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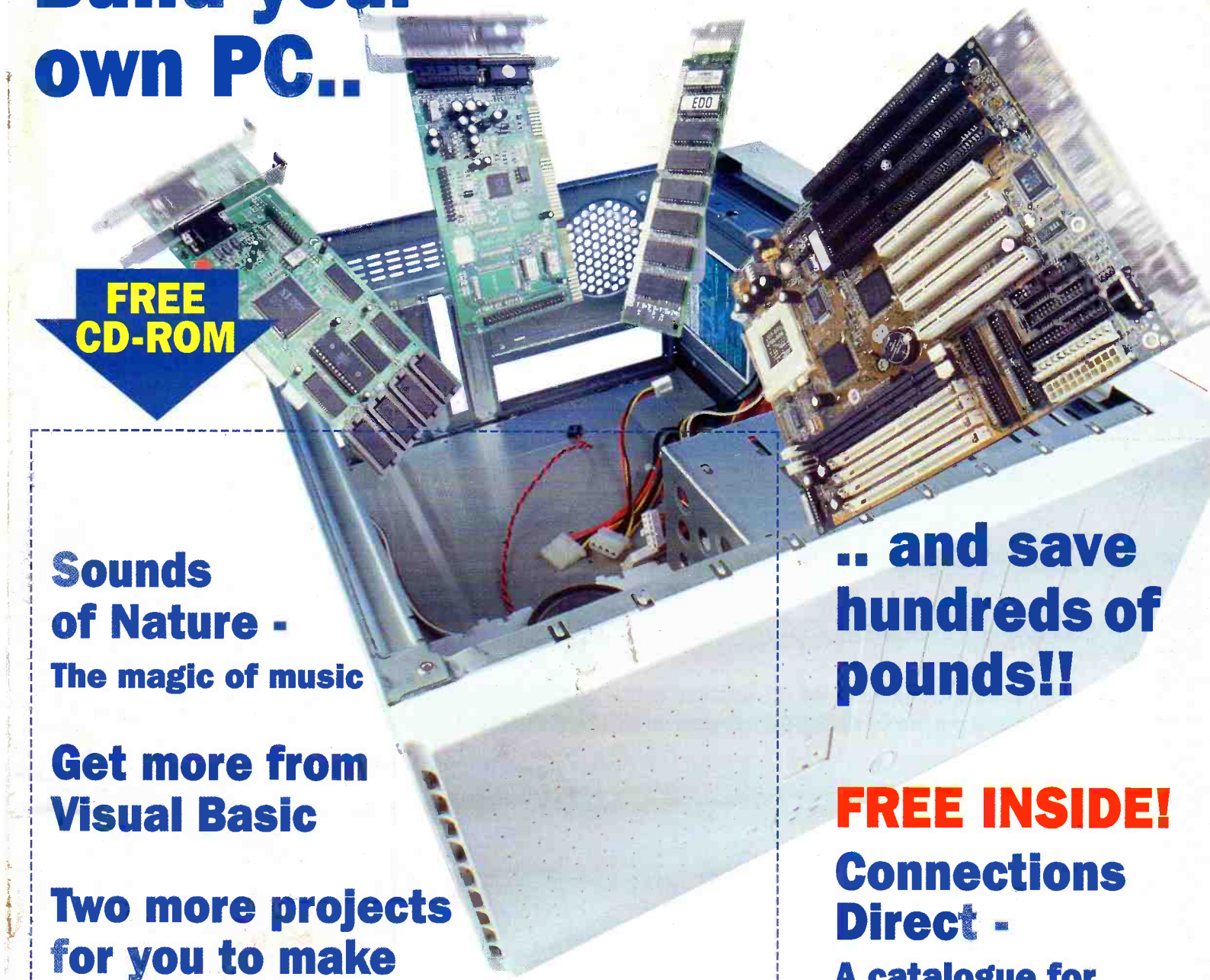

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Do you need practical help in learning the ins-and-outs of the Microchip PIC Family?

INTRODUCTORY OFFER £99.00

Then take a closer look at the Arizona Technologies Tutorial Board and modular training programme:

The Arizona Technologies is a low cost modular tutorial system for getting started with the Microchip PIC. It is based around a versatile demonstration and prototyping PCB and a windows help file software suite. All Microchip software tools are provided and dealt with in great depth. This is very much a learn-as-you-go product, with the basics covered with the main board, and further tutorials available as add-ons, once you are comfortable with the device operation.

ITEM NO	MAPLIN PART NO	DESCRIPTION	PRICE
1	NT62	Main Board	£99.00
2	NT63	Keypad Interface	£29.95
3	NT64	LCD Module Interface	£29.95
4	NT65	Dallas Touch Memory Interface	£24.95
5	NT66	Swept Tone Generator	£24.95
6	NT67	Real Time Clock Application	£19.95
7	NT68	Input Capture/Output Compare	£19.95

The introductory offer of £99.00 includes: Demonstration and prototyping board, diskette of tutorial software, Microchip CD Rom (data, apps notes, editor, assembler and simulator), Product registration and support form, PCB Circuit diagram, Technical Hotline details.

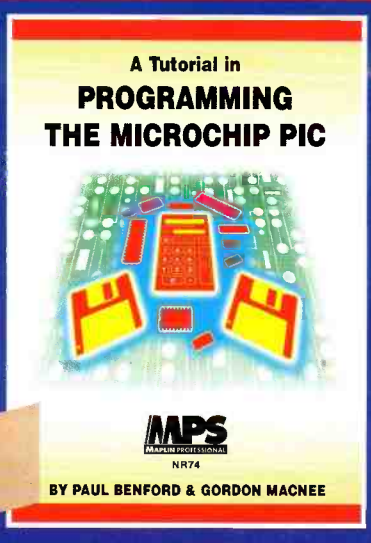
PIC Tutorial Board is supported by the UK Technical Hotline on (44) 1509 611344 or email:tutorial@arizona.co.uk. You can see before you buy by visiting the web page on http://www.arizona.co.uk/arizona

Also available to help with the PIC

A tutorial in programming the Microchip PIC **(MAPLIN Code: NR74)** is the latest in a series of learning aids to make your first steps into the exciting world of the Microchip PIC that much easier. Written by Paul Benford and Gordon MacNee, long standing experts on the PIC and microcontroller based applications, this book is a must for any design engineer getting onto the PIC trail.

NEW

ORDER YOUR COPY NOW!
MAPLIN PART NUMBER: NR74



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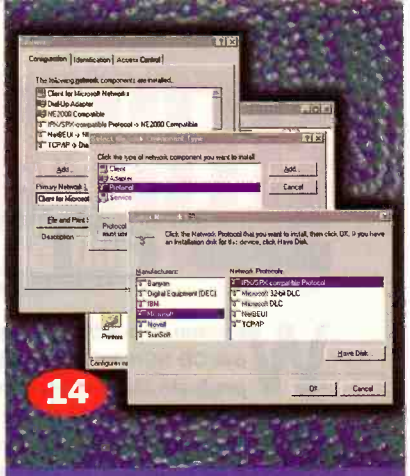
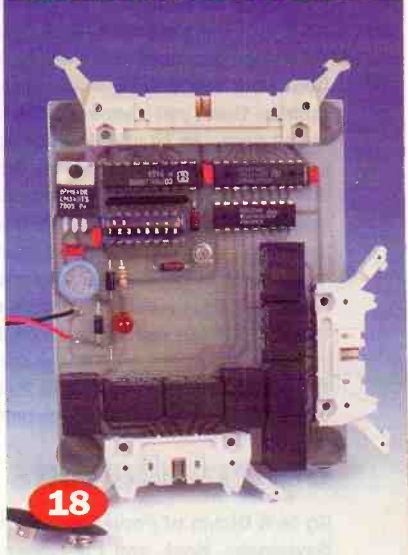
ELECTRONICS and Beyond

April 1998 Vol. 17 No. 124





Projects

Features

Regulars

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ELECTRONICS and Beyond

Welcome to our bumper edition of the magazine Use our CD ROM to locate any of the thousands of products Maplin Electronics has to offer. You'll find instructions on what to do on the back of the carrier sheet. Also do have a good look through our Connections Direct catalogue on computer peripherals which is placed in the centre of the magazine. This could become an invaluable reference source if you want to follow our series on how to build your own PC. Do make sure though that in a few months time, you phone for the latest prices.

The pressure to update your computer becomes greater by the day. This comes mainly from the ever increasing software file-size requirements and the demand for integrated multi-media communications.

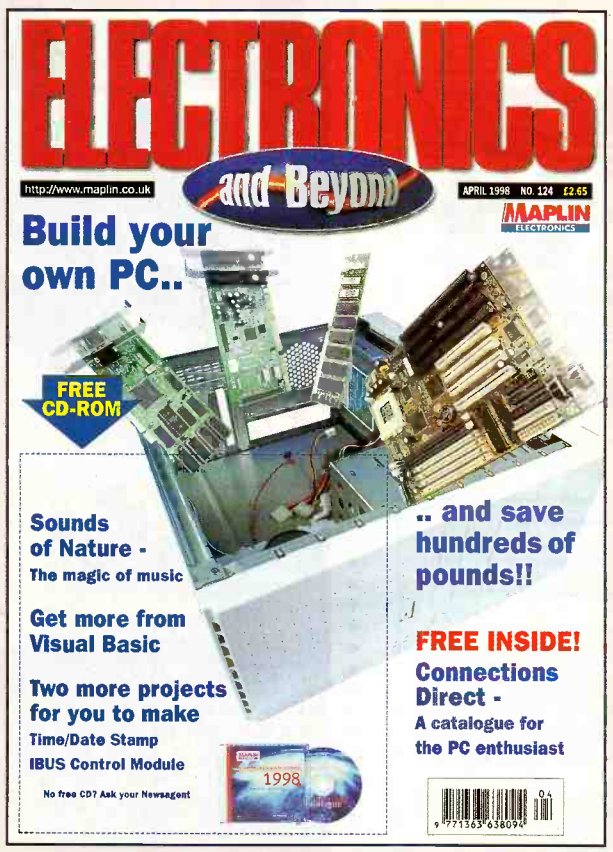
More and more people are now gaining the confidence to 'have a go' at building their own system requirements. Some would say the modular hardware construction is much easier than to sort out the software conflicts afterwards.

So our intention, by popular demand, is to supply you with the practical details of how to 'have-a-go' yourself at building one of the most popular electronic machines of all time.

Congratulations

Go to K Dickin of Poole Dorset, Peter Meinertzhagen of Sevenoaks, Kent, and J M Edwards of Tunbridge Wells, Kent for wining a copy of the Nuts and Bolts software featured in our February edition.

Paul Freeman-Sear, Publishing Manager



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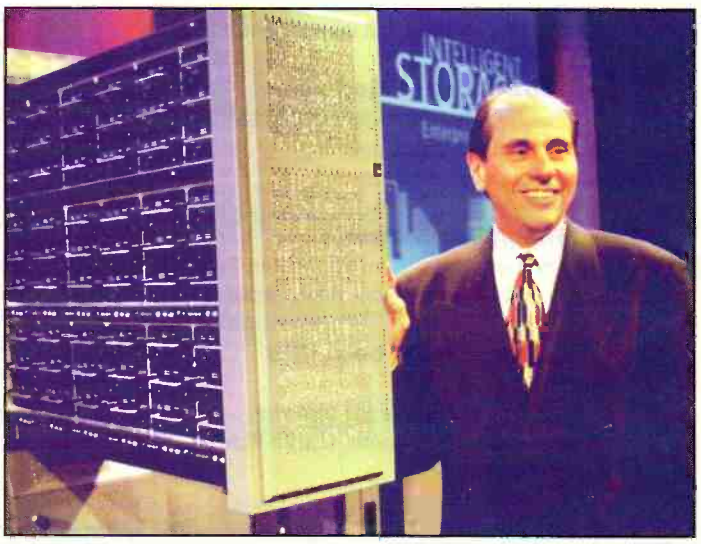
NEWS REPORT



Sun Serves Up 2.9 Terabyte

Sun has launched a new server, dubbed the StorEdge A7000 Intelligent Storage Server. The 2.9 terabyte storage device combines multiple storage discs with two UNIX computers, giving users simultaneous access to different types of data, including mainframe, UNIX and NT data.

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

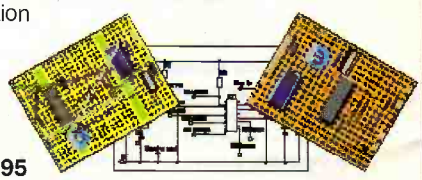
Contact: Sun, Tel: (01276) 20444.

Software for Stripboard

Ambyr Ltd of Newbury, has a new PC based computer aided circuit layout program for stripboard and breadboard called StripboardMagic. It is designed to take the drudgery out of translating theoretical electronic circuit design and turning it into a practical layout on stripboard or breadboard.

Paul Kelsey, one of Ambyr's two founders says: "We believe that Stripboard Magic is the first computer aided circuit utility that produces layouts for stripboard and breadboard. If you want to build on PCBs, there are a plethora of computer-aided autorouting utilities available, but until now you if you had wanted to use stripboard you had to work out the layout by hand".

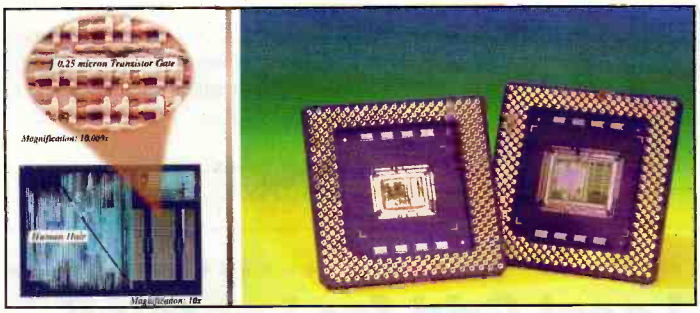
Stripboard features a drag and drop circuit editor, extensible component library automatic circuit layout on stripboard or breadboard, a detailed construction diagram to guide the assembly stage and automatic generation of component order forms.



StripboardMagic is available from Maplin Electronics **(Order Code NN97F) Price £39-95**

Contact: **http:/www.ambyr.com/StripboardMagic**

Intel Delivers Pentium II, National Follows with Cyrix 6x86MX



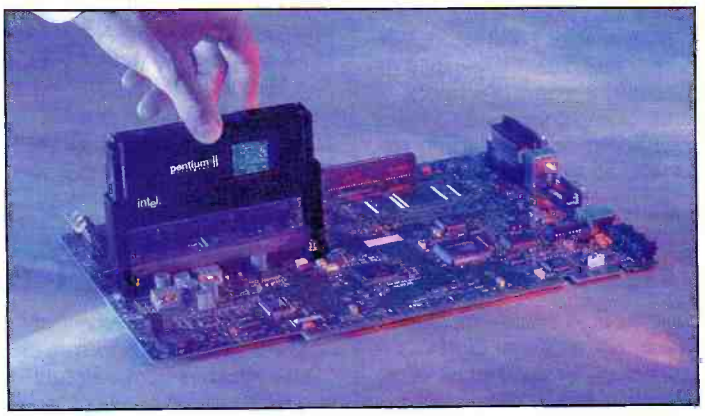
Intel has launched a 333 MHz Pentium II processor, based on 0.25-micron process technology. The 333MHz Pentium II processor contains all of the same performance-enhancing features as the current Pentium II processors, including: Dual Independent Bus architecture, Dynamic Execution, Intel MMX technology and a closely coupled 512KB Level 2 (L2) cache bus running at half the speed of the processor.

Meanwhile National Semiconductor has announced that its Cyrix 0.25 micron 6x86MX CPU is set to role off the production line later this year. A spokesperson for the company claimed that the new processor would offer Pentium II-class performance for a fraction of the price of the Intel device.

The battle for greater processing power and ever decreasing process geometries continues. The Intel and Cyrix microprocessors are produced using a fabrication process, which is 200 times smaller than the width of a human hair. A hair would become the size of a tree trunk, 20 inches in diameter, if shown at the same magnification as the 0.25-micron transistor gate.

For further details, check: **www.intel.com,** and **www.national.com.**

Contact: Intel, Tel: (01734) 403000, and National Semiconductor, Tel: (01475) 633733.



Monimal Madness Hits UK PCs

Add a furry moose cover complete with antlers to a computer monitor, then chuck in a wacky screen saver and what do you get? A Monimal of course – the latest craze to hit the UK high street since Tamagochi's swept the nation last year.

PC users can now give their PCs a whole new personality thanks to a furry Monimal – complete with hilarious screen saver. Users can choose to decorate their PC with a Cow, Lion, Sheep or Moose. Each Monimal comes with four screen savers that add the user's choice of wacky face, animation and sound effects to bring the furry character to life.

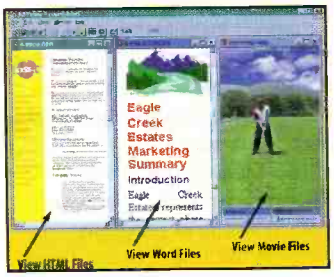
Contact: The Monimal Trading Company, Tel: (0171) 734 8939.

File Access without Applications

Computer users can now read e-mail attachments without owning the original application. Using a new software utility called KeyView Pro from Cross Atlantic Software more than 200 different files formats can be accessed with a single mouse click. The program can be used as a standalone application or as a plug-in for Netscape Navigator or Internet Explorer.

For further details, check: **www.crossatlantic.co.uk.**

Contact: Cross Atlantic Software, Tel: (0171) 228 6992.



NEWS BYTES

Must-Have Update for Mac OS 8

The pros called Mac OS 8 the must-have upgrade for 68040 and Power Mac. Version 8.1 is the must-have update for Mac OS 8. Mac OS 8 customers can now download the Mac OS 8.1 update from Apple's Web site free of charge.

In addition to all the features of Mac OS 8, version 8.1 gives improved Java compatibility, more efficient disk storage, built in Digital Video Disk (DVD) Universal Disk Format (UDF) which reads video DVDs and DVD-ROM interactive games, faster application launching and better PC compatibility with PC Exchange 2.2.

For further details, check: www.apple.com.

Contact: Apple, Tel: (0181) 569 1199.

Nottingham University Students Get Connected

Up to 5,100 Nottingham University students will benefit from a new, state-of-the-art telecommunications network, currently being installed by Diamond Cable using equipment from telecoms manufacturer GPT.

Services for students and staff will include the ability to make and receive personal calls, connect to the internet, make free internal calls within the university and use individual voicemail boxes to leave and receive messages.

For further details, check: **www.gpt.co.uk.**

Contact: GPT, Tel: (0115) 9433687.

Microsoft Defines Palm Computing

Having seen the success of the 3Com Palm Pilot, Microsoft is attempting define a new computing platform. The company has developed specifications for a new product category it is calling the Palm PC, which is designed to use a pared-down version of Windows CE.

Handheld computers based on the Palm PC specifications will be manufactured by Phillips, Casio, LG Electronics, and Uniden.

The Palm PC includes a 32-bit microprocessor chip, a connection for communication with a PC, and a tiny modem; in contrast to previous Windows CE devices the new product will use a pen-like stylus rather than a keyboard for information entry.

For further details, check: www.microsoft.com.

Contact: Microsoft, Tel: (0345) 002000.

NEWS BYTES

Sony and Fujitsu Join Forces to Produce LSI Chips

Japanese electronics companies Sony and Fujitsu are set to jointly develop process technology for next-generation system LSI (large-scale integration) semiconductors. The companies also plan to share their intellectual property and to build a facility in Japan for manufacturing the chips, which reduce the size and power requirements of devices using them.

For further details, check: **www.sony.com,** and **www.fujitsu.com.**

Contact: Sony, Tel: +1 941 768 7669, and Fujitsu, Tel: +1 408 232 9500.

Compaq to Buy Digital

Compaq Computer has made an offer to acquire struggling Digital for £5.34 billion in cash and stock. The purchase will give Compaq entree into the high-end computing marketing, as well as access to Digital's computer service operations business for large businesses. The combined company will be poised to go head-to-head with industry leaders IBM and Hewlett-Packard.

For further details, check: www.compaq.com, and www.digital.com.

Contact: Compaq, Tel: (0990) 134456, and Digital, Tel: (01189) 868711.

Motorola Incorporates Java in Consumer Products

Electronics giant Motorola has committed to embed Sun's Java programming language in Motorola products ranging from semiconductors, smart cards, automotive components and wireless devices to advanced electronics systems and computers.

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

Contact: Motorola, Tel: (01293) 404343.

StrongARM Chip to Power Internet Phone

The Advanced RISC Machines (ARM) StrongARM SA-1100 microprocessor has been selected by Philips Consumer Communications to drive its new IS-2630 screen phone. The advanced-technology phone, designed for small business users and consumers, provides instantaneous access to the Internet, e-mail, voicemail, and a wide range of messaging options.

For further details, check: www.arm.com.

Contact: Advanced RISC Machines, Tel: (01223) 400400.

Hayes Launches 56k PC Card with GSM and ISDN

Hayes has announced the availability of the Hayes OPTIMA 56K Global PC Card in the UK at a recommended retail price of £299. This high-performance 56kbps modem includes PhoneTools software, Quarterdeck InternetSuite 2, WebTalk, plus 30 days free trial with AOL, CompuServe and Premier Internet.

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

Contact: Hayes, Tel: (01252) 775577.

ICL Launches Local Grid for Learning

In response to the Government's consultation paper on the National Grid for Learning, ICL has developed a Local Authority Internet solution called the Local Grid for Learning (LGfL).

LGfL enables Local Education Authorities (LEAs) to establish a local grid to connect schools, libraries and community centres together to deliver educational services to students, teachers and community learners alike.

Based on ICL's Knowledge Utility framework, and ICL's Schools Netra Server, the LGfL supports both existing and emerging technologies, and has been developed together with Sun Microsystems.

A number of projects using the LGfL are already underway. These include the Merseyside OnLine project announced in November and the TC Trust TC-NET.

The system helps the LEA to lead in establishing an Internet-based network providing equality of access and opportunity across the whole community of learners in their area.

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

Contact: ICL Education Systems, Tel: 0117 984 2067.

Intel Drives Connected Car Technology

The new Ford Expedition, loaded with Intel Connected Car PC Technology, is Intel's latest effort at making PCs in cars a reality.

Since the announcement of its plans to bring PCs to cars in 1996, Intel has demonstrated connected Car PC Technology at various venues. And at the world's largest automotive show, IAA Frankfurt last year, Citroen unveiled a new model, the Xsara, with Intel Connected Car PC Technology.

The Ford Expedition is equipped with a Pentium processor with MMX technology-based computing platform. In the front seat, drivers can find the shortest route to their destination through voice-activated navigation, or they can make a cellular call using the computer. In the back seat, passengers can be entertained by browsing the Internet or by watching movies or playing games.

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

Contact: Intel, Tel: (01734) 403000.

Enhanced PICmicro Architecture For 8-Bit RISC

Microchip has announced an enhanced PICmicro architecture for 8-bit RISC microcontrollers at the same time as extending its range of one-time-programmable microcontrollers.

The Enhanced PICmicro Architecture offers up to two million words of program memory address spacing for its popular PICmicro family of 8-bit RISC microcontrollers.

The company unveiled a road map of 11 one-time-programmable (OTP) microcontrollers and Enhanced FLASH-based microcontrollers incorporating the new high performance PIC16C1XX architecture.

The PIC16C1XX architecture is an enhanced RISC core that is upward compatible from Microchip's Mid-Range PIC12C6XX, PIC14CXXX and PIC16CXXX core and High-End PIC17CXXX core, providing a migration path to higher integration.

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

Contact: Microchip, Tel: (0118) 921 5800.

Taking the Waiting Out Of Bus Stops

The Internet looks set to take the waiting out of bus stops thanks to a new real-time route-tracking system for buses, being developed by BT Laboratories in collaboration with Suffolk County Council.

Before leaving the comfort of either home or office, the system allows bus passengers to see exactly where a bus is while it is en route and how long it will take to arrive via a moving graphic displayed on a dedicated Internet Web site at **travel.labs.bt.com.**

Tracking devices on each bus determine its position to within 100 metres using signals from orbiting global positioning satellites (GPS). The vehicles' positions are then transmitted via a central base station, to both the Internet Web site and a number of display units at selected bus stops.

The trial is being run on Eastern Counties Buses' Superoute 66 in Ipswich, a well used route, which connects Martlesham Heath and the BT Laboratories site with the town centre and the railway station. Many of its regular passengers are commuters to the BT complex.

Some bus stops are already equipped with display units showing the predicted arrival time for the next bus and now thanks to software developed at BT Labs, Internet users can also determine exactly where the next bus is allowing them the luxury of timing perfectly when they leave either home or office to catch the next bus.

For further details, check: **www.labs.bt.co.uk.**

Contact: BT Laboratories, Tel: (01473) 606551.

General Accident Signs-Up for 4,000 NCs

In a sign of the acceptance of the network computer in large companies, IBM has announced the purchase of 4,000 of its IBM Network Stations by General Accident. This is the largest network computer contract in Europe to be signed from any vendor to date.

General Accident, one of the UK's leading insurers, will reduce its reliance on personal computers by adding 2,200 of IBM's Network Stations at the beginning of 1998, increasing to 4,000 systems over the course of the year. IBM will also provide General Accident with numerous service solutions including technical infrastructure design and systems integration.

For further details, check: **www.generalaccident.com** and **www.ibm.com/nc.**

Contact: General Accident, Tel: 01738 895805 and IBM, Tel: (0990) 426426.

Cabinet Ministers New James Bond Type Red Box

The Cabinet Office is set to computerise the traditional red boxes used by Cabinet Ministers.

In order to log-in to a Red Box, users will need to present the correct and unique hardware access token to the built in reader. Without the correct token, access is denied.

The new hi-tech security is being provided by Rhea International's Latches product, an integrated access control package that includes on-the-fly transparent encryption and decryption, anti-viral facilities, file authentication and hardware token handling.

The hardware token can be incorporated in to a number of holders such as standard security passes or key fobs. For the Cabinet Office, the hardware access token is built into a signet ring and worn by the Minister and other authorised users.

Contact: Rhea International, Tel: (01932) 830551.

PC Application That Never Lies

You can now tell if the person at the end of the phone is telling the truth using a software application from Israel start-up Makh-Shevet. Due to go on sale within a month, priced around £100, Truster is an online PC-based lie detector that can analyse the voice through a phone conversation and show on screen whether the person on the telephone is lying.

Truster uses a microphone fixed to rear of the handset and plugged into the PC's soundcard, which digitises and analyses the speakers' voice.

When an individual lies, there is a conflict between the mind and what they are actually saying. Truster works by monitoring the modulations within speech patterns to determine if somebody is stressed, exaggerating, excited, or telling an outright lie.

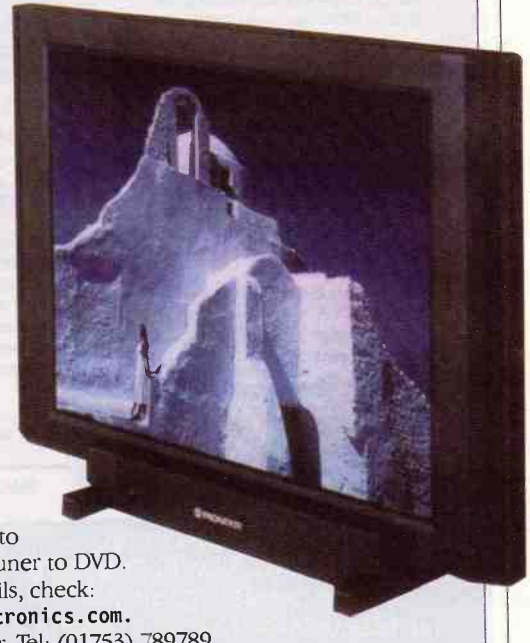
Tamir Segal, CEO of Makh-Shevet claims that the Truster will mark a new era of honesty. Politicians will have to think twice on what they say during their campaigns, voters will be able to check the speeches using the Truster. Salesmen will have to be far more cautious when selling their wares over the phone. How about getting some real answers when you are shopping for your new home or car?

A UK distributor for Truster is due to be announced shortly – check the company's Web site for information.

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

Contact: Makh-Shevet, Fax: +972 9 9552402.

Future's Bright, Future's Plasma



Pioneer is set to launch the world's brightest Plasma display in UK in March. The 40in. screen is less than 9cm deep and has a brightness of 400cd/m². The full colour PDP-V401E can be linked to almost any type of media from video to PC, and from TV tuner to DVD.

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

Contact: Pioneer, Tel: (01753) 789789.

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- **CRN1:** Embedded PIC16F84 microchip using RB7 pin 13 input output 1024 byte memory and 64 bytes eeprom.
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- **CRN202:** 2048 bit memory, using I2C Bus serial memory. (The CRN202 is just I2C memory and does not have any protection, ideal for storing data on smartcards.
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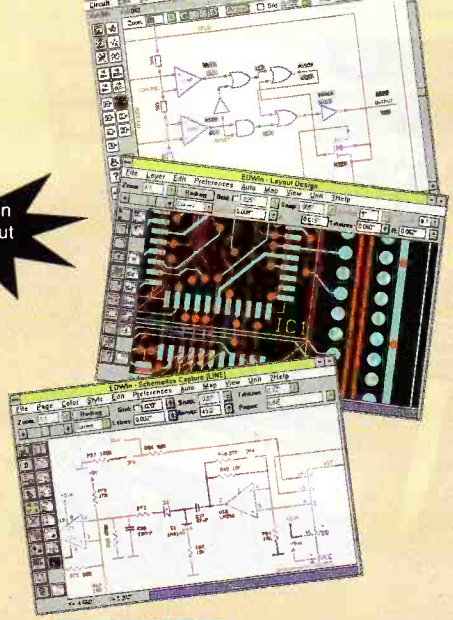

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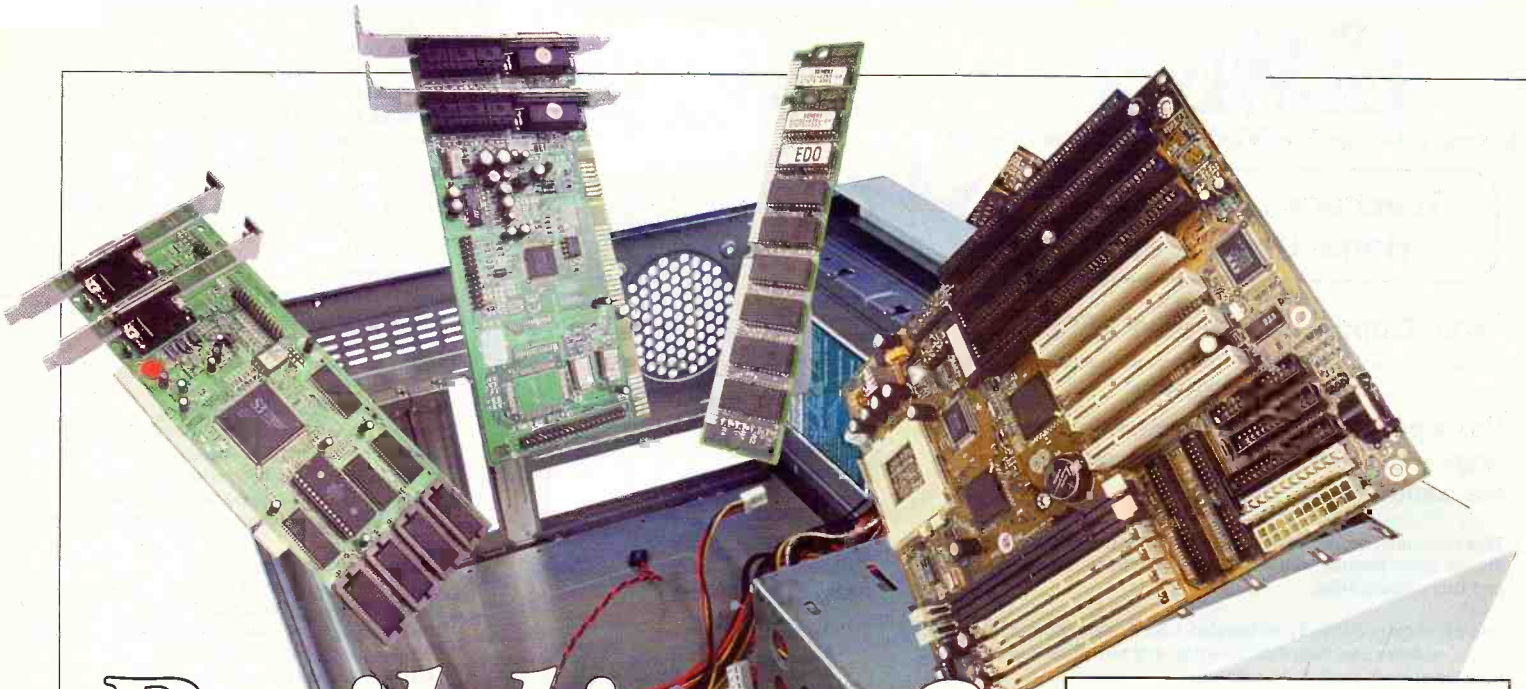


Building & UPGRADING PCs

PART 1

The Basics

Whether you want to build a Personal Computer (PC) yourself, upgrade an existing machine or just get to grips with different specifications before taking the plunge and buying a ready-built machine, this new series is for you. Over the next few months a variety of Maplin Electronics experts will provide an insight into the world of the PC. Stephen Waddington kicks off this first article in the series with a historical review, before taking a look at what's underneath the bonnet of a state-of-the-art PC.

It's four o'clock in the afternoon – I've just avoided the weekly trip to the supermarket. I logged on the Tesco Web site, filled my virtual shopping basket and e-mailed it to my local store. No traffic jams, no squabbling kids or couples and no shopping trolleys with wobbly casters. If all goes according to plan, a Tesco's van will arrive within the next 24 hours and deposit the goods in perfect condition on my doorstep.

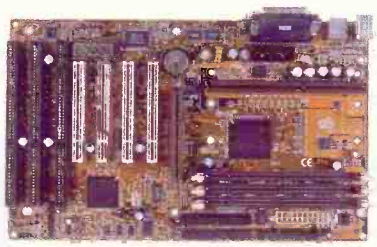
I called my Grandfather to tell him about the latest in cyber shopping. He was decidedly unimpressed. He reckons that his local greengrocer used to provide exactly this same service at the end of a phone, over fifty years ago.

So much for progress, or so I thought until my Grandfather started telling me about a bloke in Sydney, Australia with whom he had made e-mail contact. Apparently they share an interest in obscure geraniums. Cross-pollenised seeds are expected to be making their way around the globe courtesy of Royal Mail before the end of the week.

Age of Experience

According to Professor Peter Cochrane, head of the British Telecom Laboratories in Martlesham Heath, Ipswich, this is the age of experience. Technology, in the form of the PC is enabling individuals to reach new horizons and undertake activities which would never previously of been thought possible.

The driving force over the last two decades, which has been making PCs more and more useful, has been performance. Ever increasing performance has been key to unleashing the power and potential of the PC, giving us the opportunity to turn that performance into different features and applications.



Pentium II Motherboard Maplin (Order Code LY65V).

New Series

Over the next few months we will show you how to build a cutting edge PC that will last you well into the new century. We'll also show you how to upgrade an existing machine to take advantage of leading edge hardware, and update your operating system and application software.

There are a terrific number of choices to make when selecting or upgrading a PC. What processor, modem, hard disk, CD-ROM and multimedia functions should you go for? How do you upgrade to the latest processor? How do you add memory? What type of PC do you need to suit a particular application? What do you need to manipulate photographic images, or access the Internet? Over the next few months a variety of experts from Maplin Electronics will answer all of these questions and others.

This first feature in the series kicks off by examining the history of the PC and some basic fundamentals. Along the way we will review how technology is pushing out the boundaries of PC computing. Perhaps more importantly, we'll review what's inside the case of your PC and where the different cables plug in.

Types of PC

If you have been following the PC industry for the last decade or so, you will probably have come across the term IBM compatible, 286, 386 and 486. The naming system for PCs can be confusing. Unlike any other industry, marketing professionals within the computing sector have not got wise to the use of creative brand names, opting instead to use a number. This usually relates to the part number of the PC's main chip or central processing unit (CPU).

The original PC was built in the early eighties by IBM and was based around the 8-bit Intel 8088 microprocessor with 640 KB RAM. The machine was housed in a big black box and contained two 360 KB floppy disk drives, each 4in. high, 8in deep and slight wider than the 5.25in. disk. An integral monochrome green or orange monitor was fixed to the top of the main unit.

The original PC machine had no hard drive, but did have slots for up to five cards. Applications had to be run from disk within the limitations of 640 KB of RAM. If you still have one of these machines, then keep it for posterity. While early machines are worth little more than their scrap value, its possible they may become antiquities of the future – at least that's the line I give my wife, whenever she complains about the four machines stuck up in the loft.

Hard Disk Storage

In 1982, IBM added a hard disk drive, albeit with tiny storage capabilities of up to 10 MB, to their original design. These machines were called the IBM XT and were considered state-of-the-art, in comparison with the original IBM PC. Instead of storing programmes on 5.25in floppy disks, users could copy information onto their hard drive. The IBM XT incorporated an Intel 8086 or 8088 microprocessor, but like the IBM PC ran like a dog, clocking in at 4.77 MHz.

The IBM XT had a colour Enhanced Graphics Adapter (EGA) monitor and 640 KB of internal memory. Unlike its early prototype, the IBM XT was considerably more upgradeable, but if you still have one these machines, do not expect to be able to upgrade it the speed of the machines in the late nineties. While the IBM XT did have slots for eight 8-bit cards, these were clocked at a fraction of the 4.77 MHz CPU speed and like the CPU were based on 8-bit technology.

PC Forerunner

The IBM AT, launched in the mid-eighties was the forerunner of today's modern PC and incorporated an Intel 286

17" monitor Maplin (Order Code LS67X).

microprocessor. The key components and layout of the AT machine remain the same for today's PCs. The IBM AT ran at five times the speed of the original PC and XT, clocking in at 20 MHz. It also doubled the bus widths from 8- to 16-bit and had 16bit expansion slots for upgrades.

While the IBM XT is the predecessor of today's PCs, there is little chance of being able to run either Windows 3.1, or any of today's software applications on these machines. If you want to spend a heap of cash and a considerable amount of time fiddling under the case, then you could bring this machine up to speed. Add a new motherboard, a new power supply, a new hard drive, more memory and a new monitor and video card and you'll have something decent. In fact by the time you're finished, it is likely that the only original components will be the case.

286, 386, 486 and Pentium

By the early nineties, the PC era was truly upon us. The Intel 286 spawned a new family of microprocessors that included the 386, 486 and the modern day Pentium. Table 1 outlines the roadmap of Intel's processors. Do bear in mind that Intel typically launch CPUs up to 18 months before they appear in a PC. Consequently the launch date of individual CPUs such as the Intel 286 does not coincide with the availability of the 286 machine.

If you own a 386, the chances are that you're also running an early version of Windows. These machines can be upgraded relatively easily with faster CPU chips, memory, hard disk drives and video cards. There is however always a balance to be struck. If you have a 386 or 486 machine, weigh up the cost of chip upgrades versus the cost of a replacement motherboard.

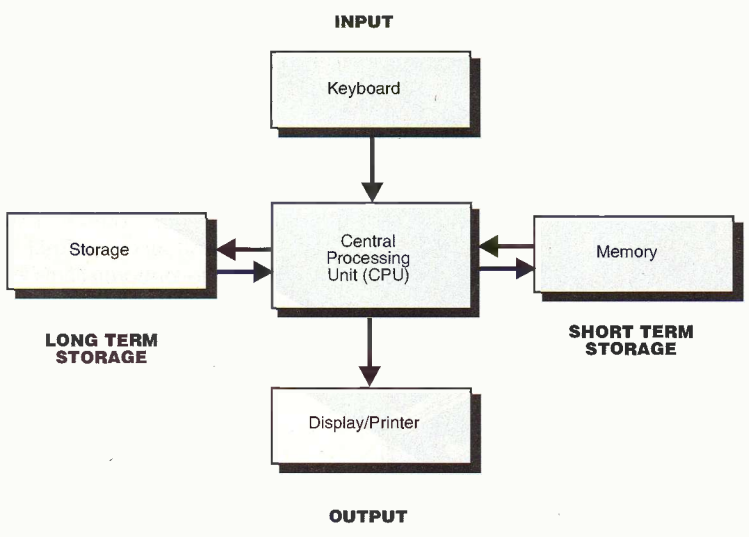


Figure 1. Five key elements of a PC.

1978: 8086 – 8088 Microprocessor

A crucial sale to IBM's new PC division made the 8088 the brains of IBM's new hit product – the IBM PC.

1982: 286 Microprocessor

The 286, also known as the 80286, was the first Intel processor that could run all the software written for its predecessor. This software compatibility remains a hallmark of Intel's family of microprocessors. Within 6 years of its release, there were an estimated 15 million 286-based PCs installed around the world.

1985: Intel i386 Microprocessor

The Intel i386 microprocessor featured 275,000 transistors – more than 100 times as many as the original 4004. It was a 32-bit chip and was 'multi-tasking', meaning it could run multiple programs at the same time.

1989: Intel i486 DX CPU Microprocessor

The i486 generation really meant you go from a command-level computer into point-and-click computing.
The Intel i486 processor was the first to offer a built-in math coprocessor, which speeds up computing because it offers complex math functions from the central processor.

1993: Pentium Processor

The Pentium processor allowed computers to more easily incorporate 'real world' data such as speech, sound, handwriting and photographic images.

1995: Pentium Pro Processor

Released at the end of 1995 the Pentium Pro processor is designed to fuel 32-bit server and workstation-level applications, enabling fast computer-aided design, mechanical engineering and scientific computation. Each Pentium Pro processor is packaged together with a second speed enhancing cache memory chip

1997: Pentium II Processor

The 7.5 million-transistor Pentium II processor incorporates Intel MMX technology, which is designed specifically to process video, audio and graphics data efficiently. It is packaged along with a high-speed cache memory chip in an innovative Single Edge Contact (SEC) cartridge that connects to a motherboard via a single edge connector, as opposed to multiple pins. With this chip, PC users can capture, edit and share digital photos with friends and family via the Internet; edit and add text, music or between-scene transitions to home movies; and, with a videophone, send video over standard phone lines and the Internet.

Source: Intel

Table 1. Historical roadmap of Intel microprocessors.

What Goes Where?

With the history lesson over let us turn our attention to the basic anatomy of the PC. The computer is broken into five key components as shown in Figure 1. This is the basic architecture of all modern PC's from the IBM AT onwards. Let's review each of the key areas.

The CPU is the brain of the PC. This is where data is added, manipulated, subtracted, multiplied and divided.

Memory is a temporary storage device for data used by the CPU.

The storage device stores data permanently. Both floppy disk drives and hard disk drives store applications and data permanently even when the PC is turned-off.

An input device such as a keyboard or mouse provides information from the user and transmits this to the CPU.

A monitor or printer provides output from the CPU and is the interface between the CPU and the user.

Motherboard

The motherboard or system board as shown in Figure 2 is the computers' main circuit board, usually green in colour that houses each of the components of the PC. The processor, memory and all expansion cards are plugged into the motherboard as shown in the schematic diagram in Figure 3. By itself the motherboard is like the shell of a car – it contains spaces or mouldings for the keys elements of a vehicle such as a boot, bonnet, axle, steering wheel and seats, but its up to the designer to add components such as an engine or petrol tank of their own selection.

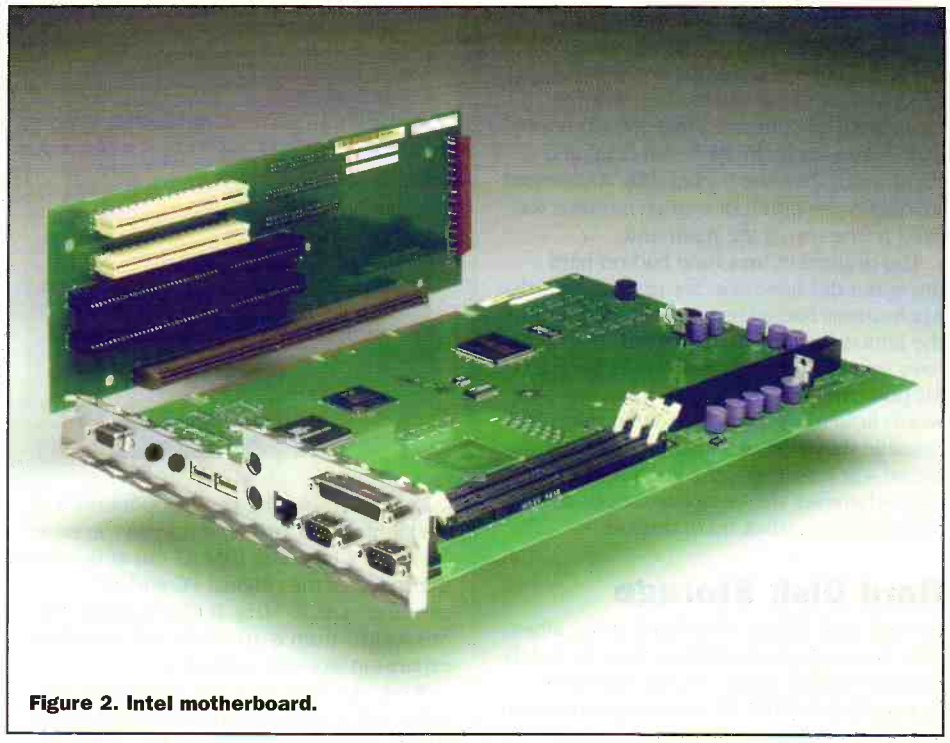


Figure 2. Intel motherboard.

Central Processing Unit (CPU)

The CPU is an integrated circuit built on a tiny piece of silicon. It contains thousands, or even millions, of transistors, which are interconnected via superfine traces of aluminium. The transistors work together to store and manipulate data so that the microprocessor can perform a wide variety of useful functions.

Even though CPUs are tiny devices, they are the most expensive PC component, often costing hundred of pounds. This is the key reason that PCs are named after the CPU they contain such as the 386, 486, Pentium or Pentium Pro. Actually PCs get two numbers to describe their performance characteristic. The first number or name is the model or design reference, the second relates to the processing speed of the processor in Megahertz. For instance, a Pentium 133 is a Pentium model chip running at 133MHz.

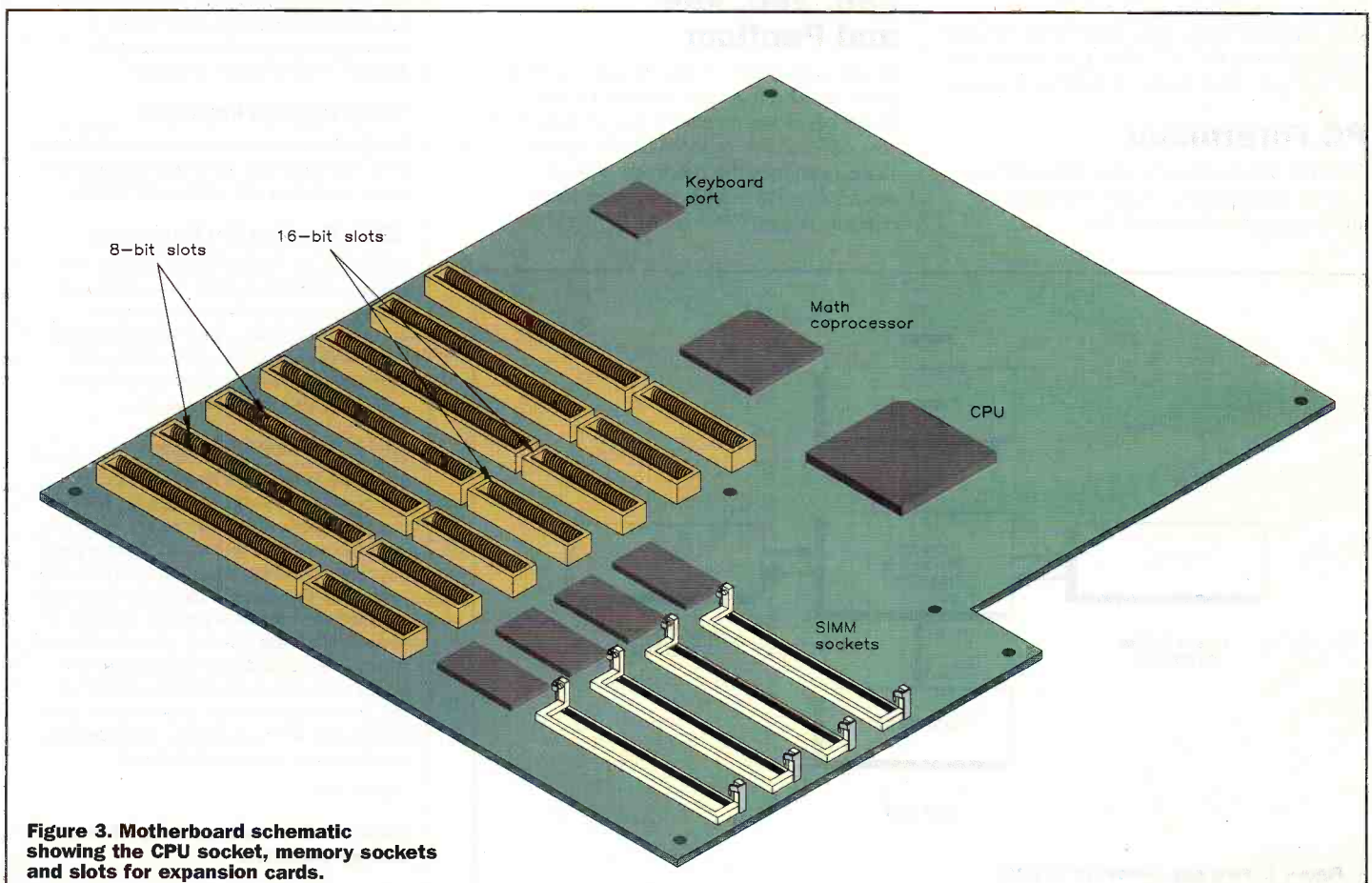


Figure 3. Motherboard schematic showing the CPU socket, memory sockets and slots for expansion cards.

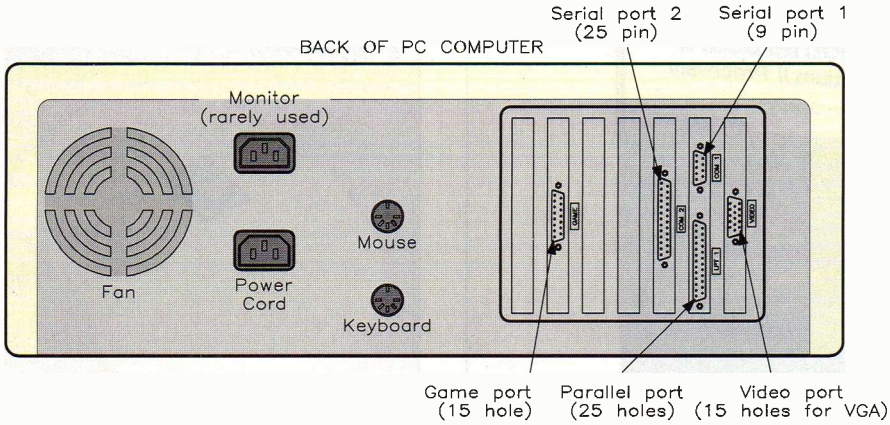


Figure 4. Rear schematic of PC showing layout and variety of ports.

