: Daniel Gee, S.A.Y.F., 37 South Road, Watchet, Somerset TA23 0HG, or Scott Mason, S.A.Y.F., 58 Park Avenue, Devonport, Plymouth PL1 4BP. http://homepages.enterprise.net/icedragon/says.htm.

SEEMUG (South East Essex Mac User Group), meet in Southend, every second Monday of each month. For details Tel: Michael Foy (01702) 468062, or e-mail to mac@mikefoy.demon.co.uk.

Southend and District Radio Society meets at the Druid Venture Scout Centre, Southend, Essex every Thursday at 8pm. For further details, contact: P.O. Box 88, Rayleigh, Essex SS6 8NZ.

Sudbury and District Radio Amateurs (SanDRA) meet in Gt. Cornard, Sudbury, Suffolk at 8.00pm. New members are very welcome. Refreshments are available. For details please contact Tony, (G8LTY), Tel: (01787) 313212 before 10.00pm.

TESUG (The European Satellite User Group) for all satellite TV enthusiasts! Totally independent. TESUG provides the most up-to-date news available (through its monthly 'Footprint' newsletter, and a teletext service on the pan-European 'Super Channel'). It also provides a wide variety of help and information. Contact: Eric N. Wiltsher, TESUG, P.O. Box 576 Orpington, Kent BR6 9WY.

Thanet Electronics Club. For school age Ham Radio and Electronics enthusiasts, enters its 16th Year. Meetings held every Monday evening from 7.30pm at The Quarterdeck, Zion Place, Margate, Kent. For further details contact: Dr. Ken L. Smith, (G3JIX), Tel: (01304) 812723

Wakefield and District Radio Society meet at 8.00pm on Tuesdays at the Community Centre, Prospect Road, Ossett, West Yorkshire. Contact Bob Firth, (G3WWF), (QTHR), Tel: (0113) 282 5519.

The (Wigan) Douglas Valley Amateur Radio Society meets on the first and third Thursdays of the month from 8.00pm at the Wigan Sea Cadet HQ, Training Ship Sceptre, Brookhouse Terrace, off Warrington Lane, Wigan. Contact: D. Snape, (G4GWG), Tel: (01942) 211397 (Wigan).

Winchester Amateur Radio Club meets on the third Friday of each month. For full programme contact: G4AXO, Tel: (01962) 860807.

Wirral Amateur Radio Society meets at the Ivy Farm, Arrowe Park Road, Birkenhead every Tuesday evening, and formally on the the first and third Wednesday of every month. Details: A. Seed, (G3FOO), 31 Withert Avenue, Bebington, Wirral L63 5NE.

Wirral and District Amateur Radio Society meets at the Irby Cricket Club, Irby, Wirral. Organises visits, DF hunts, demonstrations and junk sales. For further details, please contact: Paul Robinson, (GOJZP) on (0151) 648 5892.

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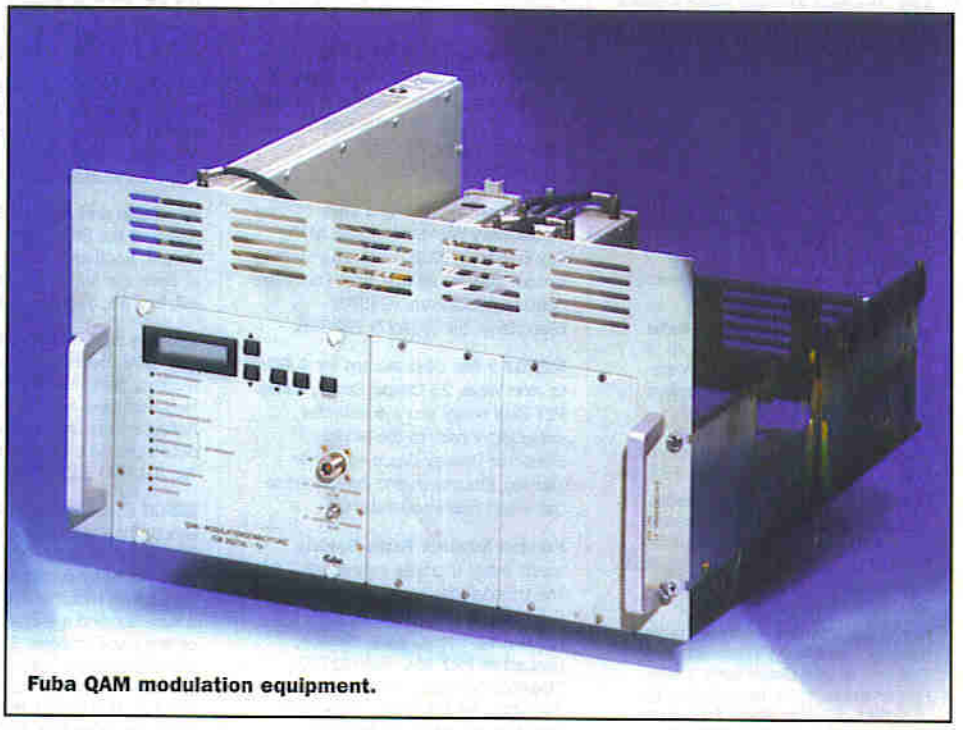
Digital TELEVISION

by Reg Miles

Whatever the social consequences of digital TV may be, they are now inescapable – despite the delayed UK introduction. A number of operators will also be offering interactive services, such as home shopping, education, information, Internet access, etc., thus realising the media convergence that has been much discussed of late. And, of course, there will be a considerable increase in subscription and pay-per-view services.

All the European TV services will conform to the Digital Video Broadcasting (DVB) standard. However, different signal specifications will be used for cable (DVB-C), satellite (DVB-S) and terrestrial (DVB-T). Thus, the set-top box necessary to decode the signals will probably suit one standard and accept optional modules for the others. Although, as the cost of boxes will be subsidised to kick-start the market, the additional cost will still be less than the true price of the box alone. In the UK, an industry-wide forum called the Digital TV Group has been formed to coordinate the introduction of digital services, particularly Digital Terrestrial Television (DTT). The group consists of most of the broadcasters, many manufacturers of broadcast equipment, all the big electronics companies, retail and rental companies and a smattering of others – over sixty in all. Much of the work is carried out by specialist sub-groups: Transmission, Technical Documentation, Marketing, Test & Interworking and Service Providers, to advise members and represent their views to government and regulators.



Fuba QAM modulation equipment.

What are the Advantages of Going Digital?

The advantages of digital signals are by now well known: they are resistant to degradation and are easily manipulated. Both of which make life easier for programme providers during recording, editing and adding special effects. The former is also a boon for transmission and reception. And both again are useful inside the TV set, where the signals can be easily processed with the minimum of circuitry. The disadvantages of digital signals are also well known: they require a greater bandwidth than analogue signals, and error correction to compensate for any corrupted data – further increasing the bandwidth.

Digital TV is entirely reliant on compression. Without it, I'd now be writing about the latest developments in analogue TV, because there would not be the financial incentives for companies to change to digital. The compression system that has been chosen is MPEG-2, developed by the Moving Picture Experts Group. Companies can now supply real-time encoders that give picture quality matching what was previously only attainable by a lengthy encoding process, thus enabling events to be transmitted live. This makes MPEG-2 encoders expensive; but because the encoders do all the hard work, decoders are relatively inexpensive, making the system commercially viable.

However, Sony has announced a single-chip video encoder LSI, and IBM and NEC are working along similar lines, so the situation should begin to change. The Sony device features the industry's widest motion search area and integrates MPEG-2 real-time encoding, system controller and motion estimation circuitry.

The 13·7×12·4mm device has approximately 4·5 million transistors and uses 0·4μm CMOS process technology. It operates on a supply voltage of 3·3V, and has a power consumption of 1·2W. It requires 32M-byte of external memory. The video encoder uses an adaptive motion estimation algorithm for efficient video compression and provides a search area of -288 to +287·5 horizontal pixels and -96 to +95·5 vertical pixels. This enables high quality encoding of even the most rapidly moving scenes. The internal encoding controller allows functions such as timing, complex motion search control and bit-rate control to be handled within the LSI for independent operation. It can be used for recordable Digital Video Disc, digital cameras and multimedia applications as well as, eventually, DVB.

As with most of today's compression systems, MPEG-2 relies on Discrete Cosine Transforms (DCT) to prepare the images. Each image is divided into discrete blocks of pixels which are then transformed into a numerical series of coefficients describing the amplitude of the various frequency components. Statistically, most of the picture information will be concentrated in the lower frequencies, allowing the highest frequencies to be largely ignored. Run length coding is then performed to reduce repetitive values to codes that merely specify the number of times they are repeated; and then variable length coding

that assigns short codes to the most commonly occurring sequences and longer codes to the least common.

With MPEG-2, interlaced fields can be coded individually or as a single frame. The choice will depend on the degree of motion in the picture; if there is a lot, then the fields are coded separately. The result becomes the intra (or I) frame, which is used as a reference for creating other frames: predicted (or P) frames to estimate motion and predict changes that will occur in the picture – with only the actual changes being stored; and bi-directional interpolation (or B) frames which average the changes based on information from previous and forward I and P frames (see Figure 1).

The frequency with which the I, P and B frames occur is determined during the encoding process, based on the application and the desired quality and bit rate. MPEG-2 can cater for 4:3 and 16:9 aspect ratios, together with the facility for carrying several channels multiplexed into a single bitstream. Because MPEG-2 is essentially the same as the lower quality MPEG-1, MPEG-2 encoders and decoders can handle both.

MPEG-2 encoders require a component video signal, consisting of luminance and colour difference signals. Most professional digital VTRs are now component types. There are also analogue component VTRs, from which the signal obviously needs to undergo A-D conversion. But much of the material that will be used in the early days of digital TV will be PAL composite, with the colour difference signals amplitude and phase modulated onto a 4·43MHz sub-carrier and added to the luminance, thus requiring conversion to component – and A-D conversion also.

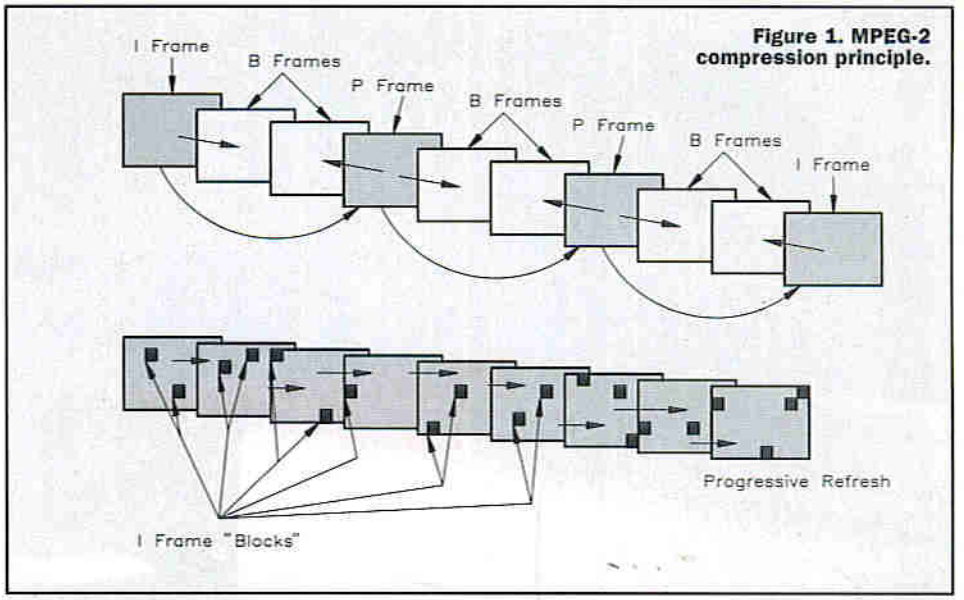


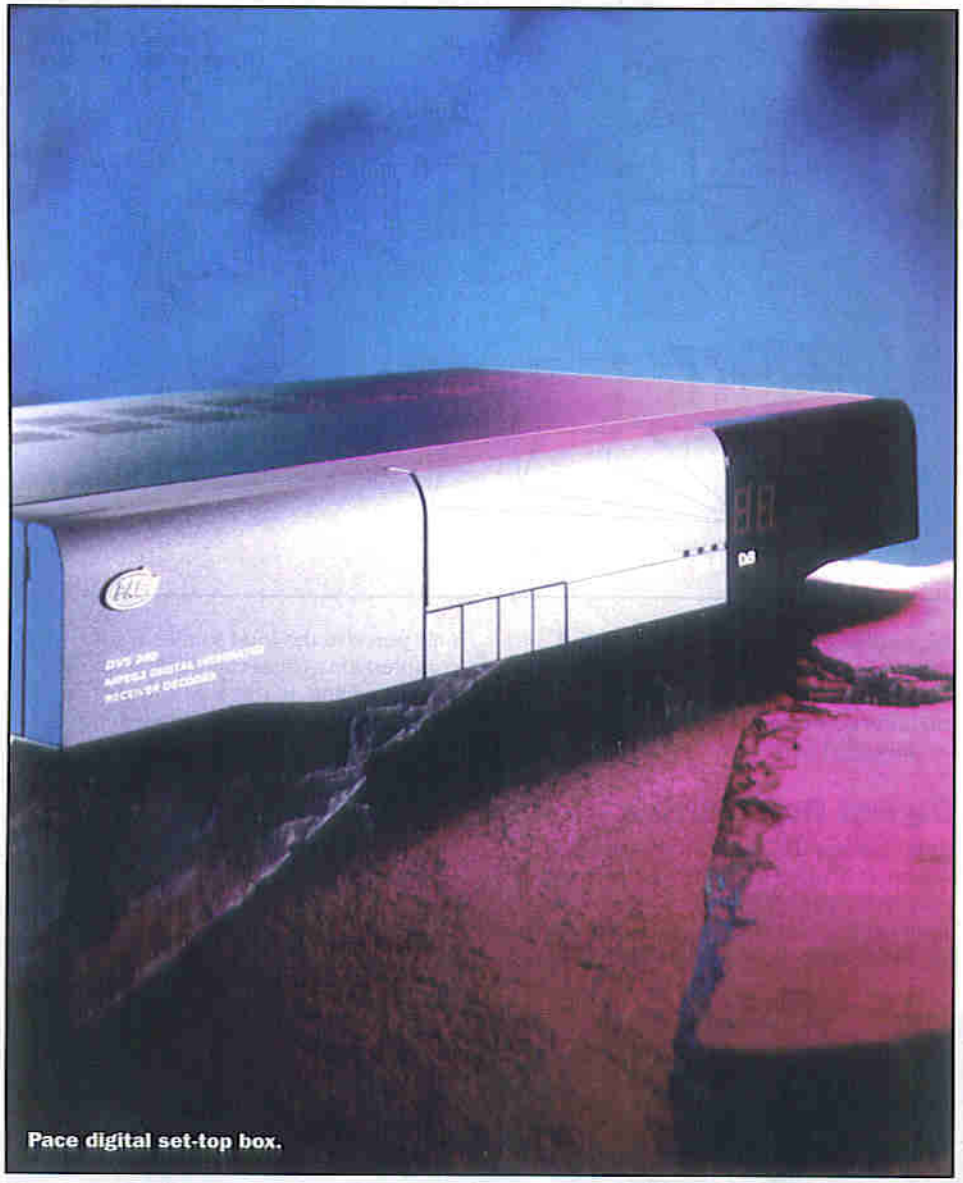
Figure 1. MPEG-2 compression principle.

Digital Soundtrack

Audio will use the Musicam compression system developed for MPEG-1. This exploits the psycho-acoustic phenomenon of masking: if a loud and a soft sound occur simultaneously, then apparently, the ear can only perceive the loud sound. The compression system can thus remove the soft sound and, in this way, considerably reduce the amount of information relative to the original signal. There will be a single channel for mono, and either dual channel or joint stereo. Dual channel keeps the two channels completely separate to avoid crosstalk, and can therefore be used for alternative language mono soundtracks or stereo. Joint stereo divides the signal into 32 frequency bands and notes the differences between the channels.

Galaxis dual reception antenna.

General Instrument DVB 2000 multimedia terminal.



Pace digital set-top box.

Both dual channel and joint stereo can carry Dolby Pro-Logic surround sound, but the phase differences between channels that Pro-Logic relies on to create surround sound from two channels are not sufficiently well maintained with joint stereo to equal what we have become used to with NICAM. The multi-channel MPEG-2 5.1 system will follow later (it is already used for Digital Video Discs). This has the five surround channels plus a discrete bass channel.

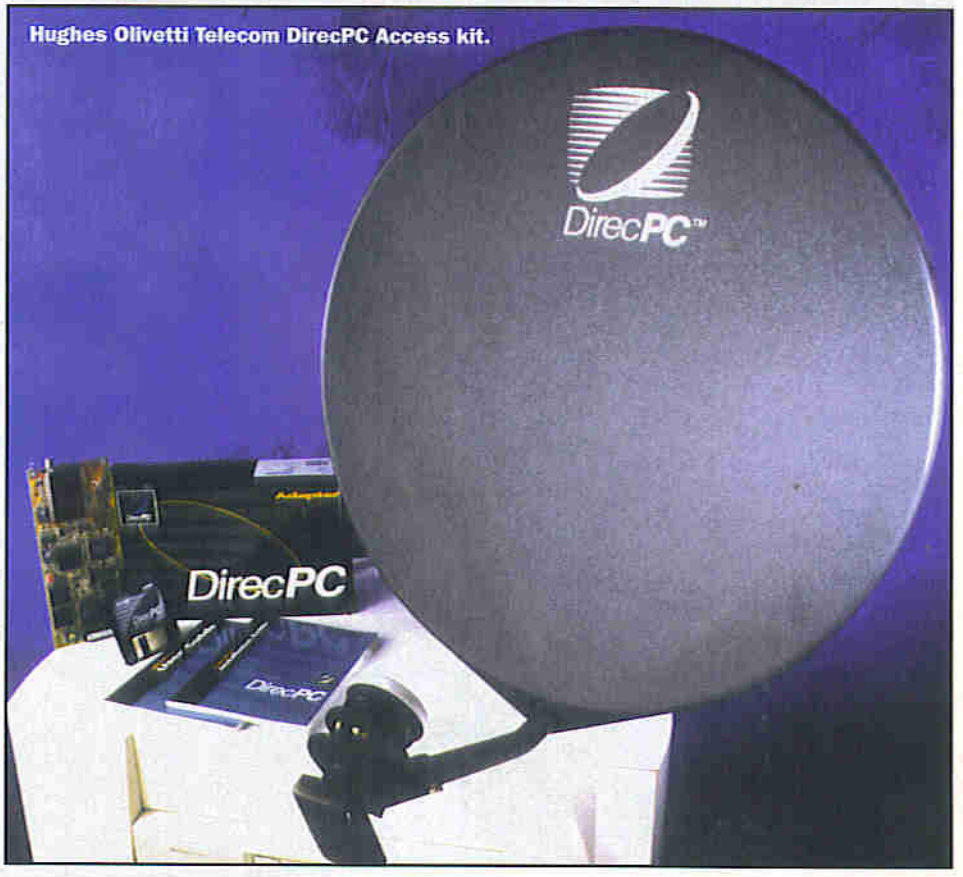
The bit rates of the video and audio streams will depend on the modulation system that is used for transmission; the robustness of the signal that the service provider wishes to achieve (the fewer the bits, the more robust it will be); the quality of the video, and whether the aspect ratio is 4:3 or 16:9; and the type of audio. A satellite encoder, for example, will typically have an output bit rate per video channel of 1·5 to 15M-bps, while the audio rate can be changed in five steps from 56 to 192k-bps for a single channel and twice that for dual channel/joint stereo. The video and audio streams are then combined with text and control data, and channel coding and error correction are performed, giving a transport stream ready for transmission.

Digital cable, satellite and terrestrial systems use different modulation systems. The DVB-C standard specifies Quadrature Amplitude Modulation (QAM), DVB-S specifies Quadrature Phase Shift Keying (QPSK), while DVB-T specifies Orthogonal Frequency Division Multiplexing (OFDM). QAM uses amplitude shift keying to modulate the phase and amplitude of carriers, and is already widely used for microwave, satellite and telecommunications because of its efficiency in allowing high-power amplifier stages to operate near peak output.

QPSK is a similar system, employing phase modulation with a number of phase angles – again, already in wide use. OFDM allows each frequency divided carrier to be phase shifted up to 64 times, and has been chosen for terrestrial delivery because it is inherently robust in the presence of existing higher power analogue signals and resilient to frequency selective fading, reflections and ghosting encountered in the journey from transmitter to aerial (even a set-top aerial). DTT will use channels within the UHF band which are unable to be used by analogue; six frequency slots are available in most parts of the country, each of which can support one multiplex – containing five programme sources.

The Practicalities

Satellite users will need a new Low Noise Block convertor (LNB) fitted to the antenna to cater for the higher frequencies of digital transmissions (the LNB converts the analogue and digital high frequency signals to the lower frequencies required by the receiver and amplifies the signals): low band analogue channel frequencies cover 10·7 to 11·7GHz whereas the high band digital services cover 11·7 to 12·75GHz (see Figure 2). On the assumption that users will wish to continue viewing analogue services as well as taking up digital, there are Universal LNBs available that cover the full range. Of



Hughes Olivetti Telecom DirecPC Access kit.

course, a new set-top box will still be necessary to demodulate and decode the MPEG-2 transport stream into pictures and sound. Incidentally, the Astra digital satellites – 1E, 1F and 1G – have a greater output power than the analogue ones, up from 45-63W to 85-100W, so much of the UK could make do with a 50cm dish to receive digital-only services. All the satellites from 1A-1G are in an orbital position of 19·2° East; but Astra will open a second orbital position at 28·2° East with their 2A and 2B digital satellites.