Intel Clones

There are series of semiconductor manufacturers, most notably AMD and Cyrix, that have recognised making microprocessors for PCs is big business and have set about cloning Intel's designs. AMD's new K6 processor matches Intel's 233 MHz Pentium on performance and beats it on price. Meanwhile Cyrix, has just released a powerful new MMX processor and claims the chip rivals Intel's Pentium II, but costs only half as much. And with Cyrix recently acquired by National Semiconductor it is possible we'll see even more impressive devices come to market within the next few months. With huge potential cost savings it is worth considering clones, but check third party reviews particularly with regard to compatibility issues.

Memory

Random Access Memory (RAM), or just memory for short, are chips that the computer uses to store information that it is in the process of working on. And just like the CPU it is rated in terms of its storage and speed. Although all memory serves the same purpose, it comes in three different packages.

DIP

This is the old-style memory format used in early machines. DIP stands for dual-in-packages and are short black 14 or 16-pin devices that sit on the motherboard.

SIMM

SIMMs are tiny strips of circuit boards that contain banks of memory chips. Older versions had 32-pin and can hold comparatively small amounts of memory: 1 MB, 2 MB or 4 MB. Newer larger SIMMs have 72-pins and have capacities of between 1 to 64 MB.

DIMMs

This type of memory is a relatively new format. Resembling long SIMMs, they are optimised to support the special memory address and caching features of Pentium processors.

If you want to add memory to your existing machine, make sure you buy the right devices. And if the slots on your motherboard are full, consider adding a memory expansion card. Adding more memory to your PC is one of the easiest ways of squeezing more power out of a machine.

Connecting to the Motherboard

It should be clear from the markings on the motherboard where the microprocessor and memory are located. Aside from these locations, the motherboard contains a row of slots for adding expansion cards to the PC. These cards look like a miniature motherboard and contain integrated circuitry and other associated components. Cards come in a variety of sizes and styles relating to the age of the motherboard as follows:

8-bit

These cards hark back to the early PCs and utilise a single tab from the bottom right of the card that matches up with the single slot which it fits into.

16-bit

16-bit cards were first introduced in the 286 and are included on 286, 486 and some Pentium motherboards to maintain compatibility. A 16-bit card has two tabs protruding from its bottom that matches up with the two slots it fits into.

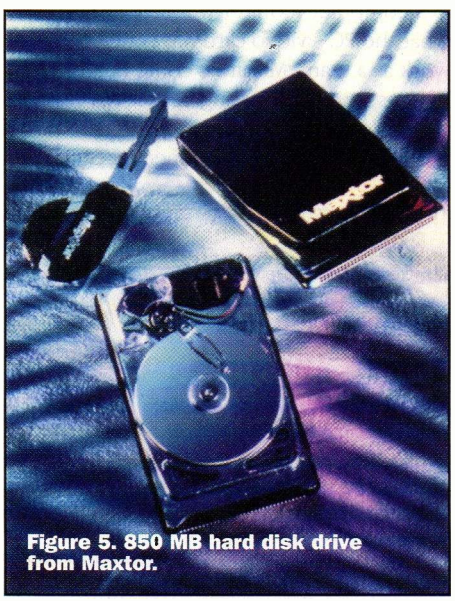


Figure 5. 850 MB hard disk drive from Maxtor.

Local Bus

A local bus card has three tabs protruding from its bottom that match up with the three little slots its fits into. These three slots, known as VESA local bus, enable the computer to interface directly to the CPU bus and thus work faster than would be possible with an 8- or 16-bit card.

Peripheral Component Interconnect (PCI)

This is a new type of connection interface implemented on generations of the microprocessor beyond the 486. Not only does it allow an expansion card to interface directly to the CPU, but it also enables tighter integration between memory and the external device.

Ports, Ports and More Ports

A PC typically has two serial ports for mice and modems, a parallel port for printers, a joystick port, a floppy disk controller and an Enhanced IDE adapter as shown in Figure 4. Most modern computers will include all these things on the motherboard. If your PC does not and you want to add any of the items mentioned you would need to buy a 'multi-I/O card' that includes them all on a single expansion board. If you are buying one of these, there are two things to check for – first, make sure that the serial ports have something called a 16550 UART. Slower chips cannot keep up with high-speed data flow. Second try to get a card that connects using PCI, if your motherboard is fitted with PCI sockets, and this will improve your hard disk performance.

Floppy Disk Drives

Disk drives are used to enable the exchange of data between machines and safeguard important files against the failure of the hard disk drive. Most machines have a 3.5in., 1.44 MB floppy drive as standard. PCs used to also have a 5.25 inch 640 KB or 1.2 MB disk drive, the former dating back to the old IBM PC. But since 5.25in. floppy disks are virtually extinct the 3.5in. device has become the de facto standard.

The size of a floppy disk is not the only variable to consider when looking at floppy disk drives. Both 3.5in. and 5.25in. floppy disks come in low- and high-density versions. High-density drives can pack in twice the amount of data of a low-density version. And if you store information on a low-density floppy disk it can be read in a high-density drive, but not vice versa. Table 2 summarises the amount of information the low- and high-density drives can hold.

Hard Disk Drives

Hard disk drives provide the main storage for applications and information. There are currently two popular Interface flavours, called IDE and SCSI. SCSI may be a better choice for extremely large disks or computers that will include more than three hard disks, scanners or Zip drives, but in general IDE is considered less expensive, less trouble and faster.

Figure 6. Motherboard incorporating video functionality from Intel.

Currently, a 1.2GB drive, is probably the smallest hard disk worth considering or you can get a 2GB device if you're prepared to spend a bit more. If you want to keep the computer for a long time or expect to use large applications consider a 3GB or 4GB drive.

Display

A computer display consists of two parts: the monitor or screen that you look at, and the electronics inside the computer that control the monitor. These electronics are called a video or graphics card and are either included on the PC's motherboard as shown in Figure 6 or are contained on a separate expansion card.

There are two important variables to consider when selecting a graphics card. The first is the method by which your computer talks to the card. As we've already seen PCI is the fastest and most common method here.

Drive Size	Storage Room
5.25in., low-density	360KB
3.5in., low-density	720KB
5.25in., high-density	1.2MB
3.5in., high-density	1.44MB (Most common device)
3.5in., extended density	2.88MB

Table 2. Floppy drives sizes and capacities.

The second issue is to decide how much memory you want on your graphics card. This is very different to RAM used by your CPU. The amount of video memory you have has little effect on speed, but determines the number of colours you can display. The greater the definition you require on your monitor the more memory you need on your graphics card. So if you want to use your PC to watch video or manipulate electronic images you'll need 4 MB, otherwise opt for 1 to 2 MB.

A computer monitor will only display what the PC's video card has sent – the two work as a team. Monitors come in a variety of sizes, and with varying degrees of pixel definition and colour capability. A summary of the main formats is outlined in Table 3.

Display Type	Description
Hercules, Colour Graphics Adapter (CGA), Graphics Adapter (EGA)	These are older types of monitor, which a typically grainy and capable of displaying Enhanced either single or poor quality colour
Video Graphics Array (VGA)	This display was the industry standard in the early nineties and still works well with Windows, displaying 256 colours perfectly adequately. Needs a 16-bit card, so won't always work with XT machines.
Super Video Graphics Array (SVGA)	This monitor packs the most colours and gives the best definition of all the graphics formats. Has replaced VGA as the accepted industry standard.
Extend Graphics Adapter (XGA)	Expensive monitor for high-end CAD/CAM graphics design. Very expensive.

Table 3. Summary of displays currently available on the market.

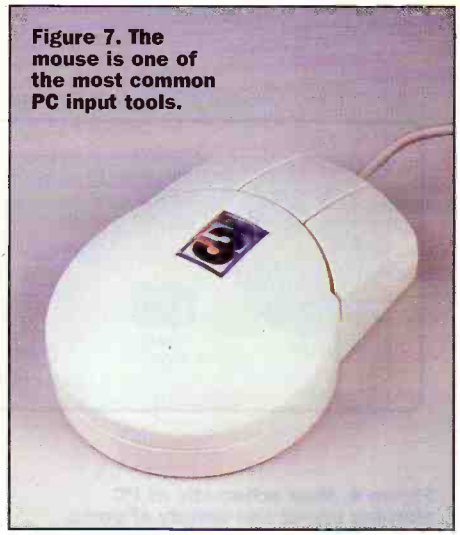


Figure 7. The mouse is one of the most common PC input tools.

Input Devices

The standard input devices in any PC system are a mouse as shown in Figure 7, and a keyboard. Even the cheapest versions of these are generally of relatively high quality, and most people will be satisfied with them. If you will be using your computer more than a few hours a day or are concerned about ergonomics because of repetitive stress injuries (RSI), you might want to consider something more than the standard models.

Cases

The standard options for a case are desktop (lies flat) or tower (stands on an edge) in small, medium or large options. Towers are more flexible because it is easier to set them on their side than to set a desktop model on its edge. A fully equipped system in a mini-tower may run out of power or space for drives; on the other hand, a full tower is ridiculously large for anything except a server. The mid-tower is the best choice for most systems: its small enough to fit on the desktop, yet is large enough to accommodate a variety of expansion cards.

Multimedia

Multimedia came into vogue in home computing two years ago. By adding a sound and moving images to the PC, manufacturers claimed that the PC would become an all-singing all-dancing box that would replace other consumer products such as televisions and audio devices. Intel developed MMX technology – incorporated within the Pentium microprocessor as

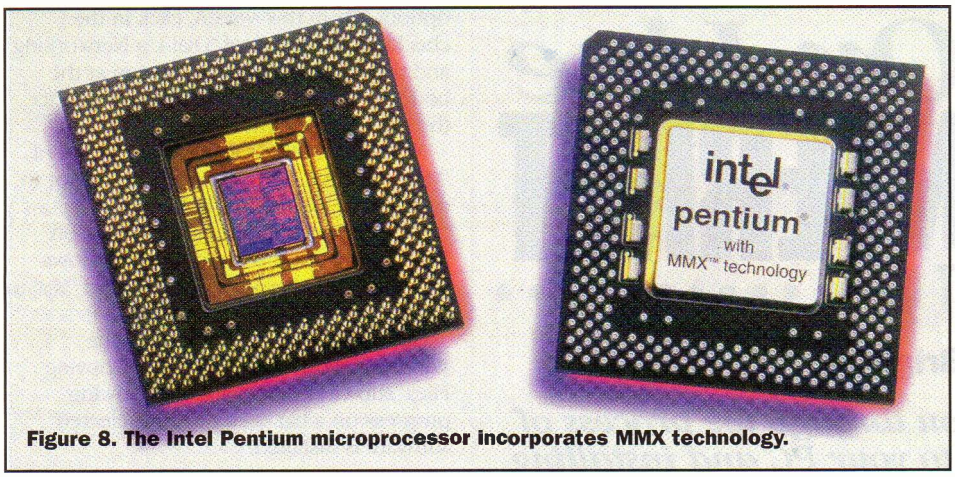


Figure 8. The Intel Pentium microprocessor incorporates MMX technology.

shown in Figure 8 – to handle manipulate multiple signal types on the microprocessor core last year, and manufacturers started to add high-specification graphics cards, CD ROM drives and sound cards to off-the-shelf PCs. And while we've yet to see PCs replace audio systems and the television, the majority of machines sold today have the capability to handle video and audio.

CD-ROM drives read computer data off specially prepared CDs. This is valuable because CDs can hold almost 500 times as much information as a floppy. Like hard disks, CD-ROMs come in IDE and SCSI versions, and like hard disks, the SCSI versions are significantly more expensive. CD-ROMs are rated in relative speed compared to an audio CD. Currently, 8x, 12x, 16x, and 24x models are available depending upon how much you want to spend. Since some software is still designed for slower CD-ROMs, you may not always notice as much of a performance difference as you would expect.

Sound Cards

The other element in the multimedia mix is the sound card. If you need to buy a sound card, you should buy a 16-bit Sound Blaster compatible card, unless you have a specific reason for buying a more sophisticated card such as a musical use. More advanced and expensive models have more features and can produce better sound, but this capability is often wasted since the majority of mainstream software rarely takes advantage of it.

You need speakers to hear the sound signals produced by your sound card. If your stereo is near your computer, the cheapest and highest quality option is to connect your sound card to your stereo. If this is not an option, you will need to buy speakers. Make sure the speakers you buy were designed for use with computers. Non-computer speakers may not have enough magnetic shielding, and could damage your disks or monitor if they are close to your computer.

Modems

Modems are devices that allow your computer to communicate over telephone lines. They are rated by their theoretical top speed (data rate) in kilobits per second. The two most popular speeds currently on the market are 28.8k and 33.6k. 56k is the emerging standard, but this has to be formally approved by the International Telecommunications Union (ITU). Most manufacturers supply modems in an internal and external format. Internal modems are marginally cheaper, reduce the clutter on your desk and avoid the 16550 UART problem, but they can't be moved between computers easily.

What's Under the Case of My PC?

If you have a PC that you haven't built yourself its almost impossible to determine what's under the lid. Windows 95 users can easily figure this out, by clicking 'My Computer' on the Desktop with the right mouse button and choosing properties at the pop-up menu. Windows lists the PC's CPU and amount of RAM. Click the 'Device Manager' and 'Hardware Profile' options along the top and Windows 95 will reveal exactly what is under the case as shown in Figure 9.

If you haven't got Windows 95 installed

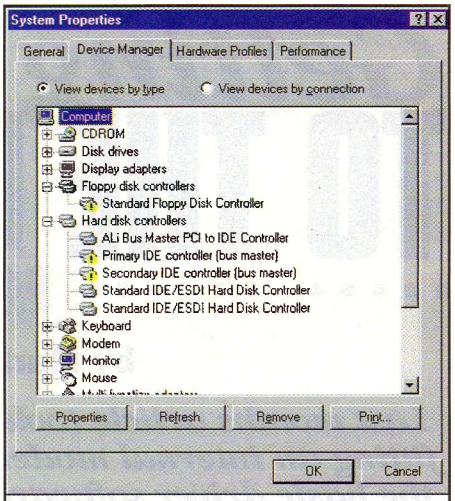


Figure 9. Windows 95 incorporates in own self-diagnosis tool.

on your machine, check your DOS directory for a file called MSD.EXE, which stands for Microsoft diagnostics. This program is bundled by Microsoft with MS DOS and with Microsoft applications. If you can't find it on your machine, download a copy from the Shareware Web site at www.shareware.com as shown in Figure 10.

When you run MSD from DOS, the programs probes the depths of your machines and reveals pertinent information, including the CPU, amount of ports, disk drives, printers and input devices. Use this program with caution. It was written in the day's of 8- and 16-bit computing, it cannot recognise CPU's beyond a 486 – the machine under test is actually a Pentium.

Further Reading

Intel	`www.intel.com`
Intel Secrets	`www.x56.org`
AMD	`www.amd.com`
Cyrix	`www.cyrix.com`

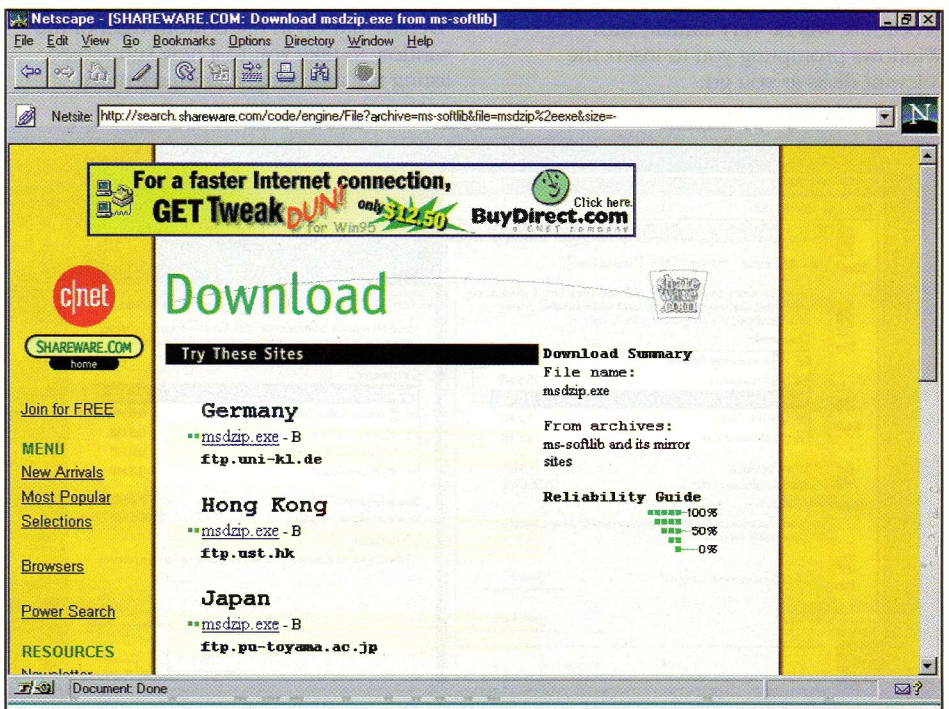


Figure 10. Download Microsoft Diagnostics from the Shareware Web site.

Getting On-Line TO THE INTERNET

PART 4

by Mark Brighton

Last months article took you through the process of fitting an internal modem to your PC and installing the basic driver software necessary for Windows 95 to recognise the modem. In this months article, we cover the installation and set up of the rest of the software you will need to make a dial up connection to your service provider and log on, along with the browser software needed to actually surf the Net.

If you have been following this series to date, you will know that we have assumed that you will be using a standard dial up account with a conventional Internet service provider. We have chosen Demon Internet for our example. If you have not already subscribed to an ISP, you will need to do so to follow the set up example in this months article. When you subscribe, your service provider will give you all of the account names, passwords, numbers and server identities that you will need to make your software interact correctly with their gateway into the Internet. If this information is given to you by phone, do please make a record of it all, as it's all needed!

We will start by loading up some of the extra software provided with Windows 95, but not installed during a default installation to your machine. We will assume for the sake of simplicity for this example that you have Windows 95 on CDROM, but the disk procedure will be very similar, with Windows prompting you to insert the relevant disks as you go.

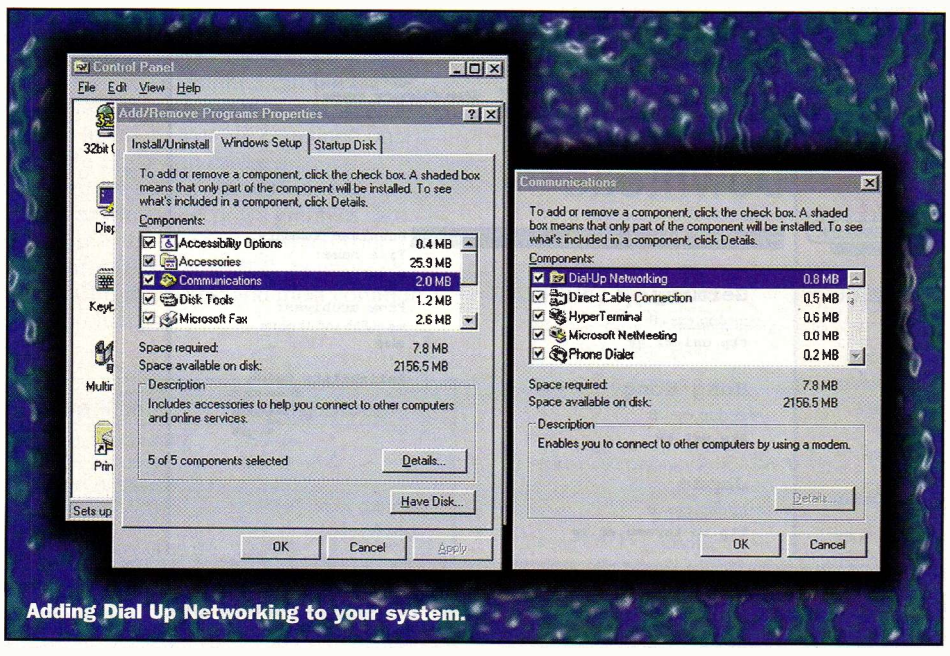
Windows software installation

Switch on your PC and let it initialise. Insert your Windows 95 CD into your CDROM drive and use your mouse to select Start / Settings / Control Panel. When the control panel window appears, double click the icon (or list entry) for 'Add / Remove programs'.

Using the tabs at the top of the new screen, select the 'Windows Setup' option. You will then see a list of the Windows 95 components and options. To the left of each entry on the list is a checkbox indicating whether or not you already have that option installed. Installed options contain a tick, partly installed options a tick in a grey checkbox and un-installed options contain a clear checkbox. Use your mouse to select and highlight the line titled 'Communications' and then click on the 'Details' button at the bottom right of the window to take you to a new sub screen listing the individual communications options. From this screen, click in the checkbox to the left of 'Dial-Up Networking' and then click on the 'OK' button at the bottom of the screen. This returns you to the previous screen.

Now click in the checkbox to the left of 'Microsoft Fax'. This will cause a prompt to appear that asks if you wish to add 'Windows Messaging' (maybe 'Microsoft Exchange' on some versions of Windows 95) to enable Microsoft Fax. Click on 'Yes' to continue.

Click on 'OK' at the bottom of the Windows Setup screen and the 'Copying Files' subwindow will appear, showing progress on a bar meter as the selected software is installed.



Adding Dial Up Networking to your system.

Microsoft Fax setup

Once the software is installed, Windows will run the 'Inbox Setup Wizard' which will prompt you with a number of screens to take you through the process of entering the information needed in order for your PC to act as a fax machine. Click on the 'Next' button to continue to the next screen until you reach the point where you enter your country (select from pop up list by clicking on the arrow next to the default country and then clicking on your country), area code (STD) and any number you may dial to get an outside line (if using an in house or business telephone exchange system). Click 'Next' to show a screen which should already have your new modem selected, then click 'Next' again to reach a screen asking if you would like Microsoft Fax to auto answer your telephone line to receive faxes and, if so, after how many rings. Set these details as you prefer and click 'Next' once more to reach a screen where you may enter your details as they will be displayed on remote fax machines connecting to you. Click 'Next' to finish Microsoft Fax set up and return to the control panel screen.

Networking

Communication with Internet Web sites requires a new communications standard or protocol to be added to your default Windows set up. A protocol called TCP/IP is required and may be added / enabled in a very similar way to the previous set up procedure.

Double click the 'Network' icon on your control panel, bringing up a list of the communications protocols already installed on your machine. Assuming you have a default set up and are not already connected to a cabled network within a company, you will need to install theTCP/IP protocol as follows. Click 'Add' to display a list of protocols that may be added. Select 'protocol' and click 'Add'. On the next screen, select 'Microsoft' on the left column, then 'TCP/IP' on the right column. Click 'OK' to return you to the first screen, now with TCP/IP protocol added to the list, and click 'OK' again to allow Windows to load the selected files from your Windows 95 CD as before. Lastly, the system tells you that it will be necessary to restart your PC to enable the TCP/IP protocol and asks if you would like to do this now. Select 'Yes' and allow your system to restart.

Windows Dial Up Networking (DUN)

Dial up networking is the part of Windows that initialises your modem and dials out to a remote Internet host site. It will run a script which automatically sends your log in account and password information to the remote site, or will bring up a terminal window to allow you to log in manually if you don't want an automated insecure log in on your machine for others to use in your absence!

DUN is set up from within 'My Computer'. Double click the 'My Computer' icon on your desktop and you will notice that there is now a folder for DUN that wasn't there before. Double click the folder to take you to the DUN window.

The only option you will initially see displayed as an icon on this screen is the 'Make New Connection' icon. This is exactly what we need to do, so double click the icon!

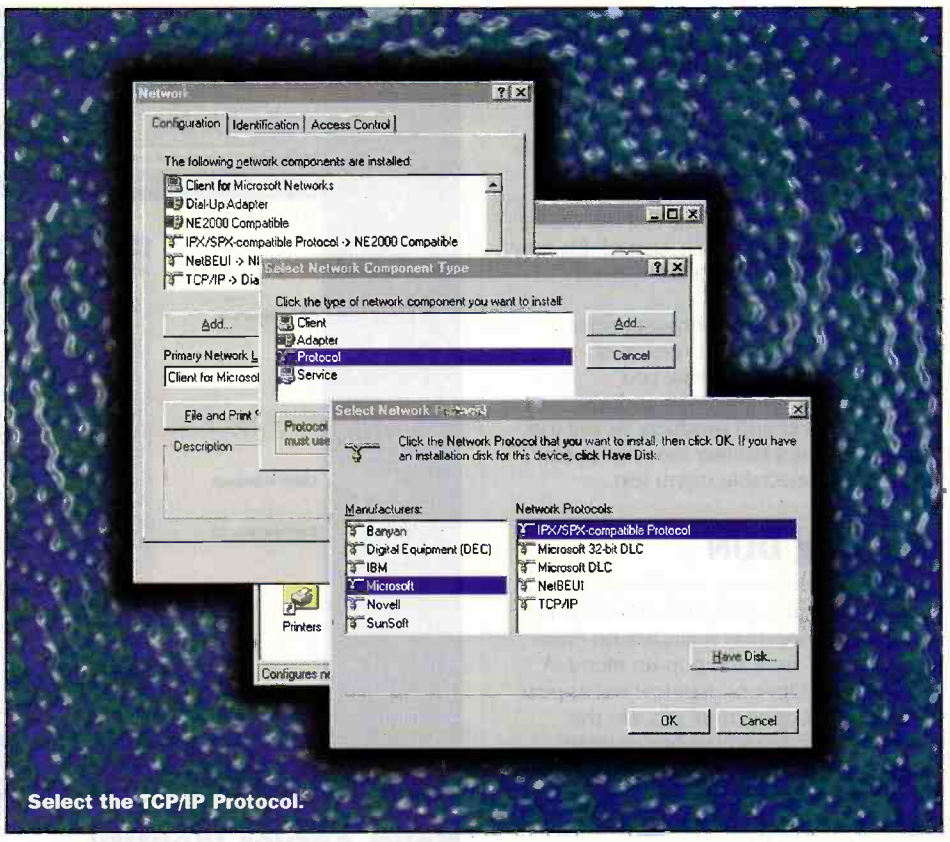
The next window will prompt you for a name for the connection. Enter a name of your choosing. Note that the modem to be used for this dial up connection is shown and specified on this screen. It should already be showing the name your modem set up under. If it isn't, you may select your new modem by clicking on the arrow to the right of the modem name line and choosing a modem from the list. If no modem is listed, your installation of modem driver software was not successful and you should go back over last months article and your modem booklet and start again!

All being well, you should move on to a screen prompting you for the number to be dialled (for Demon, this is an 0845 'Lo-Call' number, charged at local rates wherever you may be dialling from in the UK. Then you will save the connection and return to the 'My computer' window after clicking 'Finish'.

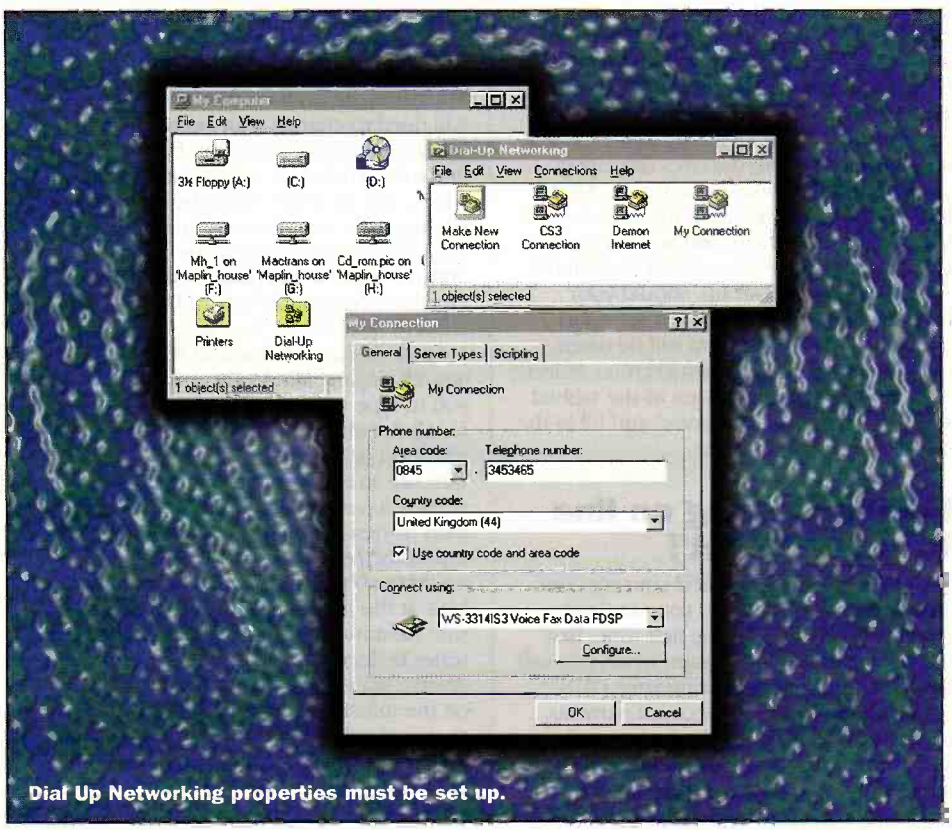
Right click your new connection icon and choose properties from the pop up selection list. This should bring up a set up window with three tabs. The first, 'General', should already be set up. Select the second tab 'Server types', by clicking on the tab.

Under type of dial up server, ensure that the following is selected; 'PPP:Windows 95, Windows NT 3.5, Internet' (exact text may vary slightly with Windows version). Under advanced options, 'Log onto network' and 'Enable software compression' should be checked. Under 'Allowed network protocols', all three choices may already be checked, but TCP/IP must be checked.

Under scripting, you may set a 'script' of pre-stored log in commands to allow Windows Dial up networking to automatically log on for you. However, this is not necessary for Demon accounts, as all you need to do is to fill in your account name and log in password on the screen that pops up each time the dialler is invoked.



Select the TCP/IP Protocol.



Dial Up Networking properties must be set up.

Browsers

If you have chosen to use Microsoft Internet Explorer as your browser, it may already be supplied with your version of Windows 95 (not early versions). Other browsers are supplied on magazine cover disks from time to time, or may be downloaded from the Internet once you are on line with Explorer. Note that the version many users will have on their Windows 95 CD (version 3) has now been superseded by version 4.

Microsoft Explorer

Look at your desktop. There may be an icon representing the world and titled 'The Internet'. If you double click this icon, you will start the Microsoft Internet set up wizard. This program assumes that you will be using Microsoft's own Internet access, Microsoft Networking. If this is the service provider you wish to use, you may use this wizard to configure your Microsoft Explorer browser and log in for the first time, after which clicking on the desktop icon will run the browser and dial up networking programs.

If, however, you are using a different service provider, you may run the browser by clicking the 'Start' button, slide the pointer up to programs, wait for the list of programs to pop up and then click 'Internet Explorer' (not to be confused with 'Windows Explorer') and the browser will run.

One of several things may happen, depending on your software set up and whether or not any browser software has previously been set up on your system. If it has, you will see a warning that Explorer is

not currently your default browser and would you like to make it so. Click on 'Yes' or 'No' as the fancy takes you and the browser will run.

At this point, the browser will (if you're lucky) invoke Windows dial up networking, but if it doesn't happen and the browser runs instead, you may easily set it up to auto run the dial up software. If the dialler window does appear, click 'Cancel' for now so that you may go on to set up your browser off-line.

You will see the main browser screen appear with a pre stored version of Microsoft's start page giving you information about Microsoft and it's Internet services and products. At the top of the screen is a familiar looking toolbar , buttons and selectable menu text.

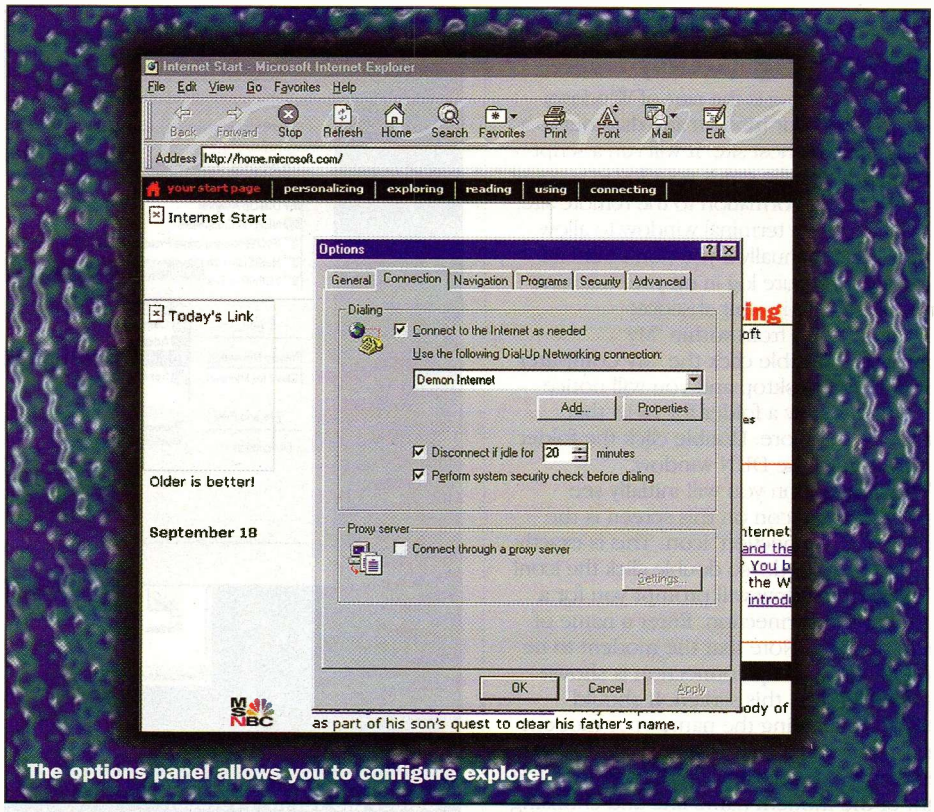
Invoking DUN

All that you need to do to tell Explorer that you wish it to automatically connect using your DUN connection is to click on 'View', then 'options' from the pop up menu. A small tabbed 'Options' window will appear . Click on the 'Connection' tab. On this window, check (click) the box marked 'Connect to the Internet as needed' and use the arrow at the right of the 'Use the following Dial-Up Networking connection' line to select the DUN connection you set up earlier. Click 'Apply' and then 'OK' to exit the options window.

Setting host mail server details

Before dialling in to your ISP's host machine, you need to take just a few moments more to let your browser know the identities of your ISP's news and mail servers so that it knows where to send and receive E-mail and newsgroup messages. Select the 'Mail' icon on the button bar at the top of the screen and choose 'Read Mail'. If the Internet mail manager has not been set up before, a wizard will run, prompting you to enter your name, E-mail address (as agreed with your service provider), server identities and account name / log-in password. Note that your account name with Demon excludes your own individual E-mail name, so for example if you are now '**john@smithys.demon.co.uk**', your account name is 'smithys'. Your mail system will use two different servers. Your outgoing mail will use the SMTP (Simple Mail Transfer Protocol) server (mail.demon.co.uk) and incoming mail will use the POP 3 server '**pop3.demon.co.uk**'. POP3 (POP being an acronym for Post Office Protocol) mail allows you to read your mail from any Internet connected PC via a password system and also allows unlimited E-mail addresses on your account.

Should Explorer have been set up before, clicking on 'Read mail' under the 'Mail' icon will take you straight into the Internet mail screen. If you need to reset the mail server names, just select 'Mail' on the toolbar, then 'Options'. This will bring up a window with tabs and you should select the 'Server' tab to fill in or edit your mail details. When you have entered the new details, click on 'Apply' and 'OK' to save settings and exit.



The options panel allows you to configure explorer.

News server identity

The news server is set up in much the same way. Select the 'Mail' icon, then 'Read mail' from the list and fill in the details relating to your ISP's news server (Demon uses news.demon.co.uk) and your identity when mailing contributions to newsgroup 'threads' (strings of correspondence and replies to earlier messages).

Newsgroups

Newsgroups are basically forums of people sending and reading threads of messages loosely related to the title of the newsgroup selected. There are over 26,000 newsgroups available on the Demon news server, so you should be able to find a few that are of interest to you and your family. Be warned however that many of the newsgroups contain a strong adult content and links to commercial sites displaying material unfit for young ones eyes. We will look a little more closely at Internet content in next months article, and at what can be done to limit access to unsuitable material.

As with the mail set up, should your browser have previously been set up to contact a news server, you will be taken directly to the Internet news screen. Select 'News' then 'Options' to get to the tabbed set up window. Select 'Server' and fill in the details for your ISP server.

Finally 'Getting on line to the Internet'!

Now that you have installed your modem and set up your software, you are finally ready to go on line for the first time. Exit the browser and run it again, when you will be prompted to dial in using your DUN connection. Fill in your account name as described in our earlier example 'smithy' and your log in password. Demon will have initially given you a quite unpronounceable password that you should have carefully written down (if given the password on the phone), taking careful note of upper and lower case letters. If you would like the DUN connection to store your password, just check the box underneath. Remember that anyone using your machine is then free to dial up using your account and connect to the Internet.

Click on 'Connect' and, all being well, your modem should dial out and connect you to your service provider (or return a message saying that the line is busy and you should try again later). After a few seconds, Explorers Microsoft welcome screen should appear, this time with live images downloaded via the Internet. Congratulations! You are a member of the Internet community and it was all your own work!

Should you not wish to connect to the Microsoft site each time you log on, you will need to change your home page to a different address. Once you have been on line for a while, you will find favourite pages, one of which could be set as your homepage. I tend to use one of the Internet search engine home pages, '**http://www.hotbot.com**'. Select 'View / Options / Navigation' tab and type the address into the address line.

Once you are on line and have found a 'search engine' like Hotbot, which allows you to type in free text and search the web for all documents containing your text, you will soon get the hang of 'surfing' from one web site to another. Alternatively, if you already have a web site address that you wish to view, just type it into the line at the top of the browser and hit return. Why not try '**http://www.maplin.co.uk**' and have a look at the new and improved Maplin web site? Next months article will round off this series by looking briefly at some of the diverse sites just waiting for you out there on the information super-highway, as well as downloading alternative browsers and some of the plug-ins that help your browser to display moving graphics, sound and music. Until then, happy surfing!

IBUS

8 CHANNEL RELAY OUTPUT MODULE

PART 4

Design & development by Neil Johnson, Cambridge Consultants Ltd

This is the third in the IBUS interface module series, giving eight computer-controlled relay switches. With it you can control a range of larger hardware, including motors, heaters, spot-lights, and so on.

The previous two modules provided a set of TTL-level digital I/O and a set of opto-isolated digital inputs. The original PC-to-IBUS adaptor was published in Maplin Magazine issue 119, with the digital I/O module in issue 122 and the opto-isolated input module in issue 123. Back issues are available from the editorial office.

Guided Tour

For those unfamiliar with the IBUS, it is a simple eight-bit parallel interface bus for the IBM PC and compatibles. An adaptor board connects to the PC's printer port and includes complete electrical isolation between the PC and the IBUS. Driver software and example programs for Microsoft Windows are also available to operate and test the IBUS system.

Starting at the top-left corner of figure 1, the connection to the IBUS is made by connector JP1, with the eight data lines going to an octal latch, IC3. The eight address lines are decoded by IC1 and address selector switch SW1 to select one of the 256 possible IBUS addresses. The eight-way resistor pack, RP1, provides pull-ups for the selector switches.

The Write Enable signal, from IBUS pin 21, activates the address decoder and, via inverter Q1, latches the data into IC3. The two resistors surrounding Q1, R2 and R3, provide a collector load and limit base current respectively. The eight digital signals are further amplified by driver chip IC4 to operate the eight relays, RLA1-8.

The switch contacts of the relays are brought to the outside world via the two connectors JP2 and JP3. They are split this way to allow use of the general purpose terminal board described in the first interface module project, back in issue 122.

The final part of the circuit is the power supply. The input voltage passes through reverse protection diode D1. The supply voltage is then smoothed by C3 and C5 before being regulated down to +5 volts by IC2, a 7805 voltage regulator. Second protection diode D2 prevents any reverse voltages from damaging IC2, while R1 and LED1 provide indication of power. The remaining capacitors, C1, 2 and 4, provide local supply rail decoupling.

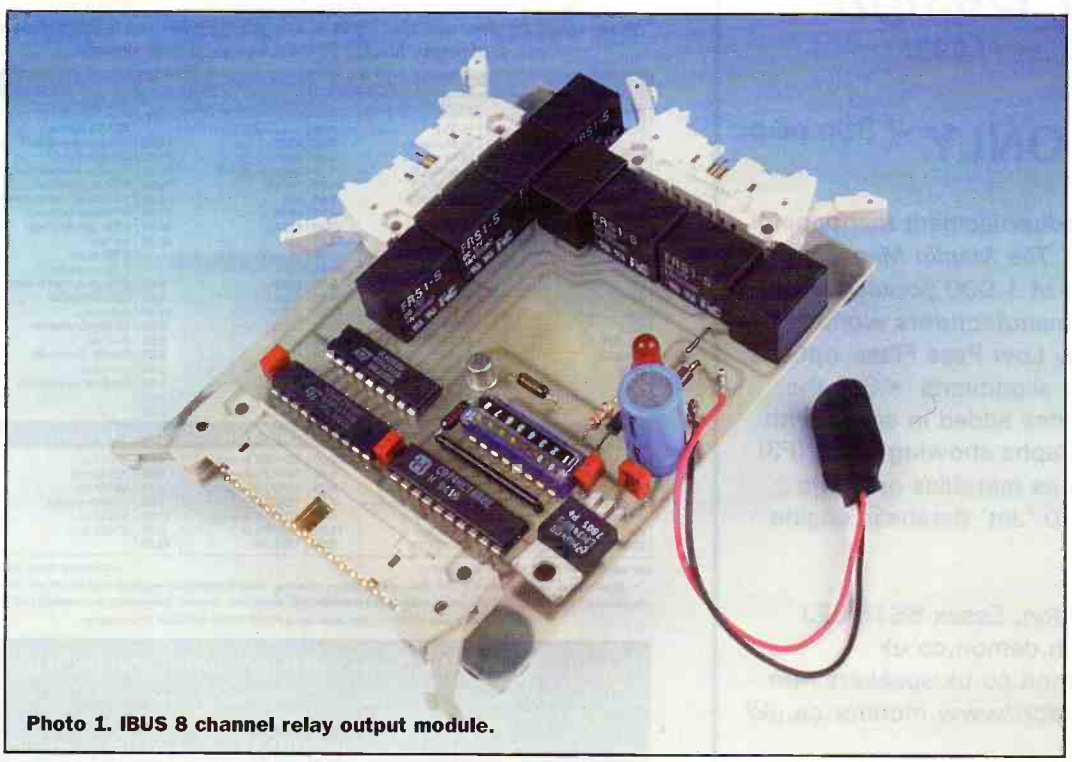


Photo 1. IBUS 8 channel relay output module.

Construction

In keeping with the author's desire for simplicity, this project has been designed to be as simple to build as possible. This goal has been achieved by having all of the components mounted directly on to the circuit board – no fiddly wiring to roaming connectors or LEDs! Figure 2 shows the PCB overlay.

In time-honoured fashion start with the smaller components (resistors, diodes, small capacitors and Q1) and the wire link. Then proceed with the three main semiconductors, IC1, IC3 and IC4, and the address selector switch, SW1. Complete the power supply with IC2, C5 and the connections to the power supply (PCB pins and some coloured wire are ideal for this).

Finally, carefully fit the eight relays, RLA1 through RLA8, and the three multi-way connectors, JP1, JP2 and JP3. You may need to take extra care with JP1 and its 34 closely spaced pins. However, once fitted it should sit flush with the PCB. Also take care soldering the pins of the connectors, watching especially for solder splashes and bridges between the pins (more on this later).

Testing

As always, the first test is to visually inspect the board for solder splashes or bridges between pins. This is most likely around the DIL components and the IDC connectors. A magnifying glass is a great help in this vital task – even thin whiskers of solder are sufficient to stop logic chips working, and are quite capable of passing several amps between supply rails before

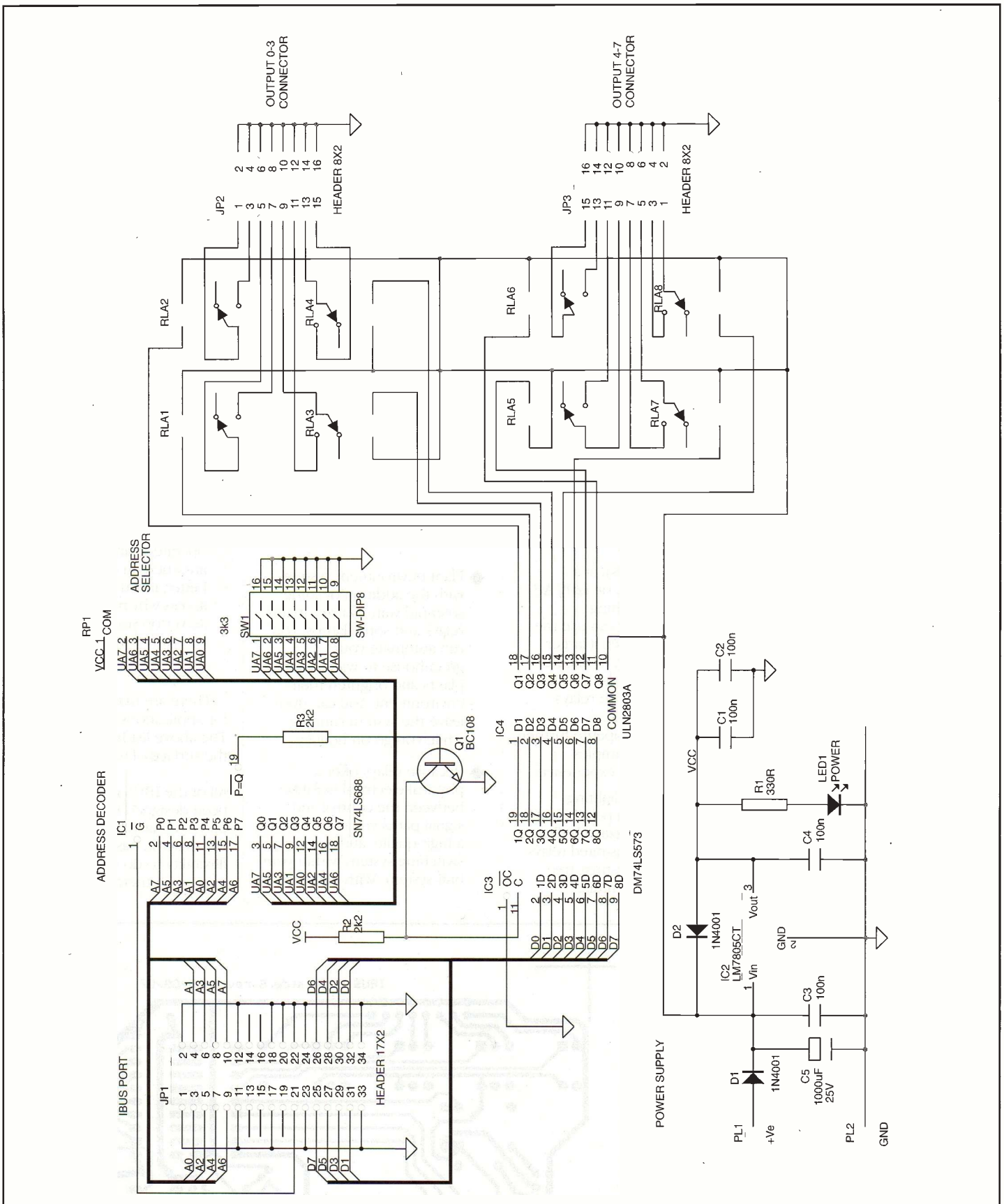


Figure 1. Circuit diagram of IBUS 8 channel relay output module.

vaporising!

The next test is to power up the board. Using a bench power supply, or one of those small black multi-voltage mains adaptors, slowly raise the input voltage from, say, 2 volts to about 9 volts. With a multimeter check the output of the voltage regulator, IC2 pin 3, rises up to, but does not exceed, 5 volts.

The final test requires the board to be connected to a PC via an IBUS Parallel Port Adaptor (PPA). This should be done with a length of 34 way IDC ribbon cable and matching connectors. The IDC connectors can be crimped onto the cable with careful use of a small bench vice.

With the board connected to the PPA, the PPA connected to a PC, both boards powered up, and the PC running the IBUS software (available from the author – see Parts List) you are ready to send data to the interface board.

The IBUS address to which the board will respond is set by SW1. With a switch closed in the ON position the corresponding address bit corresponds to a '0', and vice versa. The switches are numbered one higher than the corresponding address bit, so address bit A0 is set by switch 1, address bit A1 by switch 2, and

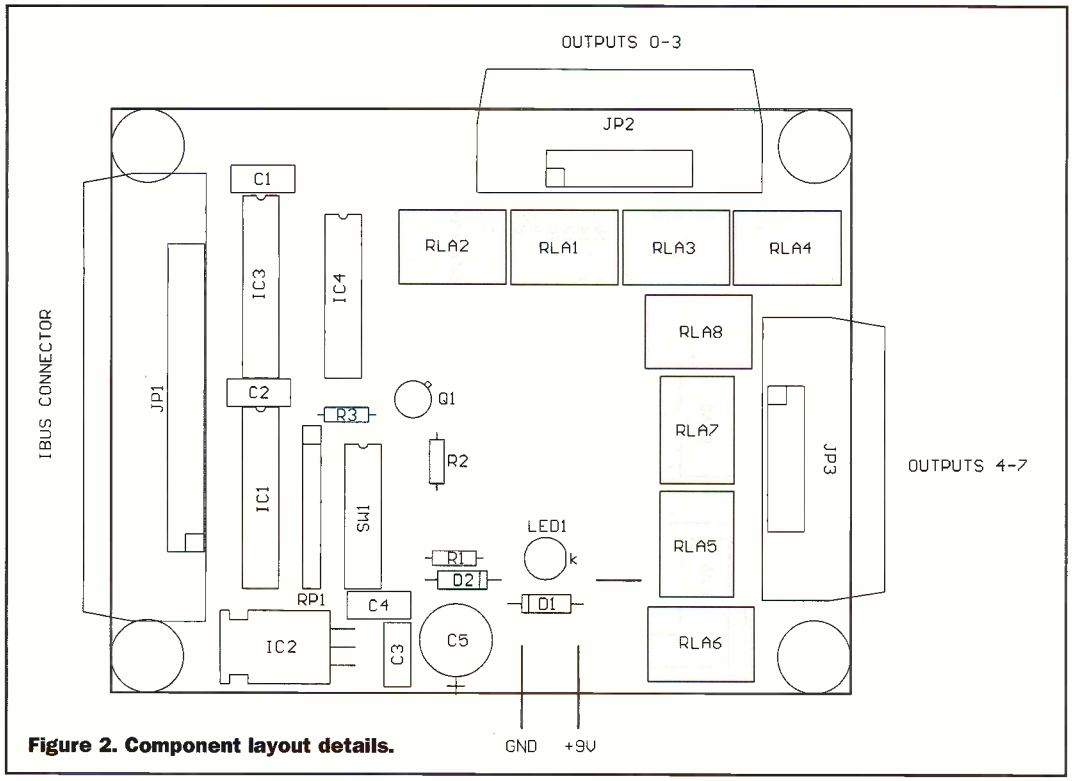


Figure 2. Component layout details.

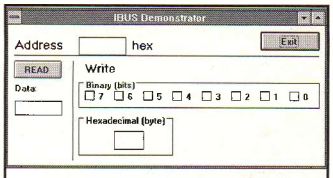


Figure 3. Windows test program.

so on. So, for example, if all of SW1 was set to ON the board address would be 00000000, or 00 in hexadecimal. Likewise, if all of SW1 was set to OFF, the board address would be 11111111, or FF hex.

Once you have determined the address of your interface board this value can be entered into the address box, see figure 3. To set the relays either click on the corresponding check-box (the square boxes under the "Write" label) or enter a hexadecimal value into the box below and press Enter. Both the bit-switches and the hex-value box will update each other.

Using a continuity tester (multimeter or the more traditional bulb-and-battery) check that each of the eight relay circuits can be turned on and off from your computer's screen.

Putting it to work

As your first application, connect a bulb and battery to one of the relays and pull the curtains. Now, with a click of the mouse, you can turn the room light on! And off. And on. And off.... You're now equal with Bill Gates, whose own multi-million dollar hi-tech home has mouse-controlled room lights. And your system cost a lot less too.

With relay outputs you can control a large range of electrical gadgets, from the basic room light mentioned above, to motors, heaters, solenoids, etc. The relays on the IBUS module can switch up to 2A resistive (lamps, heaters), or 1A inductive (motors, solenoids), at a maximum 24V DC or 120V AC.

For larger switching requirements you can use the small relay to switch a larger relay, or contactor, to handle the higher demands of large electrical loads. With relays, anything is possible.

To whet your appetite further, here are some examples suggested by past experience:

- Christmas tree lighting system – with a possible eight channels of dazzling brilliance and some mains-rated relays bring your Christmas tree into the 21st century.
- Plant environment system – with the addition of some solenoid water valves, mains relays and some lamps, you can automate your greenhouse to water your plants and brighten their environment. You can even leave the system running while you go on holiday.
- Because relays offer a physical electrical isolation between the control and signal paths you could create a high-quality audio switching system within your hi-fi system. With eight relays you can choose from one of four stereo sources to be connected to your amplifier.
- If your interest is in automation systems, you now have the means to operate a set of motors, valves and solenoids. Using one of the previous two IBUS modules you also have a number of inputs, either simple switch-contact or opto-isolated types.
- As a variation on the above scheme, why not automate your house? If your computer has a modem you could even operate your house from anywhere in the world. Even better, if you have internet access why not put a Web server on your computer and run your home from any other internet-connected computer.

There are many more ideas for applications for this module. The above list hardly scratches the surface of what is possible.

All of the IBUS modules have been designed to do one task only, so that you, the constructor, has the most flexibility to do what you want to do with them. After all, a

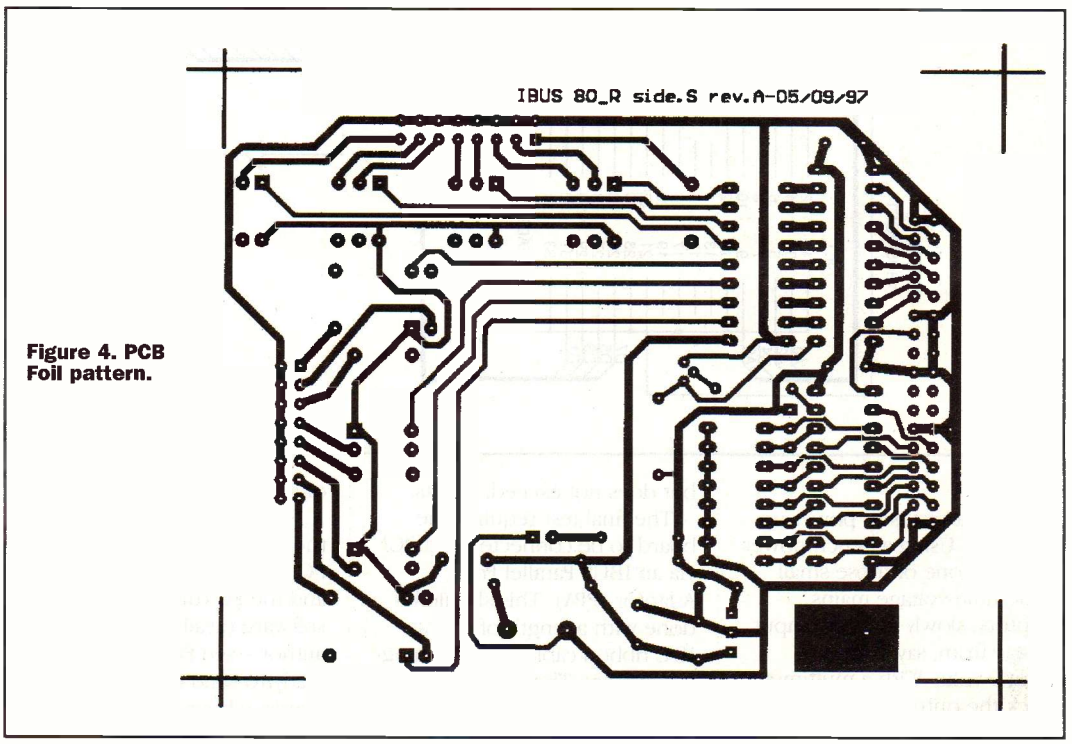


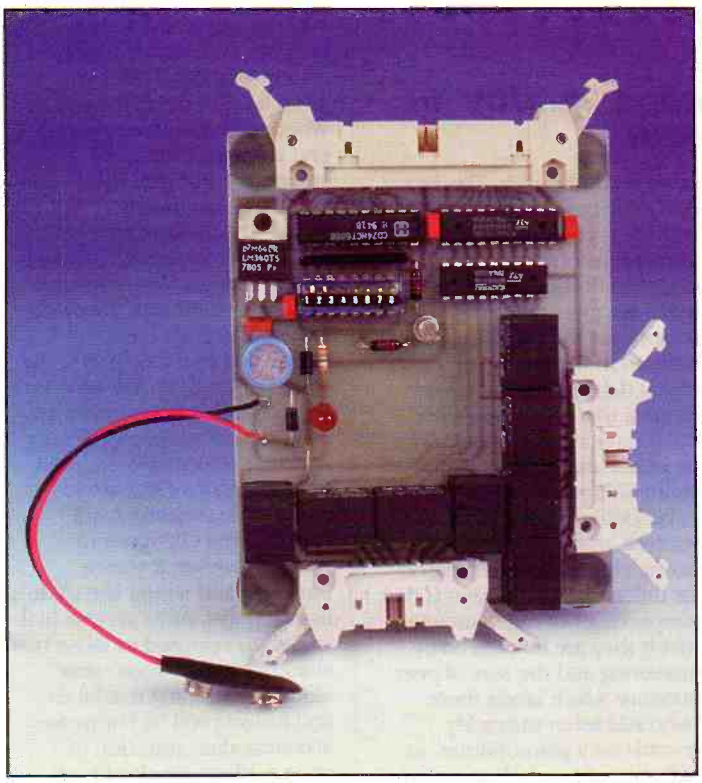
Figure 4. PCB Foil pattern.

diamond is just a simple chunk of carbon. Ah, simplicity!

That is all for this month. The next IBUS module will provide a single channel of analogue input with 8 bit resolution. Until then, happy soldering!

Acknowledgements

The author would like to express his thanks to Cambridge Consultants Ltd, Cambridge, for their continued help in providing development facilities for this project.



PROJECT PARTS LIST

RESISTORS – all 5% 0.25watt unless stated

R1	330R	G330R
R2,3	2k2	G2K2
RP1	4k7 8-way SIL resistor pack	RA29G

CAPACITORS

C1-4	100n ceramic	RA49D
C5	1,000uF 25v radial electrolytic	AT52G

SEMICONDUCTORS

IC1	74LS688	KP49D
IC2	LM7805	QL28F
IC3	74LS573	AE29G
IC4	ULN2803A	QY79L
Q1	BC109	QB33L
LED1	5mm red LED	WL27E

MISCELLANEOUS

JP1	34-way IDC right-angled PCB header	FA44X
JP2,3	16-way IDC right-angled PCD header	FA42V
SW1	8-way DIP switch	QY70M
RLA1-8	12V mini PCB mounting SPDT relay	YX94C

IC sockets (optional), PCB, solder, wire, 2 veropins for power connection

The software accompanying this project, supplied on a 3½" disk, and a set of foil pattern transparencies (two originals) are available from the author at the address below. The disk costs £10 and the foils cost £5. Postage is £2.50 for the UK, £5 for everywhere else. Please send your order, with cheque or postal order payable to "Neil Johnson", to:

Neil Johnson, IBUS Module, 2 Chapel Field, Dixter Road, NORTHIAM, East Sussex, TN31 6PQ, UK.

Digital Technology

THE UNIVERSAL PANACEA?

PART 2

Mike Bedford continues his look at so-called 'quality' in the digital and analogue camps.

Digital...

The CD Story

'Perfect sound forever' is the way Philips described the audio CD when, 16 years ago, it became the first significant consumer product to boast digital technology. But although many of those with only a passing interest in music reproduction are still perfectly satisfied with CD, there's a growing section of the audiophile community which now views that promise of perfect sound as somewhat hollow. This dissatisfaction with the CD takes two forms. Firstly, there's a significant analogue backlash. Vinyl plant which had been moth-balled is now being put back on line in Japan, hi fi magazines are, once again, running mainstream reviews of turntables and cartridges, and audiophiles talk of top-end turntables in the sort of hushed tones reserved for serious CD players only a few years ago. And secondly, there's much talk about the CD's digital successor. In all probability, this will be a format based on the DVD (the digital versatile disk, formerly called the digital video disk before its potential for data storage and music reproduction was recognised) and will offer a higher sampling resolution and/or a higher sampling frequency than today's CDs. So what's wrong with CD and, if it's really that bad, how come it wooed a generation of music lovers away from vinyl records? Let's find out.

The thing to remember about the CD is that it represents technology which is 16 years old, and this is a long time in the world of digital electronics. To put things into perspective, sixteen years ago, the PC was in its infancy, the PC/AT with its 6MHz 286 processor had still to make its debut, and computers based on the 386, 486, Pentium, or Pentium Pro were years away. More significant to the matter in hand, though, 640kbytes was considered a lot of main memory, a 10Mbyte hard disk was thought to be massive, and so the 600Mbytes of storage provided by the CD was very much at the technological leading edge. And this amount of storage allowed for the playing time of a vinyl LP – perhaps a little bit longer – sampled at 44.1kHz and 16 bits. Whether or not this is adequate is open to conjecture, but what is certain is that 1982 technology didn't allow more, certainly not at a price which would have made the audio CD commercially viable. Well that's the technological view, but what the hi fi experts will tell you is that the only important thing is what something sounds like. So how does the CD compare to the analogue equivalent, the vinyl record, in a head-to-head listening test? Most readers will already have answered this question to their own satisfaction and if you were to take a straw poll, you'd get conflicting responses. One reason is that we're talking about a subjective issue, and to a degree, not all people like the same sort of sounds. The fact that valve-based audio amplifiers continue to be popular in some quarters is evidence of this. However, there are more fundamental reasons for the diversity of opinion in the analogue versus digital debate. Human nature dictates that it you've shelled out a significant sum of money on either analogue or digital audio equipment, you're going to be loathe to admit, even to yourself, that you made the wrong choice. Another reason for differences in opinion is that people differ in the degree to which they are influenced by marketing and the sort of peer pressure which labels those "who still listen to crackly records on a gramophone" as sadly out of touch. But perhaps the most significant reason for a difference in opinion about the merits of CD is that some people have actually compared CD and vinyl reproduction on a "like with like" basis, whereas others haven't. And if you were to restrict your survey to those who had conducted a straight comparison, you'd find a much higher proportion favouring analogue than in the population as a whole.

So what do I mean when I talk about a like with like comparison? Essentially, I'm talking about a comparison of a CD player with a similarly priced turntable, and this point about comparing at an equivalent price break is fundamental to the whole analogue versus digital debate. Without a doubt, it's always possible to design a digital system which will offer any given level of performance. Whether or not that system will end up being financially attractive compared to an analogue system with equivalent performance is a very different question, though. And a large number of people who have conducted like with like comparisons have discovered that they prefer the sound of vinyl records to that of CDs. If you've never made this comparison but you're already of the opposite opinion, then, for the reasons I mentioned earlier, that statement will probably not change your views. However, if you're intrigued and would like to do a listening test, most serious hi fi shops (as opposed to those box shifters who sell audio gear alongside washing machines and fridges) will be happy to accommodate you. But, of course, there are also those people who changed to CD in the early days, and have the evidence of their own ears that CD is better than vinyl. How can this be reconciled with my assertion that many people conducting a comparison come down on the side of analogue? Once again, we come back to the issue of conducting a fair test. Ten years ago, most people who upgraded to CD added a stand-alone CD player to a midi-system comprising a turntable,

...or analogue equivalent. Which one should you choose?

tuner, tape deck, amplifier and speakers. Now let's assume that the midi system had cost £250 – how much did the turntable actually cost? OK, it's a finger in the air exercise but my guess, would be no more than £10 – £20. On the other hand, the CD player probably cost £100 – £150. So does the fact that a £100 CD player sounded better than a £10 turntable shed any light on the relative merits of analogue and digital technology? I have my doubts.

In view of the fact that there's still so much debate about the relative merits of the analogue vinyl LP and the digital audio CD, we'd have to conclude that the latter isn't the head and shoulders above than the former that the digital evangelists would have us believe. And we've already made reference to the reason. Not that digital technology is poorer than analogue per se, but that the particular specification adopted for the audio CD was barely adequate to provide a convincing substitute for the vinyl LP. Or, in other words, that the CD was introduced too early, at a time when a higher specification wasn't technically or economically viable. Certainly, as prices reduced, the end result has been that the mass market has had access to music reproduction of an improved quality, but many of those who aspired to an above average standard of reproduction were disappointed. According to Pacific Microsonics, "It's a tragedy that many 30-year old analogue tape recordings or vinyl records preserve more of the life and reality of musical performances than today's 'state-of-the-art' digital efforts. As a result, many fear that the genius of today's greatest recording artists will remain only as a compromised legacy for future generations". The company's solution to this perceived problem was a recording format called HDCD which was based on the same physical type of disk as standard CDs but which used a clever technique to cram in 20-bit data whilst maintaining compatibility with ordinary CDs. This was really just an interim solution but there's every indication that the next quantum leap is just round the corner. The DVD has already been launched both as a video distribution media and – in its guise as DVD-Rom – for data storage. And the sound track on DVD movies is already sampled as a higher resolution than audio CDs, something which hints at what the audio only DVD may offer, if it ever becomes a reality. So far, there are three views. There are those who believe that the world needs a better standard of recorded music and favour the lossy AC-3 or MPEG compression which has been adopted for DVD movies. There are those who have a similar view but favour a lossless compression scheme. And there are those who argue that the mass market isn't ready to accept a new standard, and if it was introduced as an audiophile-only format, it'd be prohibitively expensive. But if the audio DVD does come to fruition, some pretty impressive figures have been quoted – up to 96kHz sampling in up to 24-bits. And I guess that this would be enough to win over even the most dedicated analogue addict.

Photography

Whatever the technical merits of different music recording standards, the commercial war has been won by digital. Musically, that may have been a bad outcome, but as far as this argument is concerned, it's water under the bridge for most people. But in the realm of photography, the battles are just starting to get interesting.

From a pure technical viewpoint, this isn't an exact parallel to the situation with audio reproduction, but philosophically, it's similar. One of the main reasons I suggest that this is rather different technically, is that we're talking of digital electronics versus a chemical process as opposed to digital electronics versus analogue electronics. And also, whereas chemical photography certainly isn't digital, it isn't really correct to view it as an entirely analogue process either. In audio engineering, the signal is one dimensional, in other words, we're concerned purely with the way the amplitude varies with time. On the other hand, a video signal is three dimensional in that we're concerned with how a 2D image varies with time, although with still images, this reduces to two dimensions. But whereas, in the real world, light levels vary continuously in these two dimensions, virtually all recording schemes have involved recording the light level at discrete steps. In analogue TV, for example, although the light level varies continuously in the horizontal direction, the image is built up from a specific number of horizontal lines so is discrete vertically. And whereas chemical photography has no concept of scan lines, the fact that the emulsion contains particles of silver halide means that

Photo 1, 2, 3 A Top-end turntable, tonearm and cartridge can cost as much as a top end CD player (Courtesy Linn products).

spatially, the image is not continuous or analogue. And this results in the well known grain effect which is evident in film, especially in enlargements from high speed film. But although chemical photography is not truly analogue spatially, each grain of silver halide can be exposed to an almost infinite number of light levels – and this certainly has analogue overtones.

To start our look at digital photography, let's look quickly at the factors which affect quality. This will be familiar territory to anyone who is familiar with the concepts of computer graphics, so we'll keep this short but we will summarise it using a couple of sequences of images. As with audio engineering, we're concerned with the sampling frequency (well, sort of) and the sampling resolution. But in still digital photography, we're not concerned with the sampling frequency in terms of how frequently (in time) the samples are recorded. Instead, we're concerned with how frequently samples are recorded spatially. This tends to be quoted in the same way as the resolution of graphics cards, that is, as the number of pixels horizontally and the number of pixels vertically. Clearly, this affects the perceived resolution of the image or, putting that another way, the amount of detail which can be seen. Confusingly – since we've just talked about resolution – the other factor which influences the image quality, is the one which we previously referred to as the sampling resolution. But we used that word to mean the resolution in terms of the number of amplitude levels which could be represented and, in photography, this controls the number of intensity levels or colours which can be recorded. So, for example, 8 bits would allow 256 colours and 24 bits would permit 16.7 million colours to be represented.

It's fair to say that digital cameras have progressed in leaps and bounds in the 2 years they've been available as consumer products. From initial resolutions in the region of 320 x 240 pixels, we can now buy cameras boasting 1,024 x 768 or higher in 16.7 million colours for around £600. And to those familiar with image manipulation on the PC, this will sound pretty impressive. But just how good really is this when we make comparisons with analogue film? To do the comparison, we need to do a few sums – film manufacturers have their own way of specifying resolution and the word pixel is never mentioned. Increasingly, film resolution is being specified as the rather mysterious print grain index (PGI) although it's still possible to find resolution figures in line pairs per millimetre. So to get the effective pixel resolution, this must be multiplied by 2 (since a line pair is two pixels) and by the dimensions of the film which, for 35mm film, is 24mm x 36mm. Now for some figures. A typical ISO 100 film will achieve a resolution of 100 line pairs per millimetre, so converting this to pixels, we end up with 7,200 x 4,800 for 35mm film. And if we were to take a slow large format professional film, we could end up with a resolution approaching 20,000 in the largest dimension. And at this point, our impressive digital resolution of 1,024 x 768 looks rather mundane by comparison. And even if we were to go up market to the professional digital cameras which can cost tens of thousands of pounds, we still wouldn't achieve the resolution of film – around 3,000 x 2,000 is about the best we'd find.

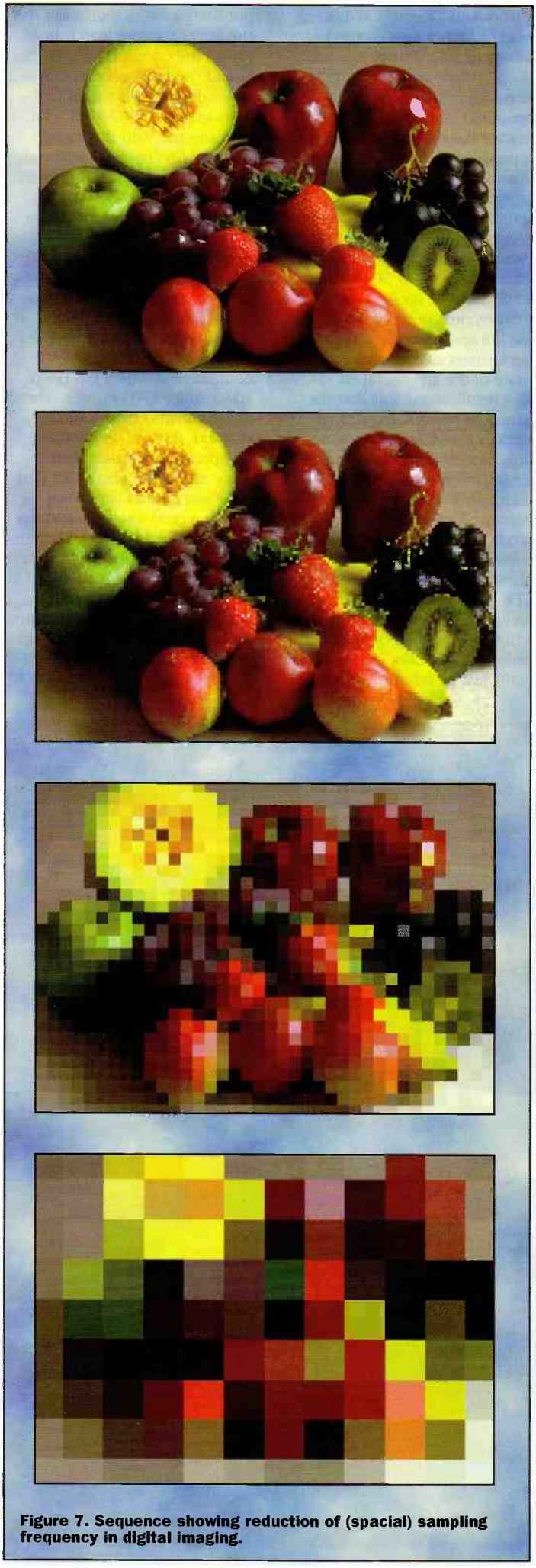


Figure 7. Sequence showing reduction of (spacial) sampling frequency in digital imaging.

OK, so digital photography isn't as good as chemical photography in terms of its resolution, but it's appropriate to ask whether it's good enough. After all, we know that digital sampling will never equal analogue recording in terms of resolution, but that it's certainly possible to design a digital system which is good enough to fool our senses. And here, we have to say that it depends on how you intend to use the photograph. For Web or screen-based publishing then yes, digital photography is perfectly adequate. When we bear in mind that few PCs operate with a screen resolution of more than 1,024 x 768 and that photographs rarely fill the screen then it's clear that cameras with a resolution of 1,024 x 768 or even less will be acceptable. However, the Web is not a medium for quality publishing, so to answer our question as to whether the resolution of digital cameras is adequate, we need to turn our attention to traditional forms of photographic reproduction. Postcard sized prints are about 150mm x 100mm and at this size, the pixels of a 1,024 x 768 digital image will be about 0.15mm square or, in other words, we're approaching the

point at which individual pixels won't be noticed. So for snapshot photography, either we've already reached, or we're not far from, the point at which the results are indistinguishable from film-based photography. But, of course, we're still not in the realm of high quality photography. In exhibition work, enlargements to 20" x 16" (500mm x 400mm) or higher are not at all uncommon and here, 1,024 x 768 will yield half millimetre square pixels. Even a professional digital camera offering a 3,000 x 2,000 resolution won't stand enlargement much above this size and at 20" x 16", the more critical viewer is unlikely to be satisfied. And when we get into the realm of poster work, digital cameras are well short of film.

But although digital cameras are still far short of film-based cameras in terms of the headline resolution figure or even in terms of what the more demanding photographer needs, this isn't to say that they're not worthwhile products. Obviously the rapid turnaround, the ease by which images can be manipulated digitally, and the scope for electronic distribution are all major benefits which make digital photography invaluable in many applications. As a general purpose replacement for chemical photography, though, as a method of producing quality images, it still has a long way to go. This isn't to say that it never will equal or even surpass the quality of film-based imaging, but it would be naive to consider that point to be in the near future.

The Way Ahead

So we've seen many real world advantages of digital technology compared to the analogue alternative. We've also seen that, by definition, a digitally sampled signal will only ever be an approximation. Furthermore, we've seen that although it will always be possible to design a system in which that approximation will be sufficiently close to fool our eyes or ears, that financial constraints are often responsible for compromising this aim. Specifically, we've seen that digital audio in the form of the CD has almost replaced the analogue alternatives despite the view among many hi fi enthusiasts that it compares unfavourably. And in the realm of photography, the performance of digital cameras is, as yet, far short of that of chemical photography.

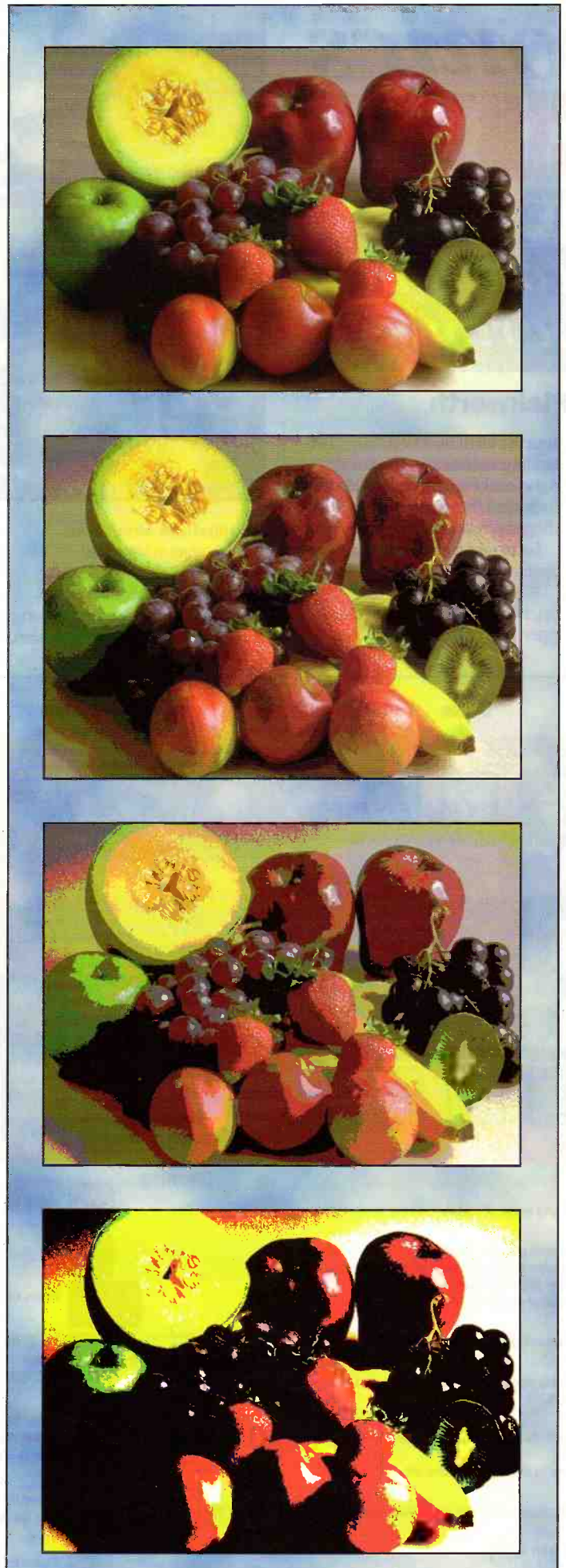


Figure 8. Sequence showing reduction of sampling resolution (in terms of colours) in digital imaging.

The Bottom Line

So what is the bottom line? Which is better – analogue or digital? Throughout this article, I've tried to avoid putting over my own feelings too much but I guess it's time to come off the fence. So, it's cards on the table time. You've probably already picked up a pro-analogue sentiment, and I must admit to being somewhat wary of the attitude which says "whatever the question, the answer is digital". And this, despite the fact that I have an MSc in computer science and have worked in the computer industry for all my working life. However, I need to moderate that statement about being pro-analogue somewhat. It would be wrong to suggest that I'm opposed to digital techniques on principle. For example, I may yet be proved wrong, but I expect that any new audio recording format based on DVD will offer the inherent quality of analogue recordings, but without the susceptibility to noise, and with all the convenience of the CD. And as such, I would embrace it wholeheartedly. What I am opposed to, however, is digital techniques ousting the analogue equivalent before the break-even point is reached in terms of quality. Sacrificing quality for convenience or in the name of progress is a questionable policy yet, arguably, this is what has happened with the audio CD.

But this isn't to say that there isn't a perfectly valid market for digital kit as a convenience, low quality alternative, even before they can compete with analogue in quality terms. And this is the current situation with photography. No way would I swap my 35mm SLR camera for a digital camera, but I recognise the terrific benefits which the digital alternative offers. But as the quality of digital photography continues to improve and as prices fall, commercial pressures to kill off the film-based camera will come to the fore. Indeed some of the photographic companies are already starting to talk about phasing out film-based cameras. If this happens at a time when digital can equal the quality of chemical photography, it's a win-win situation. But if the CD story is repeated, photography will suffer. So to answer the $64,000 question: digital – yes, progress – yes, convenience – yes, but please – not at the expense of quality.

Electronics IN AGRICULTURE

PART 3

Computer controlled milking parlours

by George Pickworth

Manual to Computer

The early manually operated milking parlours were the ideal starting point for computer controlled milking systems. However, milking parlours are proprietary installations and each system is tailored for a specific farm and herd size. Two leading names are Alfa Laval Agric and Fullwood who kindly provided the photographs and diagrams used in this study.

Let us take for example the Alpro System from Alfa Laval Agric.

With the Alpro system, all operations, including milking and operation of the feeding stations are automatic. More about feeding station later The exception to this is of actually attaching the cups to the cows teats and removing when milking is complete; but, as we have seen, in the near future this operation will be performed by robotics. In the meantime, computer programs simplify this operation and relieve the operator of significant physical effort.

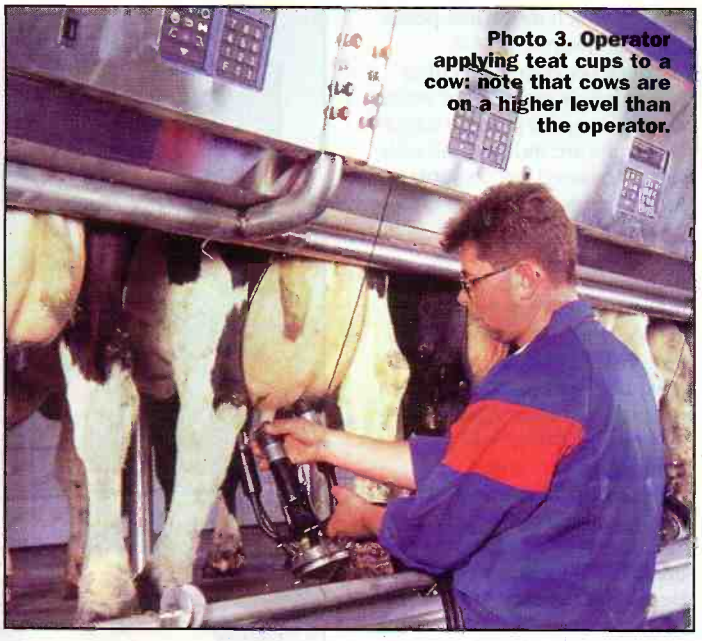


Photo 3. Operator applying teat cups to a cow: note that cows are on a higher level than the operator.

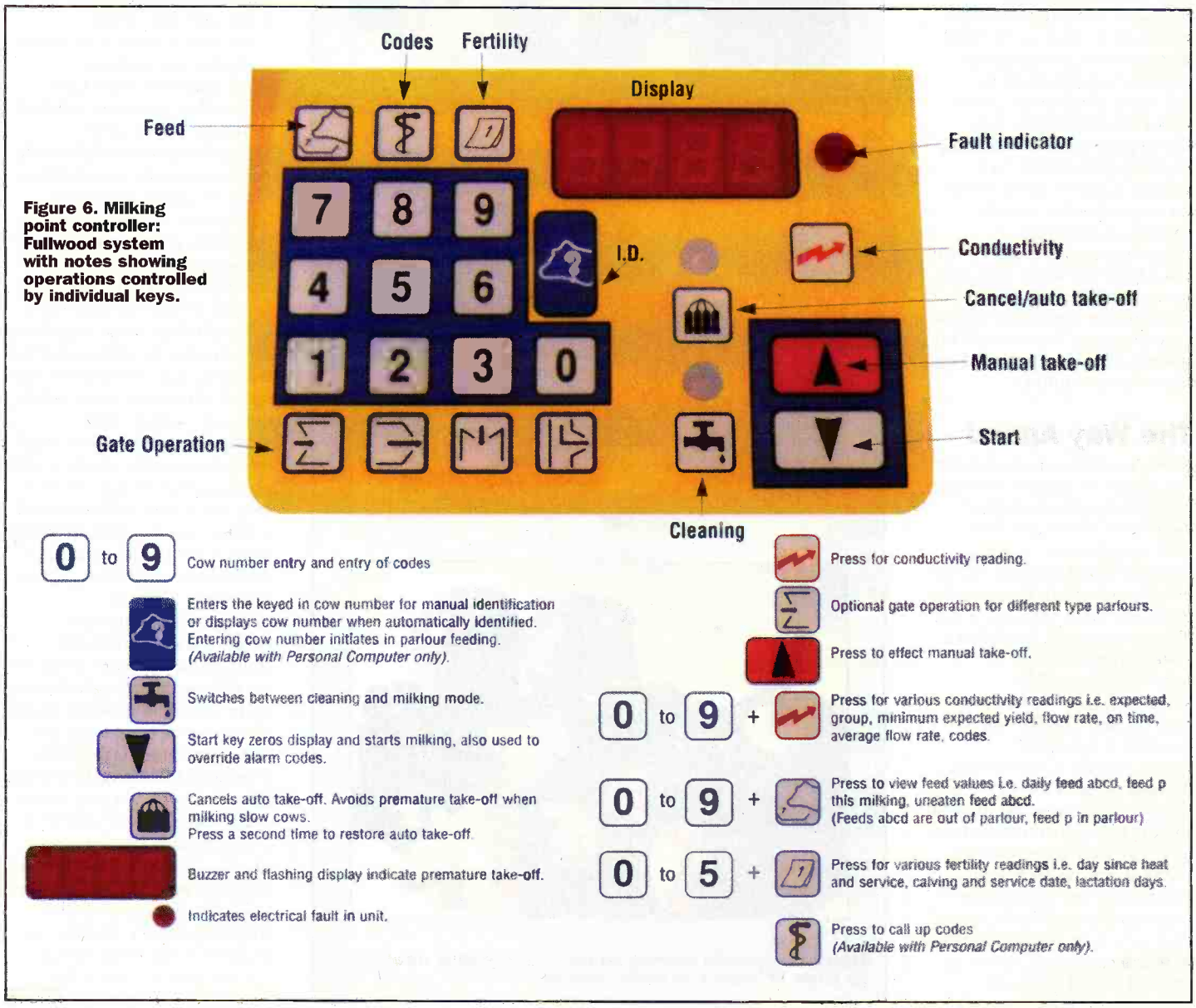


Figure 6. Milking point controller: Fullwood system with notes showing operations controlled by individual keys.

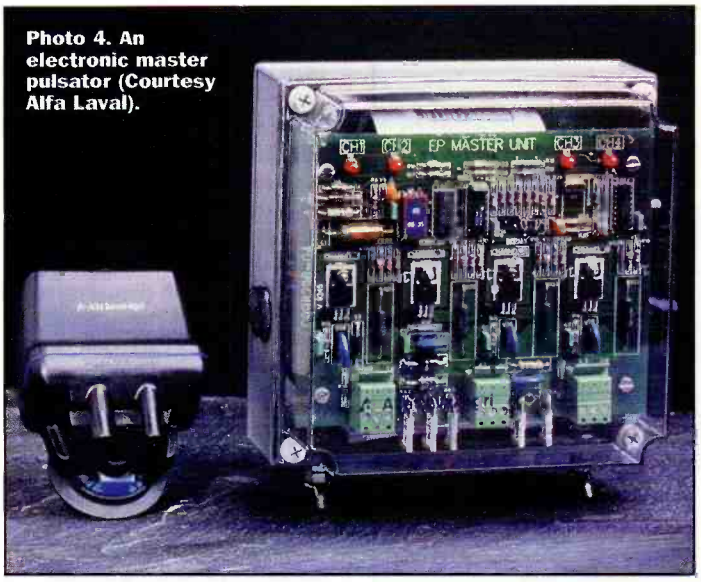


Photo 4. An electronic master pulsator (Courtesy Alfa Laval).

Processor

The "brain" of the Alpro System is the processor; this stores basic data on milking, feeding and breeding together with other relevant data on each cow during its entire lactation cycle and can handle up to 2,800 cows.

The processor presents information on a high contrast display that is easy to read; it is normally located in the office section of the parlour and linked to the farm office PC. When printouts are required, either the processor or PC is connected to a printer.

Specific Times

Milking must take place at specified times every day of the year, otherwise the cows suffer. So, the processor is designed for maximum reliability ; it has no moving parts such as a fan or disc drives. Instead, information is stored on memory cards; data is secured by back-up batteries.

The processor is also designed to cope with power surges and dips. Most dairy farms have a standby electric generator that can be quickly coupled to a farm tractor should mains power fail.

Transponder

By means of a transponder, worn around the neck of each cow, individual cows are identified as they enter the parlour and as they pass portal antennas within the parlour. This information is sent to the processor, which, by means of air operated rams, causes gates to open or close automatically thereby directing the cow into its appropriate milking point.

By means of a "cutter gate" the MPC allows individual cows to be automatically directed to special, non-milking stalls for veterinary attention or artificial insemination as the case may be.

The Processor is housed in the office section of the parlour and is connected to the farm office PC.

Photo 5. Showing a series of milking points each with their milking point controller. (MPC)

Controller

A Milking Point Controller (MPC) is located at each milking point i.e. the place where the teat cup clusters are attached to the cows). The MPC's are slave computers to the processor. There are typically twenty milking points in a parlour, which is the maximum that one operator can manage. So virtually all information on each cow can be accessed on an MPC before or during milking.

Photo 5 shows MPC's at each milking point in a tandem type parlour. In Parallel and Herringbone parlours the MPC's are mounted on the rump bar Photo 3.

Each MPC also allows the operator to set the actual milking program for each, i.e. set the duration and "rhythm" of the pulsator (more about these later) to correspond to peculiar characteristics of the cow and milk flow. Milk flow is not constant but gradually increases to maximum than falls off the towards the end of the milking period.

Figure 6 shows the milking point controller used with the Fullwood System

As computer control enables one operator can handle up to 20 milking points, it in effect means that 20 cows can be milked at the same time. Allowing for time involved for the cows to enter the stalls, be checked against the display on the MPC, washing their udders and applying and removing the teat cup clusters, milking rate is about 120 cows/hour.

But, because computerization has lessened the work load of the operator, he/she can work for three hours and milk up to 360 cows during each morning or afternoon session.

Dairy Section

In the dairy section of the parlour, the milk is immediately cooled and then kept in refrigerated storage tanks to awaiting collection by a road tanker. Then after further processing by central dairies, the milk is distributed to consumers.

Whilst on its way to the dairy section, the milk yield is automatically measured by a volumetric device and this information sent to processor. Milk yield during each lactation period are now in the order of 6,500litres or an average of about 22 litres/day, compared with 4,500 litres twenty years ago. However yield is not constant, it rises to maximum then declines towards the end of the lactation period.

Concentrate Feed

Milk yield monitoring is vital, for not only indicates the health of the cow, but, for economic reason; the amount of expensive concentrated feed given is in direct ratio to its milk

Photo 6. The processor used with the Alfa Laval system.

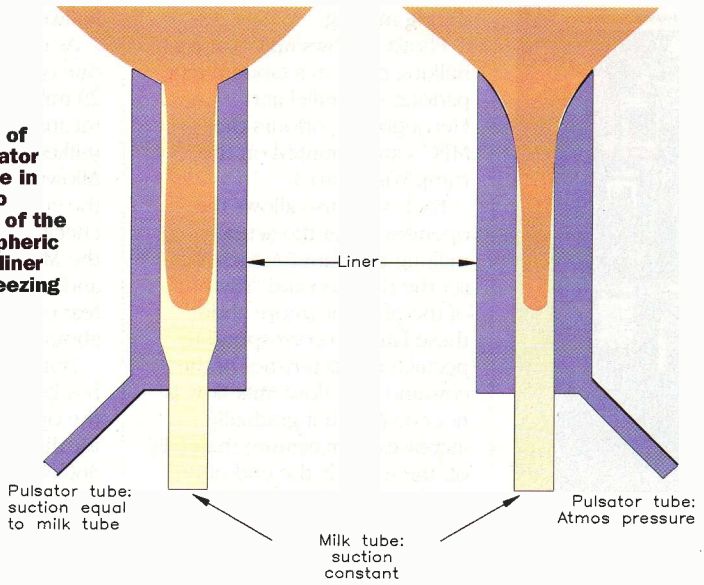


Figure 7. Operation of teat cups. The pulsator causes the pressure in the pulsator tube to alternate from that of the milk tube to atmospheric pressure when the liner collapses thus squeezing the cows teat.

steel mangers. The actual feeder consists of typically four hoppers each containing a different concentrate feed and runs along a track parallel to the feed troughs. (Figure 5 last month).

Cows get to know feeding time and alerted by the start of mechanism, enter a stall to await their feed. The feeder mechanism then deposits the correct mixture and amount of feed in front of each cow or calf as it progresses along the track.

Farm Office

As already mentioned, with the Alpro system, the processor is connected to the farm office PC where all the data can be displayed by Alpro Windows program (Microsoft). The Alpro Windows program also produces diagrams on annual milk production for each cow. It also shows where the cow is within its breeding cycle and can register insemination and other breeding activities.

Data can also be transferred

yield and this is automatically calculated by the MPC.

As we have seen with non-computerized parlours, a proportion of the concentrate feed is fed to the cow in the stall during milking; this motivates the cow to enter the stall and calms her during milking.

However, as the cows remain in the parlour stall for less than 10 minutes, it is too short a period for the cow to eat its full ration of concentrate. So, a large proportion of the concentrate feed is fed to the cows via the feeding stations.

The MPC therefore not only tells the mechanism in the parlour to deposit a certain mixture and volume of concentrates into the feeding trough in the parlour, but via the processor, tells the remote feeding station of the prescribed mixture and amount of concentrated feed to be released to each cow. Each cow, and indeed calves, are identified at feeding stations by their transponder.

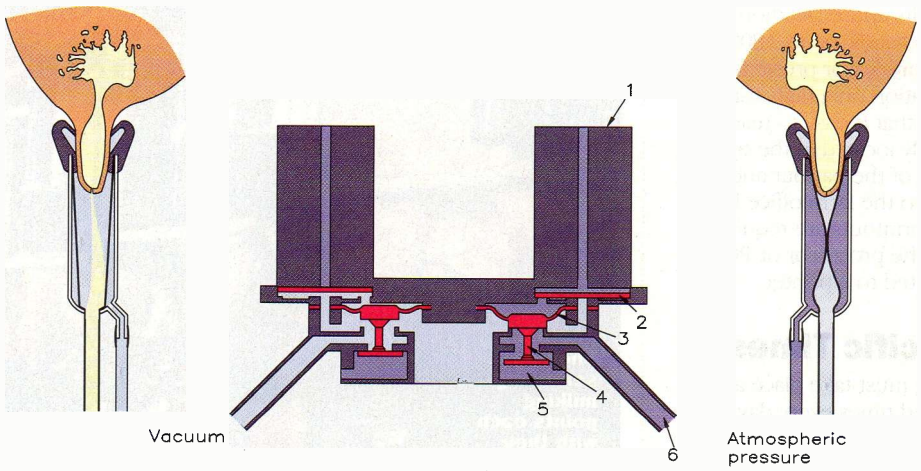
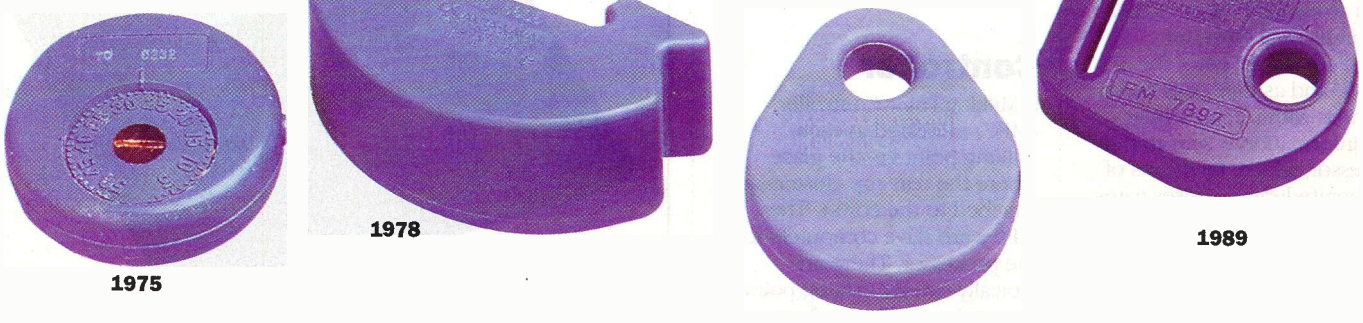


Figure 8. A computer controlled, solenoid type pulsator. During the massage phase, the solenoid (1) receives no current and the magnet washer (2) seals in the lower position. The vacuum below and the atmospheric pressure above cause the diaphragm (3) to seal in the lower position. The spindle (4) opens the flap valve (5), supplying atmospheric pressure in the pulse nipple (6).

Feeding Stations

Feeding stations are located in the sheds where the cows live and consist of parallel stalls similar to those of earlier cow sheds. With some systems, a continuous feed trough runs along the front of the stalls; others have individual stainless

Photo 7. Showing the evolution of transponders these are attached around the cow's neck.



into other programs for book keeping, administration and other functions via ISO-communication protocol. A printer can also be used to produce data printouts.

Operation

To complete this study, let us now look at the operation of a milking machine. At the sharp end of the system are the teat-cups which as their name implies fit over the cows teats. It will be seen that the teatcups comprise of a metal cylinder with a rubber liner, the cows teat fits inside the liner and makes an airtight seal around the top. The bottom of the liner is connected to a milk tube whilst the space between the liner and cylinder is connected to the pulsator.

A negative pressure of 13" Hg is constant in the milk tube and therefore on the inside of the liner; this ensures that the teat cup stays on the cow.

The pulsator causes the pressure in the space between the cylinder and the liner to alternate from that of the milk tube and the atmosphere.

When the negative pressure inside the liner equals that between the liner and the teat cup cylinder, the liner retains its cylindrical shape.

But, when the pressure between the liner and cylinder goes to atmospheric, the liner collapses, squeezing the cows teat and thus simulating the sucking of a calf.

With most teat cup clusters, two pairs of cups pulsate alternately; this is not only best for the cows but smoothes out the milk flow.

Photo 8. Showing a cow inside a feeding station.

Pulsator

The original pulsators were mechanical devices and were notorious for the on/off ratio getting out of adjustment or either running too fast or too slow. So, it is not surprising that the mechanical pulsators were superseded by electronic devices. These activate relay operated valves which allows pulse rate and ratio to be precisely controlled. Pulse rate is typically 60/min and the squeezing/release ratio typically 65/35 though other ratios are selected for some breeds of cows.

Next month

Next month we take a look at driverless and computer controlled tractors. Some readers may have noticed that the captions for photos 3 and 4 last month became misplaced. We apologise for this error, and photos 3 and 4 appear correctly in this part of the article. ELECTRONICS

Electronics Principles 5.0

'A COMPLETE PC BASED ELECTRONICS COURSE'

If you are looking for an easy and enjoyable way of studying or improving your knowledge of electronics then this is the software for you.

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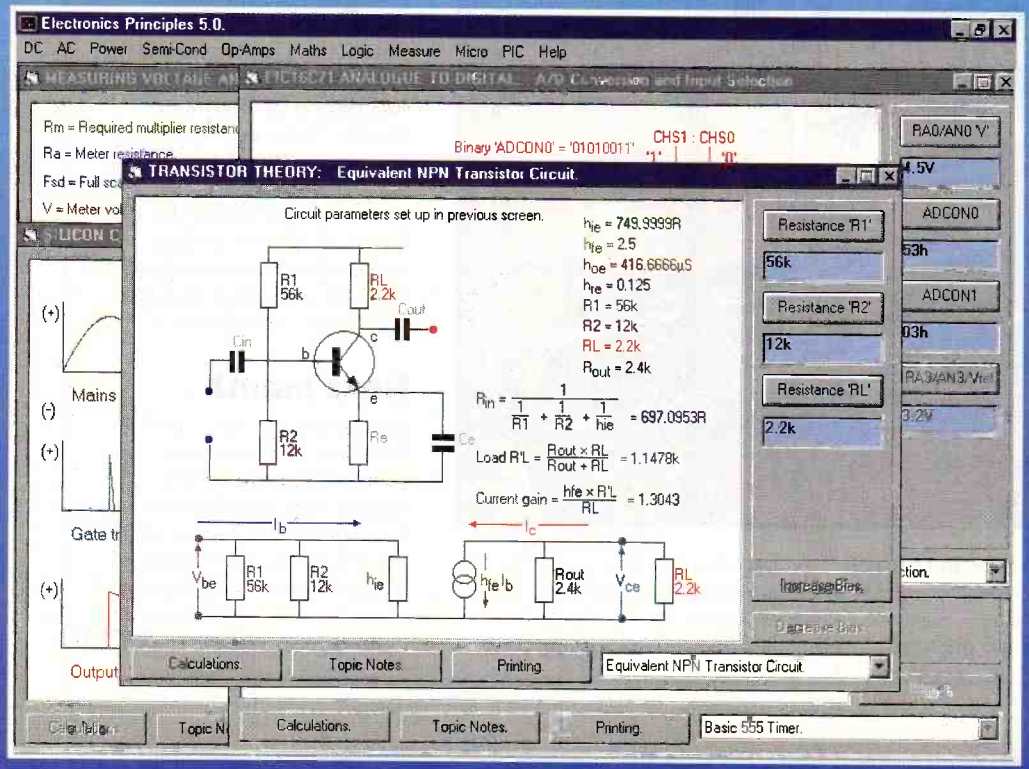

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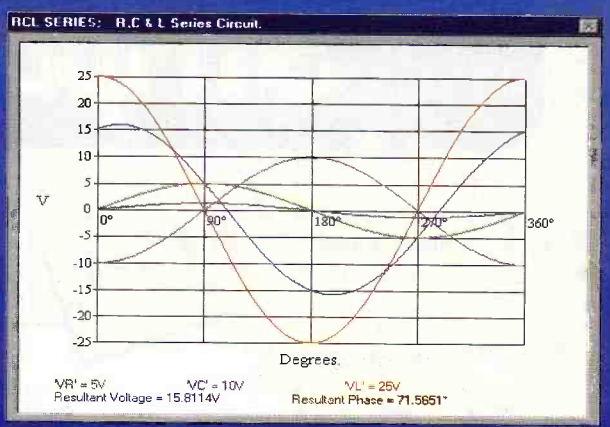

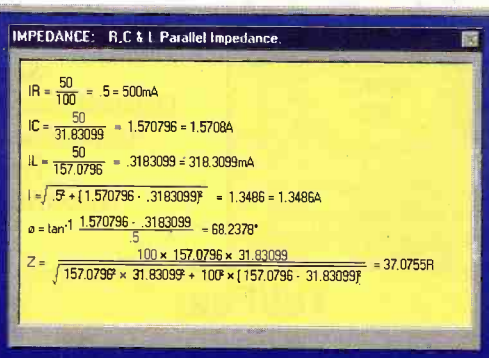

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COMMENT

by Keith Brindley

It might not be a name you're familiar with yet, but it soon will be. Merced is the code name for a new microprocessor. More than that, in fact, it's the term for a complete new range of microprocessors — destined to form the heart of the vast majority of personal computers in the new millenium. For this reason alone Merced's a topic we can't afford to ignore.