The output from early set-top boxes will be analogue, probably with a choice of composite, YC with separate luminance and colour or, best of all, RGB. The picture should still be better than present off-air reception, however, because the analogue signal will have been created just a cable's length away from the TV. A standard is being devised for a digital output but, obviously, to use it, the TV would require a suitable input; digital processing is becoming commonplace in TVs, but they all still have analogue inputs.

Until proper digital TVs are launched with all processing done in the digital domain up to final conversion to RGB signals to feed the electron guns, the digital interface will remain impractical. Once they are available, it will give a complete digital path all the way from the cameras. A number of flat panel and projection technologies can actually go further because their pixels are individually addressed, thus each pixel can be kept in a particular state until it needs to be changed rather than constantly refreshing the whole display. Digital audio should present no problem because digital connections are already available on more upmarket Hi-Fi equipment – although analogue outputs will certainly be required for many years to come. In addition to set-top boxes, digital 16:9 TVs will become available with all the necessary circuitry built in, which can thus be optimised for a particular TV to maximise performance.

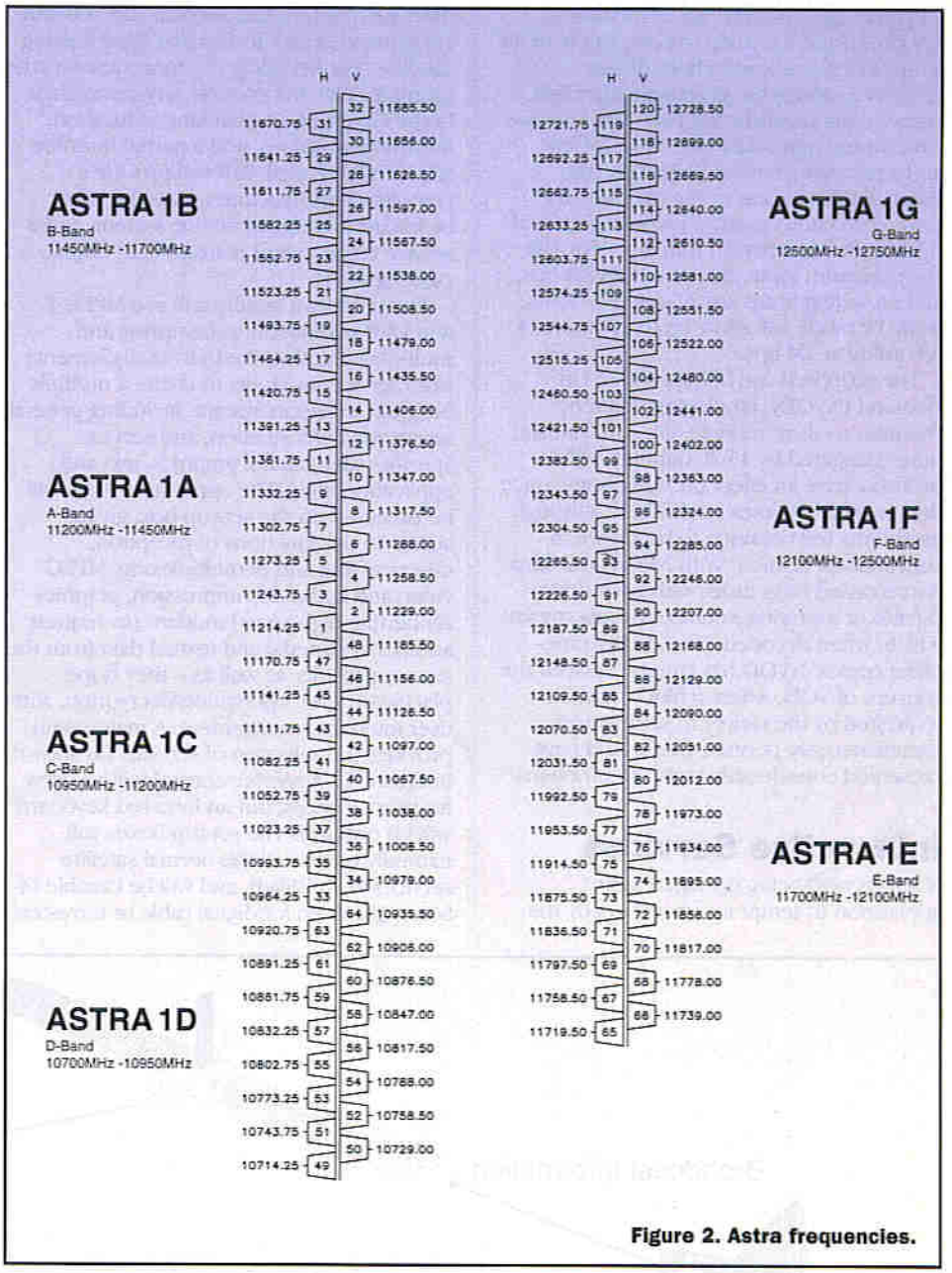


Figure 2. Astra frequencies.

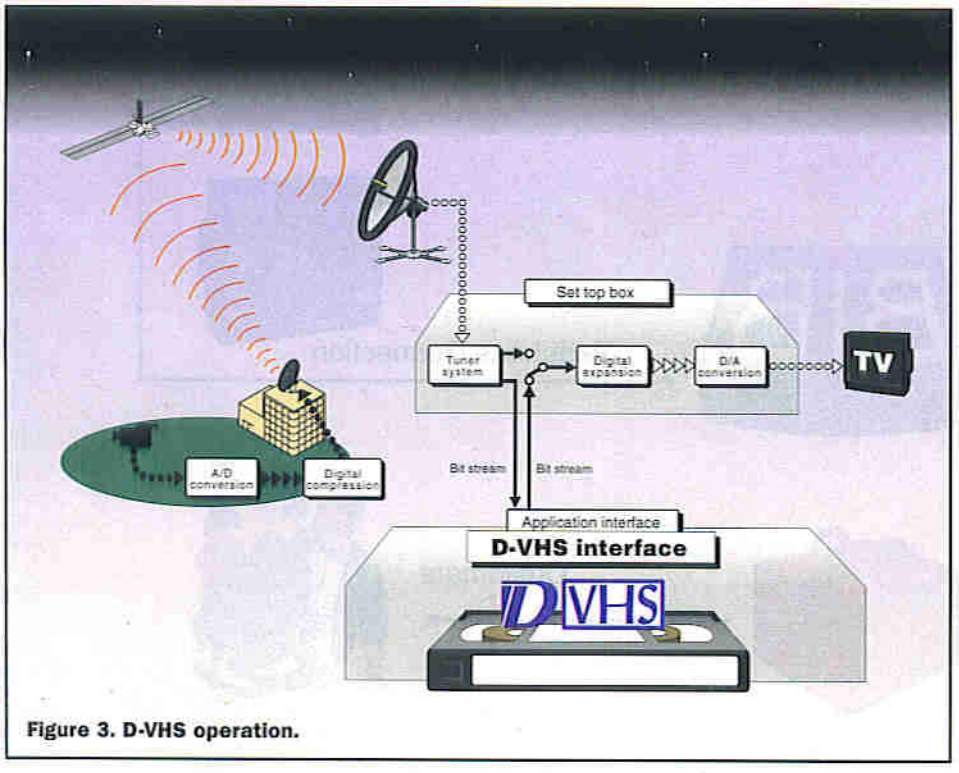


Figure 3. D-VHS operation.

Analogue VCRs will obviously require an analogue input. A DVB version of the Digital Video (DV) format is already allowed for. The specifications for this have yet to be announced, but it will presumably accept what will become the standard digital interface.

Digital (or Data) VHS (D-VHS) has been specifically designed to record the unconverted bitstream. On playback, this will be returned to the set-top box or TV for decoding (refer to Figure 3). A D-VHS machine will also have the facility to control the set-top box when in timer recording mode. It will also be capable of recording up to six multiplexed programme sources – relying on the set-top box or TV to select the desired programmes on playback. D-VHS will probably be launched here within a couple of years. Because D-VHS cannot handle analogue recordings, it will be added to analogue VCRs – either VHS or VHS/S-VHS; thus maintaining compatibility with the vast number of existing recordings, and the expected continuation of VHS pre-recorded software.

D-VHS is based on the conventional VHS mechanism and employs the same tape path with the same pair of heads for digital

and analogue, with the drum rotating at 1,500rpm, and a normal cassette but with an additional identification hole. Three recording modes are proposed: Standard, High Definition and Long Play. The first has a maximum input data rate of 14·1M-bps and a recording rate of 19·1M-bps (the difference being due to the necessity for error correction) giving a recording time of 5 hours or 7 hours with thin tape. For HD, the maximum input data rate is 28·2M-bps, and recording times are 2·5 and 3·5 hours, while LP mode will allow up to 49 hours of recording at 2M-bps.

The proposed use of Near Video On Demand (NVOD), employing different channels to show a single film with starting times staggered by 15-20 minutes, will probably have an effect on VCR useage once the practice becomes established, although most films will continue to be shown in conventional fashion. With NVOD, the films are recorded onto disks, with each drive capable of supplying a number of data streams which, when decoded, provide the time-offset copies. NVOD has largely replaced the concept of VOD, where a film would be requested by the viewer to start almost instantaneously, because that would have presented considerable logistical problems.

Interactive Services

NVOD is now being upstaged as an application to tempt in subscribers by the promise of interactive services, the recently announced British Interactive Broadcasting satellite channel being the most newsworthy example. This will provide services such as home shopping and banking, education, information, games, and a partial Internet service with E-mail. BIB will provide a complete infrastructure consisting of a broadcast system, an on-line system, and a service creation and management bureau (see Figure 4).

The broadcast system will use MPEG-2 and DVB equipment to compress and multiplex together the individual elements from service providers to create a multiple program transport stream, including general navigational information, and service-specific video, audio, graphics, text and application logic. The application logic will be executed on the set-top box, giving access to the functions of reception, descrambling and demultiplexing, MPEG video and audio decompression, graphics rendering, high speed modem (to request additional material and textual data from the service provider as well as – they hope – placing orders), encryption/decryption, and user interface management. A main menu provides the selection of services (as shown in Figure 5). A remote control will be used for most services, but an infra-red keyboard will be optional. The set-top boxes will naturally receive all the normal satellite services from BSkyB, and will be capable of being upgraded for digital cable or terrestrial.

British Digital Broadcasting will use a modified BIB service for its terrestrial transmissions, and BIB will offer a similar interactive service to cable operators. The existing analogue terrestrial broadcasters will probably provide their own interactive services when they begin digital transmissions. But the very latest trend is for Internet access directly from a satellite for high speed downloading of data (the Hitachi and Pace developed satellite PC card can cope with a multimedia signal streaming in at 38M-bps). A return signal can either be by modem or, more expensively, by a transmitter on the dish. These services, such as AstraNet and DirecPC, will initially be aimed at business users, but are likely to filter down to the consumer market as prices drop.

A number of companies, such as General Instrument, Nokia and Pace, have developed multimedia terminals for home and business use that can receive DVB, interface with a computer, access the Internet, etc. (see Figure 6). Companies are also developing large multimedia TVs which include a computer input, trading off resolution against size and brightness (the shadow mask pitch of a standard definition TV at around 0·65mm is more than twice that of a computer monitor). The introduction of digital TV has been likened in its significance to that of colour in 1967. Whether the public agrees with that remains to be seen.

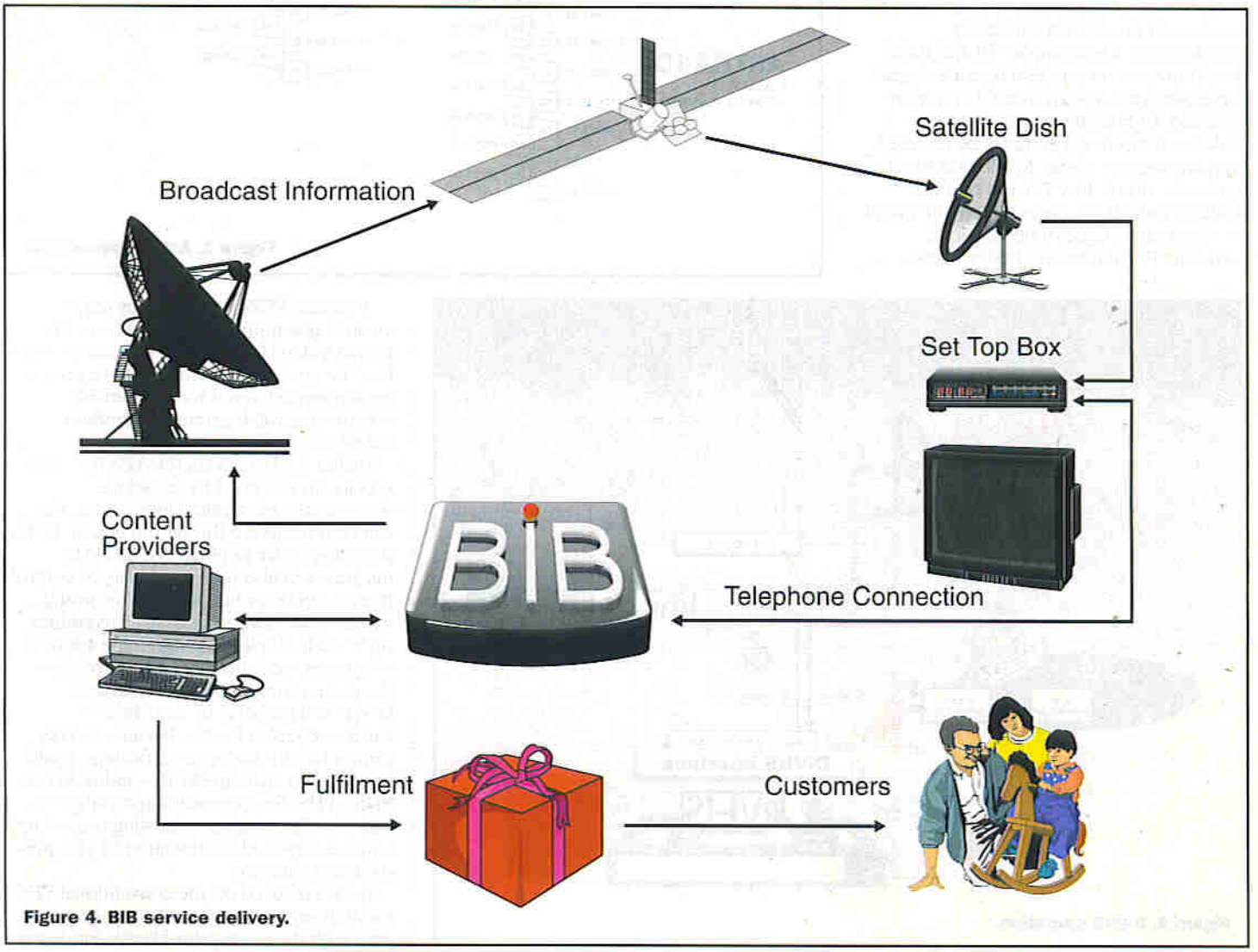
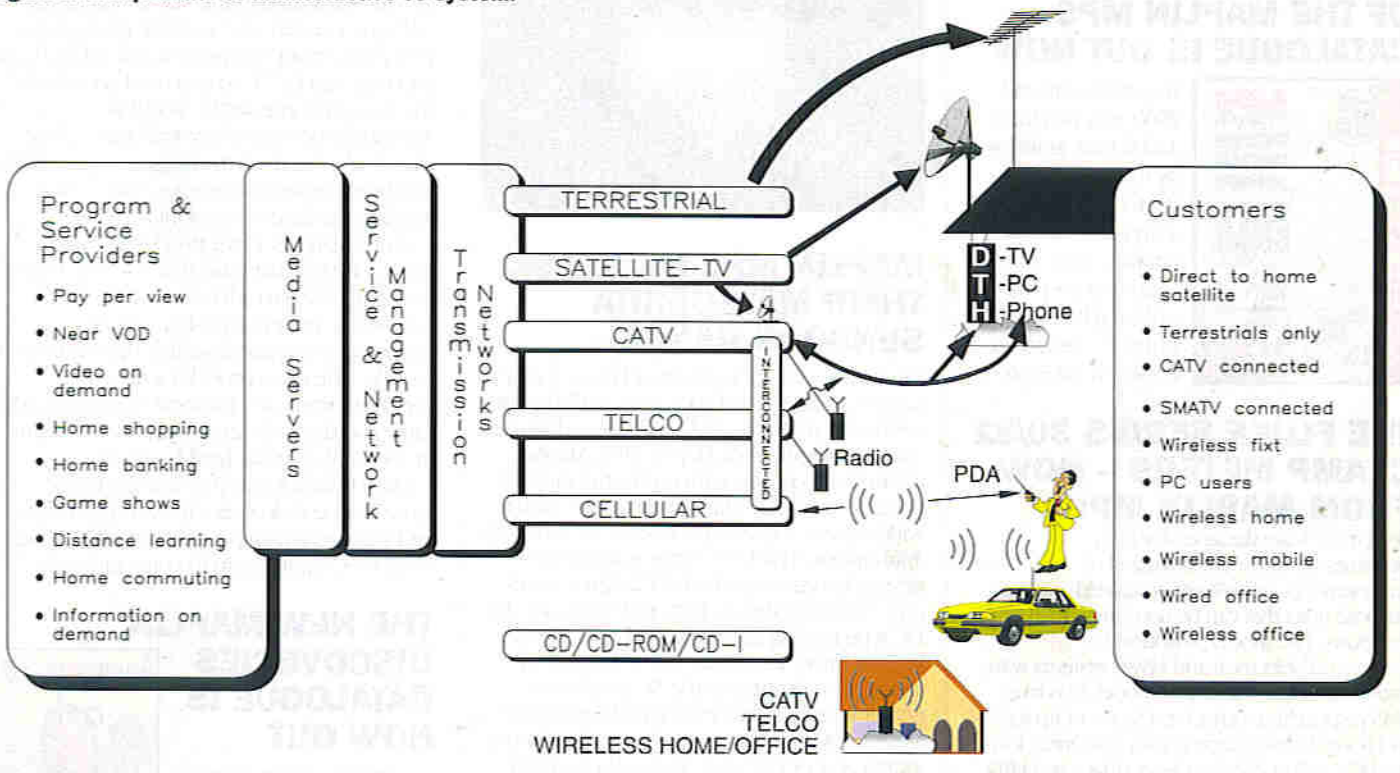


Figure 4. BIB service delivery.

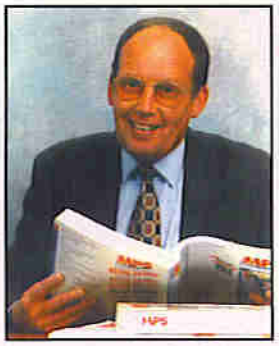
Figure 5. BIB main menu.

Figure 6. Components of an interactive TV system.



MAPLIN NEWS

NEAL TURNER JOINS MAPLIN



Maplin Electronics has recruited Neal Turner to fill the newly created post of Sales and Marketing Director. Turner was previously with Farnell Components as director and general manager responsible for sales and marketing in the UK and Eire. Neil Turner brings a wealth of experience to the newly created role, having worked for a number of major players in the electronics industry since 1975 in sales and marketing roles. His brief will be to grow the trade mail order business by capitalising on Maplin's recognised product range specialisms computer components and peripherals: cables and components: tools and test equipment: sound and vision and the hobbyist range.

"Maplin occupies a unique position in the electronics sector. distributing through a mix of retail stores and the catalogue. Maplin serves the hobbyist and the industrial consumer with the same level of professionalism.

Neil Turner's recruitment comes at a time of rapid growth for Maplin. The company opened new Mondo superstores earlier this year in Lakeside Thurrock and Castle Retail Park, Nottingham, and Maplin stores in Wood Green and Stratford, London. Seven more new stores are planned before the end of the year, necessitating a major drive to recruit store managers and senior retail staff.

THE SEPTEMBER EDITION OF THE MAPLIN MPS CATALOGUE IS OUT NOW

It contains around 2000 new products and is now available by mail order or from any of our stores around the country. Price £3.45. (Add 50p p+p if ordering by mail order.) Contact our hotline 01702 554000.

THE FLUKE SERIES 30/32 CLAMP METERS – NOW FROM MAPLIN MPS.

Both meters are designed for high performance in the most rugged of environments and are self contained, general purpose units that can be used in a variety of situations. The model 30 is ideal for commercial, electrical and HVAC systems with traditional linear loads. The model 32 is true RMS responding with a crest factor of up to 3 and is ideal for interacting with non linear loads like PC's, adjustable frequency drives and HID lighting. Both draw current in short pulses causing harmonics in the load current and distorted waveforms. Diagnostic information is instant and can be easily read from the digital display. Cramped junction boxes present no problem as both meters have tapered jaws allowing easy access and cables of up to 38mm in diameter can be accepted.

The series 30 and 32 can accept both an AC and DC current, ranging, a 3.5 digit 2000 count display, measure up to 400A AC 600V AC/ 200 and their Display hold feature can capture readings in difficult areas for later use. The series 32 has extended current measurement to 600A. Both models can operate in temperatures of -10 Celsius to +50 Celsius. Battery life is 200 hours continuous for the series 30 and 300 hours continuous for the 32. Maplin MPS have a technical support team to answer any questions with regard to specification, performance or application and are available 24 hours per day.