Currently, most of the world's personal computers run a central processing unit based on quite an old computing technology. The x86 series of microprocessors (which started many years back with the 8086 chip, followed by the 286, 386, 486, then 586 — known as Pentiums — and so on) is based on a type of microprocessor architecture known as complex instruction set computing (CISC). For long enough it's been known that CISC microprocessors are limited in their ability. Not that current generations of the x86 series microprocessors have exhibited any particular ability limit, because in the process of going from generation to generation, extra speed (in terms of clock cycles) and power with each successive generation meant that each new generation was, as far as the user was concerned, better anyway. With this in mind Intel, the developers of the x86 microprocessors, had a policy of effectively ignoring (or at least appearing to do so in public) comments that CISC was not the way forward. To all intents and purposes, of course, Intel was merely giving that appearance to counter the claims that its competitions' advances in microprocessor architecture to reduced instruction set computing (RISC) devices were (and indeed are) better. But CISC processors have now reached the practical limits of their effectiveness. To create further generations of CISC processors, the physical sizes of these devices would be beyond manufacturing abilities. RISC processors take advantage of a simplified instruction set to execute instructions in a more effective way (in a process called pipelining, actually), where high-speed logic circuits take over some of the work previously carried out by the processor. This produces a device that can be more easily made, consumes less power, and is smaller.

If proof were needed, we only have to look at Intel's competitors. Hewlett Packard's and Motorola's microprocessors built on RISC architectures produce significant advantages over the aging x86 CISC architecture, not the least in terms of performance, even at lower clock speeds. For long enough in the Intel-based personal computing world it's been assumed that a higher clock speed produces a faster computer. When RISC-based computers at lower clock speeds than x86 computers began producing significantly better performances it was hard for all but those blinded by the Intel light to understand the RISC advantages.

However, Intel's not a company to not see its mistakes (even if it never actually admits them). RISC is the way forward, and Merced is built, if partially, upon a RISC architecture. Getting together with Hewlett Packard (already a strong player in the RISC processor field), Intel has set its sights on producing a brand new type of processor. The processor instruction set Merced will use is known cryptically as IA-64, denoting the fact that it's based on a 64-bit architecture. While using RISC techniques, however, the IA-64 architecture acknowledges that even RISC isn't enough to cope with the power expected of processors over the coming years, so goes even further to remove unnecessary processing tasks from the central processor itself. Not only that, the IA-64 instruction set allows for, and indeed will benefit from the use of more than one central processing chip.

Using two or more central processors isn't a new concept, of course, and many such examples of parallel processing computers have been around for some time. All computing architectures can use parallel processors to some extent or another, but IA-64 is different in that it is produced directly with them in mind. Intel and Hewlett Packard have even given a new name to this — Explicitly Parallel Instruction Computing (EPIC). Merced is simply the code name for the processors that will run on this EPIC architecture. Long instruction words will be used, comprising three actual instructions together with template information, in a 128-bit bundle as shown. Bundles can also be chained together to create instruction groups of any desired length.

Key to these long bundled chains is the template section of each bundle. Data in a template might indicate whether instructions in a bundle or in consecutive bundles can be handled in parallel, or whether they must be handled in serial. Using a template might seem at first sight a waste. After all, it takes up space in a resultant program, and merely complicates the issue. But the fact that instruction data is held in the bundle means that certain future advantages exist. A first generation Merced processor, for example, might take quite a number of cycles to carry out the instructions, whereas a second or third generation Merced device (particularly parallel devices) may be powerful enough to cope with them all in one cycle — all taken care of by the template data. In other words, there's not the need to create a new program to use each generation of newer processor. Forwards compatibility is taken into account.

Backwards compatibility, on the other hand, is another matter. It's all very well for new generations of processors to come along and, let's be frank, in terms of the x86 series they do very regularly. This is alright if they run the previous generation's software. But Merced, with its brand new IA-64 architecture and resultant new instruction set won't — at least not directly anyway. Instead, software or hardware emulation (probably a mixture of both) will allow existing x86 software to run on the Merced processor. As long as the emulation is at least as fast as the software currently runs on x86 processors, users should be happy. Merced's increased performance due to its reduced architectural complexity should ensure this. There are precedents, of course. Motorola's conversion from its old CISC-based 68xxx processor to its current RISC-based PowerPC wasn't hampered by this need for emulation. Users of the main computers running on these PowerPCs (the Macintosh) were very happy with emulation when the new PowerPC chip gave them significant speed improvements anyway. As each version of software usually has a life cycle of only around a year, the next generation of software will take into account the processor's new architecture and provide a further performance boost.

There's no doubt, Merced is a bold step forward for a company that for long enough has seemed destined to hide its head in the sand with its CISC processors. It's also a big, OK massive, step upwards in terms of manufacturing these devices. Intel and Hewlett Packard, on the other hand, are bullish about Merced, saying that they are currently on target to produce a first-generation Merced device in 1999. The new millenium will be a very exciting time for computer users. ELECTRONICS

The opinions expressed by the author are not necessarily those of the publisher or the editor.

PLC Rewrites RULES ON SIZE

John Kennedy reviews a novel product, from a major electronics company that is sure to set new benchmarks in its field of use.

Proving that size is everything, Matsushita Automation Controls has developed a fully functional PLC. Amazingly it is only the size of an audio cassette box. This is just about as small as you can imagine a PLC is going to get, measuring only 60 x 25 x 90mm.

The desire to reduce size is on the agenda of many designers. Matsushita has grasped this concept fully and produced a new PLC which, when fully expanded to 128I/O, is still a quarter the size of a similar performing competitor.

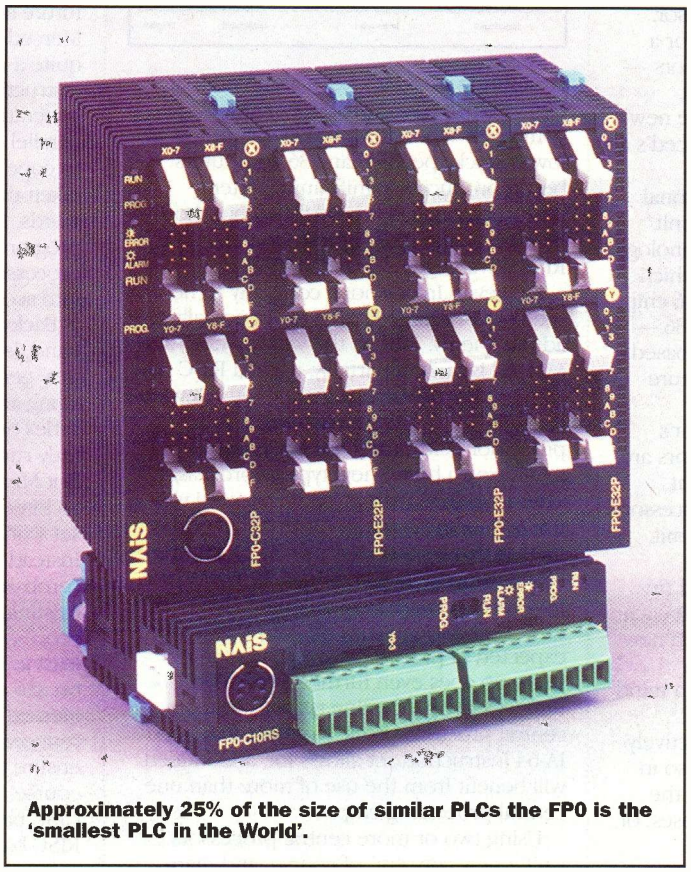
PLCs are becoming more prevalent in control environments as intermediary and control interfaces. As their use increases, one aim is to make the use of space as efficient as possible. Although many do the job of a PC, and are certainly smaller, their size can still be described as substantial when compared to other electrical equipment.

Specifiers of PLCs, will now be able to call on smaller, reduced footprint cabinets. This will enable the presence of control structures and interfaces on the shop floor to be a lot more subtle, negating the need for huge grey cabinets that prevail in many places.

The technology that has enabled this reduction in size is the use of LSI and surface mount components. The internal board population is incredibly dense wasting little space.

Performance

Some may question that the decrease in size will lead to a decrease in performance, this is far from the truth. The unit has a 5k step memory with an execution speed of 0.9μs. the CPU is a 16-bit unit running at 20MHz, combined with a 500k baud serial bus. Because there are no gate arrays, the CPU takes direct control and the part count of the PLC is reduced. When comparing characteristics against competitors' units, the FP0 excelled. In terms of speed, memory, function and maintenance, the unit was either better or evenly matched proving that the small unit certainly packs a big punch.



Approximately 25% of the size of similar PLCs the FP0 is the 'smallest PLC in the World'.

Control Unit

The main control unit is available in 4 I/O count variations. The 10 and 14I/O units have relay outputs, whilst the 16 and 32I/O units are NPN or PNP transistor types. Up to three expansion modules can be attached to the control unit.

Expansion Modules

The same basic size has been applied to the FP0 expansion modules, which are available in 8 or 16I/O relay, or 16 or 32I/O NPN or PNP transistor versions.

The stacking system for the PLC is simplicity itself. By simply removing a tab on the casing, a small socket is exposed enabling further modules to be plugged in with no intermediary gap. In addition, Matsushita have taken the stacking principle one step further. The use of a right-angle bracket allows the unit to be stacked so that it builds vertically – utilising what is often wasted space in a cabinet.

Analogue Modules and Communications

Analogue modules incorporating two input channels and one output channel can be connected in the same way as the expansion units. Each analogue module is capable of providing +/-10V, 0-20mA and 0-5V ranges, all with a 12 bit resolution.

Further more, FP0 units can be connected to Matsushita's RS485 C-Net network, enabling information sharing and wider application control. In addition, a second RS232 port is available on the control unit that can be used to communicate with SCADA packages, Man Machine Interfaces, modems and any other device with a RS232 port.

Programming the FP0

Matsushita provide a number of PC based programming packages. Among the mixture of both DOS and Windows packages, the most popular is the new Windows based FP SOFT that allows programming in both ladder logic and instruction list. For those applications that require a high level of program structure, documentation and compliance to the international IEC 1131 programming standard, Matsushita offers NAiS Control 1131 as an option.

For shop floor modification of programs, a hand held programming unit is available. This enables a program to be up and down loaded to the FP0, handheld programmer and a PC.

Applications

The FP0 is ideal for applications that require local control, either in a stand alone capacity or as part of a larger network. The small size ensures that it can be used as an embedded controller or fit in to a cabinet along with existing control equipment. The FP0, currently 'the smallest PLC in the World' has uses within many applications in many industries and is sure to set the trend for future micro PLC design. ELECTRONICS

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For Sale Tektronic 564B storage scope including 3A74 four channel amplifier 3B4 timebase new CRT all manuals all in VGC. Sensible offers only Tel: 01702 548553.

Maplin Matinee Organ (fully built and working) all original circuit diagrams and building instructions - offers invited - ring RV Holmes 01524 412048 (N Lancs) for futher details.

Club Corner

ARS (Aberdeen Amateur Radio Society) meets on Friday evenings in the RC Hall, 70 Cairngorm Crescent, Kincorth. For details contact: Martin, (CM0JCN), 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.

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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, membership and details of provisional dates of regional meetings for 1998 from: Don Bray (Hon. Sec.), 34 Etherton Way, Seaford, Sussex BN25 3QB. Tel: (01323) 894909, Fax: 01323 492234.

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.

The Lincon Short Wave Club Meetings every Wednesday from 7.45pm at Lincoln Railway Sports and Social Club, The Ropewalk London. Lincoln Hamfest 98 on Sunday 13th September. Contact: Cliff Newby G3EBH. 25 Sudbrooke Lane, Nettleham, Lincoln, LN22RW. Tel 01522 750637. Packet BBS G3EBH @gb7dx.#26.gbr.eu.

MERG? 2 first class stamps (or 4 IRCs) to John Weal, 23 Chapel Street, Yaxley, PE7 3LW brings you a substantial introductory pack to the Model Electronic Railway Group – actively applying electronics and computers to the model railway operation.

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Preston Amateur Radio Society meets every Thursday evening at The Lonsdale Sports and Social Club, Fulwood Hall Lane, Fulwood, (off Watling Street Road), Preston, Lancashire PR2 4DC. Tel: (01772) 794465. Secretary: Mr Eric Eastwood, (G1WCQ), 56 The Mede, Freckleton PR4 1JB, Tel: (01772) 686708.

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, (G0JZP) on (0151) 648 5892.

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Software HINTS AND TIPS

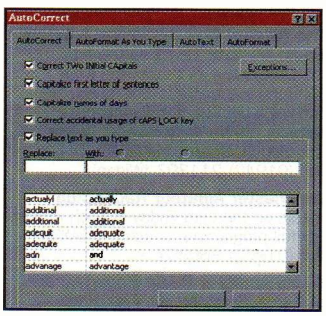
by Ruth Hewer

Lets look at letting the computer do the work this month. Here are a few things from Word 97 and Excel 97 that might help.

If you're not the worlds most accomplished typist or, like me and just plain lazy, you should find the following tips quite useful.

In Word we have something called AutoCorrect. This is a function that you can set up to correct some of the common typing mistakes. You will find that when you look at AutoCorrect in a moment that some of the obvious mistakes are already anticipated.

Click on Tools and then AutoCorrect. The following box will appear:



Using the scroll bar on the right hand side you can scroll down the available list and see what there is. You can see on the example above that if you type adn, Word will automatically correct it to read and.

As I said earlier, you can add to this list any mistakes you frequently make and any words which you frequently type. One of the most commonly used words and phrases I use is yours sincerely. I hate having to type yours sincerely at the end of every letter because I am lazy. So I use my AutoCorrect function to do it for me.

In the Replace box I type in ys and in the Replace With box type Yours sincerely and then click on the add button at the bottom of the dialog box. This has now added ys to the list. In future every time you type ys and then press return Word will replace it with yours sincerely.

Other Options

You will notice other options available to you in this dialog box. On the first tab (AutoCorrect) you will see that there are 4 other options:

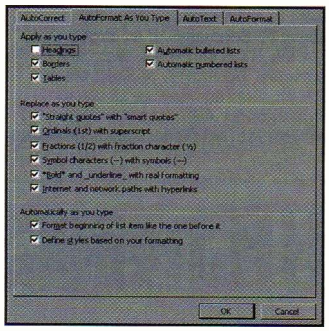
- Correct TWo INitial CApitals
- Capitalize first letter of sentences
- Capitalize names of days
- Correct accidental use of cAPS LOCK key.

You turn these options on and off by clicking on the box with the ticks inside.

The Other Tabs

- AutoFormat As You Type

By clicking on this tab the following dialog box will appear:

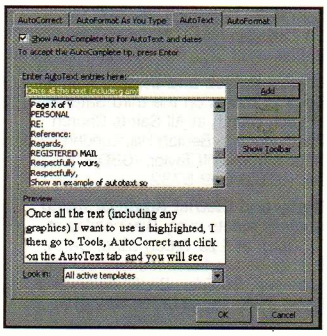


You can select any of the options by clicking the boxes.

AutoText

This is the best (in my opinion) of the labour saving devices in Word.

You can create AutoText entries to store text and graphics to use again and again. For example: let's say that I have to type the same paragraph of text every day and I don't want to keep on having to do this. I type and format the text first and then I highlight it.



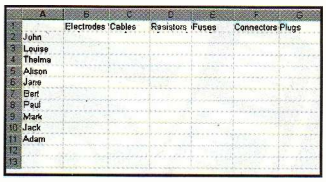
Once all the text (including any graphics) I want to use is highlighted, I then go to Tools, AutoCorrect and click on the AutoText tab and you will see that Word has bought your selection into the dialog box.

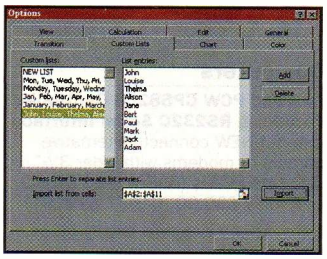
Word has called this AutoText entry "Once all the text (including any", this means that if I typed that into a document and then pressed F3 Word would insert the complete paragraph.

If however, you are like me and find even typing that much text too much like hard work, you can simplify the text in the top box (where it puts Once all the text (including any). You could put 'atext' in the top box and then every time you typed 'atext' and then pressed F3, Word would insert the text.

AutoFormat

AutoFormat is as we discussed earlier. Word will AutoFormat your document using the specified options.





Excel

In Excel there is a labour saving device called Custom Lists. This enables you to create a list on Excel and Save it so that you can use it again and again.

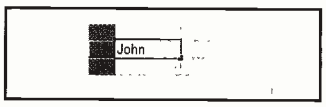
Let's say that I have a group of people and a list of products. I want the list of products to be along the top of the spreadsheet and the group of people down the left had side. I would type everything in the way I want it:

I want to create a custom list of the names and a custom list of the products to use at later dates on other spreadsheets. I highlight the list of names and then click on Tools, Options and the Custom List Tab:

I then clicked on the Import button and Excel bought in the list of names. I then click on the Add button and a new list has been created. I then do exactly the same with the list of products.

Using the Custom Lists

Once I have created the custom lists, whenever I want to use them I type in the first word of the list:



Hover the mouse over the little black dot in the bottom right hand corner of the cell so that it becomes a black cross, click the left hand mouse button and hold it down and then drag it either down the spreadsheet or across and the list will appear.

This also works with days of the week and months etc. Type in Monday, hover the mouse over the black dot until it becomes a cross and then click and drag. Try experimenting and you will find that it will save an awful lot of time.

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PROJECT Time Date STAMP

Time Date Stamp and complimentary units.

PROJECT RATING 2

Kit Available

Order as LU72P Price £99.99

Design by the Maplin Project Team

The last five years has seen the price of Closed Circuit Television cameras, CCTV cameras, tumble to unexpectedly low prices. Current prices, and they are still falling, have brought these cameras within the price range of anyone who has an interest in home or business security. A complete CCTV surveillance and alarm system for the home is now easily affordable and, perhaps, essential. The only missing ingredient is the lack of time and date information on the video signal.

This simple to built, no alignment or set-up necessary, kit is aimed at both home and professional constructors. The Time Date Stamp provides a high quality input and output connection that can be easily spliced into an existing system, or fitted simply during an installation. Designed to complement the AV Modulator and Video Distribution Amplifier, this kit is housed in an attractive, deep blue case that forms part of a 'Video Stacking System'.

The Time Date Stamp accepts standard negative-going sync. PAL signals, such as those produced by most CCTV cameras, as well as NTSC and SECAM composite video. An internal microprocessor splices time and date information onto the video signal and buffers the resultant signal for video recorders and monitors.

The time and date information is retained by an on-board backup battery for up to 6 months, allowing for loss of power. Although its unusual to experience six month power cuts nowadays, this facility is useful if the Time Date Stamp is powered up intermittently. Applications such as night-time only surveillance benefits here.

For those forgetful people, like me, who forget to change the date on their watches when February ends, (Yes. My watch is ancient) the Time Date Stamp includes automatic day-of-month correction. Further, it caters for leap years so you don't have to think 'is it really March 1st today; or tomorrow?' And, further still, it is 'YEAR 2000 COMPLIANT', so it knows that the Millennium is a leap year and doesn't do strange and unpredictable things when the celebrations begin.

Power is obtained from a simple regulated mains adapter and a power output socket is provided to allow other units to share the same supply. Alternatively, the power output can be used to supply the AV Modulator and Video Distribution Amplifier if these are used. It is important that the total current of all units sharing the power supply does not exceed the maximum power supply current rating or 800mA whichever is the lesser. See *A quick note on power supplies below.*

How it works for the less technically minded

Figure 1 shows a block diagram of the Time Date Stamp. The video input signal is connected to a band pass filter which removes unwanted frequencies (junk). A hi or 75Ω (lo) termination, which helps electrically match connected equipment, can be selected.

SPECIFICATION

Voltage	8V to 15 V DC
Current	90mA (max.) 85mA (typ.)
Video Input	0.5V to 2V pk.- pk.
Input Resistance	75Ω with terminating resistance in 1.3KΩ otherwise
Input Offset Voltage	16V DC absolute max.
Video Output	0.5V to 2V pk.- pk.
Output Impedance	2Ω @ f = 100Hz. (typ.)
Video Bandwidth	30Mhz (min.) 50MHz. (max.) 3dB down point into 75Ω
Overall Signal Gain	0dB
Battery life	6 months (Assuming fully charged battery)

FEATURES

- Adds time and date information to video signals
- YEAR 2000 COMPLIANT
- Easy construction using supplied Module
- PAL, NTSC and SECAM compatible
- In-built, battery backed Real Time Clock
- Automatic date and leap-year correction
- Semi-closed graphics for increased clarity
- 75Ω or Hi-impedance operation
- Case in kit is pre-punched, silk-screened, attractive and hard-wearing

APPLICATIONS

- Security surveillance systems
- Add time and date to home movies
- Suitable for home and professional use

The video signal contains some synchronising (sync) parts that allow the TV or monitor to reproduce the original signal without rolling or jumping (jitter). These sync signals tell equipment when to start drawing a new screen (from top left) and when to start drawing each line across the screen. Using these syncs allows the computer, CPU, to position time and date information.

The time and date are held in a special chip, the Real Time Clock Generator. This has an electronic clock built-in that can run off the small back-up battery. The form in which the time and date is supplied is no good for the CPU to write directly to the screen so it uses a conversion table in the Character Generator ROM (Read Only Memory).

The CPU then signals the Mux Amp when to display the time and date instead of the usual video signal. The Mux is a multiplexor, a device that switches one thing, then another, to some common line. The process is called multiplexing.

The new video signal, with time and date added, is buffered (given a little more oomph) by the amplifier in the Mux Amp, then passed out the Video Out.

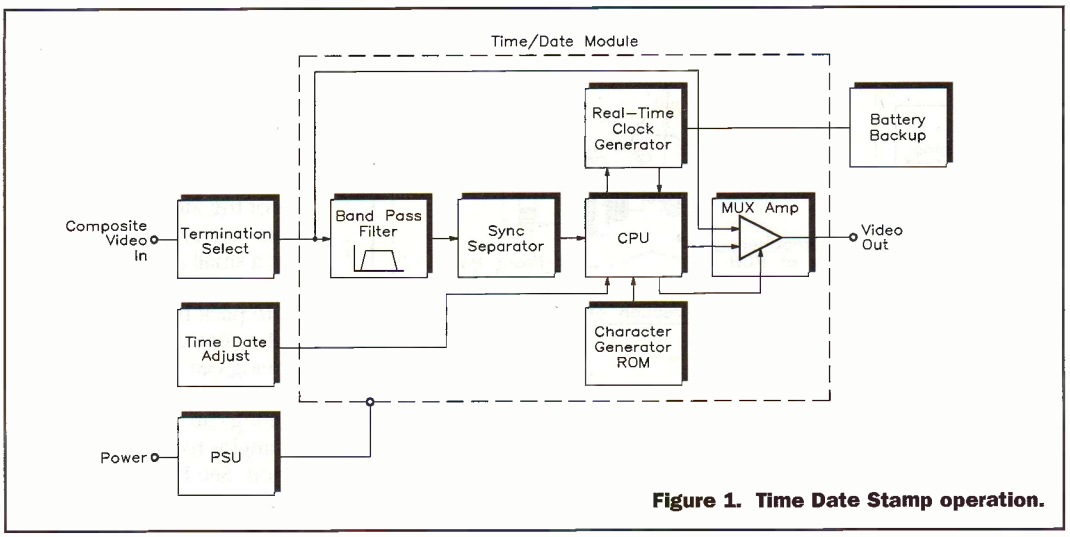


Figure 1. Time Date Stamp operation.

To adjust the time and date, three switches are provided. One selects the required number and the other two adjust that number up or down.

The Module has a voltage regulator that provides the 5V regulated supply required by the Module.

How it works for the more technically minded

Figure 2 shows the circuit diagram of the Time Date Stamp. Power is derived from an external, unregulated supply via SK1. This is paralleled with another socket SK2 which provides power output to other units. D1 provides polarity protection to the Module. D1 does not protect equipment connected to the power output socket.

LD1, a red LED, indicates when power is applied. R1 limits the current in LD1 to around 12mA for a 12V DC supply. C1 affords low frequency de-coupling of the supply rails and C2 handles higher frequency noise. The Module has an on-board 78L05 regulator and local decoupling capacitors.

Video input is by a 75Ω BNC connector which connects to P1 and P2 on the PCB. Slide switch S4 allows hi-impedance or 75Ω termination of the video signal to aid matching. The video signal is passed straight to the Module where the signal encounters a Band Pass Filter. This affords DC decoupling of the input signal and limits the bandwidth of the input with a corresponding reduction in noise. See Figure 1.

A Sync Separator extracts line and frame sync signals allowing a microprocessor, the CPU, to time and count a location for injection of the time and date information.

The time and date is maintained by a Real-Time Clock Generator which has battery backup afforded by B1. The CPU copies the time and date information from the real-time clock and obtains a dot pattern from the Character Generator ROM. The 'dots' are injected, at the appropriate instance, into the multiplexor of the Mux Amp.

As the CPU injects the data it switches the Mux Amp such that the dots are spliced into the video signal. The Mux Amp is then switched back to continue with the received video signal.

By switching the Mux Amp to CPU input and outputting a zero, the video signal will contain black dots. If a one is output, the video signal will contain white dots. Thus, the CPU is able to frame the numbers against a black background which enhances visibility on a light picture.

The Mux Amp also contains a video amplifier that buffers the signal to the output BNC connector via P3 and P4.

The time and date are adjusted using push-buttons S1, S2 and S3 which pull the appropriate pins on the Module low.

Setting and changing the time

Three push-switches are provided to adjust the time and date. These are accessible from the back of the Time Date Stamp, but are recessed to avoid accidental operation.

Pressing the adjust button causes the first number group, the hour, to flash once a second. Pressing the up or down button causes the hour to increment, or decrement, respectively.

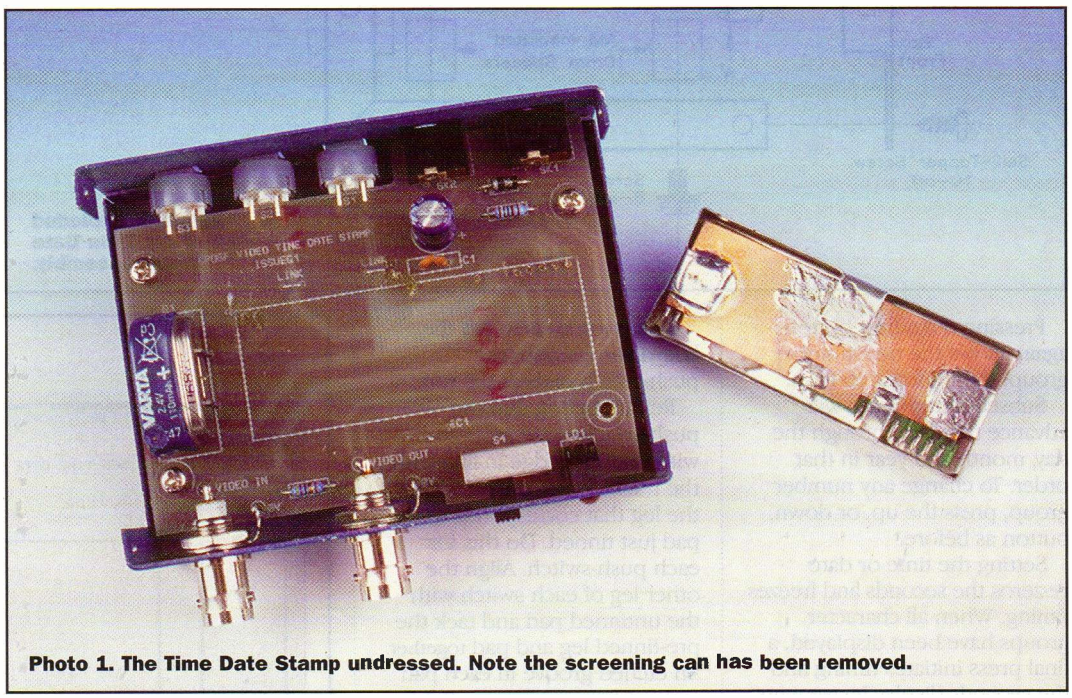
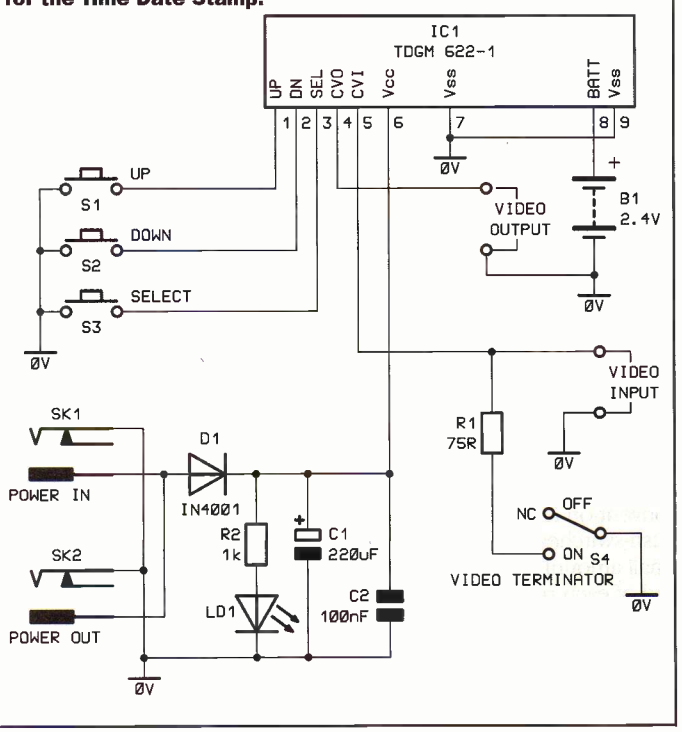


Photo 1. The Time Date Stamp undressed. Note the screening can has been removed.

Figure 2. Circuit Diagram for the Time Date Stamp.



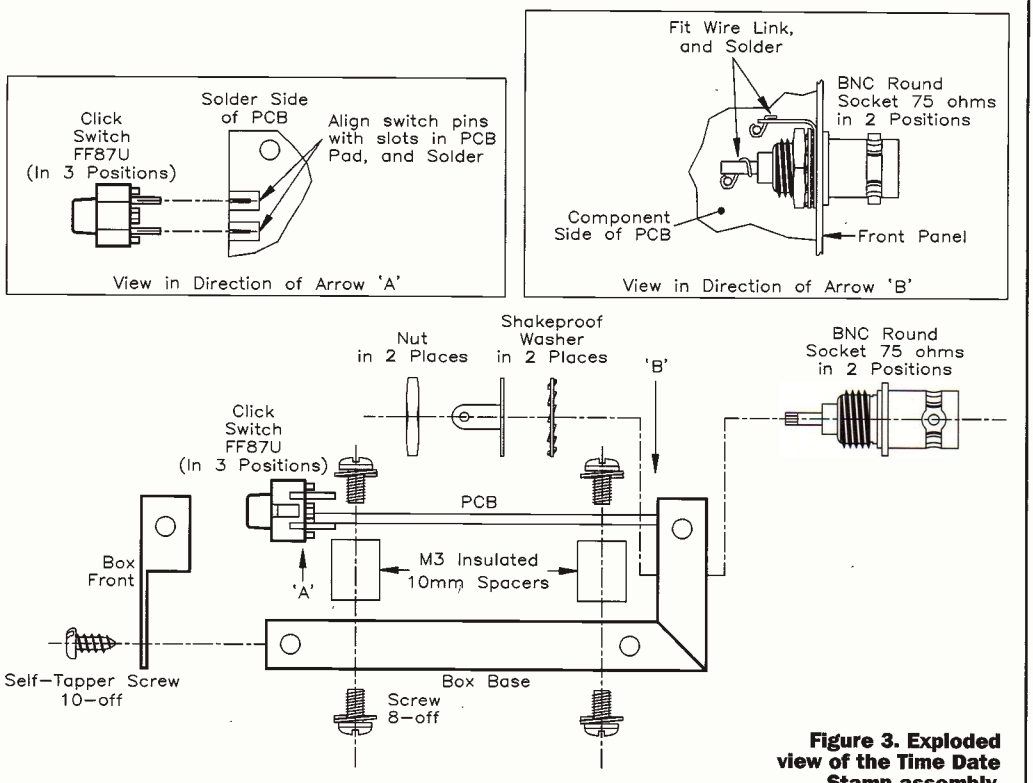


Figure 3. Exploded view of the Time Date Stamp assembly.

Pressing the adjust button again allows the next number group, the minutes, to flash.

Subsequent presses will advance the date through the day, month and year in that order. To change any number group, press the up, or down, button as before.

Setting the time or date re-zeros the seconds and freezes timing. When all character groups have been displayed, a final press initiates timing and the seconds display increments. Pressing adjust again repeats the whole process.

If 'nonsense' dates such as February 30 are entered, the next time the unit increments the date it will automatically cycle to the first valid date; in this case March 1. The Time Date Stamp automatically compensates for leap years, including the year 2000 displayed as 00.

Construction

Figure 3 shows an exploded view of the time date stamp. This, and photo 1, should help with construction.

After assembling seven Time Date Stamp Kits, I found it better to throw away all convention and start with the push-switches S1, S2, S3. Add a small amount of solder to one pad of each push-switch. It doesn't matter which pad, but it is a good idea to do the same one of each pair. Hold the board vertically in a vice, clamp or other device.

The purpose is to get the board vertical with the push-switch pads at the top.

Remembering that the push-switches are mounted with their flat edge in line with the track-side of the PCB, tin the leg that corresponds to the pad just tinned. Do this for each push-switch. Align the other leg of each switch with the untinned pad and tack the pre-tinned leg and pad together. An etched groove in each pad makes alignment easier. Solder the untinned leg and pad together and then solder the pre-tinned ones properly.

When all three push-switches are in place, check the alignment by temporarily fixing the PCB in the case then screw on the back panel.

Remove the PCB and fit R1, R2, D1 then fit C2, LD1, SK1 and SK2. Use two of the leg cutoffs to form the links. Fit and solder these. Finally fit SW2, C1 and the four Veropins.

It is a good idea to test the circuit for any faults at this stage. See Testing the Time Date Stamp part 1 below.

Carefully fold the Module pins backwards at right angles. The fold point should be immediately below the pin shoulders (the point where it widens before fixing to the Module) but not on, or above, the shoulders.

Rest the thin PCB sheet against the bottom of the Module. The pin's shoulders fit where the cut-outs are. Remove the thin PCB and apply a thin layer of adhesive to the non-copper side. Fit the glued side against the Module underside to form the base of a screening can. Remove any excess glue before it sets.

When the glue has set, solder pin 7 of the Module to the copper face of the thin PCB.

Cut a small section (30mm x 20mm will do) from the foam used to pack the kit. Put this into the centre of the metal screening can. Fold in the two tags on the shorter sides of the screening can until they are at right angles to their original position. See Photo. 1. Slide the Module under the tags, then fold down the remaining two tags. Adjust the tag angles, and the Module, so that the tags all lie flat to the Module. Make sure the Module sits square and centred in the screening can. Check that the Module pins do not touch the can or thin PCB then solder all four tags to the thin PCB. This completes the screening can around the Module.

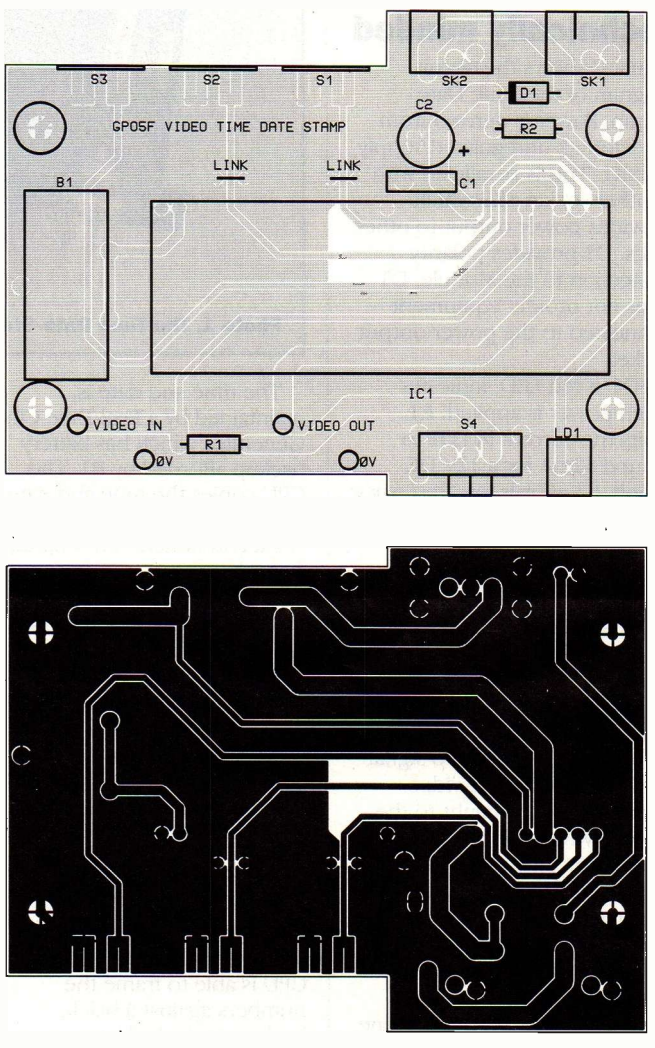


Figure 4. Track layout and component overlay for the Time Date Stamp.

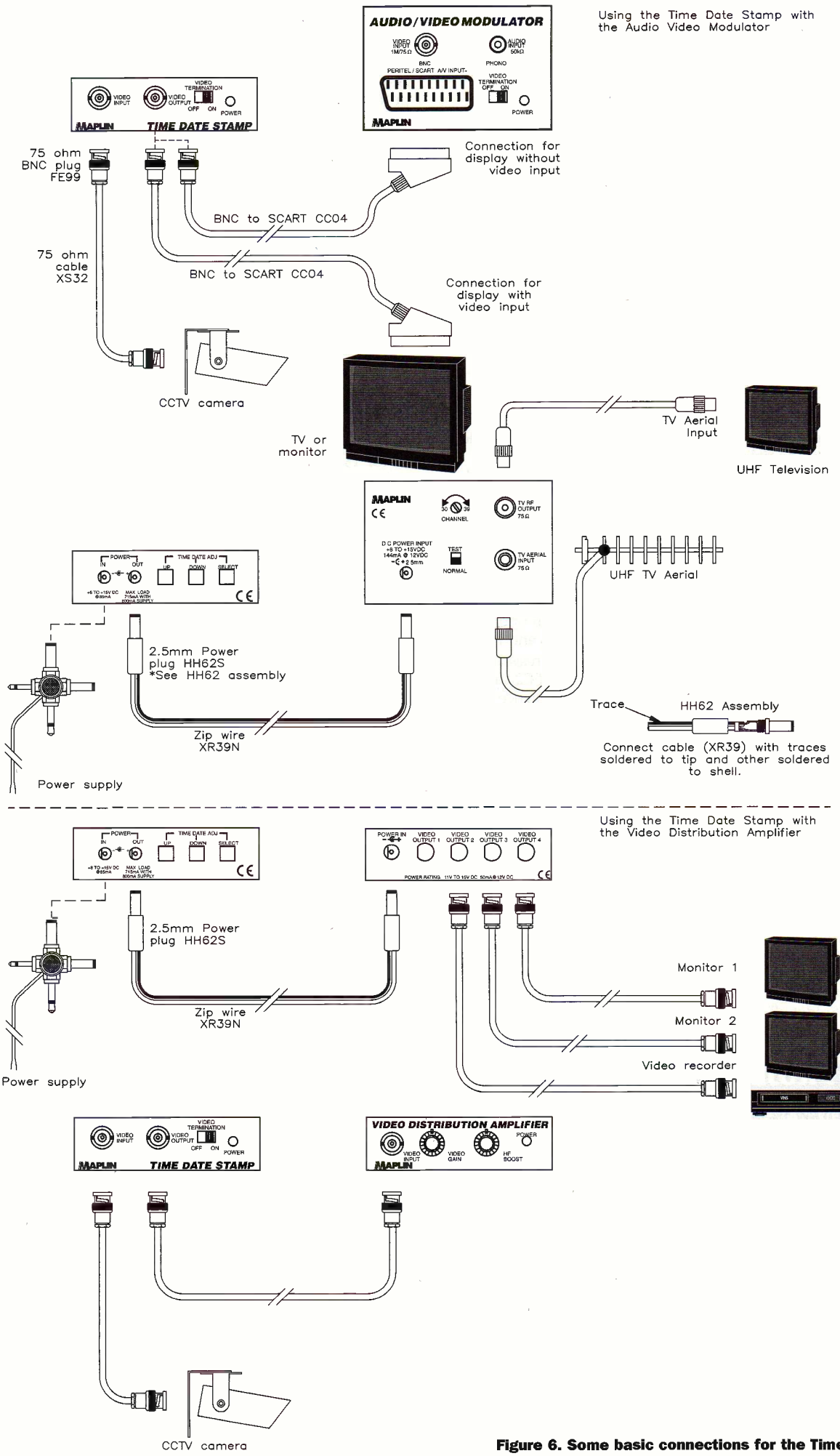


Figure 6. Some basic connections for the Time Date Stamp.

Stick the two Quickstick pads to the PCB in the area marked for the Module (or on the back of the module itself). Remove the protective top layer from the Quickstick pads.

Carefully insert the Module pins into the correct holes in the PCB and push the Module down onto the pads. Be careful to get the right alignment because the pads stick like mud to a blanket! Solder the Module pins in place. It is important that the solder joint near C1 and C2 is well formed or the Time Date Stamp may radiate some nasty noise at frequencies of 20MHz to 80MHz. Very undesirable if you want CE compliance!

Fit the battery, being careful not to short it to the screening can, then solder in place.

Check everything....The right components in the right place, well-formed solder joints, alignment of switches and LED and anything else that worries you. If you have an ohmmeter, go to *Testing the Time Date Stamp* part 2 below.

Fix the two BNC sockets in the front panel and screw the four stand-offs in the case base, as shown in Figure 3. Screw the PCB to the stand-offs. Make sure the screening can does not touch the PCB fixings. If it does, carefully twist it until clear. (Contact with the screws causes RF radiation – giving another CE failure!).

Bend the earth-tags on the BNC connectors toward pins P1 and P4. Cut four 10mm lengths of tinned copper wire and pass a length through the earth tag hole and around the closest Veropin. Do the same for the other BNC's earth tag. Wrap another length around the centre pin of each BNC where it meets P2 and P3. Wrap the other end around the closest Veropin. Solder all four of the wrap-round connections made. This prevents an accidental break between the pin and the BNC contact with subsequent degradation of the video signal.

Fix the back panel in place with two black screws. This black finish is called 'japanned', but I don't know why. Fix the cover with the remaining eight japanned screws. Peel off the protective layer from the rubber feet and fix these to the case base near the corners.

Now go to *Testing the Time Date Stamp* part 3 below.

Testing the Time Date Stamp

1. Check everything visually. Test that continuity is found between the centre pins of SK1 and SK2 and continuity is found between the outside pins of SK1 and SK2. A very high resistance (MΩ) should be found between the pins of C2. The reading will change slowly but don't wait until it settles. 47Ω should be found between P1 and P2 with S4 one way and an open circuit when set the other way. There should be an open circuit between P3 and P4.
2. Check as in 1. The resistance between the pins of C2 should be similar. The resistance between P1 and P2 should be similar. The resistance between P3 and P4 should, also, be similar. Connect a regulated supply between 9V and 12V DC (preferable but must be within the specifications). Measure the current does not exceed that given in the specifications. Check that the battery voltage is around 2.4V and if not, it is rising slowly. Switch off and finish the assembly.
3. Check everything visually. Connect the power supply to the Module and then plug into the mains. If components smoke or burn, other damage is apparent, or the power supply hums loudly – switch off. Check everything again and consider seeking professional help (for the Time Date Stamp).
4. If all appears well, connect a video source; a camera or video for example; to the Video Input. Connect a monitor or TV (via a video if you don't have a TV with video input) to the Video Output. Switch on the power. The time and date should appear in a small box in the left-hand corner of the screen.
5. Correct the time and date and leave the Time Date Stamp for a couple of hours to charge the battery. After the short charge period, remove the power and leave the Time Date Stamp switched off for 15 minutes. Re-apply power and check the time has advanced and is correct.

This completes the tests.

Note that the battery must be charged for around 6 hours before it will provide back-up for the six-month period quoted.

Some applications have been given in Figure 6 to ease connection of the Time Date Stamp, and its partners, into planned, and existing, systems.

A Quick Note On Power Supplies

The Time Date Stamp is designed to work with power supplies with an output voltage up to 15V DC. It will work quite happily with an unregulated power supply but, note the following carefully.

An unregulated power supply that is delivering only a low percentage of its maximum output current has a voltage approaching twice that quoted. Therefore, I recommend that you either;

1. Use a regulated power supply with an output voltage between 9V and 12V DC or;
2. Use an unregulated power supply at 9V only.

I have recommended two Maplin parts for the PSU. Both are regulated units that deliver plenty of current for example use. When using the output power connector, the required power supply is determined thus:

1. Determine which unit requires the highest voltage to operate. This voltage is the supply voltage required and all the units connected together must operate correctly on this voltage. It is best to use the lowest figure of any spread given as this reduces waste power.
2. Add all the currents together. Be generous with approximations. If current is not given then use the power figure. Power (in Watts) divided by Voltage (in Volts) gives the current rating. This current is the absolute minimum required from the power supply. Add a 10% margin for safety.
3. If this current exceeds 800mA then some equipment will have to be powered by other supplies. 715mA is the absolute maximum that should be drawn from the Time Date Stamp output connector.

Eg. Three different units; A, B and C; are connected together. A is rated at 5V-13V (an example of a voltage spread) and 45mA. B is rated at 11.5V – 12.5V and 75mA. C is rated at 9V – 12V and 300mA. The required power supply must provide 11.5V minimum and 12V maximum. The current rating would be 45mA + 75mA + 300mA giving a total of 420mA. A 12V regulated supply at 500mA (12V regulated at 1.2A) would do the job.

PROJECT PARTS LIST

RESISTORS: All 0.6W 1% Metal film [Unless specified].			
R1	75Ω	1	M75R
R2	1k	1	M1K
CAPACITORS			
C1	220μF Radial Electrolytic	1	AT41U
C2	100nF Ceramic	1	YR75S
SEMICONDUCTORS			
D1	1N4001	1	QL73Q
IC1	TDGM622-2 Time Date Module	1	NV10L
LD1	Red LED PCB mount	1	QY86T
MISCELLANEOUS			
S1, S2, S3	Click Switch	3	FF87U
S4	R/A SPDT Slide Switch	1	FV01B
SK1,2	2.5mm Power socket PCB mount	2	FK06G
	M3 x 10mm Insulated Spacer★	1	FS36P
	BNC sockets 75Ω	2	FE31J
P1-7	Veropins 2145★	4	FL24B
	Tinned Copper Wire 24SWG★	40mm	BL15R
	Stick-on Feet★	1	BP58N
	Quickstick pads★	2	HB22Y
	Screening can	1	NV76H
	Screening PCB	1	NW44X
B1	2.4V 110mAh PCB mount	1	BN17T
	Time Date Stamp PCB	1	GP05F
	Time Date Stamp Case	1	NV78K
	Time Date Stamp Leaflet	1	XZ52G
	Constructors Guide	1	XH79L
OPTIONAL ITEMS (Not in Kit)			
	12V 300mA Regulated PSU	1	YB23A
	12V 1.2A Regulated PSU	1	JC93B
	Adhesive	1	BP04E

The Maplin 'Get-You-Working' service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding optional) are available as a kit.
Order as LU72P (Time Date Stamp Kit)

Please note: Items in the Parts List marked with a ★ are supplied in 'package' quantities (e.g., packet strip, reel etc.), see current Maplin Catalogue for full ordering information.

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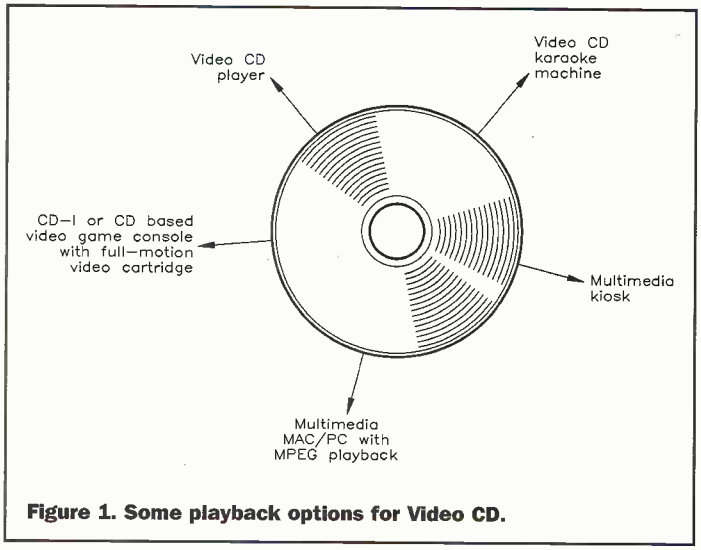


Figure 1. Some playback options for Video CD.

Making YOUR OWN CDs PART 4

In the penultimate instalment of his series on making your own CDs, Martin Pipe looks at putting video onto CDs.

In previous instalments, we've concentrated on how one-off audio CDs can be put together using the recordable CD (CD-R) medium. The CD, and hence the CD-R, is a wonderfully flexible medium, however. It can be put to all kinds of storage uses – in addition to audio, those little five-inch discs can store data (CD-ROM), and video (Video CD). Producing CD-ROMs is a well-documented application, and most CD-R burners occupy their working lives archiving data from hard disks. The price of blank CD-R discs has fallen dramatically since this series began – 80p, in bulk, from some of the companies that advertise in computer magazines – and for many, the medium is proving to be a cost-effective means of clearing less-used files off your hard disk.

The 650Mb capacity is still significant in today's world, and CD-R has many advantages over tape streamer in terms of compatibility, and read/write speed. What's more, CD-Rs can be read on any computer with a CD-ROM drive, often at speeds that aren't much slower than the hard disks of yesteryear (24-speed drives are now commonplace). CD-R's biggest disadvantage – the discs can't be re-written – isn't that much of a problem, seeing how cheap the discs are. In any case, how often do you re-use a blank audio cassette? Rewritable CDs – the CD-RW format – are available, although the media is expensive and can't be read by the majority of installed CD-ROM drives. In most cases, that data will be programs and user files – perhaps compressed to maximise the available space (I archive programs, collected as PKzipped files from the Internet and organised, by subject, into appropriate directories).

That data could, however, be digital video. If you were to write uncompressed TV-resolution video onto a CD-R, there might be sufficient space for a few seconds – not that your CD-ROM drive would be sufficiently fast to play it back! Hardly practical, and so the use of a complex compression algorithm – in the form of MPEG-1 – has been agreed upon. Thanks to this, you can fit an hour or so of VHS-quality digital video onto a blank CD. A description of MPEG compression techniques – which are completely different in principle to the aforementioned PKZip – is outside the scope of this article, but a comprehensive article on the subject was published in the December 1994 issue (no. 84) of Electronics.

There is a standard disc format for CD-delivered, known as VideoCD. At its heart is the White Book standard, which was conceived in the early 1990s by Philips and Sony amongst others. White Book sets down on paper important parameters such as the disc layout and MPEG-1 data transfer rates. Many, but not all, CD mastering programs support the creation of VideoCDs. The discs that you create can be handled by multimedia PCs with MPEG playback capability (whether implemented in hardware or software). In most cases, the video will appear within a playback window on the computer monitor. Some graphics cards with MPEG hardware playback, such as the now-obsolete Spea Showtime Plus, have separate audio and video outputs that allow VideoCDs to be experienced on a standard TV.

VideoCD playback doesn't start and end with the personal computer, however. Other equipment capable of playing VideoCDs includes CD-i players with a full-motion video (FMV) cartridge, and some karaoke machines. A VideoCD-compatible CD player is available for some home cinema midi audio systems, notably a recent model from Kenwood. The latest DVD players are also backwards-compatible with VideoCDs, although there have been some users of first-generation machines have had reported trouble reading CD-Rs.

Why Bother?

Why, though, would you bother with putting video onto a CD in the first place? First of all, a CD is somewhat less bulky and heavy than a VHS cassette – and correspondingly cheaper to post. If you're sending recordings overseas, the cost savings are significant. This doesn't apply, however, if your recording fills a 3 hour tape – you would need three CDs! An edited home video might only last 20 minutes or so, however. You do need to check beforehand that your intended recipient has access to VideoCD playback facilities. If you have family or friends in the Far East, you may be interested to learn that VideoCD is incredibly popular over there – there are apparently more VideoCD

Rainbow runner Studio and TV.

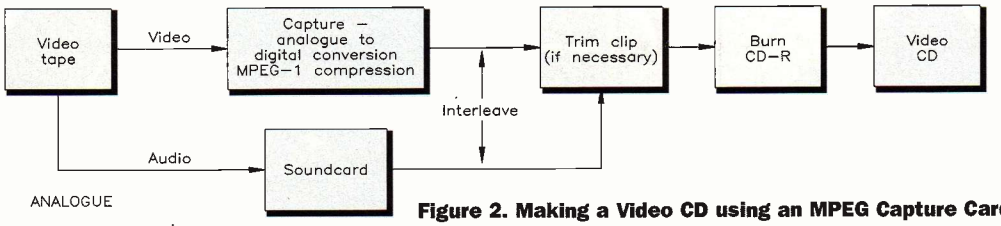


Figure 2. Making a Video CD using an MPEG Capture Card.

players than VHS recorders in China! Indeed, Chinese sales of VideoCD hardware topped 5 million in 1997, according to Philips. The biggest attraction is the availability of cheap films.

The second advantage of VideoCD is that of longevity. Tapes wear out if they are played often, and have to be stored correctly if they are to be retained for any period of time. A variety of factors, such as the Earth's magnetic field and humidity, conspire to reduce the shelf-life of a magnetic recording. Conversely, a CD will never wear out regardless of the number of times it is played – it is, after all, a non-contact medium. A suitable application of VideoCD here is the in-store, museum or exhibition demonstration film. Department stores often continuously run films extolling the virtues of the latest household gadget or cosmetic wizardry.

The standard way to do this is via a VHS tape, and a playback-only VHS deck and TV/monitor. The decks in question usually have a repeat playback option, in which the tape is rewound automatically at its end before playing back again. After some time, however, the tape wears out and in some stores you can hardly see the product being promoted for drop-outs! VideoCD gets around all of this quite nicely. VideoCD's third advantage is random access – a particular clip can be found without having to spool through a tape. Very useful if you want to demonstrate a particular feature of a product, or find the bit where Junior falls over in that home movie!

Philips make a neat portable VideoCD-compatible CD-i player, which is ideal for in-store demonstration kind work and certainly better than a power (and space) guzzling PC! The 1000 CDI-370, which is aimed at industrial markets, has an internal LCD screen but can also be plugged into a conventional TV/monitor. A portable VideoCD player is also useful for mobile salesforces – indeed, such practice is commonplace in the medical, white goods and automotive industries. Philips still produce a shoebox-sized 400 CD-i/VideoCD player, the CDI-490, which may be useful if lots of players are envisaged or budgets are tight. CD-i equipment is available from Colchester-based McNo and Cambridge Multimedia. Note that authoring programs, which allow CD-i applications to be created, are also available from the latter. In terms of playback hardware, the VideoCD-specific players circulating in the Far East are, I imagine, somewhat cheaper. Whether they're being imported into the UK or not is another matter...

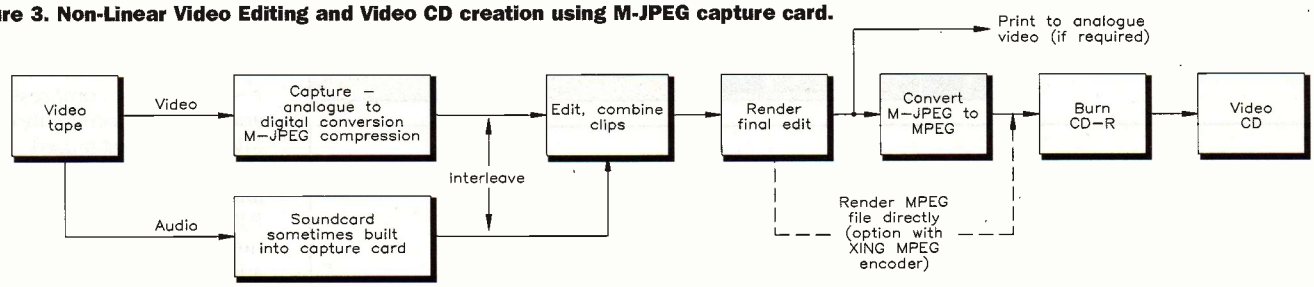
What you need

In addition to your personal computer and a CD burner, you will need a capture card capable of getting video and audio into your computer. There are two practical routes that you can take.The first, and easiest, is the real-time MPEG capture and compression peripheral. These devices, which cost tens of thousands of pounds only five years ago, can now be acquired for 200 or so! They can be configured, via software, to write a VideoCD-compatible .MPG file directly to your hard disk. The second route is more flexible and capable of better results, but is more hardware-intensive. Here, the footage is acquired with a standard video capture card, such as the Miro DC30 or Matrox Rainbow Runner. The video capture files are then converted, off-line using a specialised program, into VideoCD compatible MPEG files. Such files can then be written to a CD-R.

In both cases, the MPEG files have to meet strict criteria that are defined in the capture or conversion programs – to keep things simple, there's a VideoCD option that sets all of the parameters to the appropriate values. If these criteria aren't adhered to, the disc won't play back on VideoCD hardware – it's as simple as that. The compressed video datastream, for example, must not exceed 1151929.1 bits per second – or 1377600 bits per second, if the accompanying Layer 2 MPEG audio is taken into account. MPEG audio was, out of interest, discussed in part 2 of this series – it's a useful system in its own right! The stereo (or dual-language) MPEG audio stream must be sampled at 44.1kHz, and have an overall data rate of 224Kb/sec.

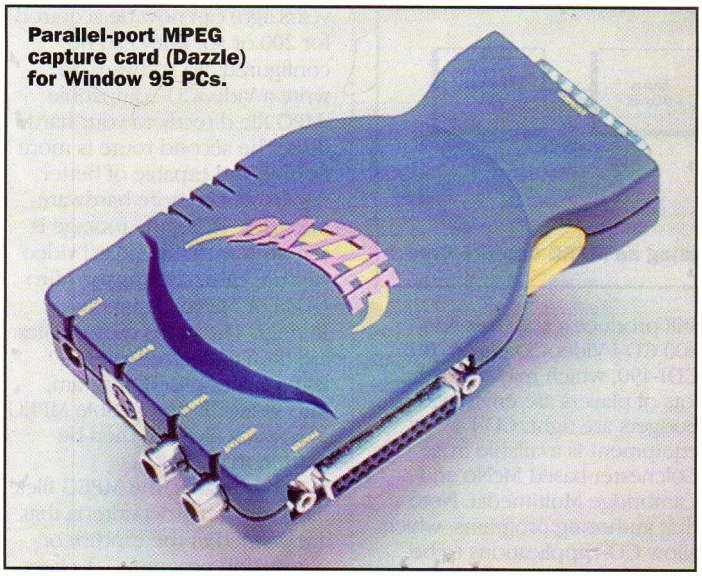
A VideoCD can store data in

Figure 3. Non-Linear Video Editing and Video CD creation using M-JPEG capture card.



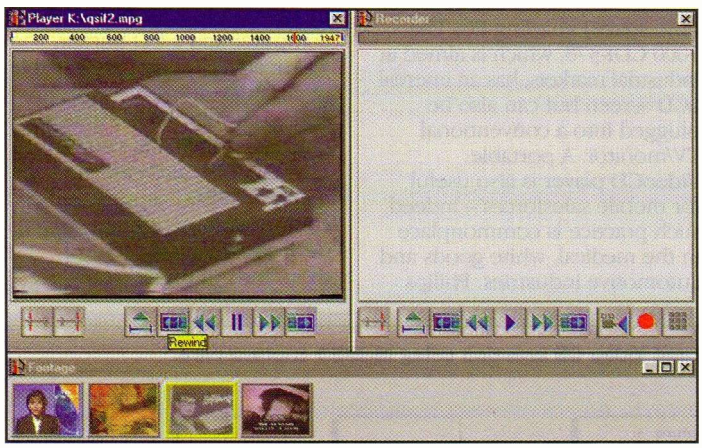
Rainbow Runner board.

PCI MPEG Audio/Video capture card for windows 95 PCs. (NT drivers available soon)



Parallel-port MPEG capture card (Dazzle) for Window 95 PCs.

two areas. The first, the audio/video tracks area, contains each MPEG track as a separate file with both picture and sound. The second, more versatile, area is known as segment play items. This can contain video-only, audio-only, audio/video and JPEG still-image files. A VideoCD player could, for example, provide hours of CD-quality music from a single disc. For further details on MPEG audio, consult the second part of this series – note, however, that you should use Level 2 rather than Level 3 compression. Note that CD-i players will only read tracks from the audio/video tracks area of a VideoCD, and so this is where the data should be stored if your disc is destined for playback on such hardware. VideoCD can draw upon one of three possible video modes; NTSC (352 x 240 pixels, 29.97Hz frame rate), film-compatible (352 x 240 pixels, 29.976Hz frame rate) or PAL (352 x 288 pixels, 25Hz frame rate). Of greatest relevance to video work are the PAL and NTSC modes; the one chosen should reflect your source material and the destination country of your CD. In most cases, the PAL option will be the one selected. It is worth checking on the TV standard in force within the recipient's country. Japan, the US and parts of South America use NTSC. The UK and Australia, together with much of Europe and Asia, are PAL areas. Compatibility is only really an issue if the disc is to be viewed with a stand-alone VideoCD player and TV set. Although picture and sound are recovered, there may be some unwanted noise at the bottom of the picture and/or distortion of the aspect ratio if, for example, you were to play an NTSC disc on PAL hardware. The Philips CDI-370 has a NTSC/PAL switch, and is thus able to handle both discs of both standards. In addition, I have found that PCs with MPEG playback capabilities are able to handle both NTSC and PAL VideoCDs without problem.



MPEG Capture Hardware

Dedicated MPEG capture cards take the video output from your VCR or camcorder, digitise it, compress it to MPEG-1 standards in real-time and then pass it to the computer's hard disk for recording. The cheapest model available, the Dazzle from LAVision, is a Windows 95 PC product capable of handling NTSC or PAL video. It transfers its MPEG videostream, which is generated by a C-Cube codec, to the PC via its parallel port (which must be set to EPP or ECP mode). Dazzle utilises the PC's soundcard for capturing audio, relying on software to ensure audio/video synchronisation and handle the combination of video and sound. The PC is also responsible for compressing the audio to the aforementioned MPEG Layer 2 standard. This is a processor-intensive activity, and needs a fast PC (such as a P200 MMX) to carry out in real-time. If the PC is relatively-slow, and only has a P133 processor for example, Dazzle has a mode in which audio conversion is carried out off-line after capture.

Most of Dazzle's features are accessed via a control panel known as Amigo. >From here, you can configure MPEG options (there are VideoCD and e-mail attachment presets'), invoke or

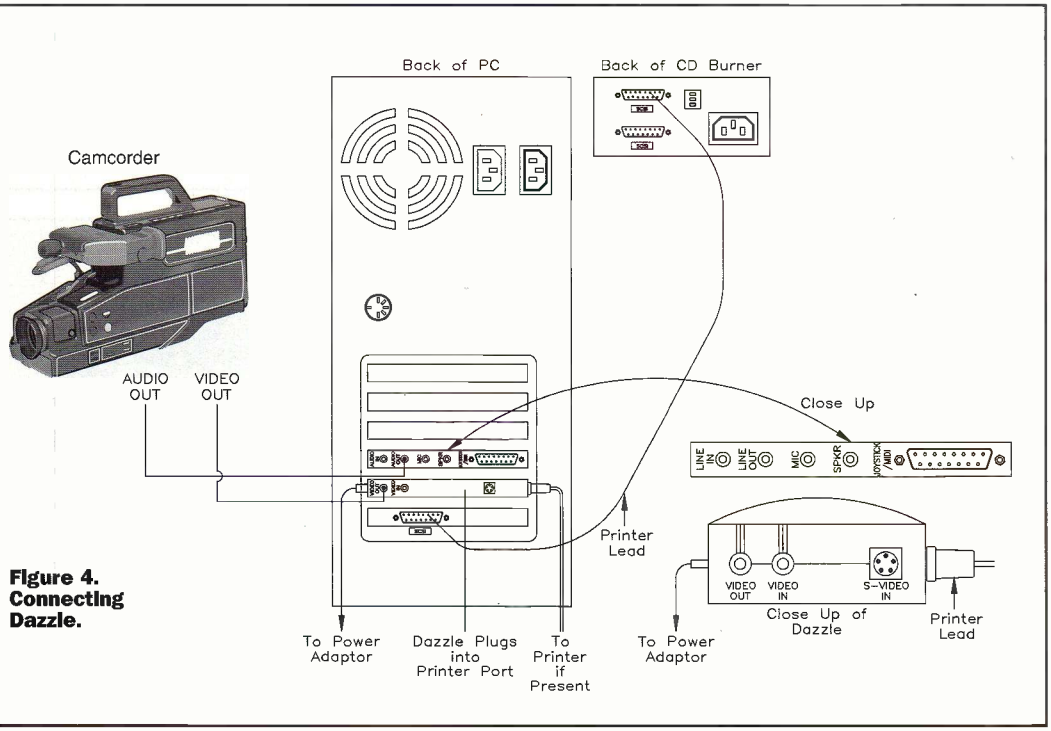
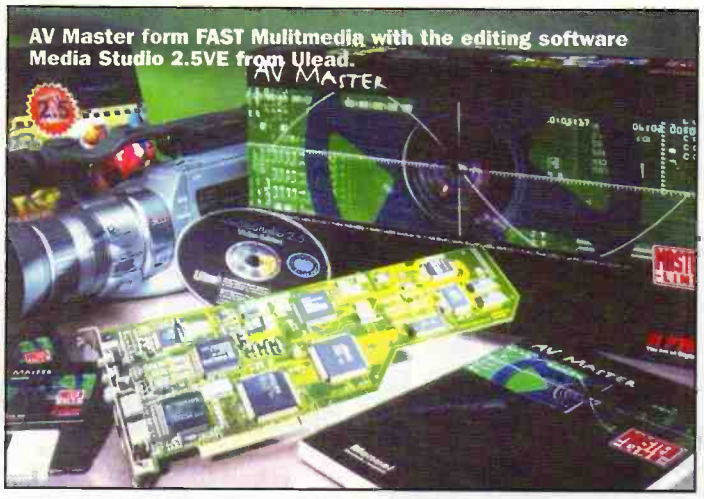


Figure 4. Connecting Dazzle.



AV Master form FAST Mulitmedia with the editing software Media Studio 2.5VE from Ulead.

stop capture. There's also a playback feature for viewing your captures. Amigo also has an excellent-quality still-frame capture utility that allows you to save single-frame snapshots, in a variety of picture formats, to your hard disk. These still frames can be incorporated into Web pages, or CD box artwork. Dazzle is also supplied with some other interesting software. Most relevant is the VideoCD-compatible CeQuadrat WinOnCD CD-R mastering software and a basic – although easy-to-use – MPEG editing program known as iFilmEdit 1.2.3. With the latter, you can trim your MPEG clip to size and delete unwanted sections, primarily those at the beginning and end of the capture.

Dazzle is capable of reasonable results, although MPEG video is noticeably marred by compression artifacts such as edge noise and blockiness. VideoCD-optimised captures exhibit a picture quality that is noticeably sub-VHS in picture quality. What's more, I found that synchronisation between picture and sound would tend to be lost over long-ish video clips. But then again, Dazzle is aimed primarily at Internet enthusiasts who want to attach short, low-resolution video clips to e-mails. They have to be short, mind – even at the lowest resolution/quality, a minute of video consumes 5Mb! A better option for VideoCD is the more expensive Snazzi, from the same company (where the hell to they get those names from?). The Windows 95-specific software is identical to that provided with the Dazzle – the difference concerns the hardware. Snazzi's electronics, which take the form of a PCI card made by Digital Semiconductor, handle audio as well as video. I found that audio/video synchronisation was better, and that compression artifacts were rather less severe.

Creating MPEG files with other capture hardware

In the field of video editing, non-linear is beginning to take off in a big way. Here, a so-called capture card digitises the video, compresses it and writes it to the hard disk in real-time as a QuickTime or AVI file. The non-linear moniker refers directly to the random-access nature of the hard disk storage medium. We've already examined the concept of non-linear editing, albeit with audio captures, in previous articles. The vast majority of video capture cards currently available for under 10,000 employ a compression algorithm known as Motion JPEG (M-JPEG). This is completely different in operation to the MPEG system that forms the basis of VideoCDs – no inter-frame compression, for example, is involved.

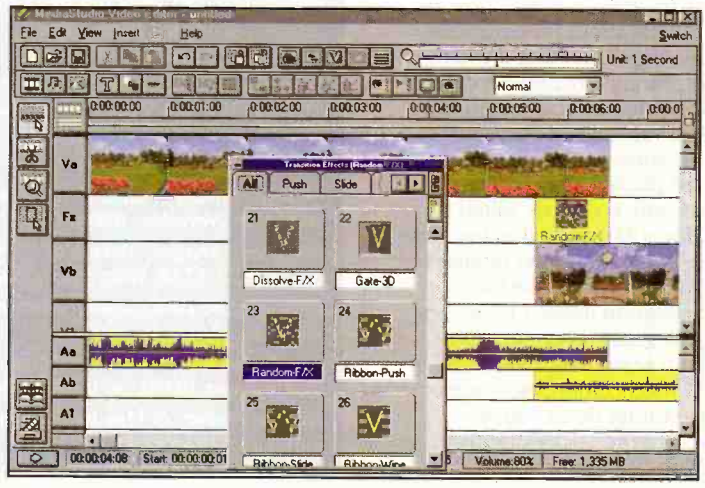
M-JPEG is basically a sequence of still images. Each is compressed to JPEG standards in real-time, and contains one frame of the original video. MPEG video capture sequences are thus the digital equivalent of a flickbook animation! Most capture cards allow you to vary amount of JPEG compression applied. At higher settings, files take up less room but are noisier – artifacts, such as blockiness, become apparent. The resolution is also variable, at least with the consumer-priced cards (products aimed at professional users tend to fixed at the full-PAL resolution of 768 x 576 pixels). With these cheaper cards you can, for example, capture one – rather than both – of the frame's interlaced fields. Although the vertical resolution is halved, so is the amount of required disk space. Such issues are highly important – a compressed S-VHS-quality clip of just under two minutes consumes nearly 90Mb!

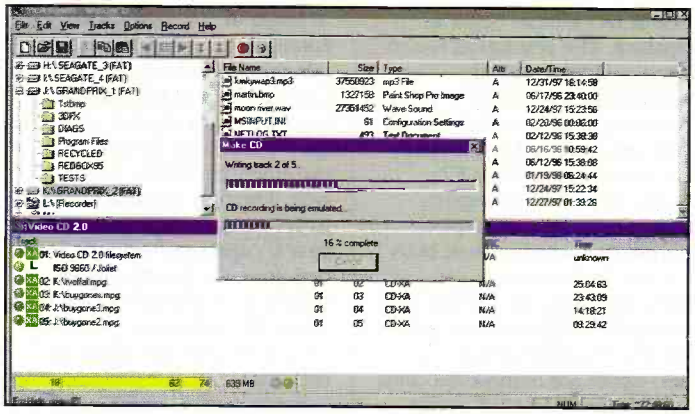
Most of the cheaper capture cards simply handle the video side of things, relying on a sound card to handle the audio, the computer combining, or interleaving, the audio and video datastreams under software control. Such models include the DC10 from Miro, and Matrox's Rainbow Runner add-on for the Mystique graphics cards. Both of these models, which are intended for Windows 95 PCs, can be had for 250 or so – which is a fair price considering the technology involved. More expensive 500-plus cards, such as the DPS EditBay (PC), Miro DC30 (PC/Mac) and FAST AV Master, have in-built audio capture. These cards are better suited to longer captures – over 10 minutes or so – since sound and vision are kept in perfect synchronisation by various on-board hardware and firmware features.

In non-linear video editing, you would normally capture a series of video clips from your camcorder or VCR. A special non-linear editing program, the most popular examples of which are Adobe Premiere and Ulead MediaStudio, are used to trim the clips and piece them together. The main advantage of the non-linear approach is the flexibility that working in the digital domain provides. Once your video is in the computer, it can be polished by all kinds of software tricks. Some of the video effects and transitions available are quite formidable, and in terms of quality are not that far removed from the results derived from extremely expensive broadcast gear. The only drawback relates to speed. Although broadcast gear is capable of working in real-time, the average PC-based system isn't. There's a long wait as the PC processes, or renders, each transition and effect of your film.

Some semi-professional capture cards, such as the Interactive Images Plum and DPS Perception Video Recorder (both PC-specific) include hardware specifically designed to accelerate rendering. The faster your PC, the quicker the rendering and the shorter the wait. The absolute minimum-spec processor for non-linear editing is a 100MHz Pentium or PowerPC. That said, the 4000 Plum card removes all rendering responsibility from the host computer, and hence will work quite happily on lower-spec Pentium-based machines. One area in which you can't skimp, however, is that of disk storage. You'll need several gigabytes of disk space, and the drive's performance is also an issue. As a bare minimum, the latest UltraDMA variety of IDE disk will do; AV SCSI drives are, however, a better choice particularly if edits of high (e.g., S-VHS) quality are required. In non-linear editing PCs, the AV drive is reserved solely for multimedia material (M-JPEG, audio and MPEG files). Programs and non-multimedia data are stored on the boot-up drive, which could be a standard IDE type.

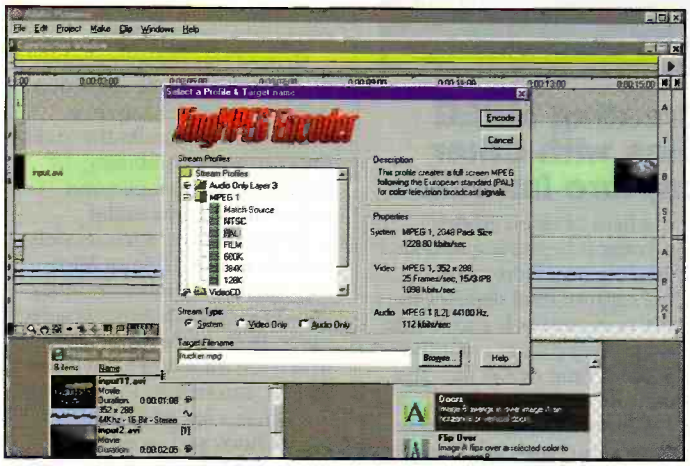
The rendering process generates the final edit file, which can be printed to video or recorded to tape. Capture cards don't just record video – they can output it as well, converting it back into the analogue form that a conventional VCR can understand. The sound, meanwhile, is handled by the same peripheral that captured it in the first place. You don't have to print your rendered edit to





video, however – and this leads us to the area that is directly relevant to VideoCD creation.

Although the final edit is in M-JPEG format, it can be converted into a VideoCD-compatible MPEG-1 file, with a third-party utility. This conversion is an off-line process that can take a considerable period of time, depending on the speed of your PC. To give you some idea, one minute of video can take around 20 minutes to convert with a P133-based PC! The picture quality tends to be



far, far superior to that available from budget real-time MPEG capture cards, such as the two LAVision products described earlier. Indeed, visually they're not much worse than commercial Video CDs!

Sometimes, MPEG conversion utilities are bundled with the capture and editing programs supplied with the hardware. One such program is the Ulead MPEG converter that ships with Ulead's MediaStudio. These free programs are, alas, cut-down versions incapable of producing files to VideoCD format. That's not to say that suitable software isn't available. Xing MPEGEncoder (Windows 95/NT, 200) and Astarte's Mpack (MacOS, 400) are both capable of doing the job to required standards. A free upgrade, that allows MPEG files to be rendered directly from Adobe Premiere or plug-in compatible editing programs, is available for the Xing program. The final edit is rendered directly to an MPEG file, thus eliminating one of the conversion stages and saving time.

What about those capture settings? I find that if you're capturing footage specifically for VideoCD conversion, the half-vertical/half-horizontal resolution option (i.e. 352 x 288 pixels), at 25 frames per second, is directly suited to VideoCD – and takes less time to convert into the required MPEG format since the resolution doesn't have to be changed. You can get away with reasonably high levels of M-JPEG compression when capturing video – in my experience, 7:1 will suffice. With CD-quality sound, one minute of video at these settings will occupy a still-significant 33Mb of disk space – 60 minutes, therefore, consumes nearly 2Gb! Those two gigabytes go down to around 600Mb, after conversion into a VideoCD MPEG-1 file.

The need for 4Gb (or greater) drives increasingly becomes apparent with AV work, particularly if you're editing from a wide range of footage rather than simply capturing one programme as a single long clip. Remember that you should leave space for the final edit, whether this is a M-JPEG or an MPEG file, and allow for the fact that hard disks get slower as they begin to fill up close to their maximum capacity. On which subject, ensure your hard disk is regularly defragmented!

Recording onto Video CD

To write a bona fide VideoCD, your CD mastering software must be capable of producing discs to White Book standard. Suitable programs include Adaptec's Easy CD Creator and CeQuadrat's WinOnCD for the PC, and Astarte's Toast for the Mac. These take the VideoCD-optimised MPEG files and burn them, together with identification files and playback sequence information. Such applications also include a VideoCD playback application for CD-i players. This should be included if the CD is to be recognised by a CD-i player with FMV cartridge; it's worth putting this small file on your CD to make it cross-platform compatible. Note, however, that your CD-R burner needs to be capable of writing mixed Form 1 and Form 2 sectors. Many can – but it's worth checking your burner's documentation. If you know that your CD will only be played back on a PC or Mac, then you can write the files to the disc in standard ISO9660 format – in which case, any CD burning application will be suited.

Copyright Warning

With the equipment and procedures outlined in this article, it is possible to make recordings of copyrighted works. If this is the case, such recordings must be made solely for your own use, and then only if you have the original recordings. If you do not own the copyright, or have permission to copy from the copyright owner, you may be violating copyright law and could be subject to payment of damages and other remedies. If you are in any doubt, please contact your legal advisor. In the final part of this article, we look at the presentation of your discs.

Points of Contact

McNo, CD-i equipment/software distributor: (01206) 751143.

Cambridge Multimedia, CD-i equipment/software/authoring tool distributor: (01638) 743121.
Web: http://www.cambridge-multimedia.co.uk

LaVision c/o Imago Micro, (01635) 294300.
Web: http://www.lavision.com

Miro, capture card manufacturer, c/o Pinnacle Systems, (01895) 442003. Web: http://www.miro.com

Matrox, capture card manufacturer: (01793) 441219.
Web: http://www.matrox.com

FAST Multimedia, capture card manufacturer: (0181) 968 0411.
Web: http://www.fast-multimedia.com

Interactive Images, makers of Plum, c/o Cameron Communications, (0141) 633 1745. Web: http://www.iimages.com

DPS, capture card manufacturer: (01252) 718300.
Web: http://www.dps.com

Xing Technology, makers of PC-specific MPEG conversion software, c/o RealWeb, (0181) 470 4494. Web: http://www.xingtech.com

Astarte, makers of Mac-based MPEG conversion software, c/o Computers Unlimited, (0181) 200 8282. Web: http://www.astarte.de

Sounds OF NATURE

by Douglas Clarkson

The status and consideration of music has changed within different eras of civilisation. The analysis of the evolution of music through the Greek (especially Pythagorean), Roman through to the Renaissance and modern interpretations is a major undertaking – and one which tends to be reviewed within a narrow academic remit. Also, the complexities of the sounds of nature have only recently been able to be explored in some detail with the advent of modern sound sampling systems. Before this, the main interpretation was essentially one of a romantic nature.

Courtesy The Strad, Harrow.

New Perceptions

It is a curious paradox that in an increasingly technically sophisticated age, and especially when the cerebral components of the hearing process can be mapped using advanced techniques of Magnetic Resonance Imaging and Positron Emission Tomography, it is becoming possible to link the physical nature of sound with its effect and interaction on the individual. Although there is very little reported work of this nature, the whole area of the response of the hearing and cognitive system to musical scales and harmonics must surely be investigated anew on a much more objective basis.

Sampling Technology

The present revolution in the world of music via synthesisers and sampling systems is effectively giving free reign to the generation of sound. The actual determination of what makes for 'good' sound or 'bad' sound is left to a process of experimentation and personal preference. The very major contribution of Helmholz in the 19th century, however, to understanding the generation and the harmonic appreciation of the sounds of music still largely holds sway. What may emerge in time is an understanding of how the brain perceives sound and how 'correct' sound can trigger an optimum response.

Missing Links

In this objective analysis of the perception of sound, which really has not yet taken place, there is the possibility that aspects of the hearing/listening process of sounds are rooted in the mechanism of the distant evolution of homo sapiens. The perception of music with its ability to separately distinguish sound components over a wide spectral range is also very probably related to hearing the snap of a twig in a forest within a background noise of wind rustling through leaves on trees. Even the most apparently basic form of mammalian life today is possessed of excellent hearing. It is also the case that this high development of hearing in mammalian life is not directly related to the development of spoken language. So while we use hearing as an integral component of spoken communication, the hearing component was probably in high development long before speech became in any way important.

Training the Ear

A normal perception of the faculty of hearing is that we are, usually provided at birth with hearing faculties which are used as required for varying applications and functions. As a note of interest, the modern world is very much a place of twigs snapping in the forest. Faculties of hearing are very important for crossing a busy modern road. The function of hearing is usually a precursor for looking to ensure a safe crossing.

In analysis of 'neural traffic' between the ear and the brain, there is the afferent pathway of 'ear to brain' and the efferent pathway of 'brain to ear'. There is an aspect of training in both of these pathways – perhaps more especially in the efferent pathway of 'brain to ear' where it is

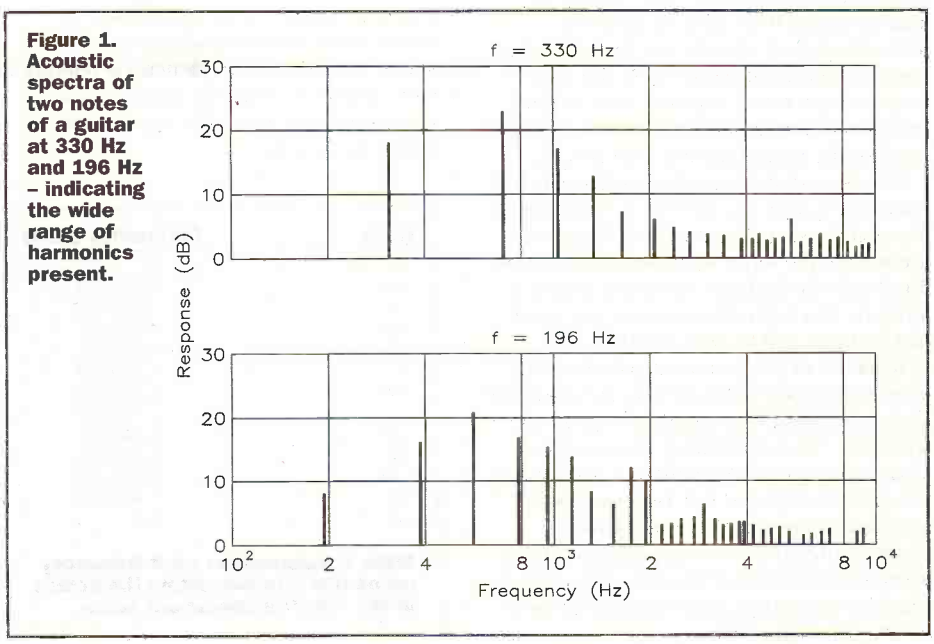


Figure 1. Acoustic spectra of two notes of a guitar at 330 Hz and 196 Hz – indicating the wide range of harmonics present.

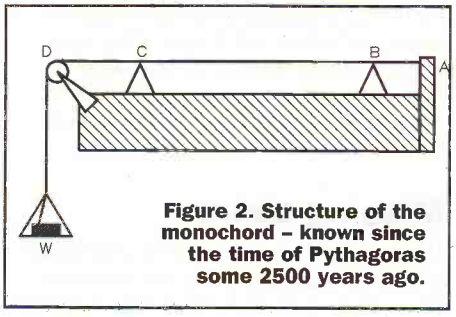


Figure 2. Structure of the monochord – known since the time of Pythagoras some 2500 years ago.

thought that components of frequency response of the cochlea can be altered by changing the stiffness of selected areas of sensitive hair cells.

Can individuals develop different sensory perceptions within complex types of noise based on frequent exposure to specific types of sound? Perhaps one can point to the demanding skills of the conductor of an orchestra who has to learn a 'correct' sound map of a complex piece of music and instantly determine if an error occurs – even as little as one note on a single instrument. It could be imagined, that in the case of the conductor he or she is training to a high level the discrimination of pitch and synchronism. There is also the possibility that as the piece of music is unravelling, the brain could be dynamically altering the frequency response of the cochlea in order to better undertake this process of sound discrimination.

The World of Harmonics

It is generally known how musical instruments are essentially different in how they sound based on the nature of their harmonics. The main types of musical instruments can be described by being string based, resonating air based or percussion. The harmonics produced are determined essentially by the permitted modes of vibration of the appropriate mechanical system. The historical development of instruments has evolved not so much from the basic scientific understanding of complex resonating structures but from appreciating the sound at a conceptual level. Thus with today's superb instrumentation, it is possible to analyse sound from a broad range of instruments and identify the characteristics based on harmonic content. At the same time, it is not totally apparent why certain mixtures of fundamental and harmonics are found to be more pleasing than others.

It is often quite a surprise to discover how many harmonics are present in what seems like quite basic musical sounds. The lower the sound, the more harmonics that can be fitted into the auditory spectrum. Figure 1 indicates the acoustic spectra of two notes of a guitar at 330 Hz and 196 Hz.

While there are dominant contribution from harmonics, there are also envelopes of sound and noise that interleave the sound spectrum. Thus artificial synthesis of the sound is not possible by merely developing the fundamental and the associated set of audible harmonics. Also, the relative duration of harmonics may change rapidly within the duration of the note. This requires sophisticated sampling systems to determine such effects.

Harmonics and Equal Temperament Scale

The scale universally used in western music is the equal temperament scale which is a geometric ratio scale where each octave comprises twelve semitones and with each higher semitone being the twelfth root of 2 (1.059463) higher in frequency than the lower one. Thus over an octave scale of twelve semitones the frequency doubles. Where harmonics are produced that are whole number multiples of the fundamental, such as 2, 3, 4 etc, the harmonics will be produced at higher octaves.

With the cut off of auditory hearing at around 15 kHz – or possibly 20 kHz if you have led a 'quiet' life, musical instruments can produce sound which is above the normal range of hearing. Thus an audience at a piano recital can be subjected to sound from 20 Hz to well above 20 kHz. Depending on the means of recording and distribution of the sound, the higher frequency content of the sound will probably be lost.

In the describing of hearing threshold, there is a distinction between the threshold of perception (ie that there is a sound there) and the threshold of sensory stimulation (ie that the cochlea is sending signals to the brain). It is not clear what is the value (if any) of the residual higher frequency neural pulses that can be communicated to the brain but which do not contribute to the sensation of hearing. Is it possible that the brain has long ago decided that such signals serve no useful purpose based on the need to integrate other functions within the tightly packed cerebellum?

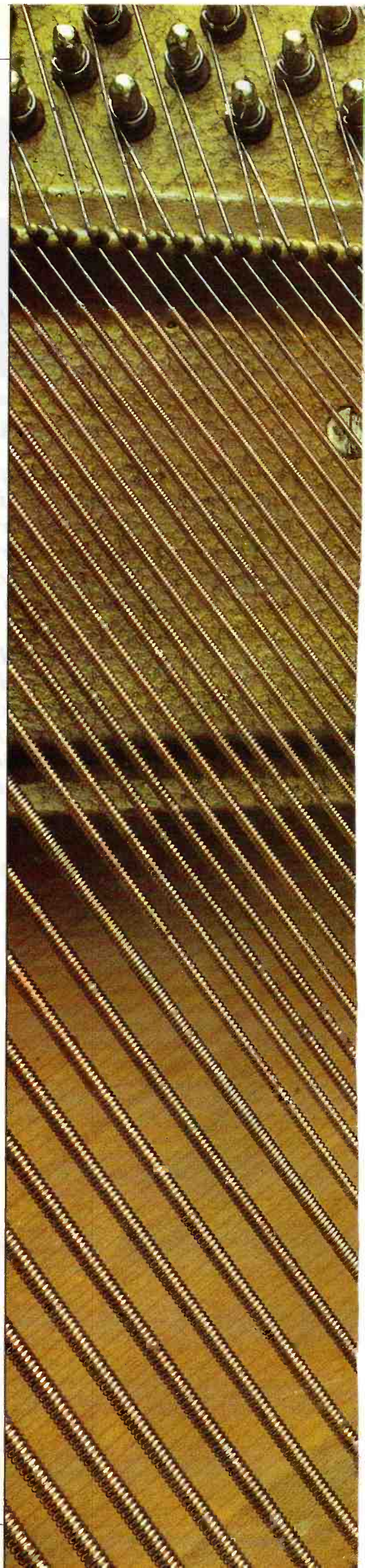
Table 1: Summary of semitone frequency ratios within the octave based on equal temperament scale.

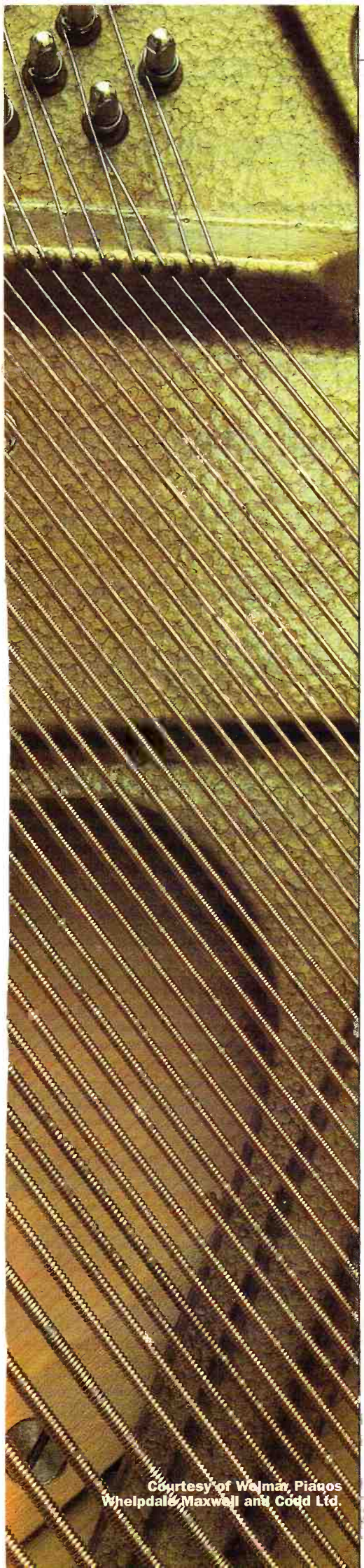
This division of frequencies provides a natural identification of so called states of consonance and dissonance where notes played together can sound harmonious or unharmonious. This has a direct relevance when notes are considered in relation to the first harmonic (fundamental) and higher harmonics.

Table 2 indicates the findings of Stumpf in further analysis if work undertaken by Helmholz in which the characteristics of sound at dissimilar frequencies is referenced with respect to when the beats are most unpleasant and when the beats can no longer be heard.

Note	Frequency Ratio
c	1
c#	1.059463
d	1.122462
d#	1.189207
e	1.259921
f	1.334840
f#	1.414214
g	1.498307
g#	1.587401
a	1.681793
a#	1.781797
b	1.887749
c'	2.0

Table 1. summarises what frequency ratios this provides within the octave of the equal temperament scale.





Courtesy of Welmar Pianos Whelpdale Maxwell and Codd Ltd.

Frequency Hz	beat at which most unpleasant Hz	beats at which no longer heard Hz
96	16	41
256	23	58
575	43	107
1707	84	210
2800	106	265
4000	-	400

Table 2. Characteristics of sound at dissimilar frequencies is referenced with respect to when the beats are most unpleasant and when the beats can no longer be heard.

Details of the importance of this will be seen when referenced to the role of higher harmonics. The unpleasantness of these sounds probably relates to the irritation of responding to a series of rapidly alternating stimuli.

With the availability of the monochord illustrated in figure 2, as developed by Pythagoras, some 2500 years ago, there has been ample time to investigate the change of sound according to the tension in the wire, the length of the vibrating string CB and the weight of the string. It was Pythagoras who identified that the period of vibration is proportional to its length. The French mathematician and natural philosopher Marin Mersenne in his publication Harmonis Universelle of 1636 further identified that the frequency of vibrations is proportional to the square root of the tension and also that the period of vibration is proportional to the square root of the weight of the string. Mersenne was a highly influential individual in the emergence of the new doctrines of science and was within the same circle as Descartes, Blaise, Pascal and Galileo to name but a few.

These very basic laws are exploited, for example, in the construction of the piano, where with a typical range in frequency of over 7 octaves corresponds to a ratio of length of a factor of around 150 at constant tension and string characteristics. The extremes of length of the low frequency wires is avoided by using much heavier wire and the extreme shortness of the high frequency wires is avoided by placing longer wires under higher tension.

A stretched string can potentially resonate at harmonics in ratio of frequency 1:2:3:4:5:6 etc.

Assigning a value of 256 Hz to middle C, table 3 indicates the frequency of harmonics and corresponding piano notes on the equal temperament scale.

It would be expected, that if the fundamental of 256 Hz was struck, then the higher indicated notes would resonate within the piano – as the harmonics present within the fundamental find resonance in the higher frequency notes. Note, however, that even in a perfectly tuned piano, the seventh harmonic is indicating some dissonance with respect to the piano note at 1825 Hz.

Thus the process of using a stringed instrument such as the violin or a piano is utilising very deliberately the nature of harmonics of the instrument and in general any musical instrument has its own identifiable timbre or distinguishing characteristic quality of sound.

Harmonic Sensitivity

In the interpretation of sound, there is invariably introduced aspects of 'how' a sound which comprises a series of harmonics subjectively sounds. According to Sir James Jeans, the second harmonic is associated with clearness and brilliance but does not radically alter the timbre or characteristic musical quality. The third harmonic introduces a certain degree of hollow, throaty or nasal quality to the sound suggestive perhaps of the clarinet. The fourth harmonic does not substantially add to the timbre of the sound while the fifth harmonic tends to add a horn like quality to the tone while the sixth adds a delicate shrillness. The seventh harmonic, however, generates a dissonance and this is also characteristic of the higher odd harmonics, the ninth, eleventh, thirteenth etc . The presence of these harmonics tends to make the sound seem metallic.

In this analysis, the struck hammer implies a brief contact. The main mechanism of reducing the high odd harmonics is to utilise hammers covered with soft material such as felt. The longer the hammer is in contact with the string, the less energy is passed into the higher harmonics. With aging of the piano, the felt surface can become less absorbing and the duration of a hammer strike will decrease – thus trending to increase presence of higher harmonics and give a 'tinny' sound.

The relative position where the string is struck is also important. If, for example, the string is struck at a node of vibration of the seventh harmonic, then this harmonic will be largely eliminated though the ninth and eleventh will still be present.

The nth harmonic will be evident in the string vibrating with n antinodes of vibration (maximum amplitude) and n+1 nodes of vibration (zero amplitude). Thus the string can be considered to be resonating in n sections. Thus to suppress the 7th harmonic, the string should be struck at one of these nodal positions. In practice the

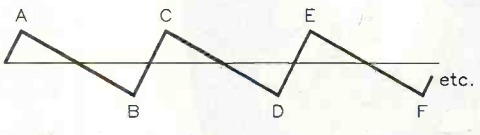


Figure 3. Motion of a bowed string. Sections AB,CD, EF relate to the string being dragged down by the bow and sections BC, DE etc relate to string slipping back.

exact choice of striking point can provide a compromise between reducing the odd high harmonics.

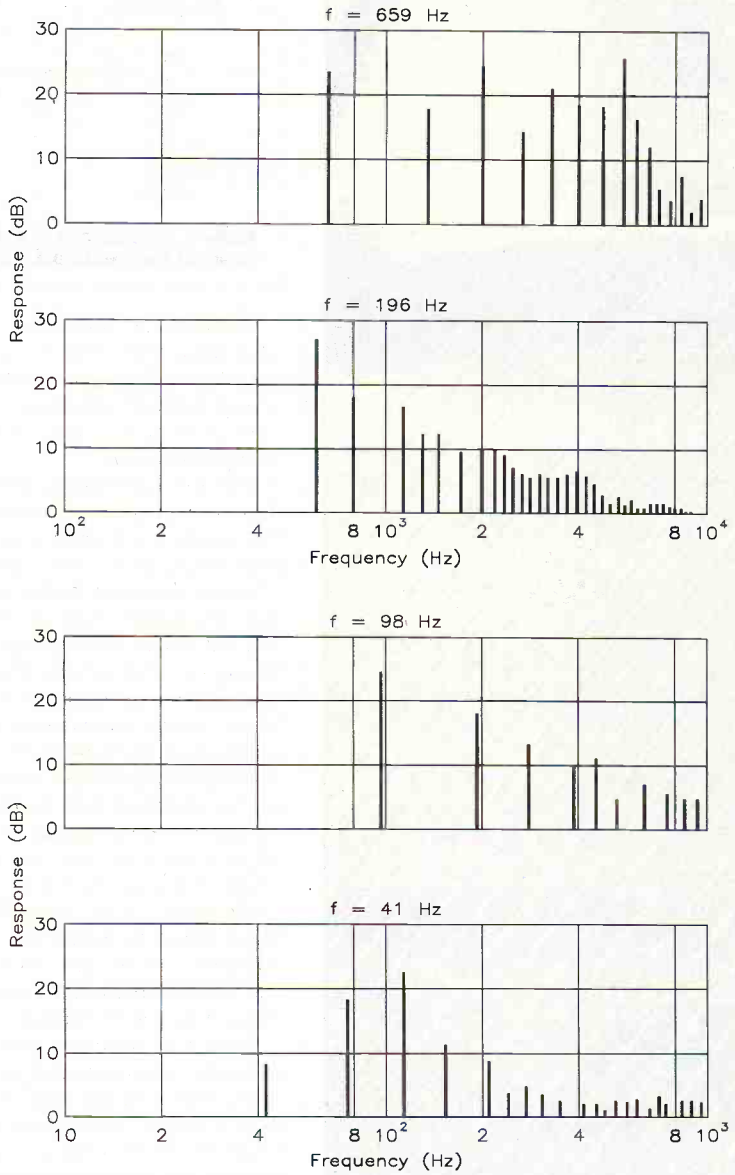
The very distinctive sound of the piano, therefore, is very much due to the deliberate suppression of higher odd harmonics through hammer strike position and damping using contact hammers.