MAPLIN MPS INCREASE THEIR MATSUSHITA SENSORS RANGE

The UZ-C series of Cylindrical Photoelectric sensors from Matsushita is now available with connector interface and can be found in the latest catalogue from Maplin MPS. Maplin continues to increase their product range in order to provide industrial engineers with a wide choice of quality products for a variety of applications. The UZ-C series is miniature in design, for instance, the UZ C23O measures only 71mm for the AC type and 56mm for the DC type making the range ideal for any tight fit installation. Engineers will find it easy to check power supply as the AC type has a power indicator on the back of it's projector and the DC type is equipped with a projection indicator on it's reverse. These photoelectric sensors have a detection speed of 2ms max while the rated power consumption is up to 25mA. The ambient temperature range of -25 Celsius to + 55 Celsius makes them ideal for numerous applications where temperature variation is evident.

The UZ-C series is IP67 rated, protected against being immersed in water for short periods of time. Maplin MPS also stock an extensive range of Matsushita sensors and relays, including the UZ-A range and continue to offer engineers a support hotline when specification performance and/or application questions arise.

EGWARE STORE GETS SET FOR THE 21ST CENTURY

Electronics specialist Maplin unveiled a new look store on Monday 4 August, designed to make the latest in electronic technology more accessible to home and business users. The changes to the store at 146-148 Burnt Oak Broadway are part of Maplin's ongoing store upgrade programme.

The range available in store has been extended so that even more of the 18,000 products featured in the Maplin Catalogue will be on display and available from stock. Everything from computer networking, home and business CCTV systems and security for the car and home will be available. Technophobes and whizz-kids alike will be able to choose from the biggest range of hi-fi and home entertainment accessories and specialist tools and components in the city.

Store manager Dave Brockman heads seven full and part time staff, each of whom is well qualified to advise business customers, traders and shoppers on choosing, using and installing the equipment on sale. The store provides a fax order service to trade and business customers, and same day dispatch for any products featured in the catalogue not held in stock.

Dave believes that the changes to the store will be welcomed by existing customers and will encourage people who have never been to a Maplin store to come and visit.

THE NEW MAPLIN DISCOVERIES CATALOGUE IS NOW OUT

It contains a wide variety of innovative products for the home. Copies are available from our stores while stocks last.

RESEARCH NEWS

by Dr. Chris Lavers

Mars Update 1

Six and a half hours after re-entry and an epic journey of 497 million kilometres, the Jet Propulsion Laboratory (JPL) mission control team at Pasedena in California erupted into loud cheers drowning out the Beatles' *Twist and Shout* as the Pathfinder Lander, renamed the Carl Sagan Memorial Station, signalled its safe arrival. The Lander's fixed carrier wave frequency was received just after 6pm BST or 3am local Mars time. The first signal was sent as part of the automated landing process and indicated that it had landed in the best possible position, on the base 'petal' itself. An hour and a half later, a second signal was received suggesting that the petals had unfurled and the airbags retracted. An incredible feat, given the method of landing chosen.

In order to survive re-entry, the Pathfinder lander had to re-enter the Martian atmosphere at an angle of 14·2°, too steep an angle and it would burn up upon re-entry, too shallow and it would skip out again into interplanetary space. In fact, the Pathfinder probe entered the Martian atmosphere at 13·9°. Eight seconds before final impact, at an altitude of only 294 feet, the airbags inflated and 4 seconds later, rockets decelerated the Pathfinder down to 100 feet up. The Lander was fully enveloped in four enormous airbags when it hit the surface at 23·5mph and bounced up twice, reaching heights of 47 and 23 feet; on the first strike, the probe experienced a force equivilent to 18 × Earth gravity (177ms^{-2}), well within the tolerance limits designed to withstand 55g. The first landing area data revealed a wide temperature range, expected from previous Viking data, -64°C (comparable with the coldest place on Earth, Vostok in Antarctica) to a more acceptable -26°C.

Preliminary signals indicated that the landing conditions were well within that expected, Pathfinder was tilted at an angle of less than 3°, suitable for the Sojourner rover to disembark and the unfurled solar panels were being powered by sunlight efficiently. Just after 4pm, prime time US TV on 4th July, the first images began to arrive at mission control. Pathfinder data is currently transmitted back to Earth at a slow 2,250bps, revealing rock-strewn plains under a salmon sky, with hills, crater rims and plateaus in the distance (see Photo 1). So startling were the images, that the NASA websites received a staggering 100 million hits on that first Friday alone!

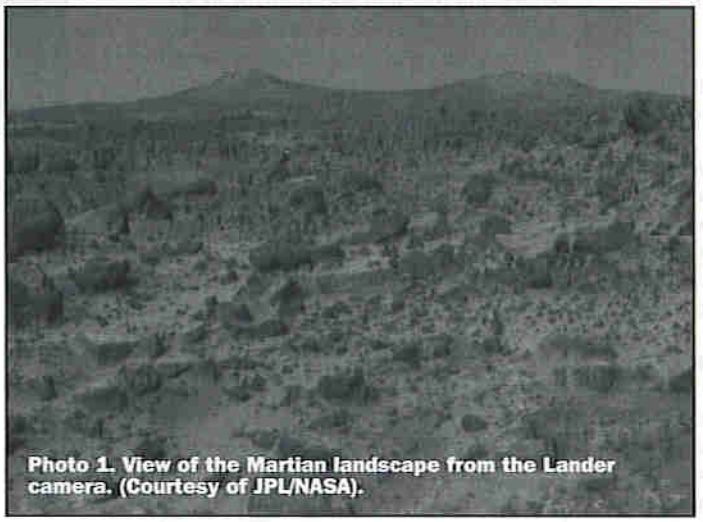


Photo 1. View of the Martian landscape from the Lander camera. (Courtesy of JPL/NASA).

Difficulties began when commands radioed from JPL to the Lander were not being relayed to the Sojourner rover, named after the US black civil rights activist, Sojourner Truth (1797-1883). The cause was a break in synchronisation and was remedied by resetting the clocks and 'power-cycling' to achieve resynchronisation. The synchronisation error occurs whenever the rover computer is asked to do too many things at once. The computer software error was discovered and will be fixed shortly by JPL engineer, David Gruel (known as 'the Gremlin' because he deliberately creates problems to be solved). A further difficulty was found in deploying the rover due to a partially deflated airbag overlapping the rover ramp, but this was surmounted by tilting the Lander at 45° until the bag dropped down.

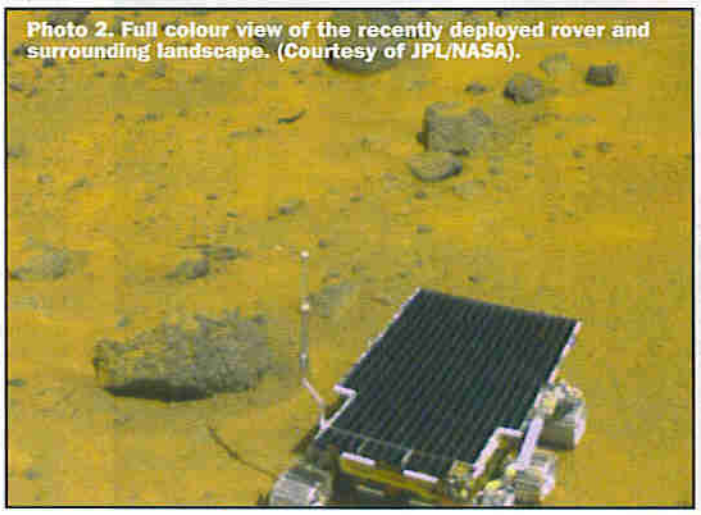


Photo 2. Full colour view of the recently deployed rover and surrounding landscape. (Courtesy of JPL/NASA).

At about 10:40pm Pacific Daylight time on July 5th, the Sojourner rover left its ramp and trundled cautiously onto the Martian surface; the ramp departure took approximately 2 minutes to complete. Its first task was to halt 10cm from the end of the ramp and analyse the chemical composition of the Ares Vallis soil for 10 hours using its Alpha Proton X-ray Spectrometer (see Photo 2). Emitted alpha particles excited atoms in the soil making them emit x-rays or protons, and the emission energies will reveal the chemical elements of the Martian rock. Since then, it has moved on to analyse soil and nearby rocks such as 'Yogi' and 'Barnacle Bill'. 'Barnacle Bill' has revealed surprising data, showing it to have a chemistry very similar to a silicon-rich version of a terrestrial rock called andesite. This is very exciting as on Earth, geologists think andesite enriched with silicon is formed through the action of both plate tectonics and liquid water.

NASA scientists plan to use the rover's chemical data to develop a complete geological map of Mars; by matching the chemical analysis of each rock with its optical reflectance in all the visible wavelengths (using the Pathfinder camera), the Mars Global Surveyor and future Space Telescopes could be used to search for large surface areas with the same reflectance characteristics. The rover driver, Kevin Cooper, wears special goggles that give him a 3D view which allows him to send the rover semi-autonomous instructions to visit target samples and rocks of interest.

The success of the mission so far fully justifies NASA's chief Administrator, Daniel Goldin's need for 'better, cheaper, faster' missions. Mr Bruce Melnick, Head of the Kennedy Space Centre launch facility at Cape Canaveral, and responsible for the Pathfinder and Mars Global Surveyor launches, expressed to me his excitement whilst in the UK as the launch team waits for the safe arrival of the Mars Global Surveyor in September, adding to the wealth of new information returned. Mars Global Surveyor will then serve as a relay for information from the Carl Sagan Memorial Station using its high gain antenna.

A Vision OF THE FUTURE

Text by Paul Freeman-Sear and Vision Control Systems

Wouldn't it be great to have complete hands free operation of a computer or indeed any interactive visual screen.

This dream or concept has been thought about for many years particularly to help physically disabled people. Many suggestions have been put forward to get around the problem of operating a keyboard, namely voice operation, pressure sensing by blowing from the mouth, head movement or eye movement. Put two of these aspects together like the combination of eye motion and simple pushbutton control and it could provide us with many applications particularly in the games area and virtual reality.

Vision Control Systems, a part of Ferranti Technologies Ltd, has moved nearer towards that 'look-and-click' approach to replacing the computer mouse. They have been researching this for two years and now, the company is unveiling its 'VCS' technology at the ECTS '97 show, at Olympia London between 7th-9th September '97.

The accuracy and speed of VCS technology will particularly appeal to computer users in applications as widespread as computer games, pilot training, advertising research and perhaps more significantly, as an aid for disabled people.

The system was originally developed for use by fighter pilots within the cockpit to minimise hand movements, and the result of that research programme has emerged a control for computers and other machines by monitoring the user's eye movements.

By integrating a miniature camera with holographic optics operating in the infra-red spectrum, Vision Control Systems uses the principles of reflection from the back of the eye to determine what the eye is looking at.

A low power infra red LED provides a collimated beam about 3mm wide from a lens.

The infra red ray passes through a reflective beam splitter surface (see illustration), then out on to a mirror and into the eye. The reflected beam from the retina takes a return path to the mirror and back through the beam splitter on to the video camera. The video camera therefore tracks the movement of reflected light from the retina. Any small angular movement by the retinal surface in the eye will result in twice the angular movement of the reflected beam. The beam hits a CMOS matrix within the camera. CMOS photo sensitive surfaces are now cheaper to produce compared to the older CCD devices. The control software to change the image into cursor movement has been developed by VCS.When linked to a computer the system moves the cursor to the user's exact point of observation. Many users find the VCS system more intuitive than conventional mouse control as well as offering faster cursor movement. Early trials

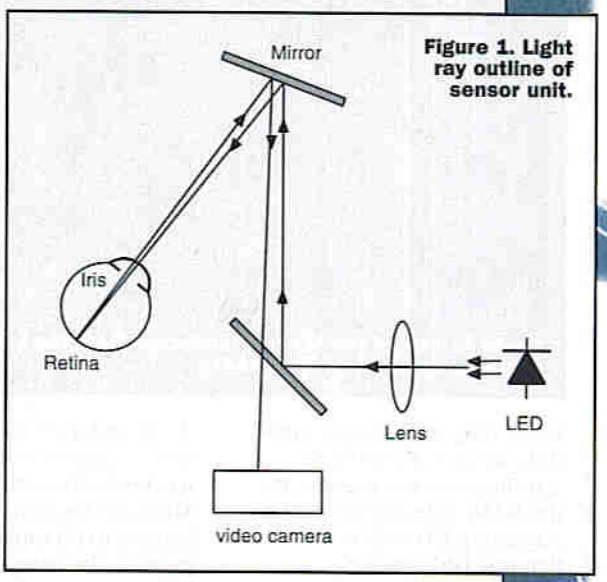
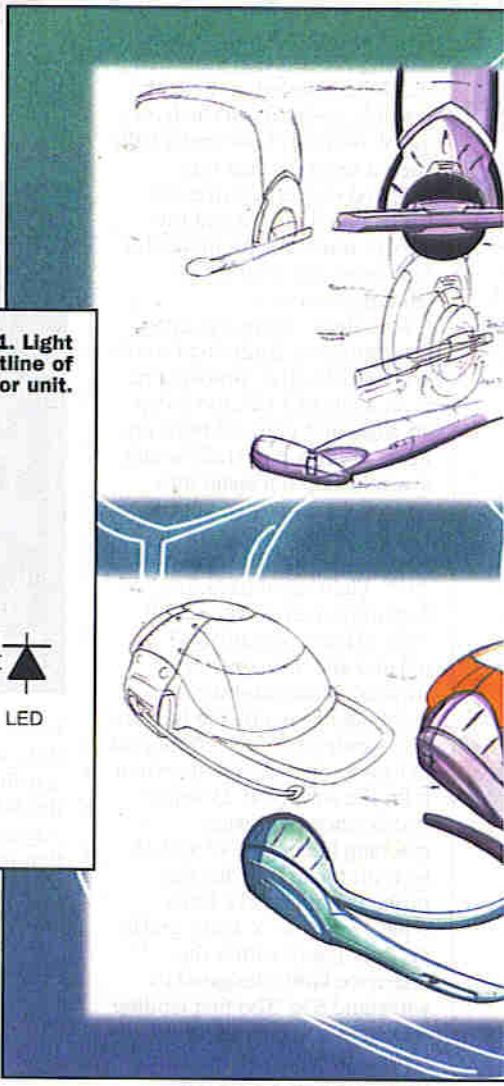
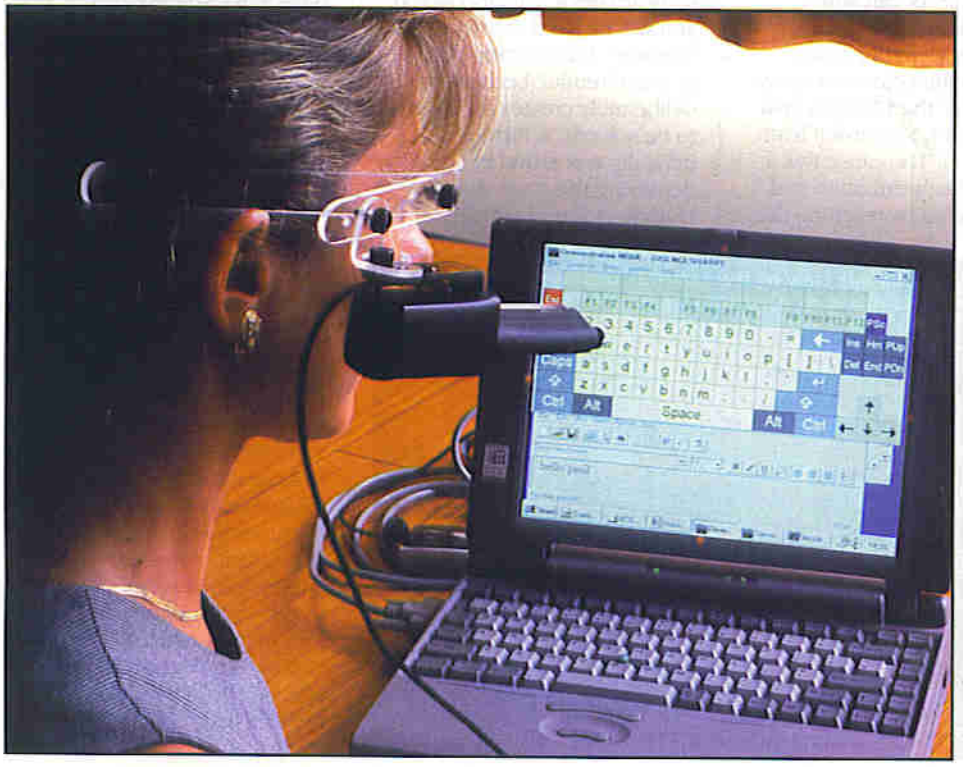


Figure 1. Light ray outline of sensor unit.





with the first generation headset have shown that the compact design makes it particularly suitable for custom integration into a wide range of OEM products. The current headset design weighs under 100g. Vision Control Systems has explored a variety of styling and headset arrangements (as shown in the artist impressions) and is currently trialing "headband" and "visor-mounted" alternatives. The headset is connected via a cable to the serial port of the host computer, although the company is considering remote operation and is offering a radio option to replace the standard cable.

Vision Control Systems is already working with application partners and will be licensing the technology to companies which wish to benefit by incorporating VCS into their own products. Evaluation equipment and software is now available to explore the potential of the technology and to develop products with a "look-and-click" control. This low cost method of eye movement tracking means that it now falls into the price range for consumer market applications such as Virtual Reality headsets

The parent company, Ferranti Technologies Ltd operations span design, development and manufacture for both defence and the commercial markets.

TECHNICAL SPECIFICATIONS

PERFORMANCE

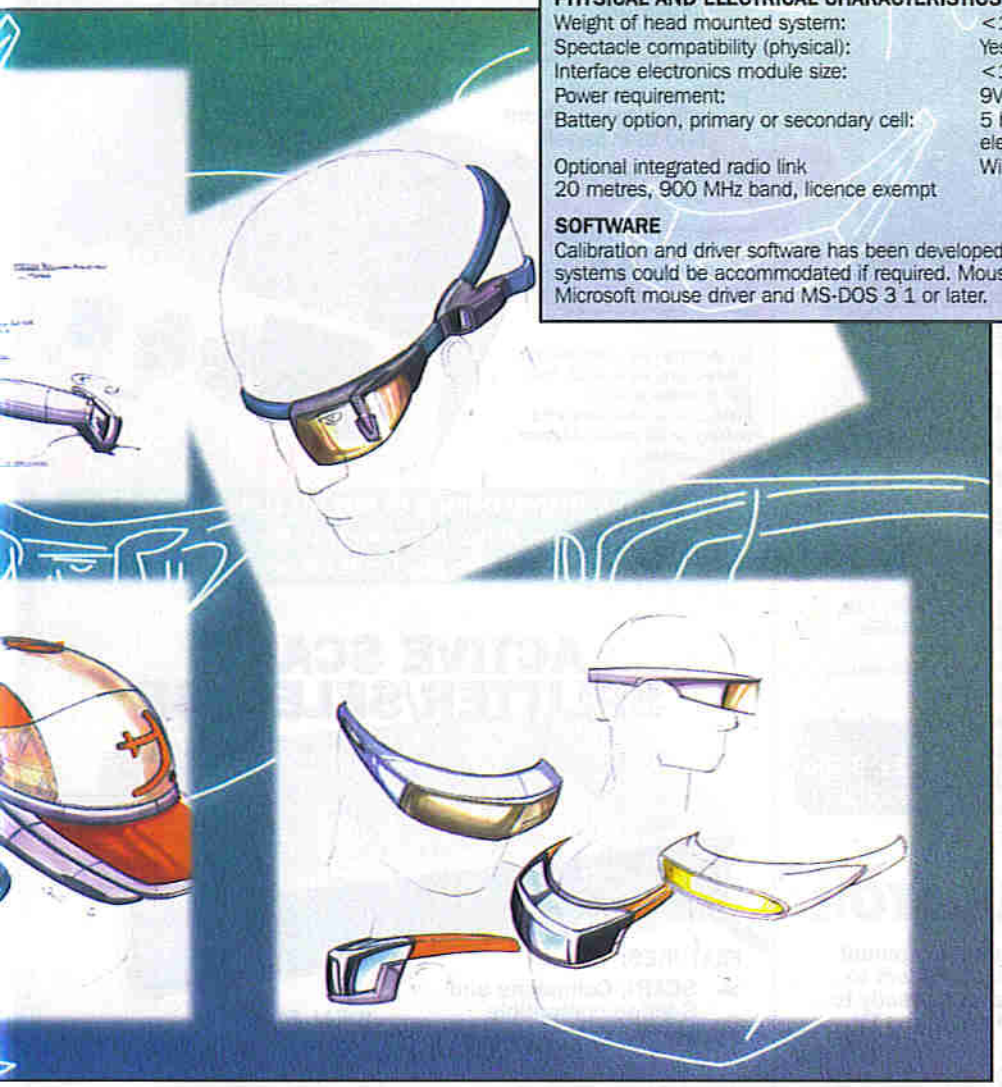
Eye movement coverage wrt straight ahead:	Horizontal > +/-20deg/vertical > +/-15deg
Theoretical resolution of point of gaze co-ords:	<0.1deg
User resolution for PC control:	<1.0deg, approx 1cm at normal computer working distance
Ambient Light Level range:	Commensurate with comfortable VDU usage
Infra red illumination	From standard LED, wavelength 880nm incident power at eye -200uWcm-2
Data output parameters:	RS 232 Protocol – 9600 baud, 8 data, 1 stop, no parity
Switchable data modes:	Coordinate mode – real-time x, y gaze position, update rate 25Hz
Mouse mode – serial mouse emulation	
Peripheral control output port:	Dedicated data

PHYSICAL AND ELECTRICAL CHARACTERISTICS

Weight of head mounted system:	<100g
Spectacle compatibility (physical):	Yes
Interface electronics module size:	<160x90x30mm
Power requirement:	9V, 300mA
Battery option, primary or secondary cell:	5 hours operation, 8 hour recharge, size similar to electronics module
Optional integrated radio link 20 metres, 900 MHz band, licence exempt	Wireless, battery powered, interface with PC Range

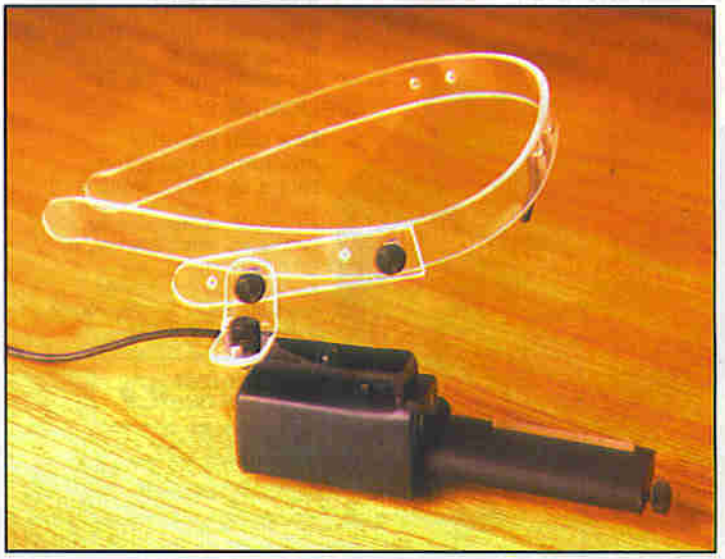
SOFTWARE

Calibration and driver software has been developed for Windows 95 compatibility Other operating systems could be accommodated if required. Mouse emulation mode for games use requires only Microsoft mouse driver and MS-DOS 3 1 or later.