Using New Technology

The piano can be identified as a highly developed instrument using traditional methods of manufacture. It could possibly be asked, what is there that could be undertaken using modern technology to improve the acoustic quality of a conventional piano? It might be possible to introduce a component of electronic control of sounding hammers – as per period of contact and level of impact force. This could for example, control more accurately the correct period of contact for the specific frequency of the note. Alternately, this could be looked upon as a measure of control of the harmonics of the piano – so that its timbre could be changed at the flick of a switch. Such adaptive controls, however, would be certain to increase the cost of such an instrument.

Courtesy Boosey & Hawkes.

Figure 4. Harmonic content of notes played on the violin (upper section) and the double bass (lower section).



The Violin

Just as the piano has reserved for itself a vast amount of written music, so also the violin is a favoured instrument. As a stringed instrument, it could be imagined that much of the laws of harmonics would apply to the violin in relation to a plucked string where the proportions of harmonics present depends on the relative position on the string that is bowed. This is, however, not the case. Significant work in investigating the nature of the acoustics of the violin was undertaken by Helmholz who photographed the dynamic motion of a point on a bowed string.

Piano note	c'	c''	g''	c'''	e'''	g'''	bs''	civ
Frequency (Hz)	256	512	767	1024	1290	1534	1825	2048
Frequency (Hz)	256	512	768	1024	1280	1536	1792	2048
Harmonic of string	1	2	3	4	5	6	7	8
Difference (Hz)	0	0	1	0	10	2	33	0

Table 3. Relationship between harmonics of middle c.

Harmonic Number	1	2	3	4	5	6	7
Energy plucked	1	1/4	1/9	1/16	1/25	1/36	1/49
Energy struck	1	1	1	1	1	1	1
Harmonic Number	8	9	10	11	12	13	14
Energy plucked	1/64	1/81	1/100	1/121	1/144	1/169	1/196
Energy struck	1	1	1	1	1	1	1

Table 4. Differences between energy distribution of struck strings and plucked strings.

Harmonic	Frequency	Relative Fraction
First	257	29
Second	514	7
Third	771	20
Fourth	1028	1
Fifth	1285	2
Sixth	1542	6
Seventh	1799	6
Eighth	2056	8
Ninth	2313	16
Tenth	2570	9
Eleventh	2827	30
Twelfth	3084	35

Table 5. Relative harmonics of a clarinet played at close to fundamental at middle C.

What was evident was that the string would take up a sawtooth motion as indicated in figure 3 where for example section AH the bow would pull the string down and at H the string would spring back in section HC and then pulled down again in section CH and so on. The precise proportion of time of 'slippage' to time of 'bowing' varied with the position of the point of bowing. Helmholz discovered that the strengths of the various harmonics is typically in the ratio of 1:1/4:1/9:1/16 etc and is essentially unchanged by the point at which the string is bowed and ensures that all harmonics are present. This contrasts with, for example, a string plucked at its mid point which would cause the odd harmonics to be present but the even harmonics to be absent. This is why the bowed string of the violin sound much more interesting than that of the plucked string.

Another main difference between the piano and the violin is that a piano note once sounded cannot be modified in volume whereas the note of a violin can be moved through a range of intensities – thus adding to the sensitivity with which pieces can be played. The model developed by Helmholz is essentially true for narrow bows. Where wider bows are involved, the relative harmonics are influenced by the position of the bowing point. Higher harmonics tend to be suppressed where they would naturally occur at the bowing point.

Figure 4 indicates the harmonic content of notes played on the violin (upper section) and the double bass (lower section).

Vibrations of Air

The human voice is very much a process involving the passage of air over resonating structures. The use of air resonating structures gives from the interaction of the laws of physics a certain scope for music making which again is dominated by the interaction of harmonics. Figure 5 indicates how basically air can be set resonating in an organ pipe with a stopped end and an open end. The resonant frequencies relate essentially to odd multiples of quarter wavelengths of sound in the pipe. The ratio of frequency of harmonics is thus 1:3:5:7 etc. Where the stop is removed and the tube is open at both ends, then the frequency of the fundamental is doubled and even harmonics only are established.

Because of the nature of the resonating column of air, there is a dependence arising from the diameter of the pipe on the frequency of the higher harmonics. Thus where resonances of a string like nature are required which contain high harmonics, pipes are used of very small diameter. The mixture of harmonics is also a dependent on the speed of air flow across the lip of the pipe. The use of resonance from air contacting an edge is utilised for example in the flute and the piccolo.

While the relative harmonics of the piano tend to be essentially beyond the control of the player, this is certainly not the case with many wind instruments. If, for example, the note is played on the flute when playing softly, moderately loud and loudly, then the notes will sound differently as with more forceful playing a higher component of higher harmonics will be introduced. Thus the flute player will have a greater control over the expression of the music since he or she will be controlling the relative mixture of harmonics sounded.

Analysis of, for example, the harmonics of the clarinet will reveal a trend for dominance of higher harmonics. In one analysis of a clarinet at middle C at 257 Hz, the relative harmonics were identified as in Table 5.

This indicates a relatively high contribution of 11th and 12th harmonics. Figure 6 indicates the acoustic spectrum of four different types of organ pipe at same fundamental pitch.

The Wind Whistle

The sound of wind blowing through a tree is characteristic of the so called 'wind whistle' effect where a constant stream of air flowing around an obstacle can set up periodic fluctuations in the vortices of moving air. It has been shown that a vortice is set up each time the air travels the equivalent of approximately 5.4 times the diameter of the obstacle.

This implies that the frequency of the sound is given in Hz by dividing the speed of the wind in metres per second by the diameter of the object in millimetres and multiplying this value by 185.2.

Values of the characteristic tones produced on various diameter objects is indicated in Figure 7. Thus the wind blowing through a tree with a wide range of thicknesses of twig and branch will produce a wide spectrum of such 'wind whistle'

Interval	Frequency Ratio occurring in ratio	Largest number Notes	Typical	
Unison1:	1	(1.0)	1	
Octave2:	1	(2.0)	2	
Perfect Fifth	3:2	(1.5)	3	F-C,C-G,G-D
Perfect Fourth	4:3	(1.333)	4	
Major Third	5:4	(1.25)	5	F-A,C-E,G-B
Major Sixth	5:3	(1.667)	5	F-D,C-A,G-E
Minor Third	6:5	(1.2)	6	
Minor Sixth	8:5	(1.6)	8	

Table 6. Interval and corresponding pitch ratios.

	Harmonic	Frequency	Ratio Corresponding Harmonics	(n+1)/n ratio	(n+2)/n ratio
Lower	1st	256	1		
Frequency	2nd	512	1		
C	3rd	768	1		
	4th	1024	1		
	5th	1280	1		
	6th	1536	1		
Higher	1st	383.6	1.4984 (3:2)		
Frequency	2nd	767.2	1.4984 (3:2)	2.9968 (3:1)	
E	3rd	1150.8	1.4984 (3:2)	2.2477 (9:4)	4.4953 (9:2)
	4th	1534.4	1.4984 (3:2)	1.9979 (2:1)	2.9968 (3:1)
	5th	1918.0	1.4984 (3:2)	1.8731 (15:8)	2.4974 (5:2)
	6th	2301.6	1.4984 (3:2)	1.7981 (9:1)	2.2477 (9:4)

Table 7. Structure of the harmonic symmetries of a perfect fifth with lower note being middle C at 256 Hz.

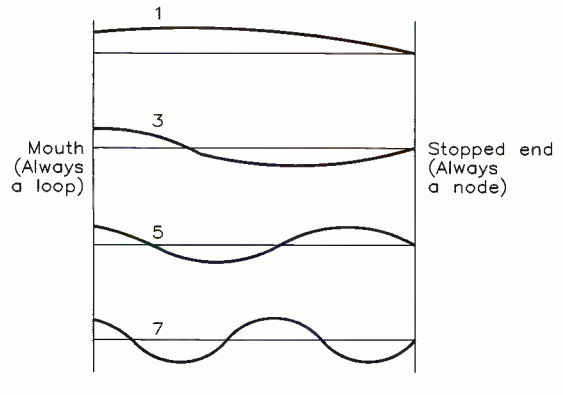


Figure 5. Resonating structures with organ pipes with one stopped end and one open end.

	Harmonic	Frequency	Ratio Corresponding Harmonics	(n+1)/n ratio	(n+2)/n ratio
Lower	1st	256	1		
Frequency	2nd	512	1		
	3rd	768	1		
C	4th	1024	1		
	5th	1280	1		
	6th	1536	1		
Higher	1st	322.54	1.2599 (5:4)		
Frequency	2nd	645.08	1.2599 (5:4)	2.5198 (5:2)	
	3rd	967.62	1.2599 (5:4)	1.8899 (15:8)	3.6626 (15:4)
E	4th	1290.16	1.2599 (5:4)	1.6799 (5:3)	2.5198 (5:2)
	5th	1612.7	1.2599 (5:4)	1.5749 (25:16)	2.0999 (25:12)
	6th	1935.24	1.2599 (5:4)	1.5119 (3:2)	1.8899 (15:8)

Table 8. Structure of the symmetries of a major third with lower note being middle C at 256Hz.

Fibonacci Number	Interval	Pitch ratio
2	major second	1.1225
3	minor third	1.1892
5	perfect fourth	1.3348
8	minor sixth	1.5974
13	augmented octave	2.1189

Table 9. Chromatic melodies and harmonies obeying proportions of the Fibonacci sequence.

there are a total of n times m harmonic interactions between the notes. Note also that the equal temperament scale does not provide for exact fractional relationships to be always achieved even though it is predicted from the theoretical ratio of the interval.

Thus the harmonic relationships are preserved for corresponding harmonics between the two components of the perfect fifth C-G – ie all the similar harmonics (2nd to 2nd, 3rd to 3rd etc) have the same ratio – assuming that the harmonics of the instrument are as anticipated.

The set of ratios of for example of the n+1 th harmonic of G with the nth harmonic of C gives a set of mainly simply related harmonies – ie 3rd to 2nd, 4th to 3rd etc. Also, the ratios of frequency of the n+2th harmonic of G with the n th harmonic of C gives another set of essentially simply related harmonics – ie 4th to 2nd, 5th to 3rd etc.

Table 8 indicates a similar set of results for a major third between C and E.

In comparison of the perfect fifth with the dominant frequency ratio of 3:2 and the major third with the dominant frequency

sound. In a cornfield, for example, the thinner diameters of the stalks will tend to generate higher tone.

The Rippling Stream

The sound of water cascading into a pool in a stream is generally regarded as one of the distinctive sounds of nature. Elements of this sound are in fact produced by resonating air bubbles which are trapped under water and with the higher frequency sounds produced by smaller bubbles and the lower frequency sounds produced by larger ones.

Resonance and Dissonance

The very foundations of western music are largely based upon associations of notes that when sounded together sound harmonious and with combinations usually being avoided which sound disharmonious. In terms of intervals that sound harmonious, a selection of these can be summarised in Table 6.

The description of the 'fifth' or 'third' etc relates to the inclusive number of letter notes within the interval. The numerical ratios are in fact not exactly represented by the precise values of the specified fractional ratios. They are typically of the order of 16 cents out where one semitone equals 100 cents though this is still close enough to sound harmonious. The attractiveness of these combined sounds which is initially assessed on the basis of first harmonic or fundamentals being present will also be influenced by the presence of harmonics, which is why music which sounds agreeable on one instrument need not necessarily transfer well to another.

Table 7 summarises the structure of the harmonic symmetries of a perfect fifth with lower note being middle C at 256 Hz.

In general where there are n harmonics in one lower note of an interval and m harmonics in the upper note of the interval

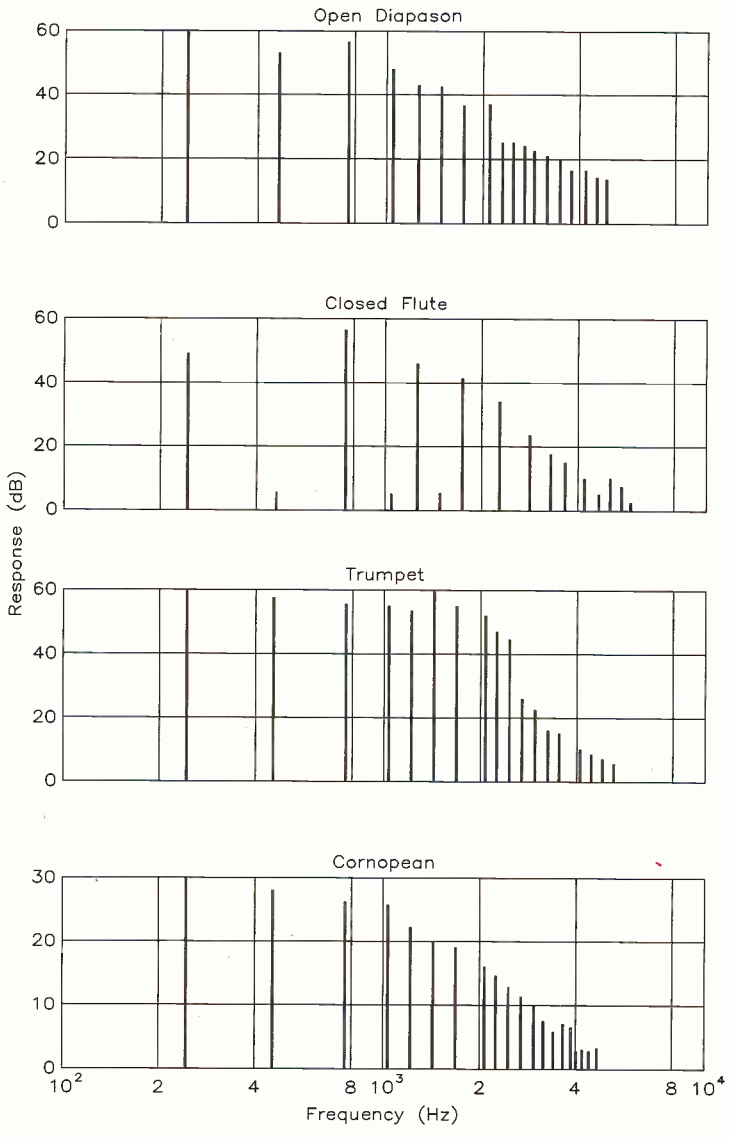


Figure 6. Acoustic spectrum of four different types of organ pipe at same fundamental pitch.

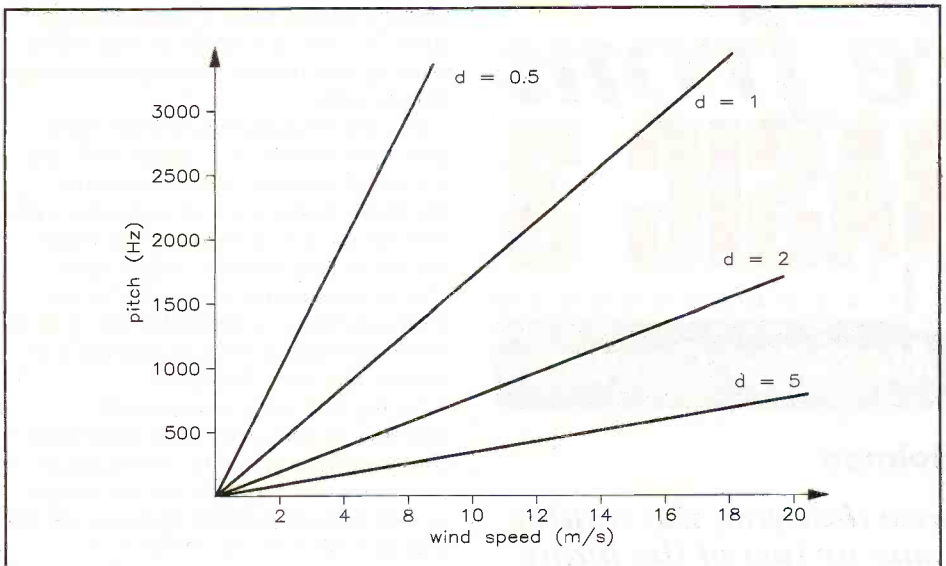


Figure 7. Values of the characteristic tones produced on various diameter objects by wind flowing past.

ratio of 5:4, calculations show that the higher harmonics are combining with less satisfactory ratios such as 15:8 in the perfect fifth and 25:12 in the major third. The actual importance of this will vary with the instrument being played. Intuitively, musicians avoid harmonic combinations and keys that are likely to introduce dissonances.

Structured Harmonic Synthesis

In an electronic age where sounds can be independently synthesised from discrete harmonic components, etc, the potential sophistication that can be incorporated into musical structures is staggering. It is even possible to develop sub groups of notes whose harmonics can combine with greater harmony in set intervals such as perfect fifths or major thirds. Such notes would therefore have supressed harmonics which would combine to form a dissonance if played together, eg 5th harmonic of E and 3rd harmonic of C in a major third as outlined in table 8. Such an active role in determining the harmonic content of notes is generally not practicable with conventional musical instruments. There is the potential, therefore, for musical synthesis to take on a much more deliberate and structured approach, where the harmonic content of intervals is controlled in a much more purposeful way.

Music of Drums

Drums may have been one of the earliest of musical instruments to have been developed. What they have by way of volume and naturalness for rhythmic content, they do not have by way of pleasant sounding harmonics. The surface of a circular drum tends to resonate in distinct surface modes of vibration as indicated in Figure 8. The actual frequencies are determined by solutions to so called Bessel Functions which in the case of a drum are not simply related and give no pleasing sounds.

In the case of a well constructed bell, however, which can be considered as a similarly vibrating structure, some of the more important harmonics derived as Bessel functions bear a simple numerical relationship to the fundamental and so the sound appears more pleasant.

Musical Mysticism

While the basic understanding of the harmonic characteristics of musical instruments is the foundation of the creation of music, the laws of physics as yet expounded do not necessarily explain why music of one composition appears dull and threadbare while another can move to tears through intense emotion. An excellent introduction into the links between music, science and the natural order of the universe is given by Jamie James in 'The Music of the Spheres'. The interest, however, in what makes for masterful music is as great as ever.

The recent publication by Erno Lendvai of Symmetries of Music seeks to highlight the use of the so called Fibonacci series of numbers (2,3,5,8,13,21,34,55,89..) etc where each following number is the sum of the two previous ones. The Fibonacci number sequence is especially identified in the law of natural growth and is evident, for example, in the number of spirals in fir cones and number of petals in flowers.

The use of these numbers in pitch structures relates directly to the scale of musical notation as indicated in Table 9.

The pitch ratios are obtained by taking values of 2 raised to the power n/12 where n

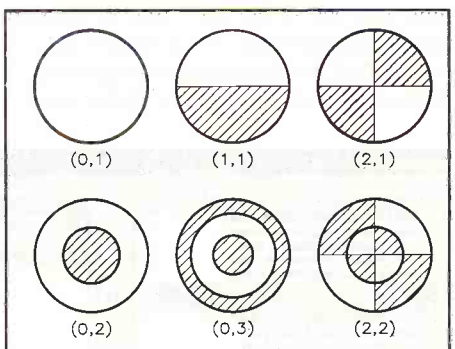


Figure 8. Surface modes of resonance of a drum.

is the Fibonacci number. Also, the utilisation of this numeric sequence can determine the ordering of the bar structure of music ie. the segments within which the music sequence is contained. The use of such structures is strongly identified with the works of Bartok. It should be emphasised, however, that to fully appreciate the utilisation of such structures requires more than a basic understanding of musical theory. Somewhere, however, there lies the suspicion that while some 'classical' music is psychologically beneficial, there exist some pieces which are less than beneficial.

In Conclusion

Since it first appeared some 60 years ago, the text of Science and Music by Sir James Jeans still succeeds in bringing together the very core of science which determines the sounds that musical instruments can make with the structures that have been developed to enable musical sequences of notes to be established. As modern technology has developed, it has enabled a much more detailed appreciation of the basics of properties and indeed limitations of musical instruments to be obtained. It is difficult in many ways to balance the broad scope of the understanding of music at the artistic level and the scientific viewpoint of resonating structures and harmonic generation. In many aspects, however, the process of understanding music is encouraged by a basic understanding of basic scientific/mathematical fundamentals such as why musical instruments sound as they do, why the equal temperament scale of notation has been adopted so widely and what its use implies in terms of musical development.

The astonishing wealth of technology now available to enthusiastic sound developers, however, certainly also needs to be applied with reference to the such fundamental interaction of sound within a basic framework of scales and harmonics.

Courtesy Boosey & Hawkes.

Further Information

Science and Music, Sir James Jeans, Cambridge University Press, 1953

Measured Tones, The interplay of physics and music, IOP Publishing, 1989.

Exploring Music, The science and technology of tones and tunes, Charles Taylor, IOP Publishing, 1992

Symmetries of Music, Erno Lendvai, Kodaly Institute, Kecskemet, 1993

Get more from VISUAL BASIC 3

PART 1

Forms, ByVals and Message Queues

by Mike Holmes

Before we begin let us suppose that you, the reader, are already familiar with one or two of the many books currently in print about how to program in Microsoft Visual Basic. Not wishing to detract from the quality or otherwise of these publications, it must be said that the majority have typically been 'tutorials' that show you how to create a window and fill it with buttons, list boxes and text fields.

What I propose to do in this short series is to build on this foundation by illustrating a few extra 'wrinkles' and secrets that you can add that will serve to make your finished programs all the more professional in appearance, and more user-friendly. This constitutes the sum total of some four years of playing around with Visual Basic on my own part, so that I am now familiar with techniques that are known to work reliably, while discarding those that are less dependable or of little real worth.

This series will exclusively refer to Microsoft Visual Basic version 3.00 at all times. The reason for this is that V3 works reliably with all versions of Windows currently still in use from V3.1 up to Windows '95. Also, the 16-bit VBX's and DLL's for this version are more numerous and easier to come by than the newer OCX's and DLL's.

While the help files provided with Visual Basic are quite comprehensive, there is still much that has been left out. One classic example is the help file for Windows API (Advanced Programming Interface) calls – this merely consists of declaration statements to be copied into your code, without any explanation of how they should be used. Without this information you'll never get them to work.

Before we go any further with this, you need to get some idea of how Windows functions, because this explains much about how Visual Basic does things.

How Windows Works

Unlike DOS, which uses a character look-up table in hardware to display words on the screen, which it can then do quite quickly, Windows is entirely graphical. What this means is that everything you see on the screen has been painstakingly drawn there, as though by a draw and paint program. This even includes every little bit of text.

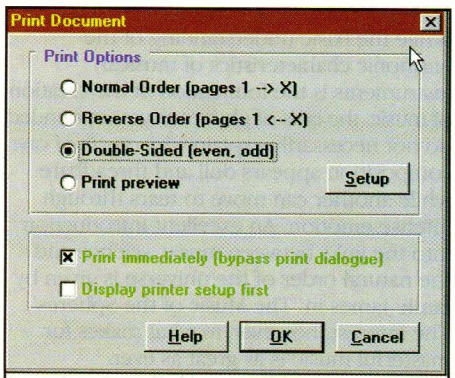


Figure 1. Example of a custom designed dialogue window that must be shown modally and waited on by code.

This is why faster and faster CPUs became necessary, along with the advent of coprocessors, because Windows uses an awful lot of processing power. In the old days of the 8-bit home computer, displaying the output results of a BASIC program was most often no more than a few 'PRINT' lines.

Nowadays, it is quite conceivable that more that 99% of the CPU's time is taken up with displaying things on the screen and doing other Windows related background tasks, as opposed to the little bit that your program actually wants it to do. Similarly, about 70 – 80% of your design time will be taken up with making the program look the way you want.

The best advantage the CPU can have here is the addition of a coprocessor – it is not merely used for complex math in a specifically maths oriented application – just working out how to resize a Window and reposition all its controls, redraw them smoothly and restore a view of what was previously hidden underneath, takes a lot of maths. Handling all these images can also take up quite a bit of memory.

For this reason the 'conventional memory', i.e. the lowest 640K where DOS and its applications reside, is not enough. (The space between 640K and 1M is taken up with essential standard hardware and the expansion cards.) Hence Windows is engineered to make use of all that is available beyond 1Mb. The more the better – 12 – 16Mb is generally a very usable amount in most cases.

The advantage to DOS is that its own RAM is then left in its entirety to itself. Indeed, 'old' DOS programs can be run here by Windows directly and, thanks to multi-tasking (80386 and above), Windows can even run more than one of these side by side simultaneously, hitherto impossible in previous DOS only systems. Moreover, in the case of Windows '95, a Windows application can be run from the DOS screen.

Conservation

It's quite staggering just how much hard disk and memory space Windows uses up, and you might be forgiven for thinking that this is very wasteful. But in actual fact Windows, and the basic concept of Windows, strives for economy in both these areas.

If you take a look at the windows and windows\system directories, you will see an enormous number of disk files, most of which are very esoteric in nature. Broadly these fall into four categories, as defined by their file extension: applications, or (by file extension) EXE's; Dynamic Link Libraries (DLL's); custom controls, or 'new' Windows objects (VBX's and OCX's); and the plain text initialisation files (INI's).

The point is that a Windows program does not contain everything it needs to run, which is completely the opposite of a conventional DOS program. When such a DOS program begins to become too large for the available memory to accommodate it, it cannot be developed any further (unless complex overlaying techniques are employed, which often decrease reliability).

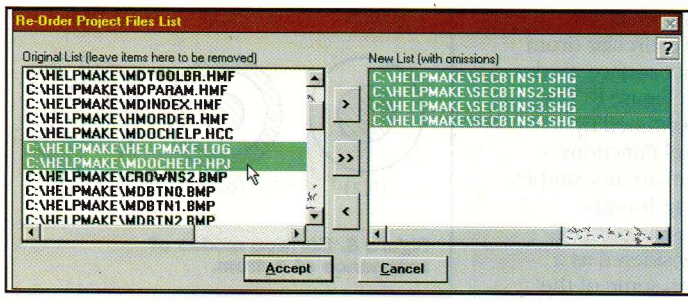


Figure 2. Standard VB listbox controls with horizontal scrollbars added.

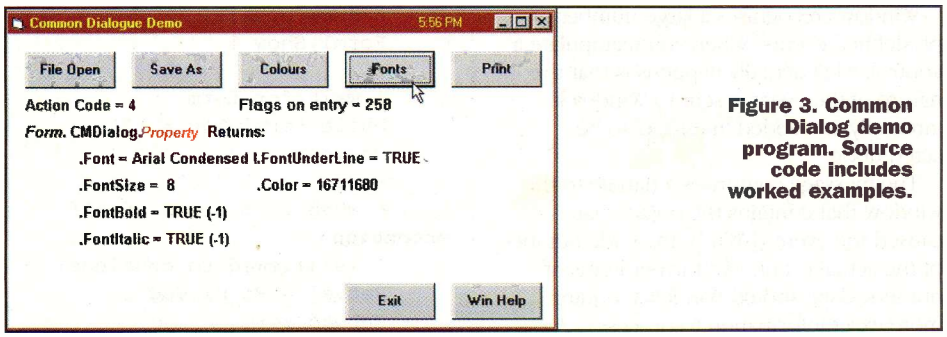


Figure 3. Common Dialog demo program. Source code includes worked examples.

The alternative multiplicity of Windows becomes obvious while working with Visual Basic.

API's And DLL's

When a Windows program needs to do something that Windows itself can do – such as simply redraw a window – it simply calls on the core of Windows itself. It doesn't need its own code to do it, it already exists elsewhere. This also applies to any Visual Basic program. (As an aside, Borland Delphi Visual Pascal is quite different – it draws its own windows and controls.)

Similarly, if the application is called on by the user to present a 'File Open' dialogue window, or a help file, or to print something, or display the colour palette or fonts selection window, it uses the dynamic link library COMMDLG.DLL, also provided by Windows.

When it needs to display 3-D option buttons or check boxes or grooved frames, it takes the appearance information for these from the custom controls file THREED.VBX. (Incidentally, where these controls used to appear as 'flat' black on white in previous Windows versions, Windows '95 will by itself strive to recreate 3-D versions of them on grey using its own THREED.VBX, in keeping with its own appearance.)

The point being that there is only one copy of COMMDLG.DLL on disk and only one copy of it loaded into memory at any one time, even though all running applications are using something from it. Similarly there is only one copy of THREED.VBX, even though several applications are using it. This is how Windows conserves space and improves efficiency for all its running applications.

Many commercial applications also come with their own DLL's and VBX's when they are installed. Here there is the advantage of using a Dynamic Link Library for something temporary, something that the application doesn't need all of the time. The DLL is loaded for that function only, then it can be 'dumped' by Windows afterwards, freeing memory for other uses.

The Swap File

Windows cheats with memory by creating what's called a 'swap file' to make it appear much bigger than it really is. Basically, while lots of applications may appear to be loaded and running at the same time, anything that hasn't been used for a while is 'dumped' out of real memory into the swap file. This

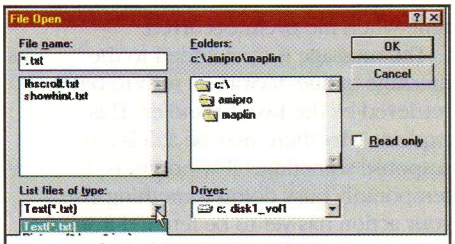


Figure 4. File Open dialogue.

makes as much real memory as possible immediately available suppose, for example, an image editor was required to load up a really large picture of several megabytes in size.

As a user, you would not be fully aware of what was really happening other than noticing a sudden and accelerated amount of hard drive activity. This also accounts for the occasional burst of unheralded hard drive 'rattling' for no apparent reason at all. At these times Windows is simply rearranging its swap file.

Where Windows Stores Its Information

Whenever you start Windows, it reappears looking more or less as it did when you left it last. Not only that but of course all its own setting up information had to be preserved.

All versions of Windows use three initialisation (INI) files, called WIN.INI, SYSTEM.INI and CONTROL.INI. In fact lots of Windows applications have their own INI files too, which also record how they were set up last time they were used. Later in this series I'll show you how to make your programs read and write their own dynamic INI files using the appropriate API calls – in other words, 'properly', the way Windows does it.

In addition, Windows '95 makes much more use of extra repository of information called The Registry. Here, The Registry comprises two large files in the windows directory, called respectively USER.DAT and SYSTEM.DAT. These are a form of database, containing information that applications specifically developed for Windows '95 have also written there. It is also possible to deposit information of your own using REGEDIT.EXE. REGEDIT.EXE can be made to do this at runtime by a Visual Basic program, where it is called with the name of the REG file passed like a DOS parameter.

When Windows '95 starts up, it updates the DAT files and makes back-ups of them both with the extension DA0. If there is a problem at any time and The Registry is corrupted, then Windows can revert to the back-ups. It is possible to examine the contents of The Registry and change them using REGEDIT.EXE, but the data is esoteric to say the least. No-one would normally attempt this except as a last resort in the event of a problem, but it's useful to create a short-cut to it and put it in one of the start menus. But enough of that, back to Visual Basic.

Windows Objects And Controls

Windows is a prime example of 'object oriented computing'. Instead of having to type tedious command words all the time, as in DOS (and invariably mis-spelling them), in Windows you have 'objects' that you can get hold of and physically manipulate. In Windows, virtually everything in the computer is given an object that has physical 'properties' and an 'icon' (picture) to help identify it.

A Windows 'active control' is an object that you can do something with, for example a button that you can press. Otherwise an object may merely display some words or be part of the background window design.

Windows Are Also Forms

Just to confuse the issue, in Visual Basic (and indeed most other Windows application development languages) a 'window' is called a 'form' at the design stage. I like to think that during the conception of Windows, Microsoft's programmers adopted 'forms' as something to describe what they were developing. It was only later that Bill Gates decided to call them 'windows'.

In any case, a form (window) is also a 'container' of its controls, which are then also its 'children'. The relationship between these controls is that they are 'siblings'. The form is their 'parent'. A control invariably has a 'parent' property as a handle to the form (not that I use it very often).

Also a form can be a Multi-Document Interface (MDI), in that it can have other more conventional windows as children. Thus it can be called an 'MDI container'. (Special rules apply to MDI's; this is adequately explained in VB Help.)

Scope Of Variables

A fundamental concept that needs to be grasped is that each form is a complete source file, a 'module'. Separate blocks of BASIC code can also be provided as BAS modules. VBX's are also modules. These modules are listed in the project window of Visual Basic.

In general, no form module can access the BASIC variables of another form module, only the properties of the form or its controls. Any module can access some BASIC variables provided they are defined as 'global' in a separate *.BAS module.

No form can call the procedures or functions of another form, only those of a

*.BAS module. That is why *.BAS modules are required. Such modules can provide single instances of globally accessible routines that any form can use, and which you can then develop into a common library for inclusion in any project – Part 2 will describe such a module.

Variables created within a procedure or function remain local only to that procedure and cannot be read from outside, because they are destroyed when the procedure ends. (The memory they occupied is released by Windows.) If dimensioned as 'Static', then they are retained in memory and their contents preserved, but still can only be read by code in their parent procedure.

A variable created by 'Dim' at the declarations level of a form is accessible to all the code in that module, but not by any other module. In other words, almost a 'global' variable, but accessible only in that one form module. This comes in handy sometimes.

Understanding these rules is key to minimising the amount of code necessary – never duplicate a procedure if you can contrive that only one instance of it be put into a *.BAS module, it makes your programs smaller. Passing an object's properties as the parameters of one of your own procedures is another prickly problem; more of that later.

There are two more things you should be aware of. The first is that each module is limited to only one segment of memory; its variables cannot cross 'page boundaries'. This limits the maximum size of a single string to <64K, less, obviously, if there are more strings. This includes string-like properties. This can be quite a problem if you are designing a text editor.

I've also discovered that menus can take up a lot of space too (having largely string-like properties). So if you want to reserve the maximum amount of available memory for a form but have a lot of menus, make it the child of an MDI container, and put all the menus and other superfluous stuff on the MDI. If you get the MDI to show the child as maximised on start-up, you wouldn't see the difference between this and a single window equivalent.

A second limitation is that standard VB Timer controls use up Windows resources, and that you can have only sixteen timers maximum.

Properties And Events

Windows objects have properties – a background colour, caption text (for a button, say), size and shape, etc. As an example, the basic appearance of all windows generally can be altered in the properties window of the background or desktop (it's still an object), while more information about a floppy disk can be got through the properties window of the drive (another object) that contains it.

Active objects or controls also have 'events'. When you manipulate a control, for instance click on a button, resize a window or scroll a text control or list box, this generates 'events'.

Windows recognises a large number of predefined events. When you manipulate a control, what actually happens is that the nature of the event is sent to Windows internally as a coded 'message' to be acted upon.

The message comprises a handle to the window that contains the object that caused the event (hWnd), the code number of the actual event; two further items of numeric data, should Windows require more exact information to process – otherwise they are zero – and, lastly, the time when the event occurred.

The message is then added to the message queue, to wait its turn to be retrieved by the Event Handler. This explains why there may be a delay in response sometimes if Windows is temporarily busy doing something else – your action has yet to be fetched from the queue and acted on. It should all happen in due course. In addition, programs can generate events on their own during normal execution. A huge file provided with VB called 'win30api.txt' (123K) lists all the Windows 3.0 recognised events, with 'win31ext.txt' the V3.1 extensions. These should be found in the 'Winapi' folder.

'DoEvents'

Here's a sure-fire way of hanging up your computer to the point where the only recourse is to press 'Reset':

```
While: Wend
```

The problem is that all Windows activity becomes concentrated in this, an infinite 'do – while' loop. While the code is running it has priority. This means that nothing is being fetched from the message queue, so it doesn't matter what you do with it, Windows is 'frozen'. It should have been written:

```
While
DoEvents
Wend
```

Which at the very least allows Windows to read the message queue and process all other events, including your clicking on the 'Stop' button on Visual Basic's title bar.

Normally a VB code procedure or function always runs to its end, even if it has opened another window and the code in that window begins to run also. This is as a direct result of multi-tasking – several bits of VB code can run concurrently.

The following is an example I have used many times with great success to force code in a procedure to wait for another window, that was designed to behave as a dialogue. The program code must wait for the user to close the window, as this same window provides user input data that the code needs before it can continue. In this example the dialogue window is called Form1:

```
Dim RetVal As String
Load Form1
Form1.Tag = ""
' show modally
Form1.Show 1

' wait for form
While Form1.Tag = ""
DoEvents
Wend
' when form hides itself
execution
' is allowed to continue:
RetVal = Form1.Tag
UnLoad Form1

' exit if cancelled
If RetVal = "0" Then Exit
Sub
' else
...
```

The 'Tag' property is a non-specific string property possessed by all objects and forms, provided for any purpose you want to put it to. It can only be modified by code, but beyond that the same rules apply as for all other object properties. In other words it's a variable you can freely use that behaves like a property.

In this case it is used as a property where Form1 stores result data for the calling procedure code to pick up. This is necessary because the form containing the procedure and Form1 are different modules, so they cannot read each other's BASIC variables. (Otherwise we would do it that way. You could use a global string variable instead, but then it starts getting confusing if there are too many of these.)

'Modally' means that no form in the same program other than Form1 can receive 'focus' while it is showing, that is, the user must finish with the dialogue and close it before doing anything else.

If abandoned, the dialogue's cancel button puts a "0" in its window's Tag property (simply by 'Tag = "0"'), and then hides the dialogue ('Me.Hide'). Note it does not also unload the dialogue (its parent); the above calling code must do that after reading the Tag property. (If the dialogue unloads first, then a subsequent access to the Tag property will cause it be reloaded and stay invisible, and the property will then be empty because it was unloaded.)

If the dialogue's 'OK' button was pressed, then 'Tag' will contain something other than "" or "0", put there by this button before hiding the form. It is then up to the code following the 'If' statement above to respond to this (not included).

The only snag with this is that you don't then want the user to be able to unload the dialogue directly via its own control menu. This will leave the 'While' loop running indefinitely, making it impossible to end the program. You could disable the form's control menu (ControlBox = False), or you could adopt the more sophisticated approach:

```
Sub Form_QueryUnload (Cancel As
Integer, UnloadMode As Integer)

    If UnloadMode = 0 Then
    ' User tried to close window
```

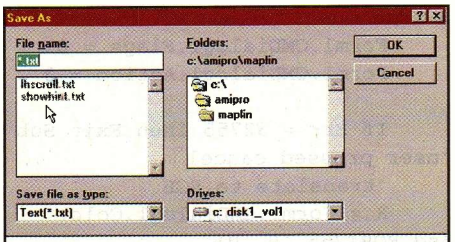


Figure 5, File 'Save As' dialogue.

```
    Cancel = True
    Tag = "0"
    Me.Hide
    End If

End Sub
```

and Cancel (in this instance) stops the form unloading (the precise value of 'UnloadMode' determines that the user tried to close it. It can still be unloaded by code or by Windows if the latter is shut down). The next two lines duplicate the action of the cancel button. To reiterate:

```
Sub Command2_Click ()
    ' Cancel button
    Tag = "0"
    Me.Hide

End Sub

Sub Command1_Click ()
    ' OK button
    Tag = whatever else
    Me.Hide

End Sub
```

An example of a custom made dialogue window that includes the above, and which is invoked by the technique described, is shown in Figure 1. Here, because Windows '95 is used, the still enabled 'control menu close' option appears as an 'X' button at top right. Clicking this has exactly the same effect as clicking the 'Cancel' button, and was deliberately engineered as described above so that it does not look out of place compared with other dialogue examples in other applications that also share this functionality.

How To Pass Object Properties To Custom Procedures

Take a look at this:

```
Function Length (Text As String)
As Integer

    Length = Len(Text)

End Function

Sub Form_DblClick ()

    Debug.Print
Length(Text1.Text)

End Sub
```

'Length' is a custom function created at the declarations level of the form. Seems okay, but it results in a 'Parameter type mismatch' error as soon as you try to run it. VB programmers come across this as soon as they want to pass properties of VB controls or windows to their own written routines. One can cheat by using:

```
    Debug.Print
Length(LCase$(Text1.Text))
```

because it's okay for standard VB keywords and functions to receive properties, but it's also very untidy. So how do you get your custom procedures and functions to accept properties? It's actually very easy – you can't pass the property directly, so instead get your function to take a copy of it:

```
Function Length (ByVal Text As
String) As Integer
```

and all other code remains the same. 'ByVal' causes a string copy of the property 'Text' of object 'Text1' to be created for the function to read. Of course using 'ByVal' means that the function or procedure cannot then modify the property by changing the input parameter, as would normally happen in a variable's case, but you wouldn't normally want to change properties like that anyway.

For variables, passing 'ByVal' also has the effect of protecting the original variable. The procedure can 'fiddle' with the input parameter as much as it likes, it won't alter the original variable. Useful to know. I will show more examples of this in Part 2, and 'ByVal' really comes into its own for API calls.

An API Example

Before we leave the subject of the message queue, here is a simple example you can try. It uses the Windows API call 'SendMessage', a means whereby you can add your own 'event' to the end of the message queue.

This is based on an article in VB Help, but I have tidied it up a bit to make it more universal. It's all to do with list boxes.

Often the contents of a list box rarely exceed the physical width of the list, unless the contents are brought in from outside – in this case the program has no control over the width of any line. In this instance, it is possible for some, if not all, lines to exceed the width of the control, so that you can't see the right-hand ends.

What this example does is add a horizontal scrollbar to the bottom of the list control. A list control does not normally have such a scrollbar, nor can it easily be added merely by setting a property. Such a property doesn't exist for this object.

The following is a TXT file that can simply be merged into the declarations section of a form in VB at design time. The comments included explain it fairly well:

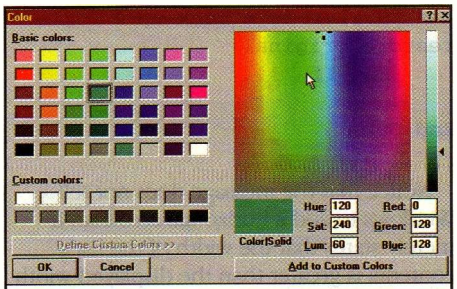


Figure 6. Colour Palette dialogue.

```
' form having a ListBox control.
'
' General Declaration for adding
a horizontal
' scroll-bar to a ListBox control
' (from VB Knowledge Base help)
'
Declare Function SendMessage Lib
"user" '(ByVal hWnd As Integer,
ByVal wMsg As Integer, ByVal
wParam As Integer, ByVal lParam
As Long) As Long
'Note: All commands must appear
on only one line.

'
' Adds a horizontal scroll-bar to
a ListBox object.
' Usage:
' 'AddHscroll listboxcontrolname,
scalefactor'
' where listboxcontrol name is
object (e.g. List1),
' and scalefactor is the ratio to
multiply its width by,
' e.g. '2' = make listbox twice
its displayed width
' and create hscrollbar to pan
across this new total width.
'
' NOTE: call from a form_load
event to set up once
' only. ListBox only scrolls
sideways if at least one
' entry is > displayed width.
'
Sub AddHScroll (Object As
Control, ByVal wRatio As Single)

    If TypeOf Object Is ListBox
Then
    ' do it, else don't
    Dim bback-upAs Integer, x As
Long

    Const LB_SETHORIZONTALEXTENT
= &H400 + 21
    Const NUL = &00

    ' User routine requires
wParam in PIXELS (ScaleMode 3).
    back-up = ScaleMode ' of
form
    ScaleMode = 3 ' change to
pixels

    ' Add the scroll bar.
    x& =
SendMessage(Object.hWnd,
LB_SETHORIZONTALEXTENT,
Object.Width * wRatio, NUL)
```

```
    ScaleMode = back-up ' restore original
    End If

End Sub
```

Notice that the message does not tell Windows to add a horizontal scrollbar. It merely states that the width of the list's contents is greater than the displayed width of the control. Windows' response to this information is, "Oh really? I'd better add a horizontal scrollbar, then."

By the way, 'user' is USER.EXE, the main program that is Windows! Figure 2 shows an example in action, where two list boxes are used to manipulate a list of file names with full paths attached, the total width of which may exceed the displayed list width.

Accessing The 'Common' Dialogues

To conclude, let's just see a quick summary of how to use the 'common dialogue' tools. The Common Dialog (American spelling) custom object, COMMDLG.VBX, enables your application to access Windows' I/O dialogue windows in keeping with other Windows applications.

This means that you don't have to create your own File Open and Print dialogues – indeed you shouldn't – but instead take advantage of the Windows tools that already exist and which are generally more powerful than anything you can create by yourself.

The only problem with the Common Dialog object is getting the code syntax right to use it properly. The help file gives you lots of information about this, in fact too much, so that it is a nuisance to have to start from scratch every time you want to create the code for a new program.

Having researched this issue, resulting in the demonstration program shown in Figure 3, I hereby pass on the essential minimum code for Common Dialog accesses. There are a total of six 'modes', five of which are shown in Figures 4 through 8.

File Open Dialogue

Typically such instructions are put in a menu event procedure, and which can then have a short-cut key. Hence to open a file you would have:

```
Sub mnuFileOpen_Click ()
    On Local Error Resume Next

    ' setup dialogue box
    Form1.CMDialog1.CancelError = True
    Form1.CMDialog1.Filename = FileSpec$
    Form1.CMDialog1.Filter = "Text(*.txt)|*.txt|All types (*.*)|*.*"
    Form1.CMDialog1.FilterIndex = 1 ' 1st item in filter list
    Form1.CMDialog1.DefaultExt = "txt"
    Form1.CMDialog1.DialogTitle = "File Open"
    Form1.CMDialog1.Flags = &H2000& Or &H2& Or &H200&
    Form1.CMDialog1.InitDir = "C:\TEMP"
    Form1.CMDialog1.MaxFileSize = 256
    Form1.CMDialog1.Action = 1 ' must be the last statement

    ' fetch info
    If Err = 32755 Then Exit Sub
    'user pressed cancel or Esc key

    FileSpec$ = Form1.CMDialog1.Filetitle
    ... code to process FileSpec here

End Sub
```

The file types you want it to match are listed in the 'Filter' property. A local error trap is enabled because it is usually more convenient to have the dialogue generate a runtime error if cancelled. If not it would be very difficult to tell if it was cancelled. The menu routine exits if Err = 32755.

If FileSpec$ is a global type variable then all other procedures in the program can read the contents at any time. You can use 'InitDir' to force the same path each time the dialogue is opened, otherwise it will open the same one it last accessed when last used. The 'Title' property returns the full path and file name.

There is a host of information in VB help about flags, too long to include here, suffice it to mention that the 'Read Only' check box in Figure 4 can be hidden by adding 'Or &H4&' to the list of flags.

You can also enable multiple selection of files with another flag. In this case the 'Title' property will return a list with items separated by spaces. The first item is always the path, followed by individual file names. The maximum string length returned in this instance is set by the 'MaxFileSize' property.

File Save As

Exactly the same as File Open except:

```
    Form1.CMDialog1.DialogTitle = "Save As"
    Form1.CMDialog1.Action = 2
```

If FileSpec$ is not empty its contents appear in the text field at top left of Figure 5, otherwise it equals the selected filter item, as for File Open.

Colour Palette

You can get the same colour palette that all the other Windows programs use simply by:

```
Sub mnuGetColor_Click ()
    Dim R As Long, G As Long, B As Long
    On Local Error Resume Next

    ' set-up dialogue box
    Form1.CMDialog1.CancelError = True
    Form1.CMDialog1.Flags = 0
    Form1.CMDialog1.Action = 3

    If Err = 32755 Then Exit Sub 'user pressed cancel
    'translate to RGB
    R = Form1.CMDialog1.Color And RGB(255, 0, 0)
    G = (Form1.CMDialog1.Color And RGB(0, 255, 0)) / 256
    B = (Form1.CMDialog1.Color And RGB(0, 0, 255)) / 65536
' MsgBox Str$(R) & Str$(G) & Str$(B) 'diagnostic

End Sub
```

The full 24-bit colour code is returned in 'Form1.CMDialog1.Color'. Often this can be applied directly to the color properties of windows objects, but is not compatible with either the 'QBColor()' or 'RGB()' functions. You can use the lines shown to extract the equivalent RGB numbers for use with the latter function.

There is also a flag that can be used to defeat the 'Define Custom Colors' button. See Figure 6.

Fonts Dialogue

```
Sub mnuGetFont_Click ()
    On Error Resume Next

    ' setup dialogue box
    Form1.CMDialog1.CancelError = True
    Form1.CMDialog1.DialogTitle = "Fonts"
    Form1.CMDialog1.Flags = &H2 '&H3
    Form1.CMDialog1.Action = 4

    If Err = 32755 Then Exit Sub 'user pressed cancel

' properties returned,
    'Form1.CMDialog1.FontName
    'Form1.CMDialog1.FontSize
    'Form1.CMDialog1.Color 'True / False
    'Form1.CMDialog1.FontBold
    'Form1.CMDialog1.FontItalic

'Form1.CMDialog1.FontStrikeThru

'Form1.CMDialog1.FontUnderLine

End Sub
```

'Color' is the same as for Colour Palette. Note that fonts can only have 'solid' colours, that is, restricted to a choice of the sixteen basic Windows colours.

Flag &H2 causes the dialog box to list only the fonts supported by the printer, whereas &H3 lists both the available printer and screen fonts. An hDC property of the same dialogue control identifies the Device Context Handle associated with the printer, which may be needed by another control before the latter can proceed. The font

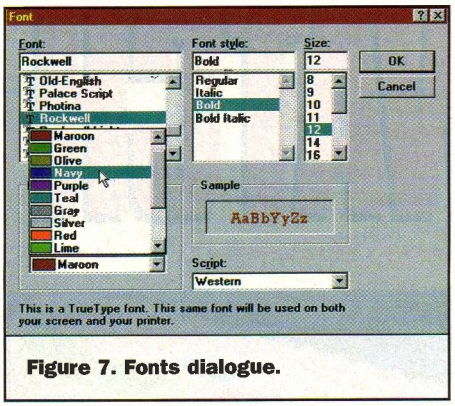


Figure 7. Fonts dialogue.

dialogue is shown in Figure 7.

Printer Dialogues

Use this before you want your program to print something:

```
Sub mnuFilePrint_Click ()
     On Error Resume Next

     ' setup dialogue box
     Form1.CMDialog1.CancelError
= True
     Form1.CMDialog1.Copies =
pages

Form1.CMDialog1.PrinterDefault =
True
     Form1.CMDialog1.Min = 1 'No.
of first page
     Form1.CMDialog1.Max = 100
'No. of last page
     Form1.CMDialog1.FromPage = 1
     Form1.CMDialog1.ToPage = 100
     Form1.CMDialog1.Flags = 0
     Form1.CMDialog1.Action = 5

     If Err = 32755 Then Exit Sub
'user pressed cancel
' returns:
     'Form1.CMDialog1.Copies
     'Form1.CMDialog1.FromPage
     'Form1.CMDialog1.ToPage

     Flags =
Form1.CMDialog1.Flags
     '(Form1.CMDialog1.Flags And
&H10) = 16 = 'Collate' is ON
     '(Flags And &HF) = 0 = 'All
Pages'
     '(Flags And &HF) = 1 =
'Selection'
     '(Flags And &HF) = 2 =
'Pages' From/To
     '(Flags And &H20) = print
'To File' is ON

End Sub
```

There are many flag options on entry, too numerous to describe here, which can be used to enable/disable the various options in the dialogue window. For example you may want to disable the print to file, selection and collate options. The control doing the actual printing may require the hDC of the dialogue control.