For further product information contact:

Richard Gay, Vision Control Systems, Oldham, OL4 3JA, England.
Tel: +44 (0) 161 624 0281.
Fax: +44 (0) 161 624 652 0972.
Email: info@visioncs.com



projects New Project

150W BIPOLAR POWER AMPLIFIER

PROJECT RATING 2

FEATURES:

- 175W RMS into 4Ω*
- 100W RMS into 8Ω*
- Classic Bipolar design throughout
- Wide frequency response 15Hz to 37kHz (-3dB)*
- Low distortion less than 0.1% at 1kHz*
- Full output at 1V RMS input*
- Operating voltage ±25V to ±50V DC

APPLICATIONS:

- PA Systems
- Disco equipment
- In Car Entertainment using PSU LP39N

*Quoted values measured using recommended PSU

Kit includes all components, PCB, heatsink, greaseless insulators, fixing hardware and full instructions. Pre-amp components and PSU not supplied.

150W BIPOLAR AMPLIFIER KIT LP33L £34.99
Construction details: 150W Bipolar Amplifier Kit leaflet XZ37S 50p
Issue 107 / November 1996 Electronics & beyond XD07H £2.25

AUDIO VIDEO MODULATOR

FEATURES:

- Simple construction. No alignment required
- Multiple inputs – SCART or BNC/Phono
- Silk-screened , pre-punched case
- Built in test signal for TV tuning
- Allows video equipment such as camcorders to be connected directly to the RF input of any TV
- Provides a SCART input to your TV (Composite video and audio only)
- Allows two videos to be linked without disconnecting the TV

APPLICATIONS:

- Low cost security monitoring using our range of CCD cameras

Kit includes all components, connectors, wire, PCB, box, and full instructions.

Requires +8V to +15V DC regulated mains adaptor 300mA minimum (not supplied).

PROJECT RATING 2

AUDIO VIDEO MODULATOR KIT LU35Q £34.99
Construction details: Audio Video Modulator leaflet XZ10L 80p
Issue 108 / December 1996 Electronics & beyond XD08J £2.25

ACTIVE TRANSFORMER DI BOX

FEATURES:

- Active design
- Battery or PSU operation
- Low battery and power on indicators
- 6.35mm (1/4in) jack inputs and XLR output
- Pre-punched silk-screened front and rear panels
- Sturdy and compact

IDEAL FOR:

- Matching unbalanced lines into balanced inputs
- Breaking earth loops
- Impedance matching

PROJECT RATING 1 Simple

Kit includes all components, connectors, wire, PCB, box, panel labels and full instructions. Requires PP3 battery or 9V mains adaptor (not supplied)

ACTIVE TRANSFORMER DI BOX KIT LU32K £32.99
Construction details: Active Transformer DI Box leaflet XV98G 50p
Issue 106 / October 1996 Electronics & beyond XD06G £2.25

ACTIVE SCART SPLITTER/SELECTOR

PROJECT RATING 2

FEATURES:

- SCART, Composite and S-Video compatible
- Separate phono audio outputs
- Split or source 2 ways
- Can be daisy chained for more outputs
- Easy to build and use
- Mains powered 230V AC 1.84W

IDEAL FOR:

- Connecting a single TV, VCR or cable/satellite unit to two other units
- Buffering of signals to reduce degradation
- Simple input selection of audio and video source

Kit includes all components, connectors, PSU, mains lead and plug, PCB, labelled box and full instructions. Connecting leads are dependant on use and not supplied.

ACTIVE SCART SPLITTER/SELECTOR KIT LU21X £39.99
Construction details: Active SCART Splitter/Selector leaflet XZ36P 80p
Issue 107 / November 1996 Electronics & beyond XD07H £2.25

These kits are:

- Supplied with high-quality fibre-glass PCBs – pre-tinned, with printed legend and solder resist
- Supplied with comprehensive instructions and a constructors' guide
- Covered by the Maplin Get-You-Working Service and 12-month warranty

Kits do not include tools or test equipment. Kits may require additional components or products, depending on application, please refer to construction details or contact the Maplin Technical Support Helpline (Tel: 01702 556001) if in doubt.

WHAT'S IN A NAME

PART 8

Hang 'em High!

by Greg Grant

Hang 'em High!, as all the best movie sheriffs – from Gary Cooper to John Wayne and Clint Eastwood – used to instruct the posse. For communications engineers though, it was more than an instruction, in fact, damned nearly an article of faith where antennas were concerned. In many cases, it's still so.

From Adcock to Yagi, more engineers have given their names to antennas or antenna systems than to almost any other electrical component. First and foremost, of course, was Marconi who, quite apart from stumbling across the basic aerial configuration*, gave his name to two other antennas: the Quarter Wave Dipole and the Marconi Fan, long abbreviated to 'Conifan.'

The Marconi Aerial or Quarter Wave Monopole, shown in Figure 1, is an aerial in which an image of the quarter wave element corresponds to the lower element of a vertical, half-wave dipole. Many historians of technology regard this aerial as Marconi's most significant contribution to communications engineering. Yet the 'Conifan' was equally as significant, if not more so.

The earliest 'Conifan' – illustrated in Figure 2 – was in fact an inverted cone, composed of 50 copper wires extended between two, 48m poles, 60m apart. Marconi's later Glace Bay aerial was not so much a cone, more an inverted pyramid. It consisted of 400 copper wires suspended from triatics, in sections, between four 61m wooden towers. The down leads were connected together at the station's cable entry point – on the roof! The aerial was rigged so that either sections, or the complete system, could be used as required.

Umbrella, or Cone, antennas were much in evidence at this time and had been designed as more effective radiators for the transmitters then in use. They were, in effect, massive tuned circuits, the Cone and earth forming two capacitive plates, whilst the inductance was supplied by the antenna coupling coil. There was one advantage to this system: cost. The arrangement required only one mast because the guy wires could be incorporated into the radiating arrangement.

Such systems were extensively used by the German company Telefunken, for example, and eventually led to the antennas used by the Imperial German Wireless Service, at their main communications centre at Nauen, west of Berlin. In the decade between 1906 and 1916, the main antenna at Nauen underwent constant development and improvement, ultimately ending up as the enormous structure that is Figure 3.

Unlike the Germans, the British had long forestalled ANY idea of a similar network for its own, still expanding, empire, regarding the telegraph as more than adequate for all imperial communications purposes.

By 1924, however, the government of the day relented and Marconi began experiments aimed at creating reliable equipment for an Imperial Wireless Chain, or Beam System, as it was known.

The antenna arrangements, designed by C. S. Franklin, consisted of five masts, 87·4m high and spaced 198m apart, giving a 396m antenna path. The system also used another Franklin invention, the Concentric Feeder, to ensure efficient coupling between transmitter and antenna. Consisting of concentric copper tubes, air-insulated and separated by porcelain spacers, it was the forerunner of the ubiquitous 'co-ax' of today.

In 1910, a young Japanese, Hidetsugu Yagi, graduated from Tokyo University and joined the Ministry of Education as a teacher. After four years at the Engineering High School at Sendai, the Ministry sent the young man overseas to further his own education. Thus began what would turn out to be a three-year grand tour of the great centres of electrical engineering innovation.

Between 1913 and 1914, he studied under Georg Barkhausen – the discoverer of the Barkhausen Effect – at the Dresden Technische Hochschule. In the following year, Yagi was in Britain, at University College London, studying under Sir Ambrose Fleming, the inventor of the Diode Valve. Finally, between 1915 and 1916, he was in America, at Harvard, under the benign eye of Professor George Pierce, inventor of the Pierce Oscillator.

On his return home, Yagi resumed his teaching career until the Sendai School was absorbed into Tohoku University, from where Yagi received his doctorate in 1921. His main area of research was continuous Short Wave radiation and in the mid-1920s, he learned of the invention of the Magnetron Tube by Albert W. Hull, at the General Electric Corporation's research laboratories. This seemed to him an altogether better way of generating Short Waves.

With his research students Kinjiro Okabe and Shintaro Uda, he used the Magnetron

* See 'Birth of the Antenna' in Issue 105, September 1966.

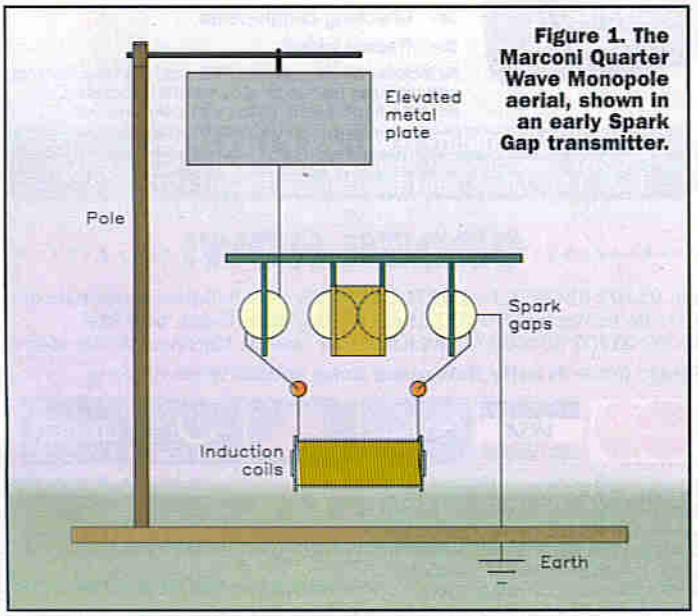


Figure 1. The Marconi Quarter Wave Monopole aerial, shown in an early Spark Gap transmitter.

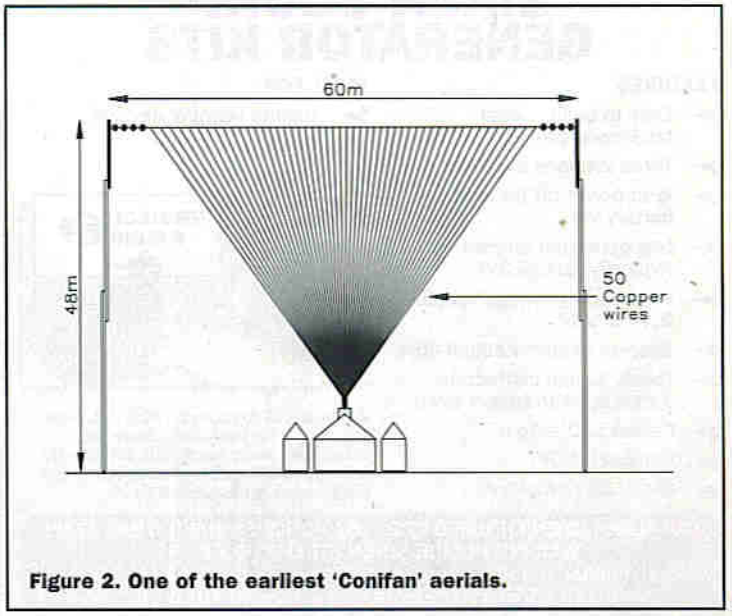


Figure 2. One of the earliest 'Conifan' aerials.

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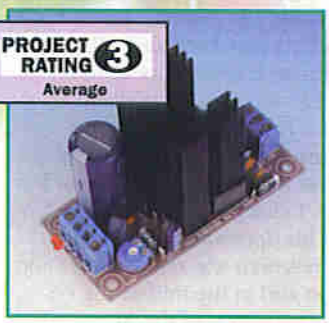

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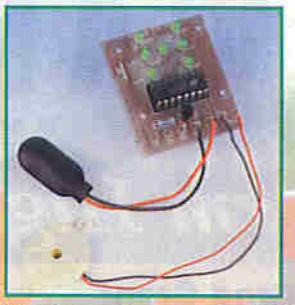

FEATURES:

- Easy to build – ideal beginners' project
- Auto power-off for long battery life
- Low quiescent current (typically 1μA)
- 3V supply voltage (2 x 1.5V cells ideal)
- Touch, switch contact or digital input to 'roll' dice
- 'Rolling dice' sound effect
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- EMC / CE Compliant

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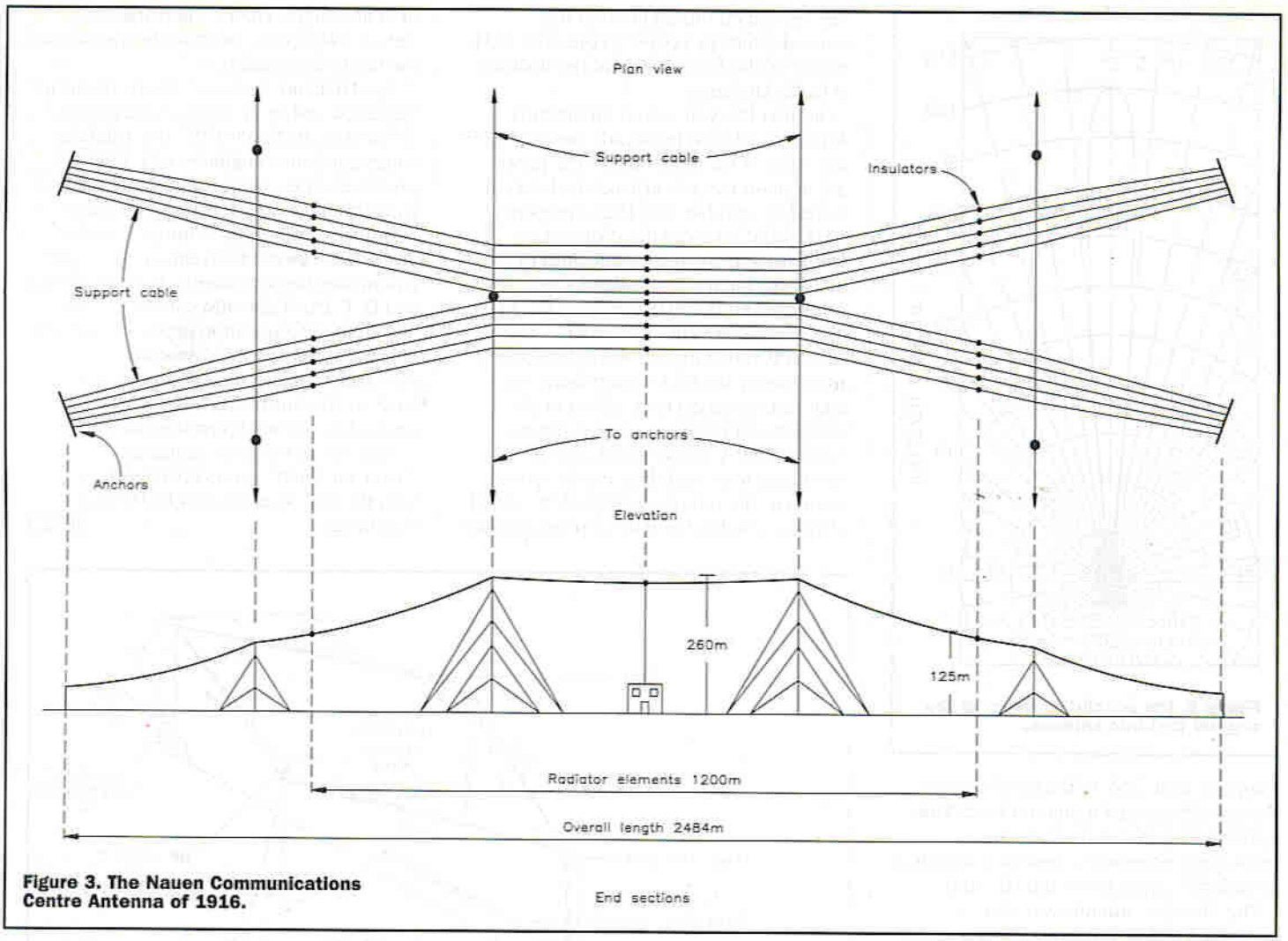

Figure 3. The Nauen Communications Centre Antenna of 1916.

Tube in conjunction with the Yagi-Uda Antenna, to generate wavelengths of a few tens of centimetres. Later, Okabe achieved greater output from the Magnetron Tube by splitting its anode into segments, in other words, inventing the Split-Anode Magnetron Tube.

Uda concentrated on the antenna, which – whether hung high or low – is now the most ubiquitous antenna in the world.

This antenna first became known in the West in 1928, through the classic paper 'Beam Transmission of Ultra Short Waves'. Working firstly as Yagi's student and then later – on being awarded his BSc in 1924 – as his co-researcher, Shintaro Uda examined and experimented with almost every aspect of an antenna's construction and electrical properties.

He looked into Reflectors, the effects of height on an antenna's performance, Directors in general and the results of firstly varying their size, secondly altering the spacing between them and finally, he studied antenna polarisation. A row of Directors along an antenna's horizontal plane – as shown in Figure 4 – was termed a 'Canal Wave' by Yagi and the results of using this arrangement were displayed on some 22 drawings in the original, two-part paper.

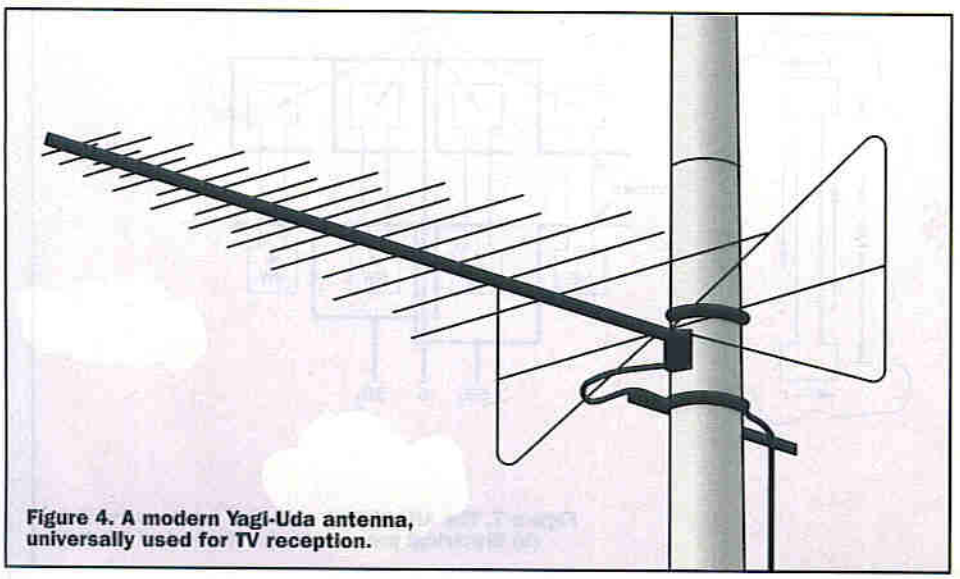

Figure 4. A modern Yagi-Uda antenna, universally used for TV reception.

Yagi and Uda showed how, by using the wave-influencing properties of the director rods, the pencil-slim beam of Figure 5 could be generated. Equally, it could be increased by adjusting the spacing between the directing elements. The world – and the communications industry in general – did not yet realise that the future of television, in one aspect at least, was assured!

By the end of the 1920s, it was becoming obvious that the High Frequency (HF) band's problems of ionisation changes and the general turbulence that resulted, was creating havoc with reception. One proposed solution – increasing transmitter power – proved to be less effective than many people had imagined. In fact, in some situations, it appeared to have no effect at all.

In 1931, three Radio Corporation of America (RCA) engineers, H. O. Peterson, J. B. Moore and H. H. Beverage, published a paper on a 'Diversity Receiving System For Radio Telegraphy'. In it, they described their Diversity Reception technique, which was based on a simple fact: that there's a statistical independence in the fading characteristics of multiple radio signal paths.