Otherwise the dialogue simply sets up the default printer from a choice of available printers that your code can then print to using merely 'Printer.Print'. To print the active window, use 'PrintForm'. Don't forget to append 'Printer.NewPage' and then 'Printer.EndDoc' at the finish. The print dialogue is shown in Figure 8.

The print dialogue can be used in one other useful way:

```
Sub mnuFilePrintSetUp_Click ()
     On Local Error Resume Next
     'init and call the common
print dialog
     CMDialog1.Flags = &H40& '<- !
     CMDialog1.CancelError = True
     CMDialog1.Action = 5
     If Err Then Exit Sub
```

What this does is to display a printer setup dialogue, from where you can choose a printer, paper orientation, paper size, print quality, dpi and any other properties the selected printer supports. This mode is specified in the flag &H40.

Getting Help

The following code fetches a Windows help file:

```
Sub mnuHelp_Click ()
     On Error Resume Next

     Form1.CMDialog1.HelpFile =
"helpfile.hlp"
' Form1.CMDialog1.HelpCommand =
HELP_CONTEXT
' Form1.CMDialog1.HelpContext =
21000
' or
' Form1.CMDialog1.HelpCommand =
HELP_KEY
' Form1.CMDialog1.HelpKey =
"search keyword"

     Form1.CMDialog1.Action = 6
     If Err <> 32755 Then 'user
pressed cancel
     End If

End Sub
```

You can only use the HELP_CONTEXT help command method if you definitely know what the context number of a particular help topic is (if it has one!). It may be much easier to use a search keyword to find a particular topic – if you get exactly right, as it is listed in the help file's search list, the code should open the help file and go straight to the required topic.

Without these extra instructions, the dialogue control will load the help file at its contents page. Note that all this also involves the use of WINHELP.EXE. (There is no Figure illustration for this example as it simply displays a help window.)

In Part 2 I will illustrate how to expand the Visual Basic language by adding a library of your own created procedures and functions, which you can add to all future programs you write, with several useful examples.

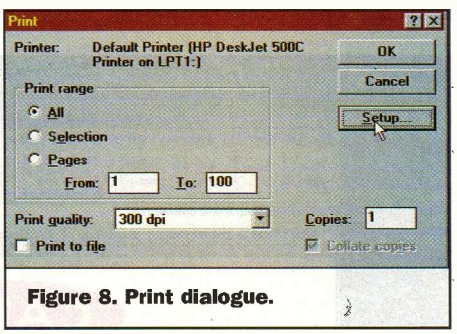


Figure 8. Print dialogue.

TECHNOLOGY WATCH

with Martin Pipe

An interesting use of the humble PC may become apparent if you live within shopping distance of the Tesco Extra superstore at Pitsea in Essex, a location that isn't a million miles away from Maplin's head office. If you visit the bakery of said store, you'll come across an interesting piece of hardware known as the Cake Machine from Cadex Limited, a company that is, suitably enough, based at the old Peek Freans biscuit factory near London's Tower Bridge. This £15,000 machine, which is a British invention and the fruit of 17 years development, doesn't actually bake the cake. Instead, it prints a colour picture on the icing to give the food a personal touch. Text, such as a happy birthday or congratulations message can also be added. All of the most commonly-used forms of message are available as presets.

The operator enters the lucky cake recipient's name into the machine by means of a virtual keyboard, which is operated via a touch screen. The same system is used to select from a limited range of font styles and type sizes, or to enter customer-specific messages. Pictures, meanwhile, can be scanned in from a colour print that the customer brings along, although a range of familiar images – such as cartoon characters – will shortly be available to adorn your cake. The Tesco store in Pitsea sells printed cakes for a very reasonable £7.99. It's probably true to say that cakes printed by the only other UK supermarket that currently offers the service, Sainsbury's Savacentre at the White Rose Centre in Leeds, fetch a similar sum. Tesco say that an average of 200 cakes a week are printed.

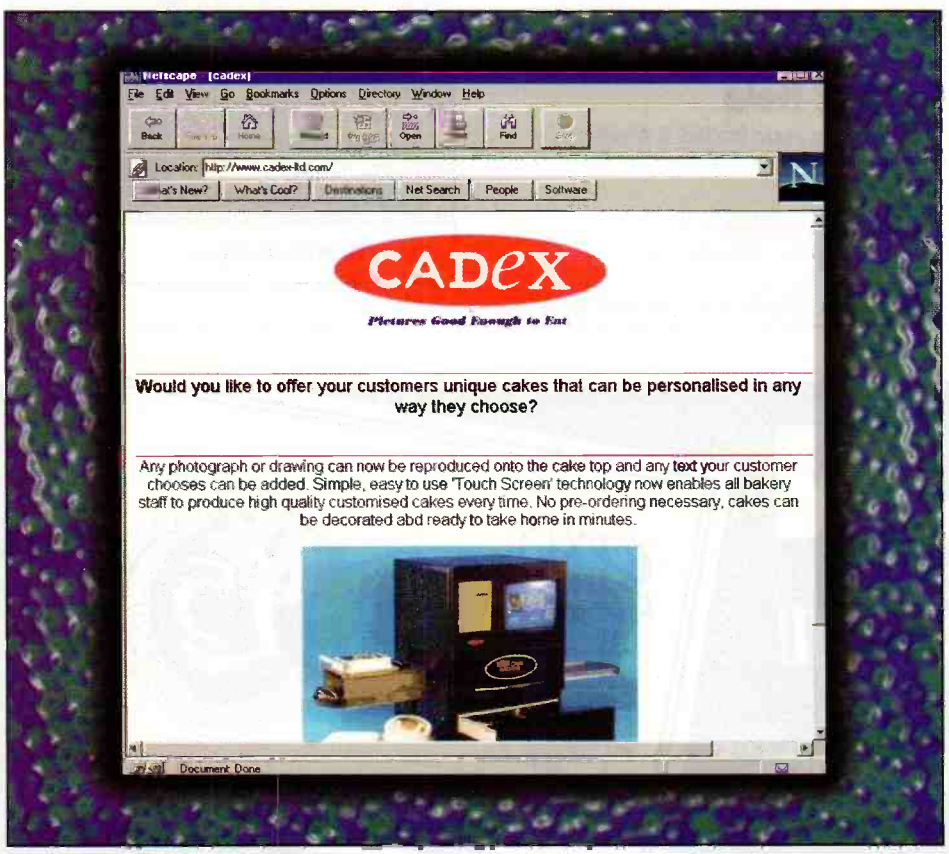
Initial impressions are that the Cake Machine is a completely new machine. The user interface is the aforementioned colour touch-screen, rather than a keyboard and mouse, and the equipment doesn't remotely resemble the typical PC. Take a close look at the machine, and certain elements appear rather familiar. To get a photograph into the machine, the attendant pulls open a drawer located in the base to reveal a bog-standard Canon single-pass flatbed scanner, which is connected to the rest of the hardware via a SCSI cable. That's not all. Look at the screen, and amongst the obviously-customised user interface is a minimised Windows dialogue box.

Ah, all is made clear. Cadex has opted to use standard PC software and hardware components wherever possible. And who can blame them? It keeps costs down, since PC hardware is plentiful and cheap. The Cake Machine uses the Windows 95 operating system, rather than a possibly more efficient one optimised for control applications. Why? Programming is also greatly eased – you can use the plentiful high-level language (C++, Visual Basic) programming and debugging tools available to create software relatively quickly and easily.

Another advantage of using Windows 95 is that drivers exist for pretty much all PC hardware currently on sale. I, for one, would hate to write my own low-level drivers for that scanner! As Linux users will know, PC peripheral manufacturers are very reluctant to release the kind of intimite product-specific details required to write such drivers. Finally, the popularity of Windows results in a wide pool of available fonts. The number available to users is restricted to avoid confusion, however; Cadex opted for simpler fonts that looked good on the cake, and could work across different styles and sizes.

The PC at the heart of the Cake Machine is a commonly-available ATX-factor motherboard, with a 200MHz Intel Pentium MMX processor and 32Mb of RAM. The motherboard's two serial ports aren't, like the PC you use at home, wired up to modems and mice. One is interfaced to the touch-screen panel. This item, which is sourced from MicroTouch, is used in conjunction with a chassis-mounted 15 inch Super VGA monitor driven by an S3-based graphics card. A touch screen, together with the software written by Cadex, provides an intuitive user interface that allows non-technical people to operate the machine with minimal training.

No mean feat, bearing in mind what's involved. Scanned photographs have to be cropped, resized and retouched. In addition, greeting messages have to be entered, edited and accurately positioned. The general-purpose programs normally associated with such tasks, such as Adobe Photoshop, are considerably more complicated and would require much expensive training.The Cake Machine, like the PC to which it is related, has a hard disk that automatically loads the operating



system, followed by the Cadex application, when the thing is turned on in the morning. Cadex say that their (dongle-protected) software occupies 15Mb of hard disk space – Windows 95 is another 65Mb on top of this. The other storage medium available to the Cake Machine is a standard CD-ROM drive, which is provided for software installation and the loading of images. There is no floppy drive.

In addition to the £15,000 purchase price of the machine, stores that opt for the machine have to take out a compulsory £1,500 per annum service contract and pay Cadex a 50p (+VAT) fee for every cake produced. To regulate the latter, a smart card system is employed. The card reader, which connects to the PC motherboard's second serial port, handles smart cards produced by a company jointly owned by DeLaRue – printers of banknotes and National Lottery tickets – and Philips. The smart cards issued by Cadex contain 250 units, and allow the machine to print as many cakes. Every time a cake is printed, a unit is knocked off' the total stored on the card – rather like a phonecard. When the allocation of 250 units is used up, it's time to ask Cadex for another card. That'll be another £125 (+VAT), please...

Cadex' smartcard system has other benefits, which will shortly be realised. Well-known characters – such as Mickey Mouse, The Spice Girls and The Teletubbies – are copyrighted. A royalty fee is due to the copyright owner each time the character is reproduced – and cakes are no different in this respect to Taiwanese stocking-fillers, chocolates or lunchboxes. Copyright characters are held on a CD-ROM as standard PC-format (bitmap) images. Whenever a copyright image is used to print a cake, a credit from a special copyright images' smart card is removed. Through this system, Cadex (and hence its customer) only pays royalties for the precise number of images used. The first character to be licensed by Cadex will be the somewhat pass Budgie the Helicopter.

When the image has been scanned and edited, it's time to print the cake. One could be forgiven for thinking that a completely new print mechanism is involved. However, this is not the case, and a machine contains the essential components of a PC-type

Canon colour inkjet printer. Instead of ink, however, special food dyes are specified. Cadex chose dyes that were closest in colour (and physical properties) to the cyan, magenta, yellow and black inks that the printer was originally designed to work with. The company spent a long time over this – obvious contenders like the very yellow tartrazine are now illegal – and ended up with colours that, although not an exact match, are more than acceptable to anybody not involved in the printing industry! To prevent clogging, however, the 5 micron ink filter in the original printer is replaced by a 3 micron type.

Obviously, the printer's paper feed mechanism is redundant – and this, like many other of the printer's components, is junked during assembly of the Cake Machine. Instead, a stepper motor-controlled platform slowly moves the cake through the printing tunnel at the required linear speed. The print head is mounted at the top of this tunnel, and is at a fixed distance from the cake's iced surface (which is prepared by the operator prior to printing). Cadex provide dimensional specifications to which the cakes must be made. The end result is highly impressive – and it tastes good too!

The Cadex web site is at
http://www.cadex-ltd.com

ELECTRONICS

E-mail your comments or suggestions to Martin Pipe at whatnet@cix.compulink.co.uk.

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.

March 1998

3 to 5 March. Integrating CADCAM, National Exhibition Centre, Birmingham. Tel: (0171) 388 2430.

4 March. Design Of Digital Cellular Handsets Colloquium, IEE, Savoy Place, London. Tel: (0171) 240 1871.

4 March. Electronic Aids For Motor Vehicles, IEE, Savoy Place, London. Tel: (0171) 240 1871.

11 to 13 March. The Production Show, Business Design Centre, London. Tel: (0171) 505 8340.

12 March. MOBILISING UK plc, London. Tel: (0171) 562 7650.

17 to 19 March. NEPCON Electronics, National Exhibition Centre, Birmingham. Tel: (01892) 544027.

19 to 21 March. Communication Skills Fair, Novotel, London, Tel: (01322) 660070.

24 to 26 March. Energy for Industry, Olympia, London. Tel: (01483) 799141.

27 March. Women In Engineering, Lecture By Veronica Perkins Davis, IEE, Savoy Place, London. Tel: (0171) 240 1871.

April 1998

6 April. Space Time Adaptive Processing Colloquium, IEE, Savoy Place, London. Tel: (0171) 240 1871.

7 to 8 April. Intranet EXPO, Olympia, London. Tel: (0181) 742 2828.

20 April. Digital Filters: An Enabling Technology Colloquium, IEE, Savoy Place, London. Tel: (0171) 240 1871.

27 Apr to 1 May. Engineering Lasers Exhibition, National Exhibition Centre, Birmingham. Tel: (01737) 768611.

29 to 30 April. Windows World International Data Group, Ballsbridge, Dublin. Tel: (01784) 210 210.

May 1998

6 May. Cellular Manufacture & New Product Introduction, IEE Technical Visit, Malvern Instruments, Worcestershire. Tel: (0171) 240 1871.

12 to 13 May. Digital Mapping Show, Novotel, London. Tel: (01883) 652661.

12 to 14 May. Internet World International, Olympia, London. Tel: (01865) 388000.

13 May. Electric Cars Colloquium, Austin Court, IEE Midlands Engineering Centre. Tel: (0171) 240 1871.

20 to 21 May. Communications in Public Safety, GMEX Centre, Manchester. Tel: (01322) 660070.

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.

What's On?

BBC Will Make Leap from Analogue to Digital

John Birt, the BBC's Director-General, pledged that the BBC will hold fast to the public service principles of BBC founder John Reith as Britain moves forward into the new era of digital technology.

Speaking in January at the Institution of Electrical Engineers in London – the site of the meeting of wireless manufacturers which established the BBC in 1922 – Birt promised that the BBC would continue to set the standards of public service in the new technologies as it had in radio and television over 75 years.

"In the digital age, the BBC will safeguard national culture; encourage diversity and extend choice; and strive to bring the benefits of the new technologies universally to every home in the land."

He said that the BBC would be as needed in the digital age as it was in the analogue age.

"The digital age brings with it risks as well as opportunities – the risk that the globalisation of culture will threaten national identities; that the powerful gateway controllers will restrain rather than promote diversity; the risk of a two-class society, the information rich, ready and able to pay for their increasingly expensive media, and the information poor who cannot."

Birt concluded, "We shall take the BBC John Reith founded forward into a new era, maintaining its ethos, principles and purposes. We shall aim to remain a licence funded service, universally present in every home in the land, satisfying every kind of licence payer with a unique, distinctive and innovative mix of programmes and services not available elsewhere."

Gates Discusses Future of Information Age

If you think that computers have had a major impact on your life, you haven't seen anything yet. This was the claim on Microsoft Mogul Bill Gates during a speech in late January at Cornell University in the US.

"We are really just at the beginning of the information age. The thing that is going to separate the successful organisations from unsuccessful ones will be the way that they deal with information: the way that they make decisions, the way they use the tools of the information age to help them design products, communicate with customers and do all the things that are crucial in a business of any kind," said Gates.

The software business is particularly exciting, he said, because it will reshape not only how companies work, but also the way that people learn, the way people buy things and the way that they entertain themselves.

"The technologies involved here are really a superset of all communications technology that has come along in the past, such as radio and newspaper. All of those things will be replaced by something that is far more attractive. The very mechanism of capitalism, the way people buy and sell things, will be changed by having this software."

Creating the building blocks that make these kinds of social changes possible "is one of the most exciting things that you can do," Gates said.

The just-announced acquisition of Digital by Compaq (see News Report) is a real milestone in the development of the computer industry, he said. The fact that a company that was all but unknown until recently can take over the company that 30 years ago was making the most innovative computers demonstrates the highly competitive nature of the industry, one where it is impossible for companies to rest on their laurels, Gates said.

"That's part of what makes things fun: We come to work every day knowing that we can destroy the company," he said. If Microsoft should falter, then it is most likely will be replaced by companies that no one has heard of, he added.

One of the big problems that the industry faces is making its products simple to operate, the head of world's largest software company acknowledged.

The key to ease of use is natural language recognition, Gates said. In future products, users will be able to describe in English or other language problems that they are having. The computer will parse the sentence and then suggest possible solutions.

And when the user indicates that the program has failed to help, the computer will send a message over the Internet to the company, where its technicians can analyse the problem and find ways to correct it. And it won't be long until computers will respond to the spoken word, which will make them even simpler to operate, he said. Microsoft is currently developing its first product that incorporates speech recognition: a PC for the automobile.

The other area where real advances will be made revolves around the Internet. Gates admitted that its meteoric rise took Microsoft by surprise.

When Internet protocols became industry standards, "We had to reorient the company," he said. "We gave everybody Internet connections, asked them to think about it, and they came up with some very creative ideas." Gates predicted that Web access increasingly would be through the television set, via a very intelligent control box.

Communication technologies have a way of spreading out. People who are connected push others to get connected as well, so the rate of Internet expansion is generally underestimated, Gates said. Despite the important advances being made to increase the capacity of the connection to the home, he believes that this will be the primary bottleneck in the development of new software.

The software magnate said that he is optimistic that the ongoing advances in information technology will be good for democracy. The new technologies will move news and information away from 'sound bites' to in-depth knowledge. By providing people with more in-depth information, it will make the government more transparent. All previous advances in information technology have been good for democracy, and the ongoing changes will be good for it as well, Gates said.

IT Sector and UK Government Shunning Year 2000 Crisis

A world-renowned authority on the millennium computer crisis has delivered a scathing criticism of the IT industry and the UK Government.

Speaking at the Regent Conference at the end of January, London, Peter de Jager, chairman of Year 2000 crisis awareness organisation de Jager and Company, claimed that the Government and many UK commercial organisations were still failing to recognise that their IT systems are 'broken'. He predicted that all other corporate IT projects would go on hold by the end of this year to focus attention on fixing the millennium bug.

The Year 2000 computer crisis arises because the majority of computers store a year component of a date as two digits, rather than four. Consequently the year 2000 will be represented as '00' and interpreted by a computer as 1900.

Regent Associates is a leading specialist in handling European mergers and acquisitions in the hi-tech sector. The Regent Conference is held annually and attracts a large audience of the UK's senior chief executives from the technology industry and the wider business world.

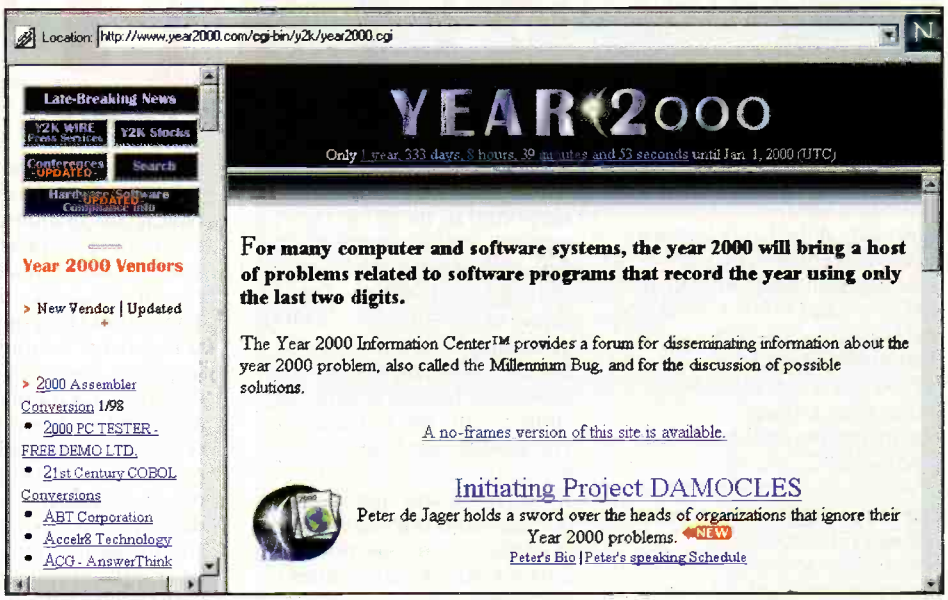
Later in the day, Regent Associates' chief executive Peter Rowell told more than 300 delegates that the Year 2000 problem was first raised as a major concern by a chief executive at the first Regent Conference in 1996.

In his address, de Jager issued a blistering attack on the UK Government. "In the UK, the Government is happy to spend £750 million on a millennium party, but has set aside only £300 million to fix its computer systems, while BT allocated £350 million to solve the problem.

"And after Robin Guernier, formerly chief executive of the Government-sponsored Taskforce 2000, created to investigate the issue in the UK, delivered his first report, the UK Government disbanded his organisation claiming he was exaggerating the extent of the problem – that's how serious your Government is taking this issue," he added.

Continuing, de Jager claimed that commercial organisations that had begun to realise to the full implications of the millennium bug were estimating final costs of fixing the problem would be more that 10-fold those of initial estimates. He forecasted that when January 1, 2000 arrives, lawyers would be inundated with actions against companies, which had failed to fix the problem. "For the legal community, this is better than asbestos cigarettes," he said.

Meanwhile a survey of 108 technology managers by the Cap Gemini consulting firm has found that 7 per cent have already experienced computer failures related to the year 2000 problem. ELECTRONICS



RESEARCH NEWS

by Dr. Chris Lavers

Microminiature Sensors and Palm Sized Silicon Microlaboratories

Pollution enforcement officers may soon carry portable biosensors that detect a range of herbicides in river water within minutes. Present samples must be sent to a laboratory and take a day or more to obtain results. Microelectronics has for many years been at the forefront in the development of microminiature sensors for environmental and medical applications, which when packaged in devices the size of a human fist will have much of the functional capability provided by the fictional Star Trek 'Tricorder' first presented in the late 1960's.

Workers at the Optoelectronics Research Centre (ORC) in Southampton England, and in several groups in the United States have successfully demonstrated working prototypes which are now progressing towards commercially available devices.

At the ORC a reusable biosensor, sensitive enough to meet the tough new European Union's (EU) maximum permissible detection limits for pesticides and herbicides in drinking water has been demonstrated. Biosensors use biological materials to detect specific chemicals, in this case, antibody-proteins are created which bind to target chemical species. The prototype sensor relies on a pesticide such as simazine binding uniquely to one kind of antibody attached to a gold coated optical waveguide, which is a channel of ion-exchanged glass only a few microns thick. Light travelling in the waveguide will attenuate in the presence of 'trapped' simazine molecules, so there will be a sudden loss in the transmitted light exiting the waveguide. This so called Surface Plasmon Resonance or SPR effect forms the basis of several University sensing systems and in this case may be calibrated. The sensor is able to meet the combined detection criterion of 0.5 micrograms/litre for simazine and atrazine herbicides and their metabolites (daughter products). However, ORC researcher Dr Richard Harris believes it may be improved further to detect specific pesticide compounds at the EU limit of 0.1 micrograms per litre (0.1ppb) in natural water and at a commercially viable cost per sensor, which could be adapted to detect a whole range of chemicals, including the monitoring of chlorine levels in swimming pools.

The BIOPTICAS project was supported by the EU to the sum of 1.5M ECU and includes several international partners including: GEC Marconi, the University of Tubingen and IOT in Germany, the University of Liverpool UK, and the Bureau de Recherches Geologique et Minieres (BRGM) in France. The system uses label-free immunoassay tests which are cheap, quick and simple to perform, and could be employed in a near continuous mode. Typical tests take 20 minutes or less, giving a significant advantage over other immunoassay techniques such as ELISA, which take 1-2 hours to perform. All the sensors developed during BIOPTICAS are capable of miniaturisation and being made portable. The BIOPTICAS project aim was to develop optically based analytical techniques for the detection and measurement of low organic pollutant concentrations in the aquatic environment. A particular advantage of this integrated optical approach is the possibility of fabricating multiple sensors all on one substrate, and hence testing for other chemical species in one go. The waveguide SPR structure (Figure 1) incorporates a metal film supporting the SPR and may also be used as an electrode to study electrochemical control of sensing reactions. Channel waveguides could be similarly applied to many areas of sensing, such as medical diagnostics, food and drug sensing, and military biochemical warfare agent sensing applications.

Dr Harris explained that the typical cost of individual lab components at present will give a worst case estimate of the cost of a single commercial unit. The cost of laser, optical components, sensitive lock-in amplifiers, flow cell and computer driven data acquisition lead to an initial bench-top system (Figure 2) costing £29,000. In reality this cost would be reduced significantly by development work on packaging and miniaturisation. This should be compared with current optical immunoassay instruments that are available commercially in the £50,000-£100,000 price range. The cost of present individual immunoassay tests is estimated at US $10, based on 5 man days to produce 1 sensor chip and a lifetime of 200 tests per chip. Mass production would reduce sensor chip costs to only a few pence.

Typical test cycle times were in the 15-20 minutes region for most devices studied, but test cycles closer to 10 minutes were made by the end of the initial project. A standard calibration curve for a single sensor chip required 30-40 assays and waveguide chips, in some cases, had lifetimes of up to 260 individual assays. The shelf life of a chemically modified chip, ready for use in immunoassays, by experience, Harris explained, is greater than 4 weeks.

The detection limits determined for several different sensors developed during BIOPTICAS were investigated, however the different sensors all reached different levels of development at the end of the project. Under these circumstances a direct comparison of the sensitivity of the different sensors is not easy to make. A reflectometric interference sensor (RIFS) and the waveguide SPR sensor underwent the most rigorous testing, including 'field' trials at the BRGM laboratories. BRGM in Orleans tested the SPR biosensor which depends on specific antibody-simazine binding changing the optical transmission of a glass waveguide device. 200 samples of standard laboratory-produced solutions and natural water samples were used. Trials showed the biosensor's lower detection limit is 0.22 micrograms per litre with a test cycle of 22 minutes. A Mach-Zehnder interferometer (MZI) sensor and a directional coupler (DC) sensor underwent thorough laboratory testing. An electro-chemiluminescence sensor has also undergone a more limited period of laboratory testing. A summary of the detection limits achieved by these optical biosensors is given in Table 1.

Silicon laboratories, where specialised chemical analytical instruments may be shrunk down to fit on a single computer chip, have also come much closer following a breakthrough at Purdue University in Indiana, USA. The University and PerSeptive Biosystems of Boston have patented the technology to construct hundreds of microlabs, each able to carrying out separate complex chemical analyses, on a single silicon chip. This will reduce the cost and increase the efficiency of many chemical and medical analyses. The work is lead by Chemistry Professor Fred Regnier, who is cofounder of PerSeptive Biosystems. The microlab chip should be available to the clinical profession initially in 3 to 5 years time. The team have developed a microminiature chromatograph, which allows different chemical solution components to be separated. Using photolithography and chemical etching, in a similar way to the waveguide sensors, channels and other structures are created. The complete microlab and chromatography columns are the size of a human hair (about 100 microns diameter) and are cut from a single silicon wafer. Liquids are moved onto and over the circuit by applying voltages between the ends of the channels. Despite their size, these microlabs can obtain accurate measurements to a few percent using only a few

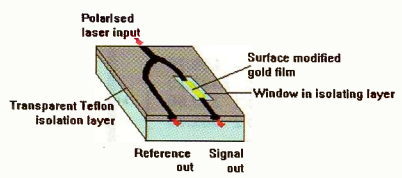


Figure 1. SPR Biosensor Structure.

Sensor Type	Target Pesticide	Detection Limit µg/l
Directional Coupler	Atrazine and Simazine	<0.5
Waveguide SPR	Simazine	0.22
RIFS	Atrazine and Simazine	0.1
Mach-Zehnder Interferometer	Simazine	0.1
Electroluminescence	Atrazine	~ 0.1

Table 1. Comparative Performance and Sensitivity of the BIOPTICAS Biosensors Trialed.

picolitres of liquid. Devices are much simpler than their whole laboratory counterparts and contain no moving parts requiring maintenance. A standard liquid pumping system may cost as much as $20000, but a chip which is fabricated for perhaps $500, and could contain 100 microlabs designed onto a single chip.

Growing Wires and 3D Circuits

A key missing element of this microlab technology was announced in September 1997 by Chemistry Professor Jean-Claude Bradley at Drexel University in Philadelphia. Bradley has found a way of constructing microscopic wires between metal components without physical contact, photolithography or templates. His group has developed a method of using electric fields to 'grow' wires.

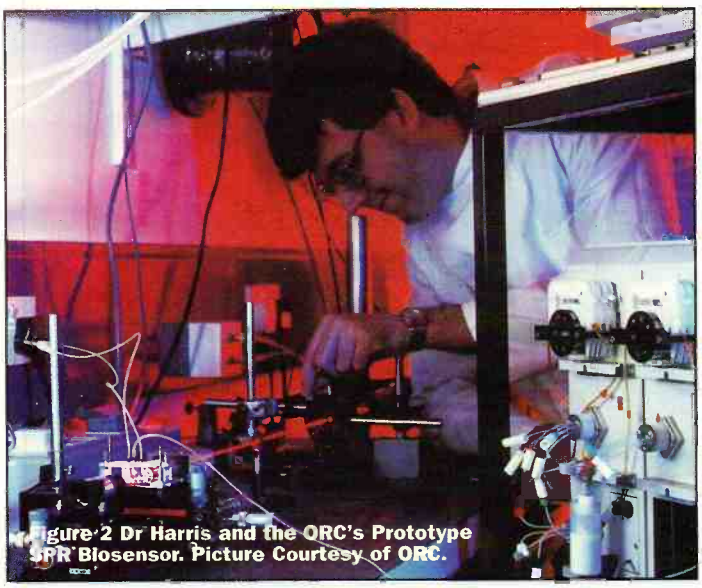
"We are extremely excited by this development," Bradley says, "because the method does not require contact with any of the components. This means that it may be far easier to attach wires to structures that are physically difficult to reach due to their size or awkward location. We are especially hopeful that it will be possible to significantly scale down the technique for microcircuit applications."

At present, microcircuits are fabricated using masks and photoresists which then require light and several chemical processing steps. Other approaches under development attempt to eliminate photolithography, but most of these techniques would still require physical contact or the use of templates.

Bradley states," What is really attractive about our approach is the possibility of eventually creating 3-dimensional circuitry. Currently microchips are constructed in 2 dimensions on flat surfaces. However, since electric fields can be generated readily in any direction, 3-dimensional circuitry should be possible." Nature uses this technique to optimise all the space available within the human skull to distribute information in the brain. "This allows the packing of an incredible amount of processing power in a very tiny space." Drexel University has filed several provisional patents on the work and potential licensees are being sought.

Taking these developments into account it is looking increasingly likely that within five to ten years the medical profession will have a powerful hand held instrument, either of UK or US origin, capable of diagnosing most common forms of illness (and evaluating their degree of severity) from routine medical check-ups, promising enormous potential savings to long term NHS costs.

Further information at: `toposome.chemistry.drexel.edu`



igure 2 Dr Harris and the ORC's Prototype SPR Biosensor. Picture Courtesy of ORC.

Security ELECTRONIC SYSTEMS & CIRCUITS

PART 7

Ray Marston concentrates on practical build-it-yourself anti-burglary circuits in this month's episode of the series.

Last month's episode of this series explained anti-burglary principles and described the basic operation of modern 'hard-wired' and 'wireless' burglar alarm systems. This month's episode starts off by briefly describing three basic categories of wireless burglar alarm and by looking at some basic types of intrusion sensor, and then goes on to describe a variety of practical hard-wired build-it-yourself anti-burglary circuits.

Wireless Alarm System Categories

Domestic wireless burglar alarm systems vary greatly in price and performance, but can be roughly divided into the categories of 'low-cost', 'mid-range', and 'top-of-the-range' types. Figures 1 to 3 illustrate the basic features of typical examples of each of these system types.

The cheapest and most popular types of wireless burglar alarm system are those that give levels of protection that are quite adequate for use in small flats or apartments, but give only very basic protection when used in 2 or 3 bedroom houses. Figure 1 illustrates, in block diagram form, the basic features of a typical low-cost system of this type. This system offers a total of four defence zones, but these are not individually selectable; in the unit shown, the user has the simple option of making either all four zones active (when the premises are empty), or of making all but one zone (Zone 4, the sleeping and bathroom areas) active (when the occupants are resting); the system gives no protection against burglars who enter the house while the occupants are watching TV, etc. Systems of this type rely on the control unit's built-in siren to scare off any intruders; often, they are not supplied with an external siren but have provision for driving an optional external siren that is powered by the control unit; such sirens can be disabled by simply cutting their feed cables.

Figure 2 illustrates the basic features of a typical 'mid-range' wireless burglar alarm system that is designed for use in most houses and in small commercial premises. This system offers a total of six defence zones, all of which are individually selectable, and offers good protection against all types of burglar, including those who enter the house while the occupants are watching TV, etc. Systems of this type are usually supplied complete with an internally-powered external siren/strobe unit that is cable-wired to the main control unit and is fully protected against tampering and cable-cutting, etc.

Finally, Figure 3 illustrates the basic features of a typical 'top-of-the-range' wireless burglar alarm system that is designed for use in large houses or medium-sized commercial premises. This system offers a total of twelve defence zones, all of which are individually selectable, and offers excellent overall protection. The system shown is completely wireless, with no cable link between the main control unit and the external siren/strobe unit, which is wireless-activated (by the control unit), is fully protected against tampering, and is powered by an internal battery that is trickle charged by an integral solar panel.

Intrusion Sensor Types

The two types of intrusion sensor most widely used in modern domestic burglar alarm systems are PIR movement detectors for 'area' protection, and reed-and-magnet switches for 'spot' protection on doors and windows, etc. Other types of sensor commonly used in domestic systems are pressure mat switches for spot 'floor' protection, vibration sensors to give 'object' protection, and window foil and glass break detectors to detect window breakage. All of these sensors are similarly used in burglar alarm systems designed to protect commercial premises, which sometimes also use IR light beams or brittle wires built into walls, floors, or ceilings to detect break-ins via the buildings shell.

Note that modern PIR movement detectors are relatively inexpensive and have a high immunity to false alarms, and have consequently replaced once-popular but unreliable capacitive proximity detectors and microwave and ultrasonic movement detectors in most modern commercial 'area' protection systems. Older readers may also note that once-popular 'dual-purpose loop' burglar alarm systems, in which all contact sensor are wired to a continuously-monitored loop that is fitted with an end-of-line resistor – are no longer used in the modern domestic security systems.

Practical Burglar Alarm Circuits

Modern microcontroller-based domestic burglar alarm systems are, like TVs and many other electronic 'consumer' products, so reasonably priced that few people would seriously consider DIY-building, rather than buying such products. This is particularly true of wireless burglar alarm systems, which

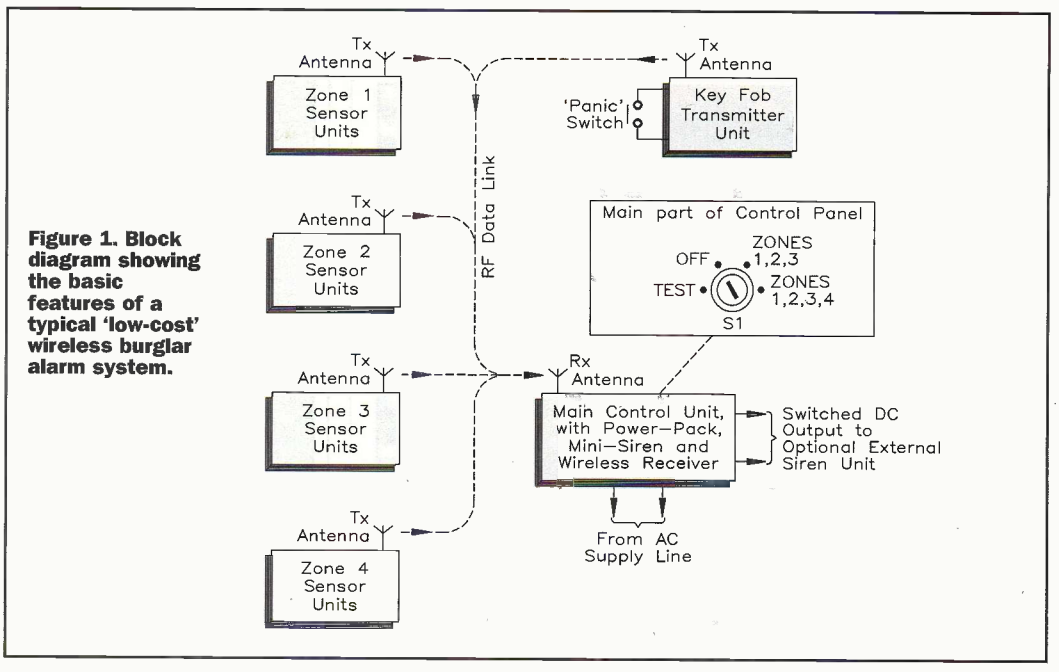


Figure 1. Block diagram showing the basic features of a typical 'low-cost' wireless burglar alarm system.

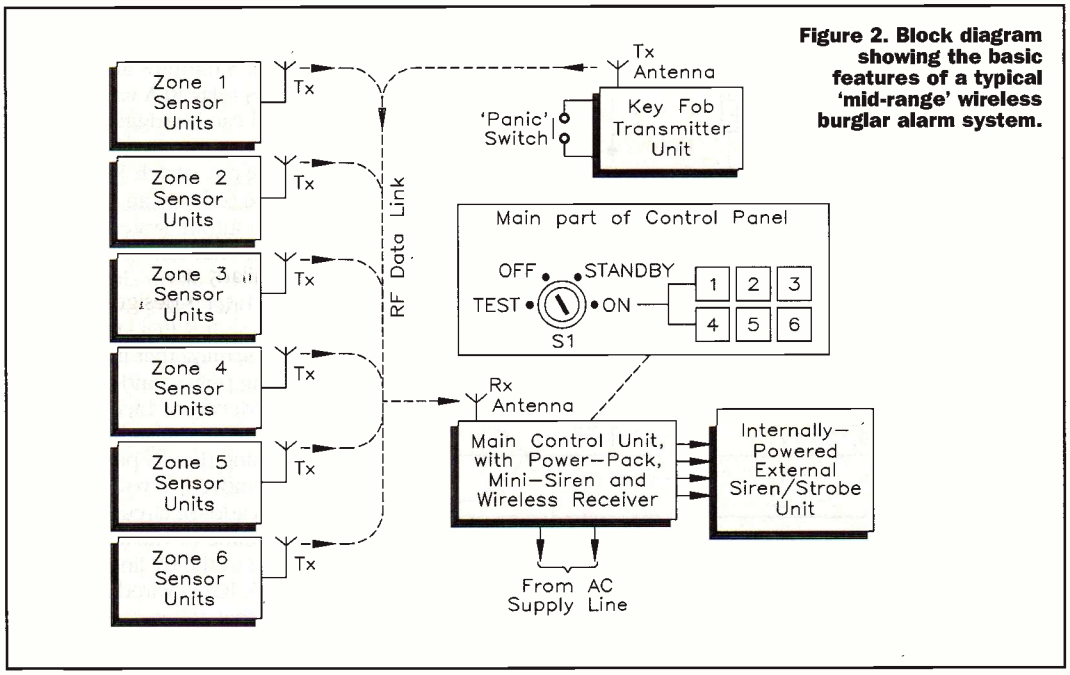


Figure 2. Block diagram showing the basic features of a typical 'mid-range' wireless burglar alarm system.

must use wireless Tx sections that have passed stringent tests laid down by a government testing/licensing authority. It is, however, possible to cost-effectively DIY-build a variety of fairly simple and inexpensive 'conventional' burglar alarm and accessory circuits, and a number of these are described in the remaining sections of this article.

A 'False Key' Booby Trap Circuit

Some people hide a spare front door key under a flower pot or porch mat or on a porch ledge when they leave the house, and burglars often make a quick search for such a key when they enter the porch area of a house. 'False key' booby trap units take advantage of this fact by activating a semi-latching siren if an object such as a flower pot is briefly moved, or if someone grabs a key that is tied to a short length of string, etc. Figure 4 shows the practical circuit of such a unit.

In Figure 4, two gates of the 4001B CMOS IC are wired as a simple monostable multivibrator. This gives a low pin-4 output when a positive voltage is fed to pin-5, but if pin-5 is low it produces a positive pin-4 output pulse it provided a positive-going transition is applied to pin-2 by opening sensor switch S1. This output pulse has a duration of about 2 minutes with the R4-C4 values shown, and is used to activate an inexpensive commercial siren unit via R5 and transistor Q1. Note that the monostable can only be triggered by a positive-going transition of its pin-2 voltage; its action is not influenced by 'standing' high or low voltages applied to pin-2 via R1-S1. Thus, the action of this booby trap circuit, which may typically be housed in an inverted flower pot, is as follows:

When power is switched to the circuit via S2, C3-R3 apply a decaying positive voltage to pin-5. That disables the monostable for at least 12-seconds, thus giving the user time to safely 'prime' the circuit (position it so that S1 is held in the closed position) without activating the siren. At the end of this period the monostable becomes enabled; if sensor switch S1 subsequently opens for a period in excess of 200ms (determined by R1-C2), the monostable fires and activates the siren for a continuous period of about 2-minutes (which is long enough to scare off most burglars). At the end of this 2-minute period the siren turns off, irrespective of the state of S1, and can only be retriggered by closing and then opening S1 again. Note that R6 discharges the circuit's timing capacitors when control switch S2 is turned off, also that most of the unit's circuitry must be weatherproofed and protected with varnish, and that the unit can be powered by any 6V to 14.5V battery supply and the unit consumes a quiescent current of only a few μA (mainly via R1 and via C1's leakage currents)

The circuit's S1 switch can take various forms; in a flower pot unit it may be an n.o. keypad switch that is normally held closed by the weight of the pot, but opens when the pot is lifted; in another case it may be an n.c. type that opens when someone tugs on a piece of string, and so on.

Shed/Garage Burglar Alarm Circuits

Domestic workshops and garages that are fitted with AC power lines are best defended by simple AC-powered 'house/flat' types of burglar alarm that can activate powerful siren/light-strobe units for several minutes, and a versatile alarm unit of this type is shown later in this article. Most garden sheds and many domestic garages (and also caravans and small boats, etc.,) are, however, devoid of AC power lines, and are best defended by battery-powered burglar alarms that, when activated, sound a siren for only a few minutes; this section looks at some practical circuits of this type.

Figures 5 to 8 show alternative versions of battery-powered shed/garage burglar alarms, which should ideally be powered by rechargeable batteries that are kept fully energised by solar-powered charger units. The Figure 5 – 6 unit is meant to be turned on and off by a key switch that is

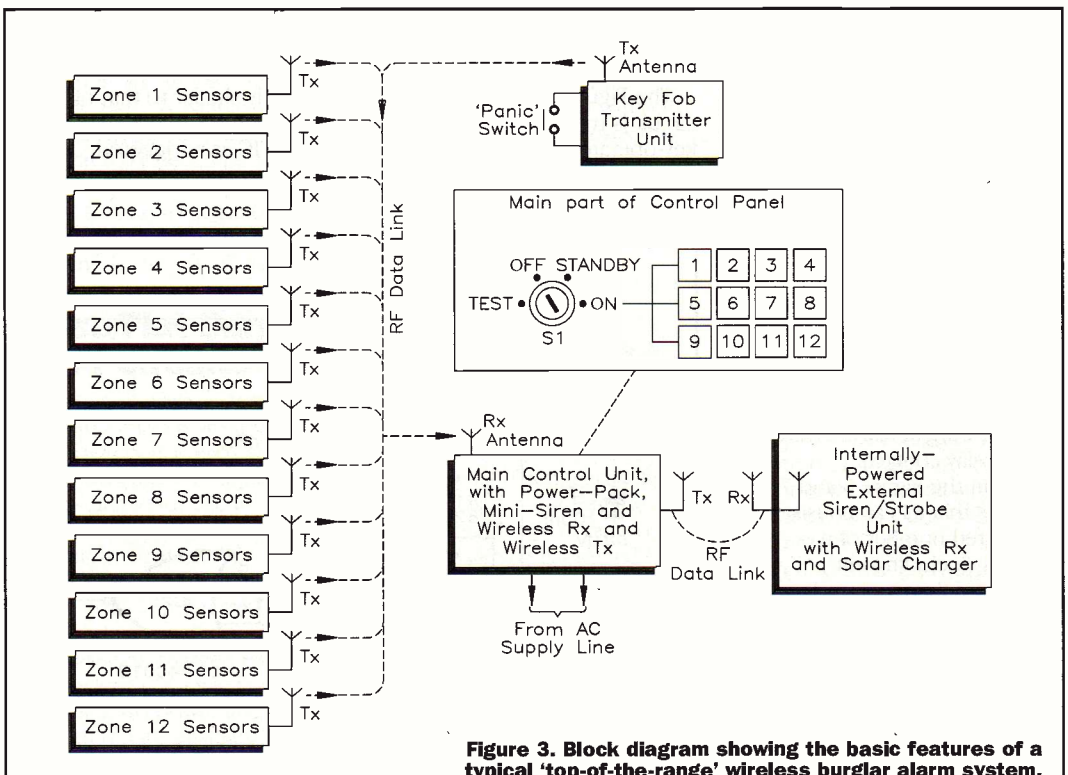


Figure 3. Block diagram showing the basic features of a typical 'top-of-the-range' wireless burglar alarm system.

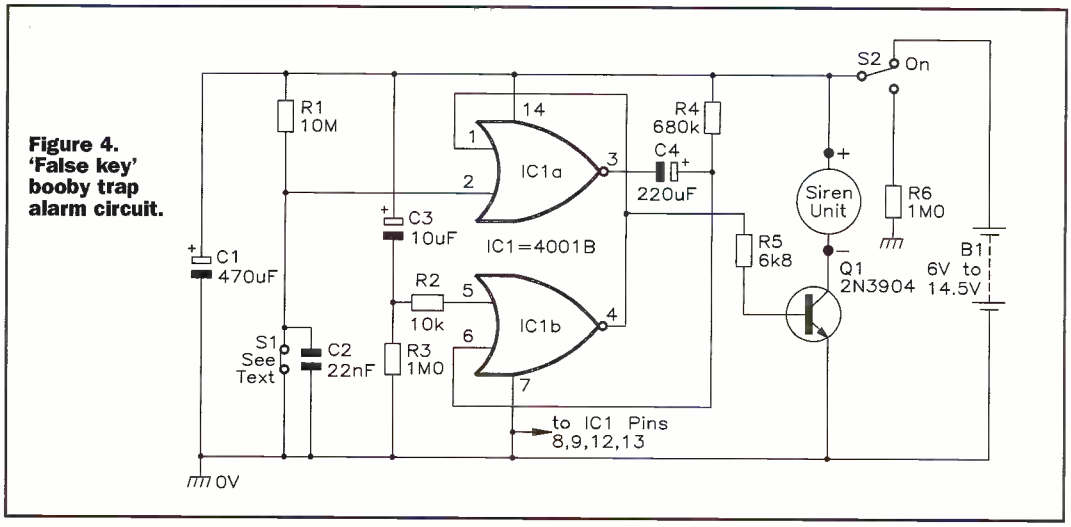


Figure 4. 'False key' booby trap alarm circuit.

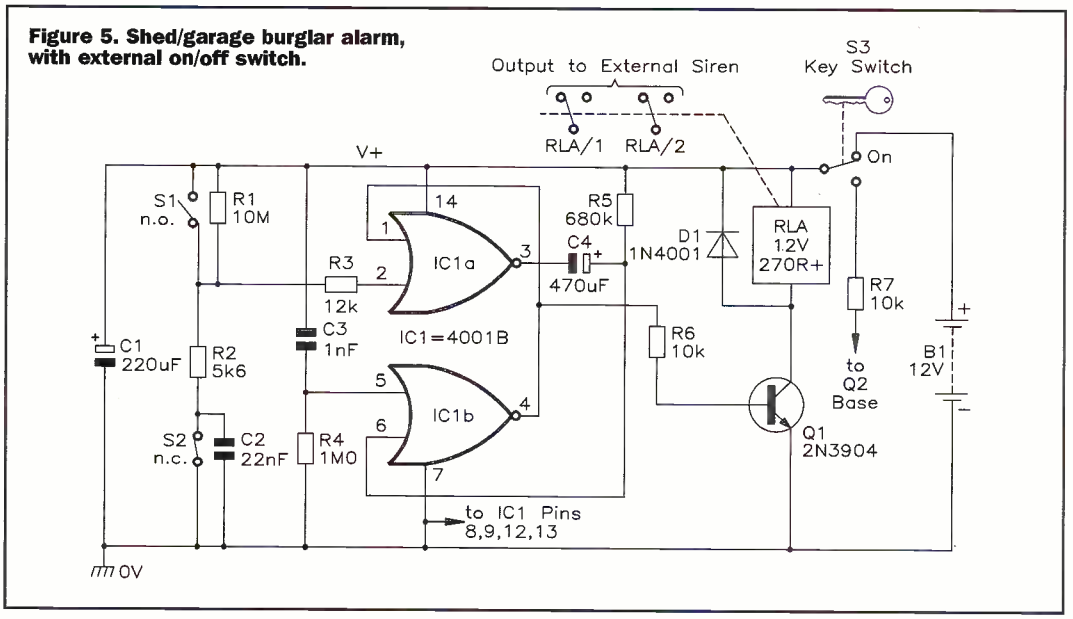


Figure 5. Shed/garage burglar alarm, with external on/off switch.

operated from outside the building; the Figure 7 – 8 unit is meant to be turned on and off from within the building, and incorporates exit/entry time delays that let the key holder leave and enter the building without sounding its alarms. Each unit consumes a typical ON ('standby') current of 1-2μA, can use any desired number of n.o. (S1) and/or n.c. (S2) sensor switches, and has a pair of c.o. relay output contacts that latch on for about 5 minutes under the 'alarm' condition and can be used to activate any type of external siren, which may be self-powered or may be powered from the burglar alarm's battery via the relay contacts.

Note in the Figure 5 and 7 diagrams that S1 can consist of any desired number of n.o. switches (including 'tilt' switches of the type used on up-and-over types of garage door) wired in parallel, and S2 can consist of any desired number of n.c. switches (such as reed-and-magnet switches on shed doors and opening windows, anti-tamper switches built into alarm and siren boxes, wire 'loops' formed inside easily-cut cables, and cable loops used to protect tools, etc.), all wired in series; if S1 is not needed, simply omit it; if S2 is not needed, replace it with a short.