The trio's Space Diversity system used three antennas, some 305m apart. The rectified outputs of the three receivers were combined across a common resistor load. The voltage thus developed then keyed a tone generator provided, of course, that

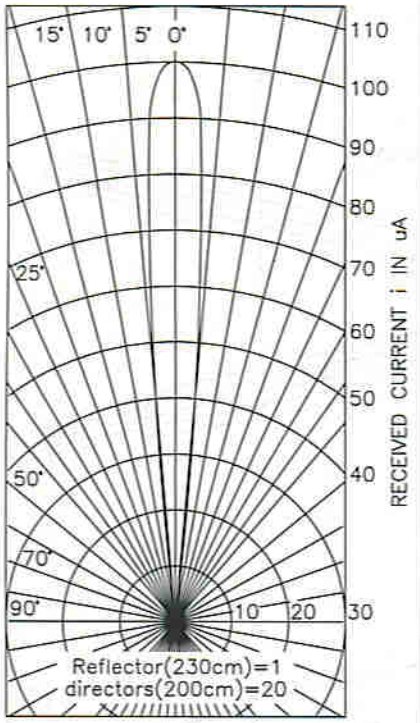

Figure 5. The pencil-thin beam of the original Yagi-Uda antenna.

reception from ANY of the receivers was above a determined minimum level. This system – easy to construct and so reassuringly economic – improved reception considerably, right across the HF band.

The Rhombic antenna was also developed at this time, by engineers at the Bell Telephone Laboratories. This wide band, highly directional antenna operated over the 5 to 25MHz range. The first published description of it was by one of the development engineers, E. Bruce, in 1931. A transmitting version of this antenna is shown in Figure 6.

Another of Peterson and Beverage's originations was the 'Fishbone' antenna, a radiator akin to the End-Fire array. Both men described this addition to the antenna family in a paper in the April 1931 edition of the Proceedings of the Institute of Radio Engineers.

Another halcyon period for antenna development was the decade between 1950 and 1960. At the beginning of the period, civil aviation navigational aids had already moved up into the Very High Frequency (VHF) band, to avoid the propagation problems and crowding difficulties of the HF band. One navigational aid specially developed for the VHF band was the VHF OmniRange, or VOR equipment.

Several VOR antennas were developed, undoubtedly the best known being the Axial Slot, designed by A. Alford of the International Telephone Development Corporation. A simple metal cylinder containing four axial slots, evenly spaced around it this antenna, or slightly modified versions of it, has been used in any number of VOR designs. Figure 7 illustrates the slot's construction, electrical properties and the method of feeding it.

The HF band, however, was by no means neglected, either by users or equipment developers. In March 1957, the American communications engineer, V. H. Rumsey, proposed a new design of HF antenna, in a paper entitled 'Frequency independent Antennas', read to the Institute of Radio Engineers national Convention. Two other communications engineers, R. H. DuHamel and D. E. Isbell also advocated a similar idea in their Convention paper 'Broadband Logarithmically Periodic Antenna Structures'. At last, the HF band would have an antenna that could, without undue loss, cover almost the entire band.

One factor, however, remained: 'Hang 'em High!' was every bit as relevant with the new antennas as it had been in the beginning!

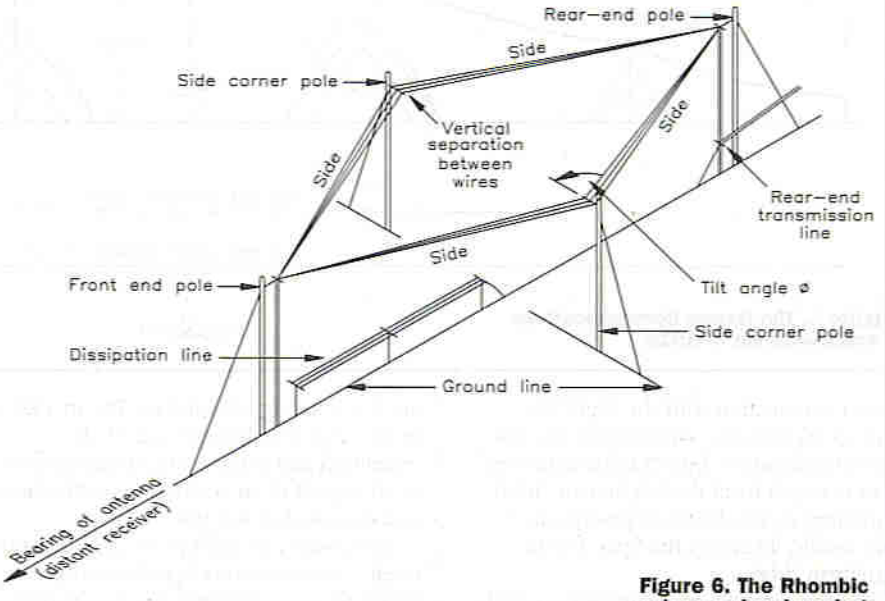

Figure 6. The Rhombic antenna, developed at the Bell Laboratories.

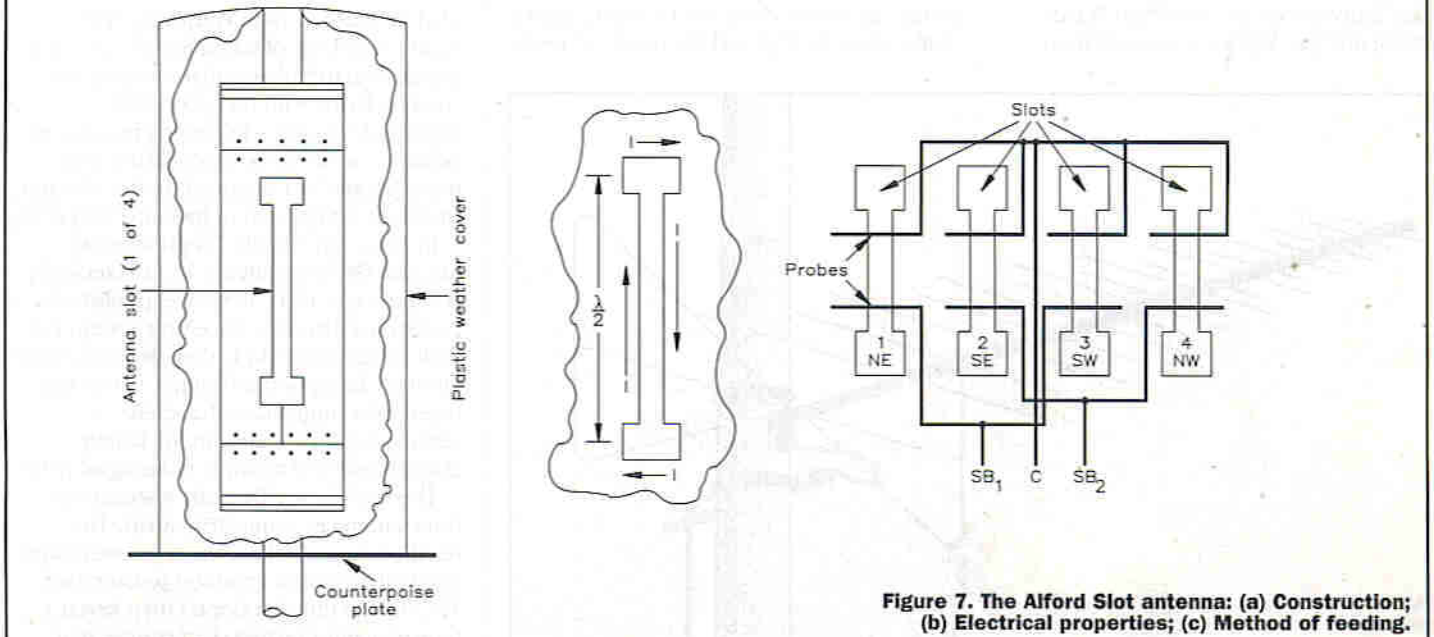

Figure 7. The Alford Slot antenna: (a) Construction; (b) Electrical properties; (c) Method of feeding.

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Security Electronics SYSTEMS AND CIRCUITS

PART 1

Ray Marston explains electronic security system principles in this new series.

Security System Basics

Any system that provides its owner/user with a reasonable degree of protection against one or more real or imagined dangers, threats, or nuisances (such as physical attack, theft of property, unwanted human or animal intrusion, machine breakdown, or risks from fire, electric shock, or vermin infestation, etc.) can be described as a 'security' system. An 'electronic' security system is one in which the system's actions are heavily dependant on electronic circuitry; simple examples of such systems are electronic door bells and mouse traps, keypad door locks, and domestic burglar alarms. This opening episode of this new series starts off by explaining electronic security system basic principles and then goes on to describe a wide variety of devices that can be used within modern electronic security systems; this basic theme is continued in next month's part of the series, but all subsequent episodes will show practical examples of various specific types of low-to-medium complexity electronic security systems and circuits.

Electronic Security System Basics

All electronic security systems consist of the basic elements shown in Figure 1. Here, one or more 'danger' sensing units are placed at the front of the system and generate some kind of electrical output when danger is sensed. The output of the sensor unit is fed, via a data link, to a decision-making signal processing unit, and this unit's output is fed, via another data link, to a 'danger' response unit such as an alarm or an electromechanical trigger or shutdown device. Note in Figure 1, that each of the system's three major elements is shown using its own power supply, but that in practice, two or more elements may share a single power supply.

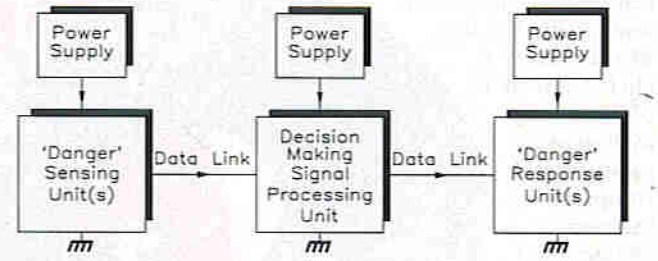


Figure 1. Basic elements of an electronic security system.

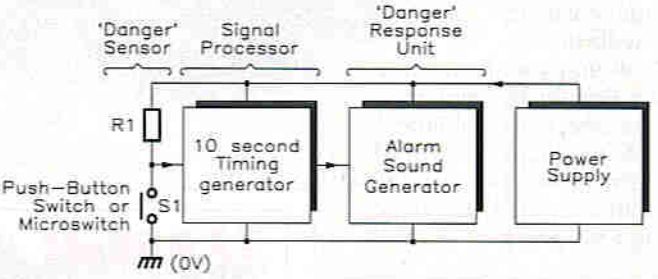


Figure 2. Electronic door-bell or shop-entry system.

Figures 2 to 5 show, in basic form, four different low- to medium-complexity types of security system. The first of these (Figure 2) is a simple electronic door-bell or shop-entry alarm system, in which the 'danger' sensor is a push-button switch in the case of the door-bell system or a door-mounted microswitch (or a pressure mat switch, etc.) in the case of the shop-entry system. In both cases, the circuit action is such that when switch S1 closes, it activates a timing generator that turns on an alarm sound generator for a period of 10 seconds, irrespective of the actual duration of the switch closure, and repeats this action each time that S1 is closed. Ideally, this type of circuit draws zero quiescent current. Note in the case of the door-bell circuit, that the 'danger' sensor (S1) is operated voluntarily by the unknown visitor, in a deliberate effort to attract the attention of the householder, but that in the

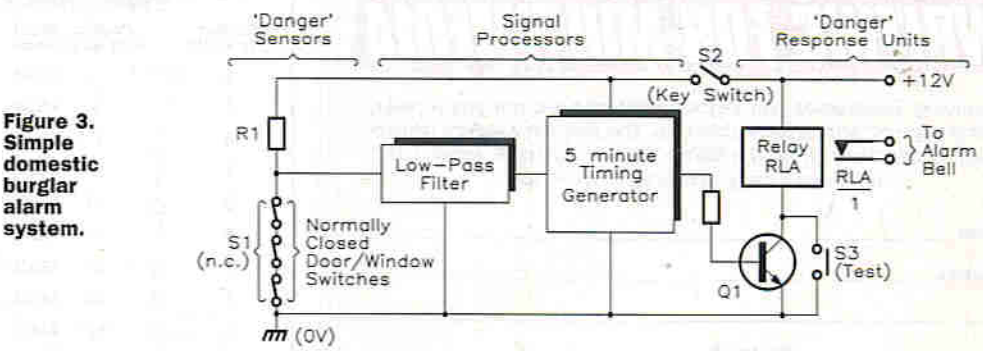


Figure 3. Simple domestic burglar alarm system.

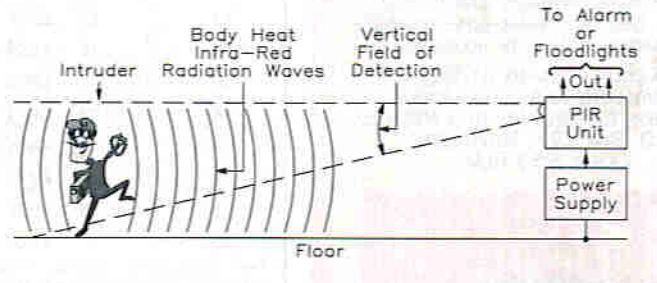


Figure 4. Passive infra-red (PIR) movement detector system.

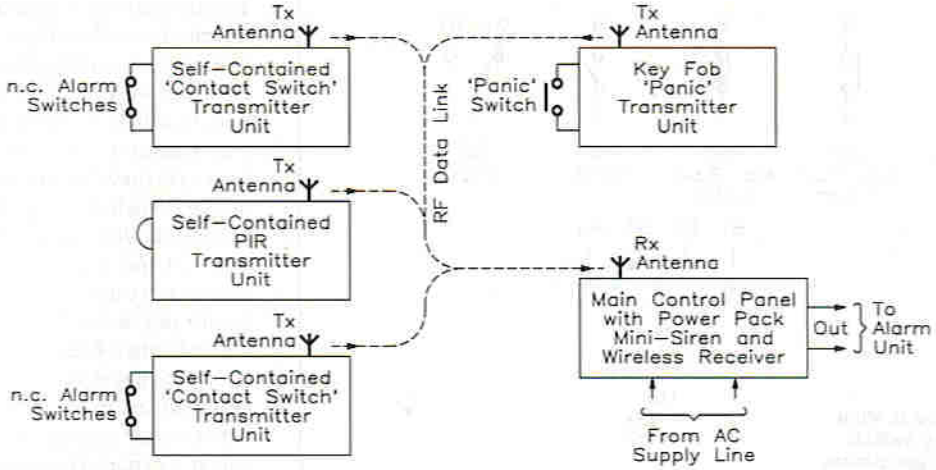


Figure 5. Wireless burglar alarm system.

case of the shop-entry circuit, S1 is operated involuntarily by the visitor, and warns the shopkeeper of the presence of a potential customer or thief.

Figure 3 shows a simple domestic burglar alarm circuit. Here, the main alarm system is enabled by closing key-operated switch S2, and the S1 'danger' sensor actually consists of any desired number of series-connected normally-closed switches (usually reed-and-magnet types) that are each wired to a protected door or window, so that the composite S1 switch opens when any protected door or window is opened or a break occurs in S1's wiring. Under this condition, R1 pulls the input of the transient-suppressing low-pass filter high, and after a brief delay (usually about 200ms), the filter output triggers the 5-minutes timer generator, which turns on relay RLA via transistor Q1 and thereby activates an external alarm bell or siren via the relay's RLA/1 contacts. Once activated, the relay and alarm turn off automatically at the end of the 5-minute timing period, but can be turned off or reset at any time by opening keyswitch S2. The alarm can be tested at any time, with or without closing S2, via push-button switch S3, which closes RLA directly.

Figure 4 shows, in pictorial form, a modern passive infra-red (PIR) movement detector system that can be used to automatically sound an alarm or turn on floodlights when a person enters the PIR detection field (the PIR has a typical maximum range of 12m and the field has a vertical span of about 15° and a horizontal span of 90 to 180°). The PIR unit detects the small amounts of infra-red radiation generated by human body heat, but gives an 'alarm' output only when the heat source moves significantly within the detection field. Most PIR units have good immunity to false alarms; some types incorporate an output relay that is normally closed (turned on) but opens (turns off) when an intruder is detected or the unit's power supply fails or is removed; units of this latter type typically need a 12V DC supply and consume a quiescent current of about 20mA. PIR units are widely used to give room or area protection in modern burglar alarm systems.

Figure 5 shows, in simplified form, the basic elements of a modern domestic 'wireless' burglar alarm system, in which the data link between the various major parts of the system takes the form of a coded RF (usually 418 or 458MHz) signal, thus greatly easing installation problems. The heart of the system is the main control panel, which houses a wireless receiver and decoder and control logic, plus a high-power mini-siren, and has an output that can activate an external high-power siren and light-strobe alarm unit. The system's 'danger' sensing units each house a small RF transmitter and antenna that sends out a coded signal under a danger condition; each of the units are designed to give a minimum of six months of normal operation from a small battery.

Most domestic wireless burglar alarm systems can be used to monitor a maximum of four to six zones (individual protected areas) via suitable sensing units. The sensing units come in three basic types; 'contact-switch' types transmit a danger signal when one or more series-connected normally-closed switches are opened, and can be used to protect a zone of any desired size; 'PIR' types transmit a danger signal when a human moves within the visual field of the PIR unit, and can be used to protect a zone of limited size; 'panic' types transmit a danger signal when a key-fob button is pressed, and can be used to protect a person against sudden physical attack or threat whenever they are within communication range of the system's receiver (control panel) unit. All three types of sensing unit also send out monitoring signals that give warnings of failing battery power or deliberate interference, etc., and the wireless burglar alarm system thus offers a high degree of security.

Note that simple electronic security systems such as those shown in Figures 2 & 3 can be easily and cheaply built on a DIY basis, but that it is not cost-effective to build a PIR unit of the Figure 4 type as a DIY project, or cost-effective or legal (because the RF transmitters must be certified by an approved state or national body) to build (rather than buy) a Figure 5 type of wireless burglar alarm system as a pure DIY project. Commercial PIR units and wireless burglar alarm units can, however, easily be used as special elements that can be incorporated in a wide variety of DIY security systems.

Security System Reliability

The most important parameter of any practical electronic security system is its reliability in performing its designated task. Specifically, all such systems must be easy to use, difficult to disable, and have good immunity against malfunctioning and the generation of false alarms (which very quickly destroy the user's confidence in the system). The degree and types of reliability required from a security system vary with the level of security that the system is designed to provide. Domestic burglar alarm systems (in which only a few family members have access to the major functional parts of the system) have, for example, relatively low anti-tamper requirements, but anti-burglary systems used in large shops and stores – in which the public have easy access to many protected areas during normal 'opening' hours – have very high levels of anti-tamper requirement.

The overall reliability of any electronic security system is greatly influenced by the nature of its major system elements, i.e., by its danger sensing units and its data links, etc. Simple electromechanical danger sensors such as reed-switches and pressure pad switches have, for example, far greater intrinsic levels of reliability than electronic sensors such as ultrasonic, microwave, and simple light-beam intrusion detectors, but electronic keypad security switches usually have far greater reliability than the mechanical key switches that they are designed to replace, and so on. To gain a useful insight into this subject, the reader needs a good understanding of the wide variety of elements that are used in modern electronic security systems, as follows:

Security System Elements

All electronic security systems consist – as shown in Figure 1 – of one or more 'danger' sensing units that generate some kind of electrical output when danger is sensed, and which feed that output – via a data link and a decision-making signal

processing unit – to a 'danger' response unit such as an alarm or an electromechanical trigger or shutdown device. Apart from the actual signal processing unit, the three other major elements of any electronic security system are thus the sensing unit, the data link, and the response unit, and each of these elements may take an electromechanical, electrical, or an electronic form. Each of these three basic elements are available in a variety of guises, and the most important of these are described in the remaining sections of this chapter.

Electromechanical Sensors

Simple Switches

The simplest and most widely used electromechanical sensors are ordinary electrical switches of the various types shown in Figures 6(a) to 6(e). The types shown in (a) to (d) are linear pressure-operated types and may take normal manually operated forms or may be microswitches that are activated by the mechanical movement of a door, window or machine part, etc. The (e) type is a rotary multi-step pressure-operated switch that is (normally) activated manually. The sensor shown in (a) is a normally-open (NO or n.o.) push-button switch, (b) is a normally-closed (NC or n.c.) push-button switch, (c) is a single-throw, single-pole (SPST) toggle switch, (d) is a single-pole, double-throw (SPDT) or 'changeover' toggle switch, and (e) is a single-pole, 4-way rotary switch.

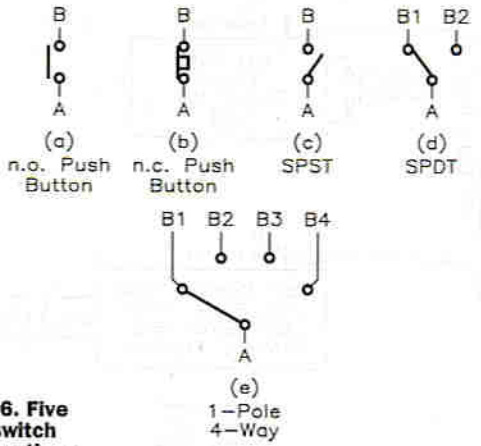


Figure 6. Five basic switch configurations.

Figure 7 shows three basic ways of using normal electrical switches in power (or signal) switching applications. In (a), a SPST switch is used as an on/off controller to switch power to a single load; in (b), a 1-pole, 3-way switch is used as a power distributor to switch power to any one of three loads; and in (c), is used as a power selector, to connect any one of three power sources to a single load.

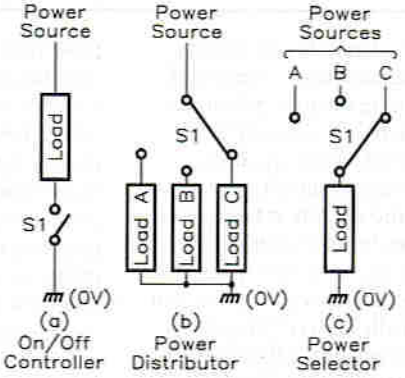


Figure 7. Three basic types of power (or signal) switching circuit.

Switched-output electromechanical sensors are available in a variety of basic types, including temperature-sensitive thermostats, orientation-sensitive 'tilt' and 'tip-over' switches, pressure-sensitive 'mat' switches, key-operated security switches, and time-sensitive 'timer' switches, all of which are shown in basic form in Figures 8 to 10.

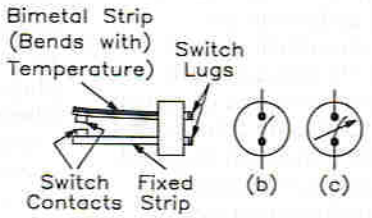


Figure 8. Basic construction of a simple bimetal thermostat (a), and symbols for (b) fixed and (c) variable thermostats.

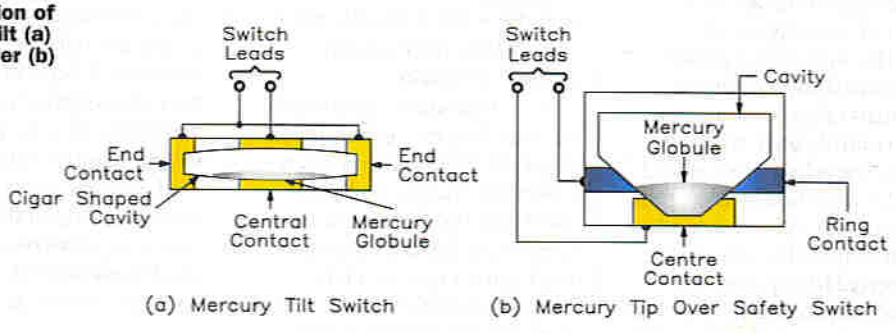


Figure 9. Basic construction of mercury tilt (a) and tip-over (b) switches.

Thermostats

Thermostats are temperature-activated on/off switches that usually work on the 'bimetal' principle illustrated in Figure 8(a), in which the bimetallic strip consists of two bonded layers of conductive metal with different coefficients of thermal expansion, thus causing the strip to bend in proportion to temperature and to make (or break) physical and electrical contact with a fixed switch contact at a specific temperature. In practice, the bimetal element may be in strip, coiled, or snap-action conical disc form, depending on the application, and the thermal 'trip' point may or may not be adjustable. Figures 8(b) and (c) show the symbols used to represent fixed and variable thermostats. A variety of thermostats are readily available, and can easily be used in automatic temperature control or danger-warning (fire or frost) applications. Their main disadvantage is that they suffer from hysteresis; typically, a good quality adjusted thermostat may close when the temperature rises to (say) 21°C but not re-open again until it falls to 19·5°C.

Tilt Switches

Figure 9(a) illustrates the basic construction and operating principle of a mercury tilt switch, which (in this example) consists of a cigar-shaped cavity that is formed within a block made of two electrically connected metal end contacts and a central metal contact, which are separated by insulating sections. The cavity holds a mercury globule, which rests on the central contact but is insulated from the end contacts when the switch is horizontal, but rolls and touches one or other of the end contacts (and also the central contact) if the switch is tilted significantly (typically by more that 10°) out of the horizontal. The mercury 'switch' is thus normally open, but closes when tilted, and can be used to activate an alarm if an attempt is made to move a normally stationary protected item such as a TV, PC, or Hi-Fi unit, etc.

Tip-over Switches

Figure 9(b) illustrates the basic construction and operating principle of a mercury tip-over

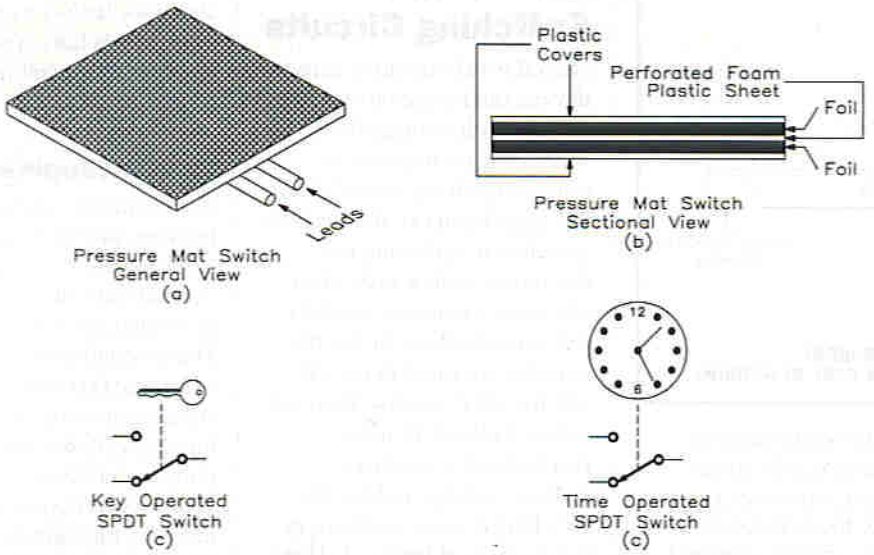


Figure 10. General (a) and sectional (b) views of a pressure mat switch, and symbolic representations of (c) key-operated and (d) time-operated SPDT switches.

safety switch. In this case, the cavity is fairly steep-sided, and the construction is such that the mercury globule touches both a ring contact and a centre contact when the unit is vertical, and thus acts as a closed switch, but breaks this contact and acts as an open switch when the unit is tilted heavily (typically by more than 40°) out of the vertical position. One common application of this type of switch is in free-standing electric heaters, where the switch is built into the unit and wired in series with its power lead, so that the appliance automatically turns off if it is accidentally knocked over.

Pressure Mat Switches

Figures 10(a) and 10(b) illustrate the general appearance and basic construction of a pressure mat switch, which is designed to be hidden under a mat or carpet and acts as a normally-open switch that closes if a person steps heavily on any part of the switch. The device consists of two sheets of metal foil that are normally held apart by a perforated sheet of foam plastic. This sandwich is encased in a hermetically sealed plastic envelope; when a person treads on the envelope, their weight compresses the foam plastic, and the metal foils make electrical contact via the foam sheet's perforations. Pressure mat switches are widely used in domestic and commercial burglar alarm systems. Most such switches have four output wires; the two 'switch' wires have partly bared ends; the other two wires are not bared, are internally shorted together, and serve a n.c. anti-tamper function in which an alarm system activates if the sensor wiring is cut (this technique is described in the DATA LINKS section of next month's episode of this series), and can be ignored in most domestic applications.

Key Switches

Figure 10(c) shows a symbolic representation of a simple key-operated SPST electric switch, in which the switch arm is moved by turning a Yale-type key in a matching tumbler mechanism. Switches of this basic type are available in many different switch and key-type styles, and are widely used in security applications in buildings and vehicles, and on items such as PCs and burglar alarm control units.

Time Switches

Figure 10(d) shows a symbolic representation of a simple analogue time-operated SPST electric switch, in which the switch arm is moved by a mechanical (clockwork or slow-release), electrical (current-heated thermostat) or electromechanical (synchronous motor plus gearbox) timing mechanism. Switches of this basic type are available in many different switch styles, with many different timing ranges, and are widely used in light-switching and solenoid-operating security applications.

Reed Switches

One of the most useful types of switched-output electro-mechanical sensor devices is the 'reed' switch, which activates in the presence of a suitable magnetic field and is particularly useful in proximity-detector applications. Figure 11 shows the basic structure of a reed switch, which consists of a springy pair of opposite-polarity magnetic reeds with plated low-resistant contacts, sealed into a glass tube filled with protective gasses. The opposing magnetic fields of the reeds normally hold their contacts apart, so they act as an open switch, but these fields can by nulled or reversed by placing the reeds within an externally generated magnetic field (see Figure 12), so that the reed then acts as a closed switch.

A reed switch can be activated by placing its reeds within an externally generated magnetic field, which can be derived from either an electric coil that surrounds the glass tube, as in the 'reed relay' diagram of Figure 12(a), or by a permanent magnet placed within a few millimetres of the tube, as shown in Figure 12(b). Reed relays are used in the same way as normal relays, but typically have a drive-current sensitivity ten times better than a standard relay. Reed-and-magnet combinations are very useful in proximity-detector applications in security and safety systems, etc., as

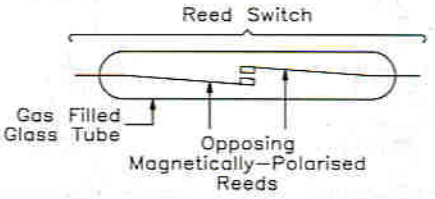


Figure 11. Basic structure of a reed switch.

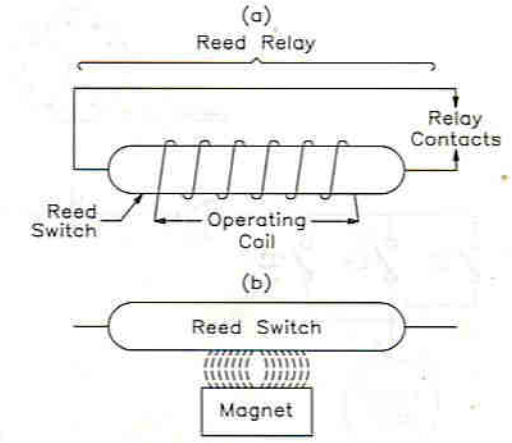


Figure 12. Reed switch operated by (a) coil or (b) magnet.

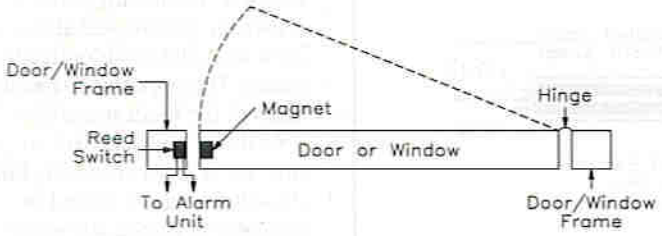


Figure 13. Method of using a reed switch/magnet combination to give burglar protection to a door or window.

illustrated in Figure 13.

Figure 13 shows a method of using a reed and magnet to give burglar protection to a door or window. Here, the reed switch is embedded in a door or window frame, and the activating magnet is embedded adjacent to it in the actual door or window so that the reed switch changes state whenever the door/window is opened or closed. The reed switch can thus be used to activate an alarm circuit whenever a protected door/window is opened. In practice, the reed and magnet may take the basic forms shown in Figure 12(b), or may be encapsulated in special housings that can easily be screwed to – or embedded in – the frame/body of the door/window.

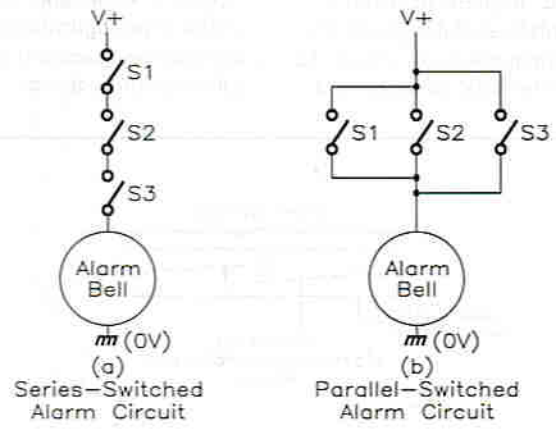


Figure 14. An alarm bell can be activated by several switches wired (a) in series or (b) in parallel.

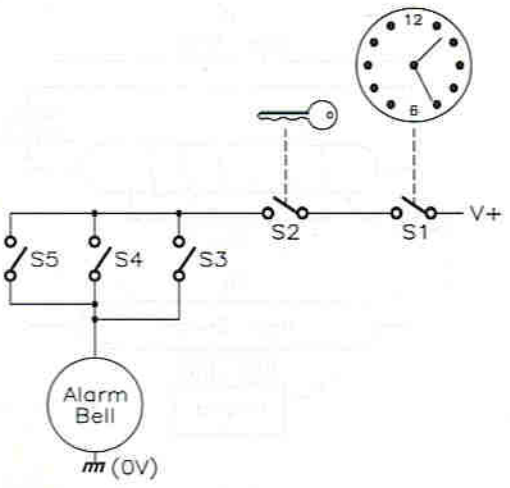


Figure 15. Simple security alarm, using a combination of series and parallel-connected switches.

Basic Alarm Switching Circuits

Several switched-output sensor devices can be used to activate an alarm bell or other device by connecting them in one or other of the basic modes shown in Figure 14. In (a), the switches are wired in series and the alarm thus sounds only when all three switches are closed at the same moment. In (b), the switches are wired in parallel and the alarm sounds when any switch is closed. In most practical alarm systems a mixture of series and parallel switching is used, as shown in the example of Figure 15. Here, the alarm system is enabled (made alert) by closing series-connected time switch S1 and key switch S2; once enabled, the alarm bell can be activated by closing any of the parallel-connected S3 to S5 switches. In burglar alarm systems, important intrusion-sensing switches should be n.c. types that are wired in series and used in the basic manner already shown in Figure 3, so that the alarm activates of any switch opens or if its wires are cut; R1 should have a high value (typically several megohms), to give low quiescent current consumption.

Electrical Sensor Devices

Thermistors

A thermistor is a passive resistor device with a resistance value that is highly sensitive to the device's temperature. Practical thermistors are available in rod, disc, and bead forms, and with either positive or negative temperature coefficients (known as PTC and NTC types, respectively). Unlike electromechanical thermostats, they do not suffer from hysteresis problems, and are thus suitable for use in a variety of precision temperature sensing and switching applications. Figure 16 shows two alternative symbols that can be used to represent a thermistor. In most practical applications, thermistors are used in conjunction with electronic circuitry that gives a switch-type output when the thermistor temperature goes above (or below) a pre-set limit. Thermistors have typical operating temperature ranges of -40°C to +125°C.

Thermocouples

When a junction is formed between two dissimilar metals, a thermoelectric (temperature-dependent) voltage is generated across the junction. Thermocouples are devices in which the two types of metal are chosen to exploit this effect for temperature-measurement purposes; a device using a copper and copper-nickel junction, for example, has a useful 'measurement' range from -100°C to +250°C and has a typical sensitivity of 42μV per °C over the positive part of that range; some devices using other types of metal have useful measurement ranges that extend above +1,100°C. Figure 17(a) shows the symbol used to denote a normal thermocouple. In some special types of thermocouple device, the junction can be heated via a DC or RF current passed through a pair of input terminals, and the unit's output can then be used to indicate the magnitude of the input current or power; units of this type use the symbol shown in Figure 17(b).

Light-Dependent Resistors (LDRs)

An LDR (also known as a cadmium sulphide (CdS) photocell) is a passive device with a resistance that varies with visible-light intensity. Figure 18 shows the device's circuit symbol and basic construction, which consists of a pair of metal film contacts separated by a snake-like track

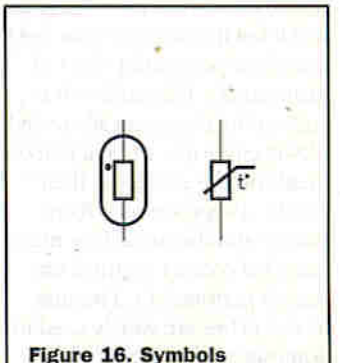


Figure 16. Symbols commonly used to represent a thermistor.

of light-sensitive cadmium sulphide film; the structure is housed in a clear plastic or resin case. LDRs have many practical applications in security and auto-control systems. Figure 19 shows the typical photoresistive graph that applies to an LDR with a face diameter of about 10mm; the resistance may be several megohms under dark conditions, falling to about 900Ω at a light intensity of 100 Lux (typical of a well lit room) or about 30Ω at 8,000 Lux (typical of bright sunlight).

Microphones

Microphones are acoustic-to-electrical transducers and have a number of uses in eavesdropping and other security applications. The three best known types of electrical microphones are the moving-coil ('dynamic'), ribbon, and piezoelectric ('crystal') types. In most security electronics applications, microphones are required to be small but sensitive types that generate medium-fidelity outputs; electronic 'electret' microphones are widely used in such applications.

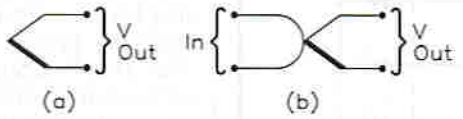
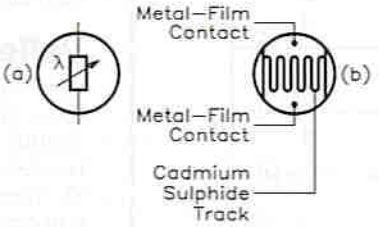


Figure 17. Symbols of (a) a conventional and (b) an electrically-heated thermocouple device.

Figure 18. LDR symbol (a) and basic structure (b).



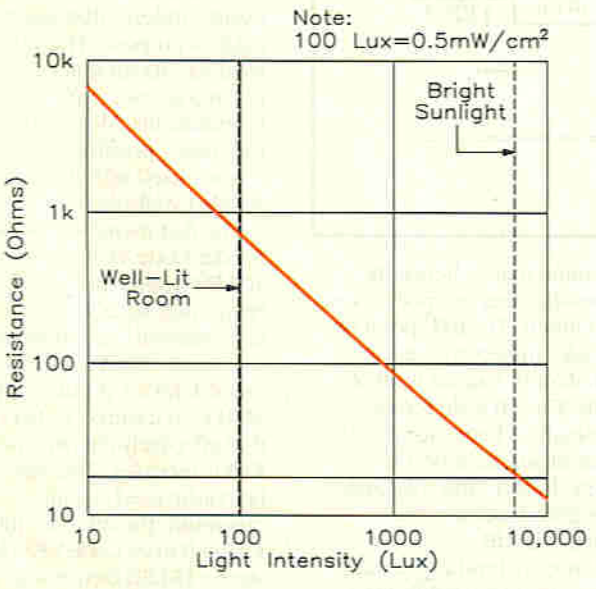


Figure 19. Typical characteristics curve of an LDR with a 10mm face diameter.

TO BE CONTINUED NEXT MONTH....

Velleman LED VU METERS

Reviewed by Martin Pipe

VU (Volume Unit) meters, which display the average level of an audio signal, have traditionally been built around moving-coil meters. This is because they're easy to incorporate, typically requiring only a resistor and diode to drive them. Moving-coil meters are essentially a specialised form of electric motor (well, it conforms to Fleming's Left-hand Rule!). The pointer, which moves over a calibrated scale, is coupled to a coil assembly, wrapped around a drum-shaped soft-iron core. The coil assembly is suspended between two permanent magnets of opposing polarity, and fitted to low-friction jewelled bearings on its axis.

When a DC voltage is applied to the coil, the coil rotates on its axis by an amount that is directly proportional. The current (which is used to specify the full-scale deflection of the device) required to do this is minuscule – modern meters are efficient beasties. Mechanical end-stops prevent the needle from travelling too far in either direction and causing permanent damage. The drum is also coupled to a watch-type spring, which ensures that the pointer moves anticlockwise when a lesser voltage is applied.

Unfortunately, this electromagnetic construction limits the response time of a moving-coil meter, and thus makes it unsuitable for monitoring rapidly changing phenomena such as transient-prone audio signals. Their sluggish ballistics mean that some peaks, which may over-saturate a magnetic tape during a live recording or drive an amplifier into clipping, may go unnoticed.

For many years, moving-coil meters were pretty standard on audio equipment, such as cassette decks and amplifiers. In such cases, the designer would normally include a single LED, which would glow whenever peak signals were encountered. Because of these limitations, solid-state VU meters are now widespread. These use fluorescent vacuum tubes or LEDs, which have a much faster response time than their older counterparts. The kits we examine in this article use LEDs.

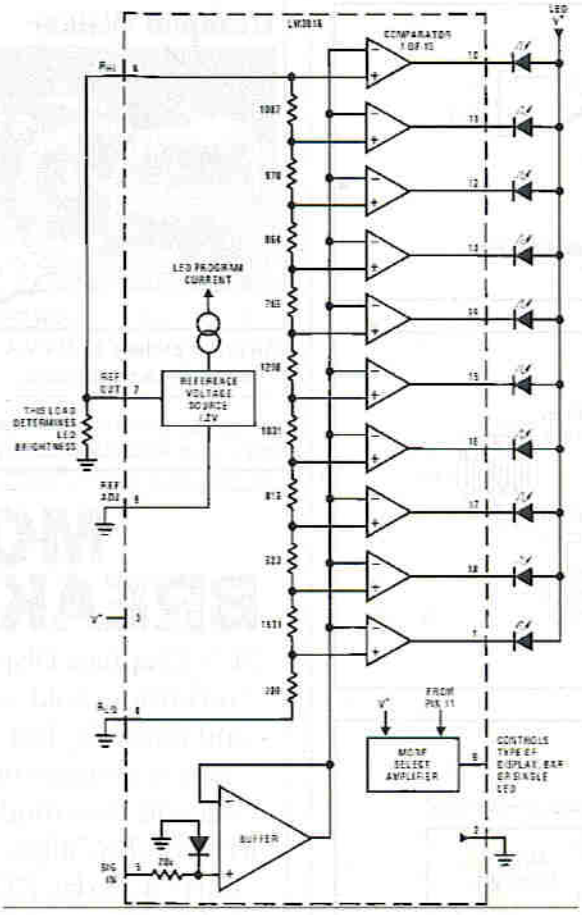


Figure 1. Block diagram of LM3916. Courtesy National Semiconductors

The VU meter is associated with a logarithmic scale, normally calibrated from around -20dB to +6dB. The 0dB point on the scale corresponds to a voltage of 0·775V rms. It is worth pointing out that VU meters were originally calibrated in volume units – hence the name – but this practice is now uncommon. The 0VU point on the older meters was, in fact, equivalent to a signal level of +4dB. The dB scale is more meaningful – hence its almost universal adoption on VU meters. Indeed, the solid-state types examined here are calibrated in dB.

VU meters tend to fluctuate wildly – often too wildly for a poor old moving coil meter to cope. This is another reason why LEDs have become commonplace on the VU meters built into cassette decks, mixer panels and the like. In professional audio circles, however, the moving-coil meter is still king. Not that they use VU meters, dear me, no. An unregistered peak may not pose too much trouble for us consumers – largely because in many cases, we simply don't encounter them, thanks to the wondrous compressor/limiters used by broadcasters and recording studios.

In the professional audio world, that unnoticed peak could overmodulate a radio transmitter, or oversaturate the tape during a once-in-a-lifetime recording session. Engineers aren't too enamoured with the cramped logarithmic scale or rapid to-ing and fro-ing of a VU meter, either – particularly if they have to stare at it frequently. Instead, they use the PPM (Peak Programme Meter), an innovation of the BBC's engineering department. It has a seven-point near-linear scale that encompasses a 24dB range, registers peaks much more accurately and is rather easier to follow. At over £100, PPMs are expensive (they include active driver electronics) and require calibration before use.

Velleman Kits

Here, we examine three LED VU meter kits from Velleman, and available from Maplin. They can be used to replace moving-coil VU meters on existing equipment, or built into your own audio projects (compressor/limiters, amplifiers, mixers, SPL meters, etc.). The meters can also be used with the Velleman stereo mixer design; indeed, that was their original purpose. The latter is a modular design that can be tailored to your own requirements. Most of the other modules – pre-amps, faders and so on – used within this mixer are also available from Maplin.

The first meter kit, K4304 (Order Code VF90X) is a mono 10-LED device capable of registering signals over a conventional logarithmic range that spans -20dB to +3dB. The second, K4305 (Order Code VF91Y), is a stereo 10-LED kit that effectively contains two K4304 modules. They have to be constructed slightly differently, though. The third kit, K4306 (Order Code VF89W), is a stereo 15-LED device with an extended (-23dB to +5dB) range. The display of the stereo 15-LED meter is rather different to that of the 10-LED version, insofar as most of it works over a relatively small range. There

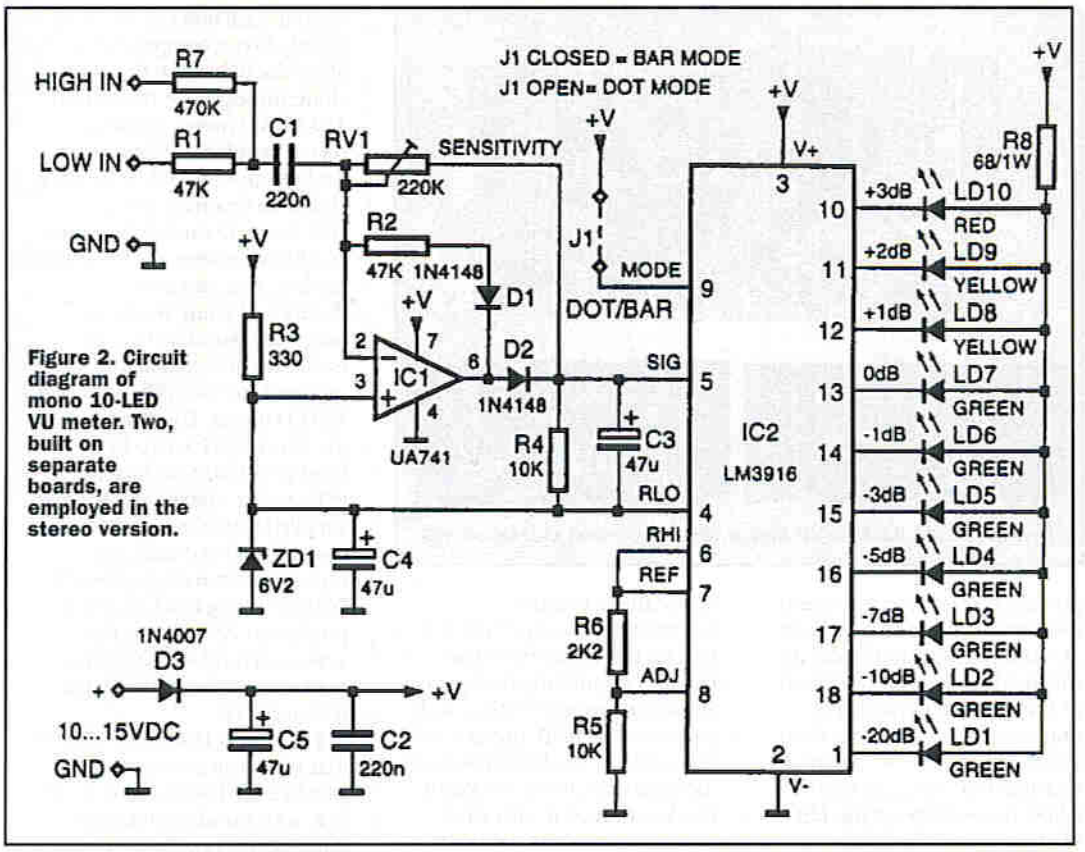


Figure 2. Circuit diagram of mono 10-LED VU meter. Two, built on separate boards, are employed in the stereo version.

are ten LEDs that cover the -4dB to +5dB portion – effectively one for each decibel. The remaining five cover the rest of the range, down to -23dB. All designs work from a single-rail DC power source of between 12 and 15V.

In each kit, all components (including a decent-quality fibreglass PCB) and a neat calibrated scale are supplied. The scale can be read from both horizontal and vertical positions, allowing flexible mounting of the meters. None of the scales are self-adhesive, and so they need to be glued into place. Although they are primarily intended for use at line-level, there is a high-level input suitable for direct feeding from an amplifier (although Velleman stresses that bridged amplifier, common in car audio systems, are incompatible). There is a similarity in design between the 10-LED and 15-LED versions. In each case, a 741 op-amp is used as a full-wave average detector (interestingly, it inverts the audio signal). A preset adjusts the gain of the op-amp, allowing the meter to be calibrated. The output from the 741 feeds a 10-LED bargraph driver IC, the National Semiconductor LM3916.

The use of this specialised 18-pin DIL chip – shown in Figure 1 – keeps costs down, and construction simple. Basically, the LM3916 is an adjustable voltage reference and an accurate ten-step voltage divider. It contains an input buffer, which drives 10 individual comparators referenced to the precision divider. National Semiconductor claim a typical accuracy of better than 0·2dB, and this dictates the performance of the kit. Interestingly, the LM3916 is capable of working in either standard 'bargraph', or 'dot' mode, and the kits make provision for this through a number of links.

In 'bargraph' mode, all LEDs up to the peak average signal at that point are illuminated. In 'dot' mode, only one LED – that corresponding to the input peak – is turned on. Although the bargraph undoubtedly looks prettier, the 'dot' mode will be useful for battery powered equipment such as portable mixers. This is because less current will be drawn, since fewer LEDs are operating. Another interesting function of the LM3916 is its ability to be cascaded, so that higher-resolution displays comprising more LEDs can be designed. The 10-LED meters don't need this facility and only employ a single chip, as can be seen from Figure 2. The dual 15-LED meter, shown in Figure 3, does, however. In this case, each channel is served by two LM3916s. One drives the first ten LEDs, while the second drives the remaining five.

Constructing the kit is simple – the dual 15-LED model, with its 271 soldered connections, took around an hour. As stressed before, you get everything – and that includes wire links, all LEDs and even sockets for the ICs. Mind you, some PCB pins wouldn't have gone amiss (fortunately, Maplin sell these separately). Basically, construction starts off with the links (some of which, remember, dictate operating mode), followed by the passive components (resistors, capacitors, diodes, etc.), the IC sockets and the LEDs. The correct orientation of the components (in physical terms, as well as electronic) is helpfully printed on the board legend. Once you've checked your work for mistakes, dry joints and so on, you can plug in the ICs, power up and start calibrating.

It's a shame that Velleman

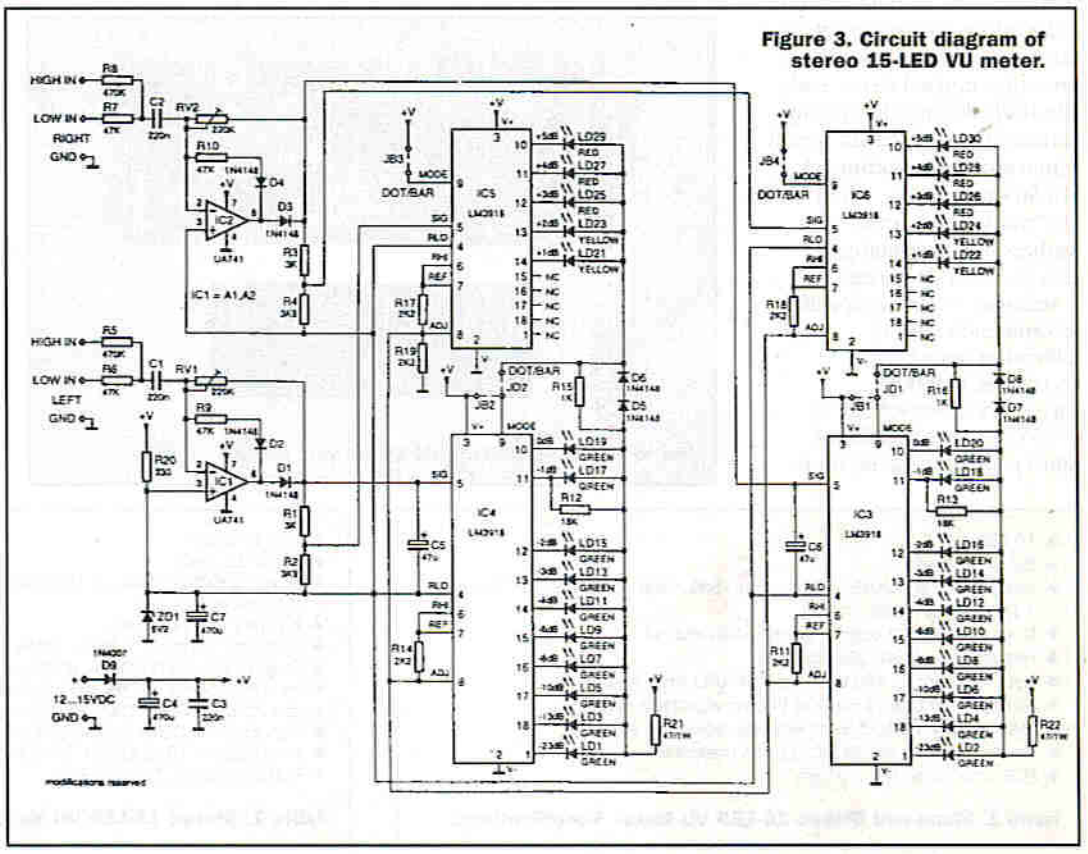


Figure 3. Circuit diagram of stereo 15-LED VU meter.

didn't specify a segmented LED bargraph array – it would have quickened construction. Presumably, there was a problem regarding the availability of devices that had segments in the colours Velleman required. The use of coloured segments helps to ease at-a-glance monitoring. In the 10-LED meters, the first 7 LEDs are green, the next two are yellow and the final one red. The seventh green LED corresponds to 0dB. In the stereo 15-LED meter, the first 10 are green, the next two are yellow and the final pair are red. In this case, the tenth green LED corresponds to 0dB.

In the mono (single) 10-LED and stereo 15-LED meters, the LEDs are soldered conventionally to the board – no lead-bending is required. Here's a hint to ensure that all LEDs are at the same height – before soldering, turn the board over and place it so that the component side rests on a flat surface. Hold the board down so that all LEDs rest against this reference surface, and then solder them in. The stereo 10-LED board makes use of two mono 10-LED boards, which are screwed together. In this case, the LED leads are bent so that they protrude over the side of the PCB. This design aspect, necessary because of the use of two mono boards, has implications for mounting – more on this shortly. Unfortunately, Velleman haven't included spacers to separate the two boards. This is interesting, since the supplied stereo scale effectively dictates the spacing between them. Velleman specify 15mm spacers; unfortunately, Maplin's nearest size is ½in. (12·7mm) and so some extra washers may be required to gain the extra clearance.

Velleman makes no specific recommendations for calibration but with the knowledge that 0dB corresponds to a voltage of 0·775V rms, it is possible. A signal generator can be set to provide a 1kHz sine wave, and its output fed to the meter. An AC voltmeter, set to display an rms reading, is also connected to the signal generator. The output of the oscillator is then adjusted until the AC voltmeter registers 0dB. You can then adjust the presets on the LED VU Meter until the 0dB segment is lit. An oscilloscope can also be used; remember that the rms value of a sine-wave is 0·707 times its peak value.

If you don't have test equipment, but have a CD player, there's an alternative. The Sound Check Audio Reference CD, which is also available from Maplin (Order Code AY00A) has a 0dB track on it. Feed the output of the CD player into the meter, and adjust those presets accordingly. Another option is to feed the meter from the output of your tape deck, and adjust the presets so that both tape deck and DIY meter read the same. In the latter case, put the tape deck in record/pause mode and feed it with white noise from a tuner (switch to FM, disable muting and find a point on the dial where there's no station – disconnect the aerial if you have to!) In both cases, watch out for the effects of output level controls, which are built into some Hi-Fi equipment!

Now that they're calibrated, it's time to build the meters into the equipment of your choice. Each meter has punched holes for mounting screws. You'll need to drill holes in the front panel of your equipment to allow the light from the LEDs to shine through. For the stereo 15-LED VU meter, Velleman recommends two slots – each 7×118mm – spaced by 22·6mm. Velleman recommends a 60×7mm cut-out for the mono 10-LED VU meter; for the stereo version, two, separated by a distance of 8mm, would be necessary. An angle bracket (sadly, not included in the kit) is required for use with the stereo 10-LED meter. This is because the two PCBs have to face the front panel side-on, so that the LEDs will be visible. The manuals supplied with the respective kits give full drilling details, and explain where the countersunk PCB mounting holes should be positioned. After fitting, the scales can be glued so that the markings correspond with the relevant LEDs.

The stereo 15-LED VU meter that I constructed worked very well indeed. I built it into an ABS box, with phono inputs and outputs; it is now being used with a noise reduction unit for a reel-to-reel tape recorder. The device could also be used for line-level in-car installation applications; in this case, the power supply could be derived from eight AA alkaline cells – or indeed, the car battery itself. If a small unidirectional mike insert (such as Maplin's FK44X) and preamplifier (e.g., VE21X) were also to be added, a basic sound level meter could be constructed.

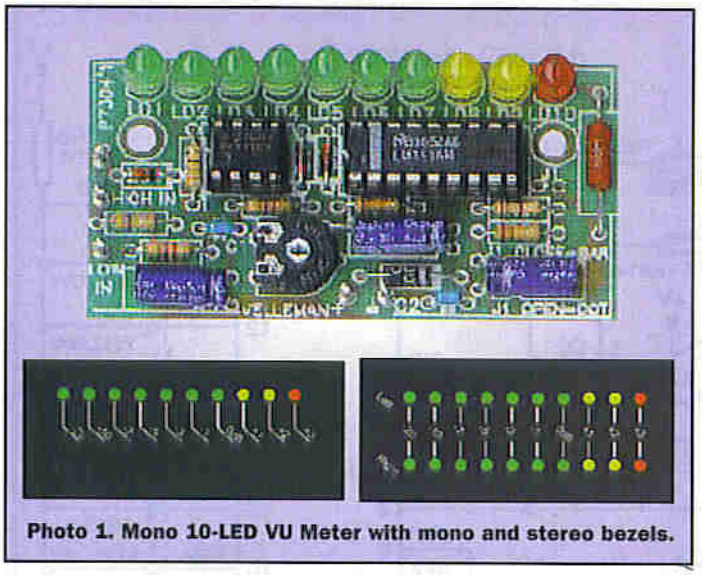


Photo 1. Mono 10-LED VU Meter with mono and stereo bezels.

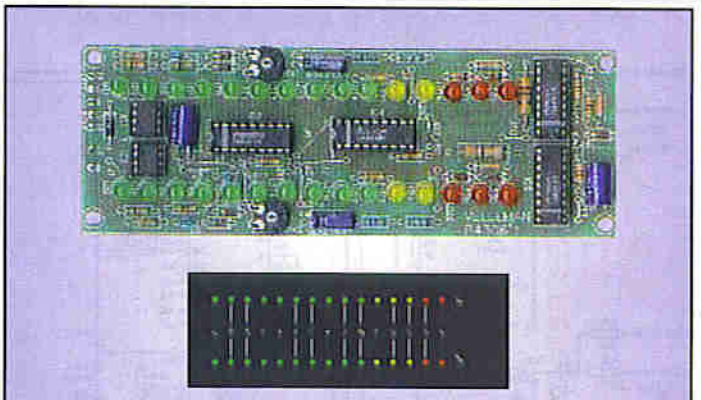


Photo 2. Stereo 15-LED VU Meter, and bezel.

Ordering Information

K4304 Mono 10-LED VU Meter Kit. Order As: VF90X, price £10.99 inc VAT.

K4305 Stereo 10-LED VU Meter Kit. Order As: VF91Y, price £17.99 inc VAT.

K4306 Stereo 15-LED VU Meter Kit. Order As: VF89W, £29.99 inc VAT.

An angle bracket (to mount stereo 10-LED meter assembly to equipment front panel) may be needed. Spacers, screws and other hardware: As Required.

- 10 LEDs
- Bar or dot mode
- Indication range: -20dB, -10dB, -7dB, -5dB, -3dB, -1dB, 0dB (0·775V rms), +1dB, +2dB, +3dB
- Three different LED colours: green, yellow and red
- Frequency response: 20Hz to 30kHz
- Input impedance : 47kΩ (low input)/470kΩ (high input)
- Low input (for 0dB): 150mV to 6V rms, adjustable (47kΩ)
- High input (for 0dB): 1·5V to 60V rms, adjustable (470kΩ)
- Power supply: 10 to 15V DC, 110mA (maximum)
- PCB dimensions: 68 × 37mm

Table 1. Mono and Stereo 10-LED VU Meter Specifications.

- 2 × 15 LEDs
- Bar or dot mode
- Scale: -23dB to +5dB, 15 LEDs per channel; 1 LED per dB from -4 to +5dB (1dB per LED)
- Accuracy: 0·5dB (1 kHz)
- Frequency response: 20Hz to 30kHz (-3dB)
- Three different LED colours: green, yellow and red
- Input impedance : 47kΩ (low input)/470kΩ (high input)
- Low input (for 0dB): 150mV to 5V rms, adjustable (47kΩ)
- High input (for 0dB): 1·5V to 50V rms, adjustable (470kΩ)
- Power supply: 10 to 15V DC @ 300mA maximum
- PCB dimensions: 150 × 57mm

Table 2. Stereo 15-LED VU Meter Specifications.

SEPTEMBER CLEARANCE SALE

DESCRIPTION	ORDER CODE	SEPTEMBER CAT PAGE NO.	CURRENT PRICE	OFFER PRICE
Garage Sensor	72171	860	£7.99	£2.99
3-Way Converter	72172	559	£10.99	£5.99
Siren/Strobe Box	72154	862	£13.99	£6.99
Beam Break Detector	72155	866	£24.99	£12.99
Digital Weekly Timer	72156	585	£17.99	£9.99
Dummy Camera	72157	878	£34.99	£19.99
2.2A Auto Breaker	72158	517	£1.12	£0.89
Door Phone Lock	72159	870	£37.99	£27.99
Tone Dialler	72160	1188	£4.99	£2.99
28V Lamp + Holder	72161	1167	£ 1.71	£0.99
Electricians Pliers	72162	1263	£3.56	£1.99
Cablestripper	72163	1271	£20.29	£14.99
MultiPurpose Lantern	72164	126	£6.11	£3.99
Water Resist Torch	72165	125	£6.11	£3.99
Indoor Thermometer	72166	1250	£7.13	£4.99
Vernier Dial Medium	72167	496	£7.64	£4.99
Cam Aud/Stereo Mixer	72168	90	£19.99	£12.99
1.5W Low Cost Speaker	72169	533	£1.99	£1.49
3.5mm to Phono Adaptor	72170	394	£0.60	£0.30

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ECC81	5.00	EL34G	7.50			B9A (Ceramic or PCB)	1.60
ECC82	5.00	EL34 (TESLA)	8.00	6336A	46.00	B9A (Ch. or PCB) Gold Plated	3.00
ECC83	5.00	EL34 (Large Dia.)	8.50	6550A	11.00	Octal (Ch. or PCB)	1.80
ECC85	6.00	EL84/6BQ5	4.70	6550WA or WB	13.50	Octal (Ch. or PCB) Gold Plated	4.20
ECC88	5.00	EL509/519	13.00	7581A	11.00	4 Pin (For 243, 3008 etc.)	3.30
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E81CC Gold Pin	6.80	KT88 (Gold Lion Pair)	60.00	RECTIFIER TUBES		9 Pin (For EL, PL509, Ch. or PCB)	5.00
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E88CC Gold Pin	8.00	211	22.00	EZ81	4.50	Anode Connecter (For EL509 etc.)	1.70
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				805 CETRON	50.00
				5842A GEC	15.00
				6080W TUNGSOL	12.50
				6550A GE	22.00
				6146B GE	17.00

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Germany Rules – US Don't

Germany is the first of the expected European nations to legislate the Internet and other forms of electronic media. In the recently passed Information and Communications Services Act, which took effect at the beginning of August, Internet service operators of all types must ensure that any content they provide is not contrary to the law. All operators must be licensed according to the act. It's now increasingly likely that other European countries will follow the German lead, using the act as the basic framework of individual country laws. Services such as e-mail and video conferencing are not included, as they are merely methods of passing information between users.

On the other side of the atlantic, however, a similar act called the Communications Decency Act prepared to do a similar thing with the Internet in the USA, was ruled unconstitutional by the United States Supreme Court because it cut across the freedom of speech enjoyed by US citizens in the form of the First Amendment of the United States Constitution.

Such differences in the legal situations between countries surely only mirror the social situations prevailing between countries. While the US will probably now take a more technologically-driven approach to keeping indecent material off the Internet, preferring Internet service providers themselves to monitor and maintain their own houses in order, German Internet service providers (and online service providers, for that matter) will be told how to order their houses.

Sponsorship Will Push Struggling Internet Industry Beyond Banners

Online advertisers, wanting more intrusive and potentially powerful advertising models, will increasingly turn from banners to sponsorships, placing more of their media buys with Internet publishers that provide these opportunities, according to a new report from research firm, Jupiter Communications.

By 2001, advertisers will dedicate, on average, one-quarter of their budgets to each of these two emerging models. The remaining half will go to banners, which currently represent 80% of online advertising spending.

"Banners – mainly interactive ones – will remain a big part of the media mix," said Peter Storck, director of Jupiter's Online Advertising Group. "But as sponsorship opportunities emerge, advertisers are going to take to these models, they'll spend more freely, and that will be welcome relief for leading publishers."

For further details, check: **www.jup.com.**

Contact: Jupiter Communications,
Tel: +1 800 773 4545.

International Net Search with Netscape Partners

A new International Net Search Engine at www.netscape.com will feature technology from four of the leading search engines including Excite, Infoseek, Lycos and Yahoo. Much like Euroseek at **www.euroseek.com,** the European 12-country search engine, the International Net Search program provides international users the ability to search in different languages in the Japanese, German, French, Spanish, Swedish, Korean, Italian, Danish, Dutch, Brazilian, Portugese, British and Australian markets.

Hot Downloads

Starting next month, @Internet will feature details of electronic shareware available for download over the Internet, such as printed circuit board (PCB) designers, circuit schematic layout applications and RC calculation utilities. If you know of a hot applications which you think we should pass on to readers, let us know by e-mail at: **swaddington@cix.compulink.co.uk.**

Site Survey

The month's destinations

See page 78 for this month's destinations

Britain's Internet Site Goes Live

Secretary of State for Culture, Media and Sport, Chris Smith, launched the Britain Internet site at **www.visitbritain.com,** creating a national focus for Britain on the Web.

Built by the British Tourist Authority (BTA) – together with all the national and regional tourist boards – the site is aimed at anyone interested in travelling around Britain. The new service will open up to the public – for the first time – the tourist board's vast database of attractions, events and accommodation, with a user-friendly interactive map and a dedicated search engine to guide users through some 40,000 pages of content.

The site's technology will ensure that users in other countries see the version of the site that best suits them. Future 'Market Gateways' in America, Japan, Australia, and Singapore, will allow BTA offices overseas to provide travel information and special offers translated into the home language and tailored towards their specific customers

Contact: BTA,
Tel: (0181) 563 3033.

Web-based Filter Design

Check out **www.kemo.com** for a guide to electronic filter design and selection. The new site created by UK-based signal-conditioning manufacturer, Kemo, contains full application guidelines, covering the need for filters and how to select the best device for a particular task.

Contact: Kemo, Tel: (0181) 658 3838.

EU Ministers Issue Clear Internet Guidelines

European Union officials have issued a broad declaration related to future regulation of the Internet in Europe. The declaration is the result of intense discussions among delegates from 29 European countries over two days.

On the issue of content liability, delegates agreed that what is illegal offline should also be illegal online. Further, it was agreed that Internet service providers could not be responsible for what their subscribers do.

In addition, the declaration states that Europeans support the ideal of non-discriminatory taxes on Internet use, but stops short of declaring it a free-trade zone. Value added taxes and other sales taxes that apply to goods purchased in stores should apply to products and services ordered and delivered over the Internet.

Contact: European Union, at: **www.cec.org.uk.**

Step Closer to Transaction Security

The Secure Electronic Transaction (SET) standard took one step closer to becoming a global standard earlier this month, as nearly 20 technology companies showcased their SET technology at the 'Promise of SET' event co-hosted by MasterCard International and Visa International in San Francisco.

Welcoming media, analysts and nearly 100 event participants, MasterCard's senior vice-president of electronic commerce, Steve Mott, recognised the technology partners that have played a key role in the development of SET 1.0.

"Today's participants play a crucial role in the acceptance of SET as the global payment standard of choice for shopping on the Internet, providing financial institutions, merchants and consumers a secure means of electronic commerce at a time of dramatic growth", said Mott.

SET 1.0 is a single method that consumers and merchants will use to conduct bankcard transactions in the future, over the Internet as securely and easily as they do in retail stores today.

For further details, check: **www.mastercard.com.**

Free Internet Presence For Businesses In The UK

YELL at **www.yell.co.uk,** the Yellow Pages web site, intends to offer a free Internet presence to businesses in the UK. From the beginning of August, businesses will be eligible for a Web site consisting of a page of information in Electronic Yellow Pages.

The offer has been issued to over a million UK-based firms via a questionnaire mailing. The Web site will contain information such as address, phone, fax and mobile numbers, payment methods, opening times and a description of the business and its products or services.

This offer complements other web services already available from YELL. During 1997, YELL launched low-cost Internet advertising on the electronic version of the Yellow Pages, to allow businesses to promote themselves not just locally, but nationwide, or even globally. Paying advertisers gain a number of additional benefits including priority listing, sales lead collection and forwarding, usage statistics and free text updates.

Contact: Yell, Tel: (0800) 935569, or e-mail: **eypsales@yellowpages.co.uk.**

Internet Threatens High Street Bookstores

Clive Bradley, chief executive of the Publishers Association, has warned the industry that bookshops are under threat from the Internet. Bookpages, a UK-based Internet bookshop at www.bookpages.com, is discounting prices by as much as 20% across its 100,000 titles. Bookpages, one of the larger Internet bookstores, claims it is increasing its sales by 25% per month and in the first six months of trading, is already selling as many books as a high street retailer.

Internet bookshops have no shop front overheads and typically work direct with a wholesaler, so can offer lower costs. Their other great advantage is that they are excellent for searching for books. You simply type in the title you want and they can tell you whether it is in stock or not.

Industry commentators ultimately expect the UK publishing market to mirror its counterpart in the US, where online bookstores claim to offer more than 2·5 million titles. Orders are taken over the Web, with purchases delivered by mail within two to three days.

@Internet

Pizza to Go for Pavilion

Pavilion Internet at **www.pavilion.co.uk,** is offering its subscribers the chance to order pizzas online by trialing a new online shopping system called RealTrade. Cooked up by Brighton-based Victoria Real, the new system is currently being beta tested by Famous Moe's Pizza.

Internet connected pizza munchers in the Brighton and Hove area can now create the pizza of their dreams from the online selection menu. Once the personalised pizza has been created, the touch of a button sends the order to Famous Moe's Pizza chefs, who are standing by to create the delicious delicacies for delivery straight to the customers' door by bike courier.

Beta testers will also receive a complimentary dessert from Famous Moe's Interactive menu as a thank you for taking part in tests.

So far, the service looks set to be a major success, with over fifty beta testers registering with Pavilion within the first day. Prospective online pizza guinea pigs in the Brighton and Hove area wishing to click their way to the perfect pizza should make their requests to: **betatesters@pavilion.co.uk.**

Contact: Pavilion Internet, Tel: (01273) 607072.

IBM and CyberSource Launch Electronic Software Clearing House Pilot

IBM and CyberSource have announced an agreement to create the first electronic software distribution (ESD) clearing house pilot in Europe. The first-of-its-kind European license clearing house will accelerate the development of electronic software distribution in that marketplace and generate opportunities for software publishers, distributors, resellers and customers.

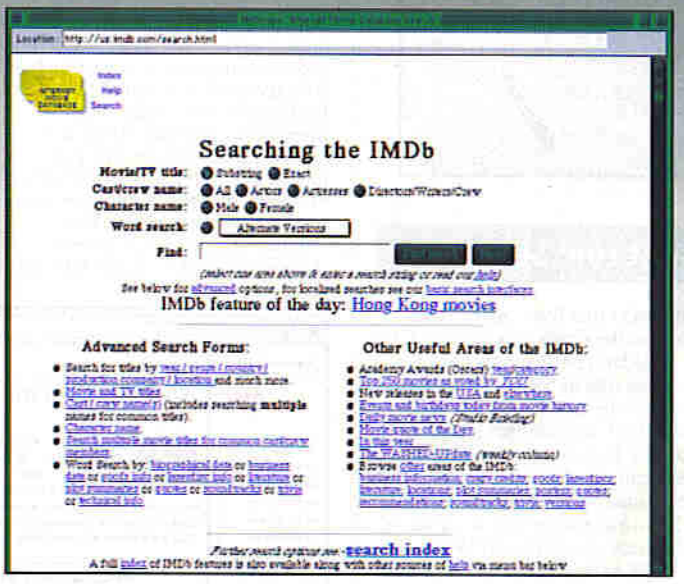
CyberSource will provide backend transaction services to resellers throughout Europe, with the CyberSource License Clearing House supplying third-party rights registration to securely distribute software and other digital products via the Internet.

Until now, the different financial and regulatory issues that exist between countries have complicated the process of setting up ESD models in Europe. However, in the IBM and CyberSource pilot, end-user transactions will be processed through an IBM financial service technology that can convert multiple currencies, calculate the local value added tax (VAT), and interface with banking systems for online credit card validation.

Contact: IBM, Tel: (0990) 426426.

Site Survey

The month's destinations



Whether in one form or another, Java looks set to become the programming language of the future. One of its main advantages is its use of Java applets – small, easy-to-use programs written in the Java language. Java applets will run on any computer with a standard Java-compatible Web browser, no matter what the computer or operating system is. Apple's new Education Online Economy (EOE) aims to act as a library of such Java applets for education. Recently developed in cooperation with several universities and others, the Education Online Economy already holds a very large number of Java applets (at the time of writing, over 700), which can be downloaded and used by education personnel worldwide. Look for it at: **http://trp.research.apple.com.**

If you're a movie buff, or if you just enjoy the flicks, the Internet movie database, at: **http://us.imdb.com/search.html** might be worth a look. You can search the movie database for just about any film on public release – and a few that aren't – to locate links to actors, directors, and the movies themselves, all from the comfort of your desktop. Pass the popcorn, please.

It's useful to have survey results for those important business discussions, either in the boardrom or (the more important ones) in the pub. Finding surveys about the Internet has never been easier than a quick surf to Nua's rather decent Web site at: **http://www.nua.ie/surveys/index.cgi,**

where all the relevant surveys you'll ever need to consider are listed. Nua is an Irish Internet consultancy and development firm who could teach most people a thing or two about designing Web pages. You can search by geographical references on the survey page, which is possibly useful for isolating those hard to locate ones about how the Internet affects residents in East and Lower Bottomsdroppings, near Hastings.

ELECTRONICS and Beyond

in the pipeline

Don't miss another great assortment of entertaining and easy-to-make projects and essential electronics information aimed at the novice constructor.

Issue 119 on sale Friday 3rd October

Neil Johnson describes a design of expandable 8-bit PC Interface Bus using the printer port.

***Timber!* – it's the second part of Dr Pei An's Game Port Data Logger.**

PLUS AVR – an introduction by Kevin Kirk describes a new microcontroller based around advanced Reduced Instruction Set Computer (RISC) architecture.

Part 3 of Stephen Waddington's series on The Information Economy examines how the Telecomms, Networking and Broadcasting fits in to the overall scheme.

Hi-tech Hits the Betting Jackpot from Alan Simpson demonstrates how modern communications play an ace in the hand of gambling.

In the Interests of Security by Douglas Clarkson details the hidden applications of CCTV camera technology – there's no escaping it!

Stephen Waddington provides a review of a phone/Fax switch.

Part 2 of Security Electronics Systems by Ray Marston covers electronic sensor devices, data links and alarm response units.

Technology in the Mountains from Rob Sperring describes the use of the latest hi-tech gadgetry when mountain-climbing.

Part 9 of Greg Grant's series What's in a Name inspects the evolution of circuit diagrams.

ELECTRONICS and Beyond

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Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:

Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no setting-up needed.

Easy to build, but not suitable for absolute beginners. Some test gear (e.g. multimeter) may be required, and may also need setting-up or testing.

Average. Some skill in construction or more extensive setting-up required.

Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.

Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

Ordering Information

Kits, components and products stocked at Maplin can be easily obtained in a number of ways: ❶ Visit your local Maplin store, where you will find a wide range of electronic products. If you do not know where your nearest store is, telephone (01702) 554002. To avoid disappointment when intending to purchase products from a Maplin store, customers are advised to check availability before travelling any distance; ❷ Write your order on the form printed in this issue and send it to Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, SS6 8LU. Payment can be made using Cheque, Postal Order, or Credit Card; ❸ Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554000; ❹ If you have a personal computer equipped with a MODEM, dial up Maplin's 24-hour on-line database and ordering service, CashTel. CashTel supports 300-, 1200- and 2400-baud MODEMs using CCITT tones. The format is 8 data bits, 1 stop bit, no parity, full duplex with Xon/Xoff handshaking. All existing customers with a Maplin customer number can access the system by simply dialling (01702) 552941. If you do not have a customer number, telephone (01702) 554002 and we will happily issue you with one. Payment can be made by credit card; ❺ If you have a tone dial (DTMF) telephone or a pocket tone dialler, you can access our computer system and place your orders directly onto the Maplin computer 24 hours a day by simply dialling (01702) 556751. You will need a Maplin customer number and a personal identification number (PIN) to access the system; ❻ Overseas customers can place orders through Maplin Export, P.O. Box 777, Rayleigh, Essex SS6 8LU, England; telephone +44 1702 554000 Ext. 376, 327 or 351; Fax +44 1702 554001. Full details of all the methods of ordering from Maplin can be found in the current Maplin Catalogue.

Internet

You can contact Maplin Electronics via e-mail at **<recipient>@maplin.co.uk** or visit the Maplin web site at **http://www.maplin.co.uk**.

Prices

Prices of products and services available from Maplin shown in this issue, include VAT at 17.5% (except items marked NV which are rated at 0%). Prices are valid until 3rd October 1997 (errors and omissions excluded). Prices shown do not include mail order postage and handling charges. Please add £2.95 to all UK orders under £30.00. Orders over £30.00 and MPS Account Holding customers are exempt from carriage charges.

Technical Enquires

If you have a technical enquiry relating to Maplin projects, components and products featured in Electronics and Beyond, the Technical Sales Dept. may be able to help. You can obtain help in several ways: ❶ Over the phone, telephone (01702) 556001 between 9.00am and 5.30pm Monday to Friday, except public holidays; ❷ By sending a facsimile, Fax (01702) 554001; ❸ Or by writing to Technical Sales, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Don't forget to include a stamped self-addressed envelope if you want a written reply! Technical Sales are unable to answer enquires relating to third-party products or components which are not stocked by Maplin.

Maplin 'Get You Working' Service

If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker ideas; Mini-Circuits or other similar 'building block' and 'application' circuits. To take advantage of the service return the complete kit to: Returns Department, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Enclose a cheque or Postal Order for the servicing cost (minimum £17) as indicated in the current Maplin Catalogue. If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost, plus parts.

TECHNOLOGY WATCH

with Martin Pipe

This month, we look at how we're beginning to see the various electronic systems within a car talk to each other. Until comparatively recently, they've been pretty much isolated from each other – the only thing in common being a connection to the car's battery. Get them to work together, and you could ease diagnosis of faults, improve safety or simply add new user-convenient features. At a simple level, things are already beginning to change – at least, in the much-publicised field of mobile communications. The hands-free car kits now being sold, to encourage the safe use of cellular phone handsets while driving, have a special logic-level output that connects to a corresponding input on recent car audio systems. When a call is being made or taken, the audio system will mute automatically – there's no need to fumble around for the volume control. Simple, but a distinct safety aid nonetheless.

More advanced car kits don't tell the audio system to shut up – they relay the incoming part of a cellular conversation through the speakers instead. In the future, we're likely to see a return to the old-fashioned car-phone. Within the next two years, car manufacturers will be introducing digital GSM (Global System for Mobile communications) cellphones as options. These will integrate with other electronic systems within the car (including audio), and the speaker, mike and keypad will be built into ergonomically-positioned cockpit mouldings. A far cry from the aftermarket (afterthought?) options currently available! The GSM subscriber's SIM (Subscriber Identity Module) card will be slotted into a conveniently accessible receptacle before driving starts. At the end of the journey, it can be removed and re-inserted into the GSM handset that the driver will almost certainly own.

If you can't wait that long for such levels of cellular/audio integration, there's an alternative. A few weeks ago, German in-car audio company, Blaupunkt, launched its Radiophone. This quaintly-named unit combines a hands-free GSM mobile phone and a high-specification RDS radio cassette. It will, no doubt, be offered as an option on certain high-spec German cars that all of us would like to afford. The Radiophone will also be available as a retrofit option from car audio and cellular dealers, at a price of around £500. For ease of installation, the Radiophone is a standard DIN-E fixture that will replace most existing radios (however, beware – some car manufacturers are now 'going their own way' and installing radio/cassettes and CD players of their own specification that don't conform to this established physical standard).

Other areas of integration are also becoming apparent. The voice-aided navigation systems currently available, such as the GPS (Global Positioning System) based Carin from Philips and Trafficmaster's Trafficmate (available from Maplin) will give their instructions via the audio system. A new system devised by Vauxhall, the £500 (plus annual subscription) Onstar, combines hands-free GSM cellphone and GPS receiver. It is already available as an option for certain models, including the Vectra. Lost Onstar subscribers call Vauxhall's 24-hour information centre, which is run by the AA. Data from the GPS receiver, containing location information, is also sent to the AA operator. Since the operator knows where the lost driver is, directions to the intended destination can be provided. Onstar could also be used to save time under life-threatening circumstances where police or ambulance assistance is necessary.

Photo 1. Blaupunkt Amsterdam Radiophone.

Security is another in-car application that could benefit from higher levels of car electronics integration. In the event of an attempted break-in, the alarm system would instruct the GSM phone to dial a preset number, and transmit a pre-recorded message. GPS could also be involved; if the car was removed, accurate location details could also be periodically forwarded using the in-built cellular phone. In the future, we're also likely to see engine control units (ECUs) networked into car electronics. In the event of a breakdown, the ECU would call, via the cellular link, a central service centre. There, an operator would use a computer to interrogate a diagnostics system built into the ECU, and determine the cause of failure (and any parts that would be required) before arranging the dispatch of a recovery operator to the breakdown location.

The operator would know, from a database, which recovery operator to call – a database would contain details of service contracts and/or AA/RAC membership. Again, the location of the unfortunate vehicle could be derived from a GPS component of a in-car navigation system. The reason for the breakdown would also be given, via a voice synthesizer and the car's audio system, to the driver. Feedback, regarding possible courses of action, would be possible via a voice recognition system fed from a microphone normally used by the hands-free cellular installation. Although much of this won't happen until sometime into the next millennium, it is interesting to note that Vauxhall – among other car manufacturers – is working on the basics of such a system.

Photo 2. How Japanese in-car electronics manufacturer, Alpine, sees the future of integrated car electronics. Key: A = Mobile Media Computer, B = Interface Unit, C = Communication Unit, D = Audio/Visual Unit, E = Safety Unit, F = Sensor Unit, G = Security Unit.

Anybody who has considered interfacing the CD autochanger from one manufacturer to the radio cassette ('head unit') of another will know that there is a distinct lack of standardisation concerning connections and protocols. As more electronic systems within cars become entwined, a standard interface bus will become necessary – after all, car manufacturers buy in most of the various electronic modules from different sources. Standardisation would help to bring costs down, improve the availability of spares, and facilitate future 'proofing' (upgrades and so on). An integrated future for car electronics is demonstrated at ICE manufacturer, Alpine's web site **(http://www.alpine.co.jp/ave/ae_mb002.html).** It is interesting to learn that a standard interface bus already exists. It is already being implemented by some manufacturers of cars and trucks.

The CAN (Controller Area Network) bus was first developed by the German company Bosch – owner of Blaukpunkt, and inventors of the popular antilock braking system (ABS) – in 1986. Its first application was a system that would allowed the three ECUs of a Mercedes vehicle to communicate with each other. All the major car manufacturers, including Mercedes, General Motors (Vauxhall), BMW, PSA, Ford, Renault, Fiat, Saab and Volvo, are developing models in which the CAN bus plays a major role in the networking of different electronic components. In 1993, CAN evolved into the ISO 11898 standard 'Road Vehicles – Interchange of Digital Information – Controller Area Network (CAN) for High-Speed Communication'.

The ISO11898 version of CAN is a frame-based multi-master bus that can run at speeds up to 1M-bps. Theoretically, CAN will link up to 2,032 devices on a single network. The devices are linked by a twisted pair (balanced line), although the specification also caters for optical links. The CAN standard also makes significant provision for error confinement and detection. As a result, the CAN bus is physically suitable for use in electrically noisy environments such as cars. Indeed, CAN is also finding application within industrial control systems. The major semiconductor manufacturers – including Philips, Siemens, Motorola, National Semiconductor and Intel – are producing CAN silicon.

Martin Pipe welcomes comments and ideas. E-mail him as: whatnet@cix.compulink.co.uk.

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