The Figure 5 burglar alarm circuit is turned on and off via key-operated switch S3, which is mounted in a position where it can be operated from outside of the building's main entrance; thus, S3 is used to enable the alarm after leaving the building, and to disable it before entering the building. The circuit is basically similar to that of Figure 4, which uses two gates of a 4001B IC as a triggered monostable pulse generator. In this case, however, the monostable output has a period of about 5 minutes and activates relay RLA via transistor Q1, and can be triggered by closing n.c. switch S1 or by opening n.c. switch S2.

Figure 6 shows an optional audible-output 'system-state' indicator that can be added to the Figure 5 alarm circuit and emits a brief 'bleep' when the alarm circuit is first switched on, confirming that it is receiving power, and emits a longer 'decaying' bleep as the alarm circuit is switched off, confirming that its power has been removed (if you do not use this add-on circuit, change the R7 value to 1k0 and wire its low end to the 0V line). In Figure 6, IC1 is wired as a gated astable that, when gated on by a 'low' voltage on pin-1, generates an audible tone signal in a low-cost piezo sounder. The action is such that the astable is briefly driven on via R8-C5 as S3 is switched to the ON position, thus generating a brief 'bleep' in the sounder; when S3 is switched to the OFF position, C1's stored charge drives the astable on via R7-Q1 and supplies the astable with limited operating power, thus producing a decaying 'bleep' in the sounder.

The Figure 7 burglar alarm circuit is turned on and off via key-operated switch S3, which is mounted inside the shed/garage. When S3 is first turned ON, an 'exit delay' comes into operation, giving the key holder about 18 seconds to leave the building, after which all S1/S2 sensor switches become fully active. When the building is re-entered after this period, the sensor switches trigger an 'entry delay' timer that, if S3 is not switched OFF within 18 seconds, triggers

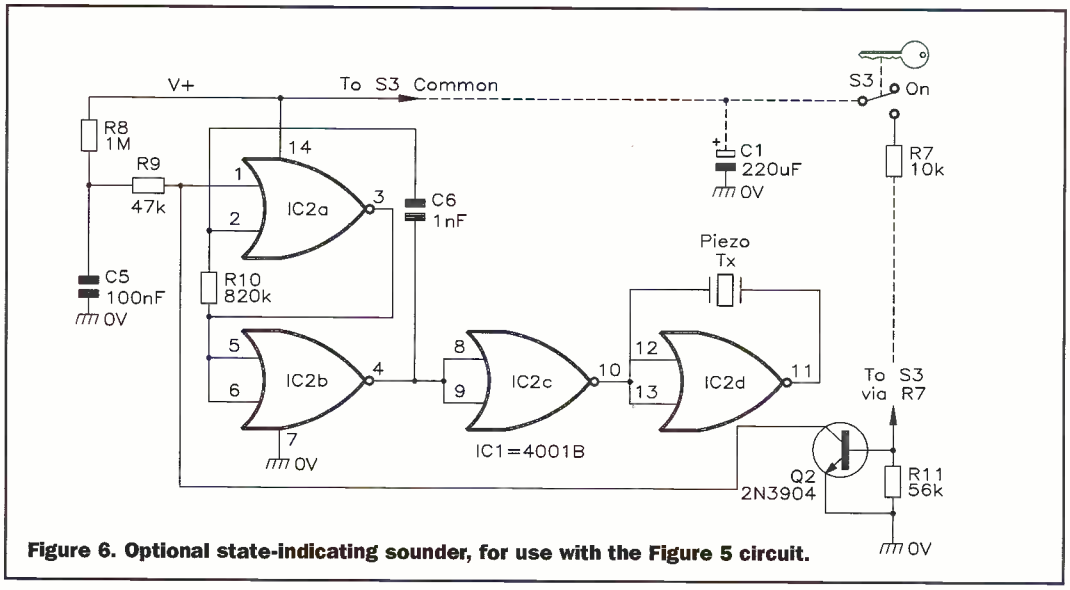
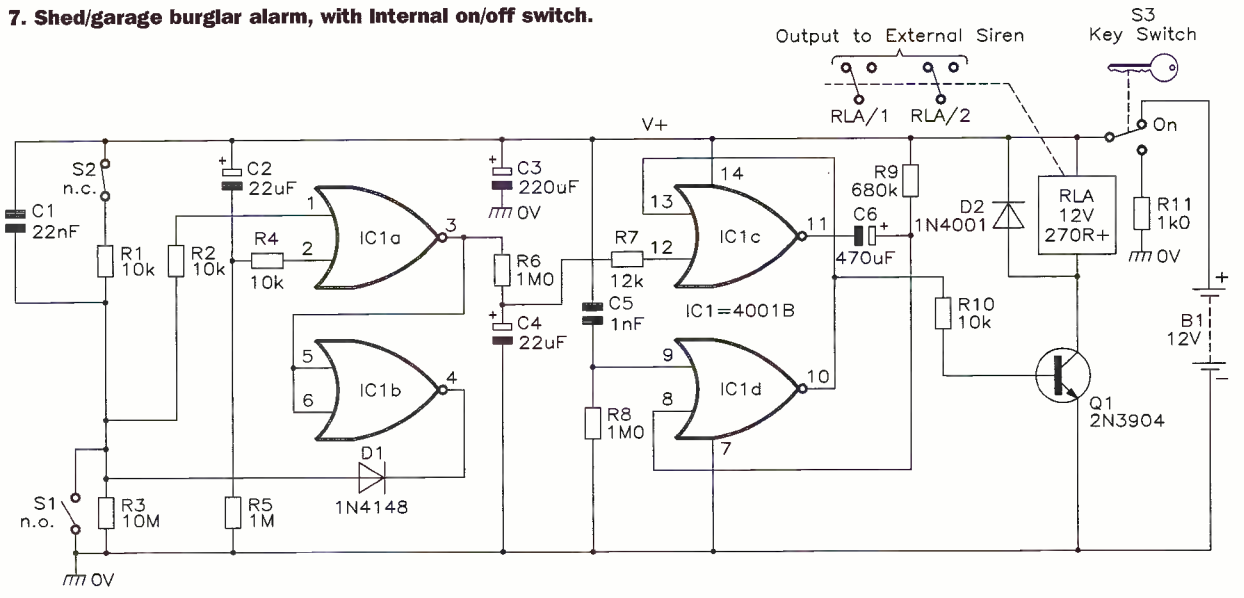


Figure 6. Optional state-indicating sounder, for use with the Figure 5 circuit.

Figure 7. Shed/garage burglar alarm, with internal on/off switch.



a 5-minute monostable that drives an external siren via the contacts of relay RLA. The basic circuit is similar to that of Figure 5, except that exit/entry time-delay logic is interposed between the outputs of S1/S2 and the input trigger point of the 5-minute monostable (IC1c-IC1d). The circuit operates as follows:

In Figure 7, IC1a is used as a NOR gate that gives a low (logic-0) pin-3 output if either input is high, and gives a high output only if both inputs are low. The pin-1 input of IC1a is normally high, but goes low if S1 closes or S2 opens; the pin-2 input of IC1a is normally low, but is held high by the C2-R5 'exit delay' network for about 18 seconds when power is first applied to the circuit via S3. Thus, IC1a's output is locked low during the 'exit delay' period, but can subsequently switch high if S1 closes or S2 opens; if this latter action occurs, the output of inverter IC1b pulls IC1a's pin-1 input low via D1, thus locking its output into the high state, irrespective of subsequent S1/S2 actions. This 'high' output is fed to the pin-12 'trigger' input pin of the IC1c-IC1d relay-driving 5-minute monostable via the R6-C4 'entry delay' timing network, which triggers the monostable about 18 seconds after pin-3 goes high.

Figure 8 shows an optional audible-output 'system-state' indicator that can be added to the Figure 7 alarm circuit and emits a brief 'bleep' when the alarm circuit is first switched on prior to leaving the building, and emits a series of 50ms 'bleeps' at roughly 1-second intervals when anyone re-enters the building, reminding them to turn S3 OFF before the siren-activating finish of the 'entry delay' period. In Figure 8, IC2c-IC2d are wired as a gated astable that, when gated on by a 'low' voltage on pin-13, generates an audible tone signal in a low-cost piezo sounder, and IC2a-IC2b are wired as a gated asymmetrical astable that gates the IC2c-IC2d astable via D4 and activates automatically when anyone re-enters the building. The action is such that the IC2c-IC2d astable is briefly driven on via R15-C8 as S3 is switched to the ON position, thus generating a brief 'bleep' in the sounder, and is activated via the IC2a-IC2b astable whenever the main unit's 'entry delay' circuitry becomes active, thus generating a series of 50ms 'bleeps' that are repeated at 1-second intervals until the main alarm unit is turned off via S3.

House/Flat Burglar alarm Circuits

Shed/garage burglar alarms of the Figure 5 to 8 types are simple battery-powered single-zone units. Modern burglar alarms suitable for use in houses, flats and apartments are moderately complex AC-powered multi-zone units with built-in 'panic' and 'tamper' facilities; they usually have an internal trickle-charged battery that provides power in the event of an AC power-line failure, and have auxiliary 12V DC outputs suitable for powering external PIR movement detectors, etc. Figures 9 to 13 show the block diagram and practical circuit details of a sophisticated modular 'universal' burglar alarm unit of the latter type that can quite easily be built to suit the precise needs of the individual user.

Figure 9 shows the basic block diagram of the 'universal' burglar alarm unit, which can be fitted with one exit/entry zone plus any desired number of 'normal' defence zones, all of which are individually switch-selectable; each zone is provided with its own audio/visual 'state' indicator (not shown in this diagram) and activates internal and external alarm sirens when an intrusion is detected. The unit can also be fitted with any desired number of n.c. 'panic' switches (S3) wired in series, and with any number of n.c. tamper switches or loops (S2) wired in series. The unit comprises the four major sections shown in the diagram, and offers the following modes of operation, which are selectable via 4-way key-switch S1:

ON

When S1 is in the ON position, all four major sections of the unit are energised, and the 'alarm timing/control' circuitry's 50-second and 16-minute timers are immediately triggered if an intrusion is detected by the 'alarm triggering' circuitry or if PANIC switch S3 is opened for more than 200ms. Under this condition the internal siren is immediately driven on via D4 and Q4, but the external siren (which is activated via Q2 and RLA) is held off for 50-seconds via R4-Q1, thus minimising the chances of accidentally sounding the external alarm. Both alarms switch off when S1 is moved to the RESET position, or turn off automatically at the end of the 16-minute timing period. The intrusion detector's piezo buzzer also sounds if an intrusion is detected and operates for the duration of the intrusion condition. The internal siren is driven on (via D5) if TAMPER switch S2 opens, and sounds for the duration of the o.c. condition.

TEST

When S1 is in the TEST position, the 'alarm timing/control' circuitry and the TAMPER and PANIC switches are disabled, but the intrusion detection circuitry is fully active; if an intrusion state is detected under this condition, only the internal piezo buzzer is activated. This mode is useful when testing or checking sensor switches, PIR units, or sensor wiring, etc.

OFF

When S1 is in the OFF position, the intrusion detection circuitry is disabled, but the TAMPER and PANIC circuitry is fully active. If TAMPER switch S2 opens, the internal siren is driven on (via D5-Q4) for the duration of the o.c. condition. If PANIC switch S3 opens, the internal siren is driven on immediately (via D4-Q4) and the external siren activates 50-seconds later; both sirens turn off when S1 is moved to RESET, or turn off automatically at the end of the 16-minute timing period.

RESET

When S1 is in the RESET position, the entire circuit (except the power supply circuitry) is effectively disabled, and Q3 rapidly resets the intrusion detector circuit's 'exit delay' timer.

Figure 10 shows the basic circuitry of the 'universal' alarm unit's intrusion sensing/signal processing circuitry, specifically applied to a unit with one

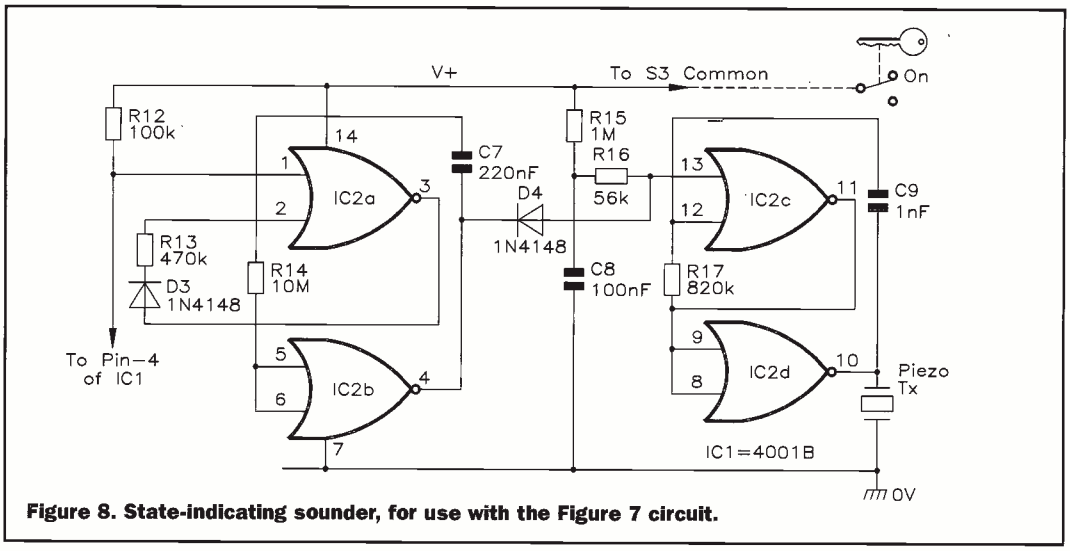


Figure 8. State-indicating sounder, for use with the Figure 7 circuit.

entry/exit zone (Zone 'A') and three 'normal' zones (Zones 'B' to 'D'); additional 'normal' zones can be added by simply duplicating the Zone 'D' and D5 circuitry for each extra zone. All zones use the same intrusion sensing circuit design as shown for Zone 'A'. Each zone can use any desired number of series-connected n.c. (SWa) and/or parallel-connected n.o. (SWb) sensor switches, and is selected by a DPDT switch (SWc) that – when closed – connects the output of inverting buffer IC1a to a state-indicating LED (LED1a) and also connects the +12V supply to any auxiliary units (PIRs, etc.) that are associated with the zone. When a zone is selected by SWc and key switch S1, its action is such that the output of IC1a goes high and illuminates the LED and activates a piezo buzzer (via D1 or D2) if any of the zone's intrusion-detecting sensor switches are activated; this 'high' signal is also passed through the unit's signal processing circuitry, as described in the next two paragraphs.

In Figure 10, the output signals from the sensing circuits of all selected 'normal' defence zones are ORed via D3-D4-D5 and are then fed to input A (monotone sound) of the piezo buzzer via D2, and also through transient suppressor R10-C3 (which only passes signals that switch high for at least 200ms); the output of R10-C3 is then inverted by IC3a and passed to one input of NOR-gate IC3c, which has its other input derived from 30-second switch-on delay generator R13-C4-IC3b, which disables IC3c for 30-seconds when power is first connected to the circuit via S1. The net result is that the circuit gives an instant audio-visual indication if the output of any selected zone switches high, but under this condition IC3b's output only generates a siren-activating signal (via D8) if the circuitry has been energised via S1 for at least 30-seconds.

In Figure 10, the output signals from the entry/exit zone are (when SWc is closed) fed to input A of the piezo buzzer via D1, and also passed, via transient suppressor R5-C1, to the input of a gated self-latching non-inverting buffer formed by 1C2a-IC2b. This is gated by the R13-C4-IC3b 30-second switch-on delay generator, which provides the zone with its 'exit' delay. If the zone's output switches high during the 30-second exit delay period (as, for example, when someone exits the zone), the circuit gives an instant audio-visual indication if the fact but produces no other effects. If the zone's output switches high after the end of the 30-second exit delay period (as, for example, when someone re-enters the zone), the circuit again gives an instant audio-visual indication if the fact, but in this case the output of IC2b switches high and is latched into that state via D6-R7; this action drives input B (timing-beat sound) of the piezo buzzer high and also initiates a 30-second entry delay timing period (controlled via R8-C2 and non-inverting buffer IC2c-IC2d); if the complete circuit is not switched off (via S1) by the end of this 30-second 'entry' period, IC2d's output switches high and activates the unit's sirens via D7.

Note in Figure 10 that D9-R14 are used to rapidly discharge C4 via the positive supply rail and Figure 9's transistor Q3 when S1 is moved to the RESET position. Also note, when building the Figure 10 circuit, that pin-14 of all 4001B ICs must be wired to the +ve supply rail, pin-7 to the 0V rail, and that all unused gate input pins must be tied to the 0V rail. All LEDs must be high-brightness types.

Figure 11 shows the circuit of the unit's state-indicating piezo buzzer unit, which is powered from the supply rails of the intrusion sensing/signal processing circuitry and consists of two gated astables that are activated by high (logic-1) gate voltages. IC1c-IC1d are wired as a simple 'tone' astable that, when gated on via pin-13, generates a 680Hz tone in the piezo sounder, and IC1a-IC1b

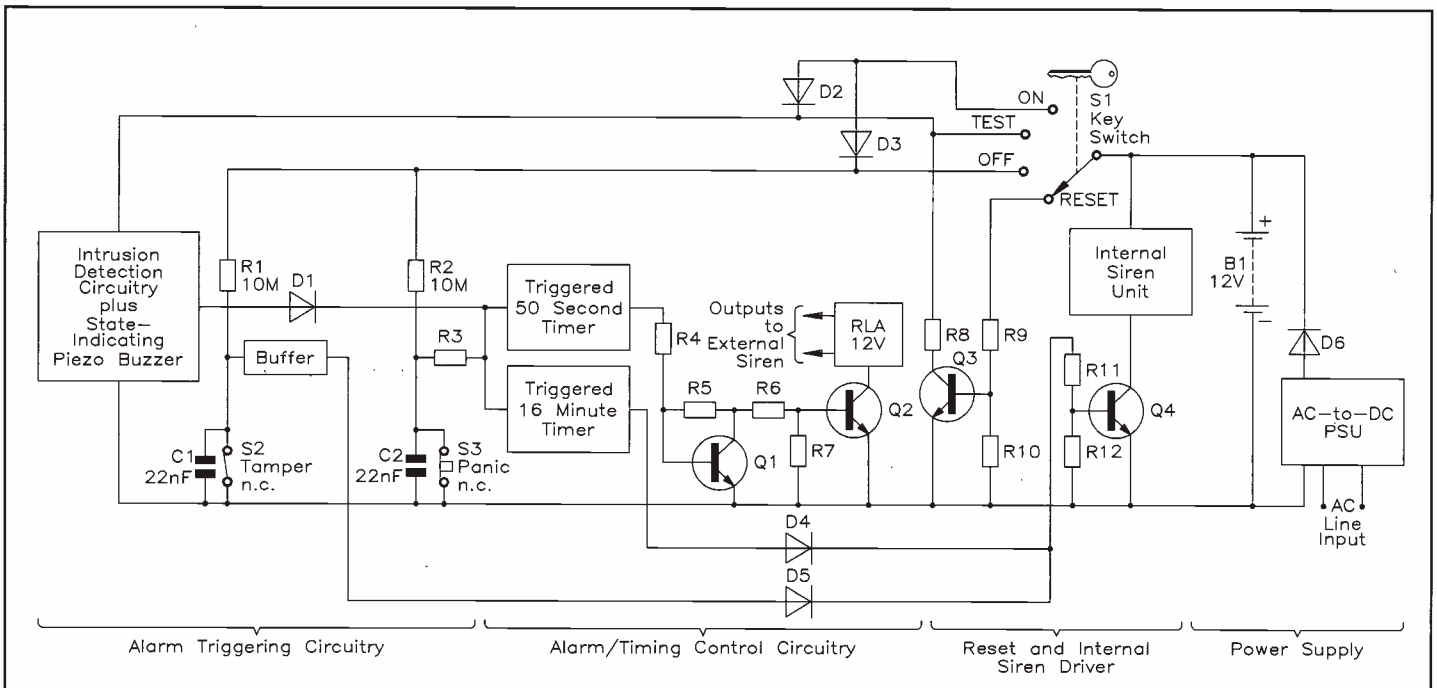


Figure 9. Block diagram of the 'universal' burglar alarm system.

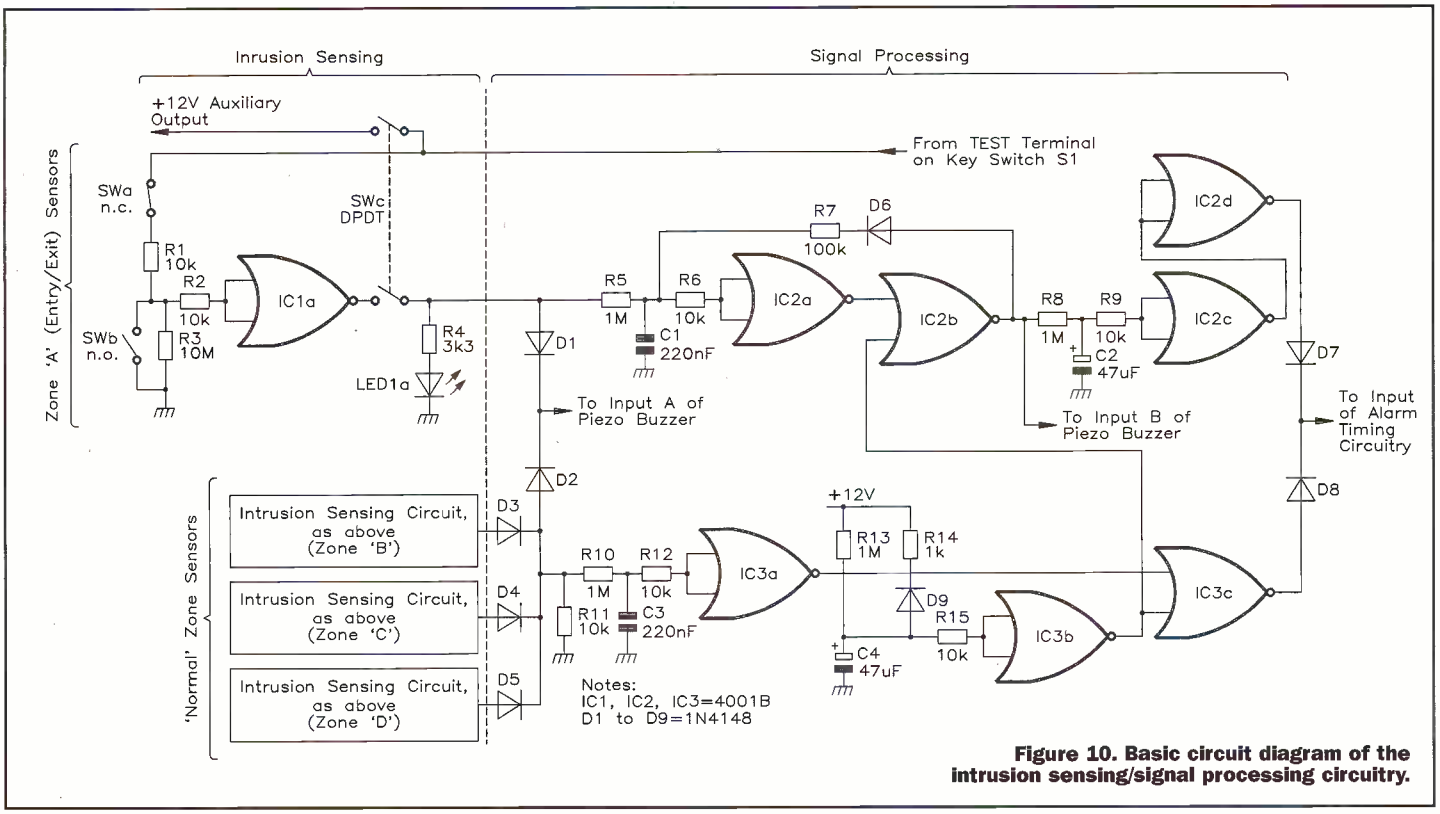


Figure 10. Basic circuit diagram of the intrusion sensing/signal processing circuitry.

are wired as a gated semi-latching asymmetrical astable that – when gated on via the alarm's 'entry delay' timer (see Figure 10) – produces one-per-second 50ms output pulses that gate the tone astable via D2. The action is such that the tone astable is briefly driven on via C2-R6 when power is first switched to the circuit, thus generating a brief 'switch-on' bleep in the sounder, and is activated via the input-'A' terminal whenever a sensor switch is activated in any of the alarm's active zone areas, and is also activated via the IC1a-IC1b astable and D2 whenever the alarm's 'entry delay' circuitry becomes active, thus generating a series of 50ms 'bleeps' at roughly 1-second intervals when anyone re-enters the building, reminding them to turn keyswitch S1 OFF before the siren-activating finish of the 'entry delay' period.

Figure 12 shows the circuit of the alarm's siren control unit, which is based on the block diagram of Figure 9 but uses its own component numbering system and is energised when S1 is in the ON and OFF positions. Here, IC1a-IC1b are wired as a non-inverting buffer that drives the internal siren on (via D1-Q3) if Tamper switch S2 opens. The remaining ICs act as triggered 50-second and 16-minute timers that activate the internal and external sirens if Panic switch S3 is opened or if a 'high' input is received from the output of the alarm's intrusion detector circuitry. These timing circuits operate as follows:-

In Figure 12, IC1c-IC1d are wired as a simple monostable timer that controls the external siren's 'hold-off' period; it is automatically reset at S1-switch-on via C3-R5 and is triggered by a positive-going transition on pin-12 (derived from the intrusion detector, or by opening S3). When triggered, the monostable's pin-10 output switches high and activates the IC2-IC3 16-minute timer and turns Q1 on, but switches low again at the end of its 50-second (nominal) timing period, which is controlled by R6-C4. In practice, this timing period also depends on the 'threshold' voltage value of the individual IC, and may vary substantially from the 50-second value; if it does, make the timing roughly correct by changing the R6 value.

The output of the 50-second timer triggers the 16-minute timer, which is a semi-precision design built around a bistable latch (IC2a-IC2b), a gated 8.5Hz astable (IC2c-IC2d), and a 14-stage (divide-by-16,384) ripple counter (IC3). The action is such that, at switch-on, the bistable is automatically reset (with its pin-3 output low and pin-4 high) via C3-R5-R7, thus gating the astable off, and the counter is reset via C6-R9. As soon as the 50-second timer (IC1c-IC1d) is triggered, its pin-10 output flips the IC2a-IC2b bistable, driving the internal siren on via D2-Q3. This feeds a drive current towards the base of relay-driving transistor Q2 via R12-R11, and also gating on the astable. The astable immediately starts feeding clock pulses into the IC3 counter at a 8.5Hz rate.

Note that, in the early stages of this 16-minute timing sequence, Q1 is driven on by the monostable timer, thus preventing the bistable's drive current from reaching the base of Q2, but that Q1 turns off after 50-seconds, thus enabling Q2 to turn on and activate the external siren via relay contacts RLA/1 and RLA/2. Meanwhile, the astable keeps feeding clock pulses into the counter until, after 16-minutes, on the arrival of the 8192nd pulse, the pin-3 output flips high and resets the bistable via D3, thus terminating the timing process

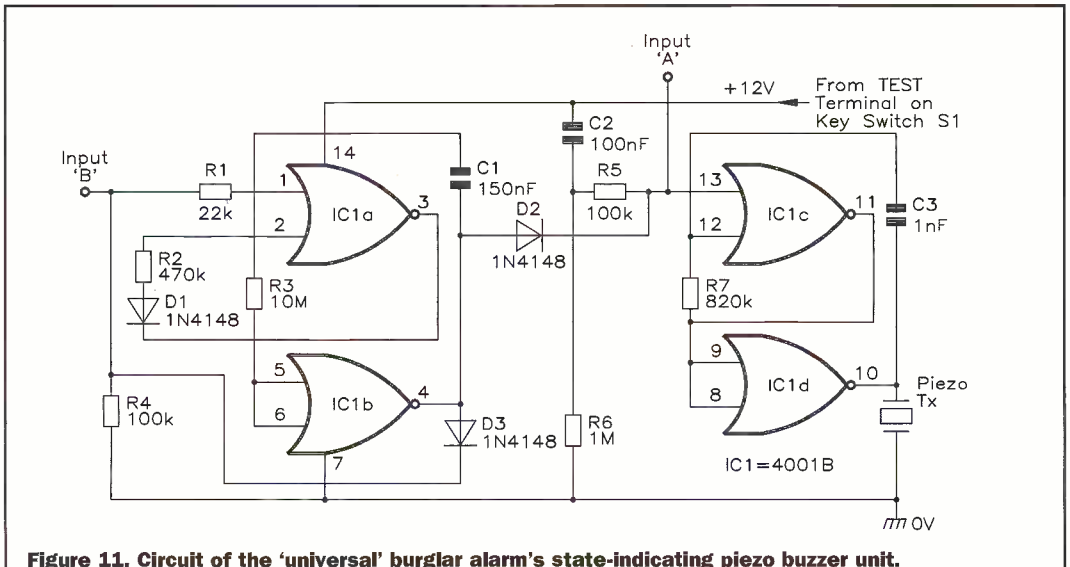


Figure 11. Circuit of the 'universal' burglar alarm's state-indicating piezo buzzer unit.

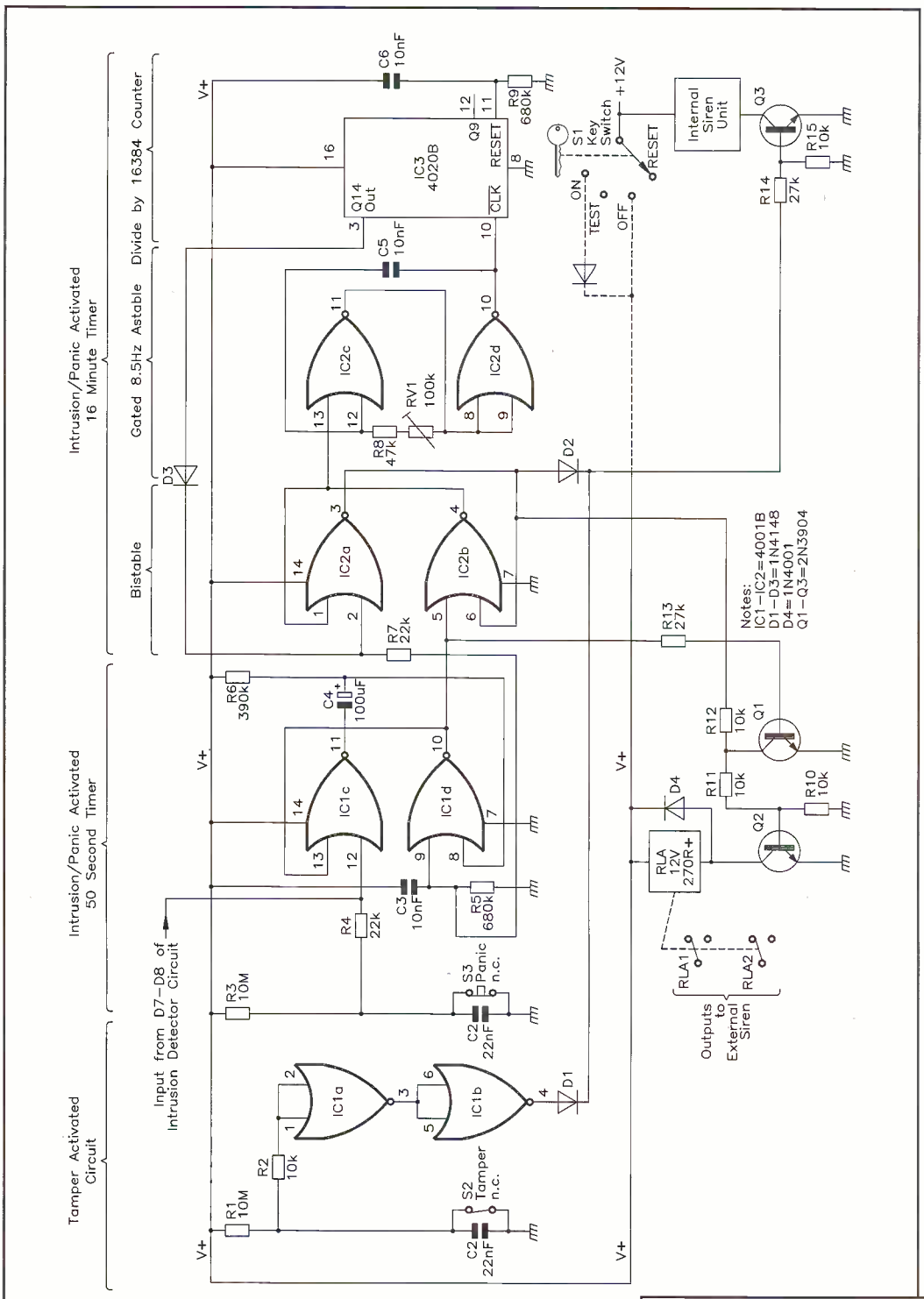


Figure 12. Circuit of the alarm's siren control unit.

medium-power 12V sirens.

Regarding the 'universal' burglar alarm's power supply, note that the basic unit consumes a typical standby current of only a few microamps and can, if desired, simply be powered by a rechargeable 12V battery. In practice, however, modern burglar alarms are usually used in conjunction with PIR detector units, each of which typically consume a quiescent current of 20mA; thus, a system that uses three PIRs consumes a quiescent operating current of about 60mA, which can if desired – be supplied by a 12V rechargeable 1.2AH battery that is fed via a protective diode and via the output current of a line-powered 60mA trickle charger. In a unit of this type, the charger supplies the full operating current when the alarm is in its ON but untriggered mode; the battery supplies all excess power if the alarm is triggered, and receives a safe 60mA (1/20th of its 1.2AH capacity) trickle charge when the alarm is not in the ON state.

Finally, note that the 'universal' burglar alarm is very simple to operate, and is normally used in the ON mode when required to respond to an intrusion, and in the OFF mode (in which its Panic and Tamper switches are still active) when it is not required to detect an intrusion. The TEST mode is only used when setting up or testing the system. The RESET mode is only used to reset the alarm timing/control circuitry once an alarm siren has activated, or to rapidly reset the intrusion detector's exit delay timer when an unexpected repeat of the full 'exit delay' time is needed.

and turning both the internal and external sirens off. The circuits timing period can easily be set to precisely 16-minutes by connecting a LED and 4k7 series resistor between pins 12 and 8 of IC3 and – with the timer triggered – carefully trimming RV1 so that the LED operates with precise 30-second on and off periods.

Figure 13 shows the circuit of the alarm's 'reset' and internal siren driver circuitry, together with its connections to S1; this diagram is based on those of Figures 9 and 12 but uses its own component numbering system. Here, Q1 is driven on whenever S1 is in the RESET position, and rapidly resets the alarm's intrusion detector 'exit delay' timer by discharging its timing capacitor (C4 in Figure 10). Q2 is driven on (via the output of the alarm timing/control unit) and activates the internal siren unit (a low-cost multi-tone medium power commercial unit) whenever an intrusion is detected or a tamper or panic switch is operated; the specified Q2 transistor has a maximum current rating of 200mA, which is adequate for driving most

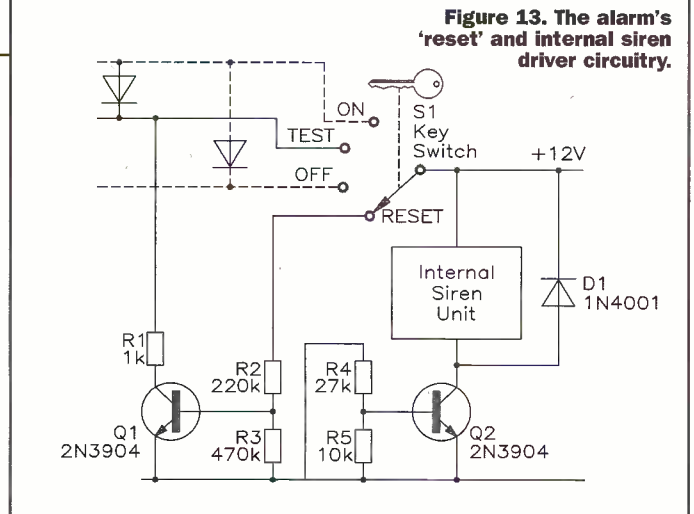


Figure 13. The alarm's 'reset' and internal siren driver circuitry.

Radio COMMUNICATION PRODUCTS

PART 4

New Catalogue Items

by Harry Watkins

Some very interesting new items appear in the 1998 March-September Maplin catalogue which need further explanation so here goes.

The Beta 3100 mobile FM 80 channel CB tranceiver (Maplin Order Code NV66W).

The Citizen Band (CB) frequencies were allocated for the use by anybody over the age of 14 to use as they wish for either business or pleasure purposes.

Citizens Band radio has recently taken a major step forward with the introduction of an 80 channel (40 UK channels and 40 CEPT channels) allocation (previously 40 UK channels only were available).

So far only mobile transceivers with 80 channels have been launched by the manufacturer's. The hand held models will be available any day now and may well be on the market by the time you read this. Contact Maplin for the latest news.

The BETA 3100 mobile FM 80 channel CB transceiver (Maplin code NV-66) sells for the very low price of £89.99. It is a basic model which will fulfil the needs of both beginners and experienced operators alike. It is simple to operate and easy to use. If you are looking for a CB that does "everything" without being complicated then this is the model for you.

It has a power output of 4 Watts (the full legal limit), and a highly sensitive, selective, dual conversion superheterodyne receiver with tuned RF stage and built-in automatic noise limiter. The unit measures a tiny 123mm wide by 165mm deep and 38mm high. The unit weighs only 750g making it ideal to fit almost anywhere in a vehicle. It is supplied with a fused DC cable (hard wired), hand microphone (with separate up and down buttons and a button to change between the two sets of 40 channels.) plus microphone bracket, and mobile mount for the transceiver with fixing screws for easy installation (either vertical or horizontal) and removal. Also a spare fuse is included.

The front panel is well laid out and easy to read. It has a 5 pin microphone socket, separate squelch and volume controls, a large LCD for channel display, a button for channel up and a button for channel down and another button to change between the two sets of 40 channels.

On the back of the radio there is a SO-239 50 Ohm antenna socket (for PL-259 plug), a 3.5mm mono jack socket for extension speaker (not supplied), and a 3.5mm mono socket for external S-Meter (not supplied). The speaker is built into the underside of the radio. The supplied handbook is very informative giving all the information you are likely to require.

The MAYCOM EM-27 (Maplin code NV-99H) is also a 4 Watt FM mobile 80 channel CB transceiver but this is a full-featured model to suit the most discerning radio operator. Retailing at £129.99. The unit is supplied with a fused DC cable (detachable), hand microphone with remote control functions, microphone bracket and mobile mount with fixing screws for easy installation and removal. A comprehensive instruction manual explains all the features in easy to understand language.

The unit measures 150mm wide, 45mm high and 157mm deep and weighs 1.4kg. The front panel has a 6 pin microphone socket and rotary controls for volume, squelch, channel number change and RF gain. There is also a large multi-function LCD display which not only displays the channel number but frequency as well. The rear panel features a SO-239 50 Ohm antenna socket, DC socket and a 3.5mm mono jack socket for extension speaker (not supplied).

The are almost too many features to mention, but these include scanning of all channels or only the 7 user programmable pre-set memory channels; dual watch which enables the user to be using one channel whilst monitoring another; key lock to stop accidentally tuning to another channel; instant access to channel 9 or 19; direct display of supplied voltage; beep on or off switch; back lit illumination; RF gain control and last channel recall. This is a superb transceiver that has already become a firm favourite with enthusiasts.

The HORA C-408 (Maplin code NW-36P), which sells for £89.99, is an exceptional value 70cms hand held amateur radio transceiver. It comes with a portable antenna (SMA) and runs from 2 x AA batteries (not supplied). There are the usual sockets for external speaker and microphone. The unit is a super mini size of 58mm x 80mm x 25mm, small enough to fit in any pocket. There are 6 selectable tuning steps, 20 memory channels and the display can either be in frequency or channel numbers. It covers 430-439.995MHz but for export purposes only

The Maycom EM27 A 4 Watt FM mobile 80 channel CB tranceiver (Maplin Order Code NV99H).

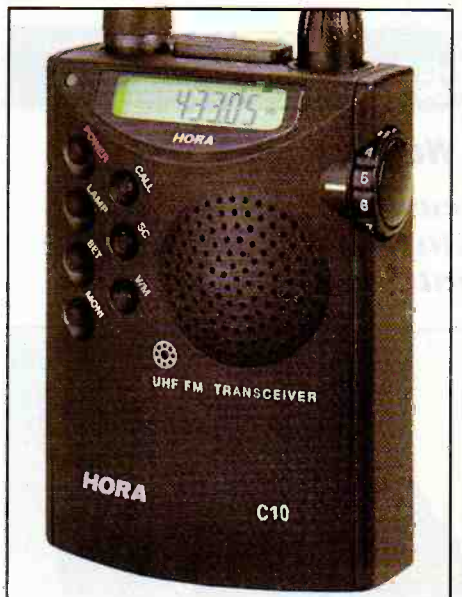
this can be extended to 400-460MHz with a small modification.

Other features include internal dual watch, semi-duplex operation, beep on or off, back light, pause or busy scanning modes, battery save and auto power off. There is programmable repeater shift and full CTCSS encode and decode. The RF output is 230mW. This radio has features on it only usually found on much more expensive types. Absolutely ideal for amateur radio Novice licence holders.

The YUPITERU MVT-3300 (Maplin code NV-94C) which sells for £179.99 is the latest VHF/UHF scanning radio (scanner) to come out of the Yupiteru stable. Now undisputed world leaders in scanner manufacturing, Yupiteru have come up with a budget model that covers all the favourite bands of frequencies of most listeners at a very favourable price indeed. It is supplied with a helical antenna (BNC) a wrist carrying strap and a 3.5mm mono earphone for personal listening. A desk stand is built into the receiver. It can run from 4 x AA batteries (not supplied) or external 12V DC.

Frequency coverage is 66-88, 108-170, 300-470 & 806-1000MHz. Modes are NFM & AM (user switchable). The unit has 5 selectable frequency steps, these are, 5, 6.25, 10, 12.5 & 25KHz. There are 200 memories for single frequencies, 10 memories for whole bands of frequencies, 10 priority channels and 100 search pass memories for blocking out the unwanted noises etc. that can clog up some channels. It can scan an incredibly fast 40 channels or 50 steps per second. The scanner measures 59mm wide x 152mm high and 32mm deep and weighs only 310g including the aerial and batteries. In average use 14 hours battery life can be expected.

The supplied fully comprehensive hand book will ease a beginner into the operation with the minimum of fuss and the experienced operator will love the way its operation is so logical. The dual on-off/volume knob with separate squelch knob are a good size and easy to use situated as they are on top of the radio. The back light and monitor buttons are placed where the thumb naturally holds the receiver, all other buttons are on the front of the receiver to ensure simple and quick operation.



The Hora C408 hand held amateur radio tranceiver. (Maplin Order Code NW36P).

As this radio covers VHF Airband, Marine band, 2m/70cm amateur radio bands, analogue cellular phone band and many public services, it is both ideal as a beginner's radio and hobbyist radio for someone who needs a portable receiver but does not want to take his main home base receiver around with him.

The ICOM IC-PCR1000 (Maplin code NW-35Q) which sells for £349.99 is a computer controlled receiver covering 100KHz to 1300MHz and offering USB/LSB/CW/AM/NFM & WFM reception. Computer controlled but operated remotely from the PC it takes our hobby into the next century and really is a sign of the products of the future. It does the job of receivers that cost over a thousand pounds more!

Computer requirements are system: Microsoft® Windows® Version 3.1 or Windows® 95. (® registered trademarks of Microsoft Corporation in the USA and other countries) CPU: Intel i486 DX4 or better (Pentium ® 100MHz or better recommended) Hard disc: At least 10MB of free space. Memory: At least 16 MB. Serial port: Serial interface (38400 bps throughout. Display 640x480 pixel resolution or greater. (800x600 pixel recommended).

The explosive growth of the Internet in the last few years has brought a wealth of information to PC users around the world. However, long before the Internet existed, the airwaves have been filled with communications of all kinds – broadcast radio and television, ham stations, marine and aviation to name just a few. The IC-PCR1000 lets you listen in to this exciting world from your computer. Don't miss out!

The unit measures 127.5mm wide x 30mm high x 199mm deep. And weighs about 1kg. It comes with a mains AC power supply, 2 x 3.5" discs, 9 pin D type plug to socket lead (RS-232C serial cable), 12V DC lead, telescopic whip aerial (BNC), two spare fuses, a 3.5mm mono jack plug for external speaker and instruction booklet.

There are three receiver interface screens to choose from. Firstly there is a screen that looks like the front panel of a typical communications receiver with signal strength meter, frequency readout, keypad etc., secondly there is a component type screen which is divided up into four components and shows all the available functions which are tuning, mode/vol, meter/scan and bandscope. This would be a favourite for those already familiar with full function communications receivers and thirdly a simple radio screen like a typical stereo tuner which shows pre-set buttons for stations and frequency readout etc. for monitoring your most listened to stations such as AM/FM broadcasts and TV.

Again features are almost too numerous to mention but include real-time bandscope function to find busy frequencies easily and unlimited number of memory channels (in groups of 50). For easy recognition and better organisation, a bank and memory name function is available. Each memory can store not only frequency, receive mode and station names, but also tuning step, attenuator and filter settings, and more. It also offers CTCSS tone squelch decode, six types of scan and 9600 baud data receive capability. Super fine tuning resolution to 1Hz is included. The RF attenuator (20dB) protects the receive signal from distorting

The Yupiteru MVT3300 VHF/UHF scanning radio. (Maplin Order Code NV94C).

The Icom IC PCR1000 computer controlled receiver. (Maplin Code NW35Q).

due to excessively strong nearby signals. Finally there is an external speaker level control for using a computers built in speaker.

This receiver has already established itself as a "must have" item for many radio enthusiasts as well as more casual listeners. A product that that lets you listen to whatever you want to listen to at the press of a mouse button and at a very reasonable price.

One of my favourite new products is the BAGEN® FREEPLAY® FPR-2 (Maplin code NW-05F) which is a AM/FM portable radio that sells for £59.99. But this is no ordinary portable radio as it does not work from batteries (kind to the environment) and it does not need an external power source! It works from personally generated power! The radio will receive 500-1700KHz AM (medium wave) and 88-108MHz FM. Its dimensions are 200mm high x 290mm wide x 200mm deep and it weighs 2.4Kg. This model replaces the earlier model FPR-1 which was larger, heavier and did not last so long after winding up.

The Bagen® Freeplay® FPR2 AM/FM portable radio. (Maplin Order Code NW05F).

The energy storage and release mechanism is based upon energising a textured carbon steel spring by winding it from one spool to another. As the spring returns to its original position, it releases its energy and applies a rotational torque into a transmission. The transmission consists of a gearbox, which drives a direct current generator which provides energy for the radio receiver. 60 winds of the built-in handle provides full energy storage, enough to last for upto one hours listening.

The unit can be powered from an extemal DC supply of 3-12V 100mA (minimum). The built-in speaker is 102mm Silverdome 8 Ohms 5 Watt maximum. There is a built-in ferrite bar aerial for AM and a telescopic whip for FM.

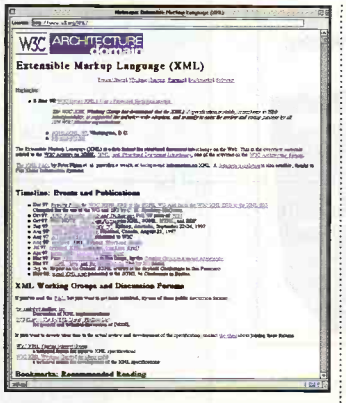
This radio has serious applications in the third world and on expeditions where batteries may be hard to come by as well as educational applications. And its fun! ELECTRONICS

@Internet

No sooner does one system gain public acceptance than it's time to upgrade to a new one. The World Wide Web, happily running on hypertext markup language (HTML) pages, is already looking to the future with a brand new programming language, called extensible markup language (XML).

XML isn't a brand new language — much of it is common to HTML anyway — and is, in fact, based on the same sort of tagged text format that HTML is itself. They both are generated from the main principle developed in the first such programming language, called standard generalized markup language (SGML). SGML was developed (back in 1986) for, and is still common in, certain types of publishing environments — aircraft maintenance manuals and the like — where documents need to be viewable on-screen as well as off. It was the first such document programming language to use coded commands — called tags — inserted within a document inside angled brackets (the less than and greater than symbols, actually). Thus, a command to underline a word could be in the format: <bold> word <bold>, which in the viewed document produces the effect: bold.

In SGML, the tags a document uses, and the rules for using them, are all stored in a document type definition (DTD) file along with the document itself. An SGML programmer can therefore literally make up the tags required in the document out of thin air, because as long as the tag definition and rules are included in the DTD file, then all the necessary information required to use it is present. When HTML was later developed for the Web, however, the overriding principle was that downloading a separate DTD file would be too time-consuming and too tricky to handle (due to slow modems and unreliable connections). HTML therefore was



developed to use just a set number of tags. As the set is defined, there's no need for a separate DTD file, and a Web browser incorporates all the tag definitions directly.

XML goes back to the SGML method of using DTD files, and a Web page designer can develop his or her own, or use DTD files of other designers. As it's extensible, XML allows new and better techniques to be developed by the designer too.

For a start, XML pages will offer more capabilities for being driven by data. Tags could easily be identified as fields of data for use in a database, say, or offer the possibilities of hyperlinking to one of a number of URLs depending on what information the user has already supplied. A Web page itself, may even appear differently to different users, depending on user preferences. As such, it means that pages will be significantly more complex under the surface, yet no more complex to the user surfing the page.

Despite the power XML promises, it isn't ever likely to replace HTML so users of existing authoring tools needn't despair. Web pages which don't need the power of XML could run quite happily in an HTML way. Only pages needing the extra power XML offers need to consider it.

As for the Web browsers themselves, Netscape and Microsoft, developers of the world's two most used browsers Navigator and Internet Explorer, have committed themselves to supporting XML. Indeed, the latest version of Internet Explorer (v4) already has a Java-based XML processor. Checkout <http://www.w3.org/XML/> for details.

Sizzling Web Access

Internet users could benefit from spectacular improvements in their Web-access speeds by downloading the beta version of Quick Web from Internet start-up Web 3000. Quick Web accelerates the first visit to a Web site by compressing the graphical Web-page content transmitted from an Internet-service provider to users over modems.

NetSonic's IntelliCache technology accelerates all subsequent visits to the same Web site by intelligently caching and updating the largest portion of most Web pages – their graphics – thus making the annoying delays of the Internet transparent to users.

NetSonic will be officially released in February. A beta version is available for free at www.Web3000.com/products.htm.

Diagnostic Utility Improves Internet and Modem Connectivity

Modem Wizard 97, a modem repair and monitoring software utility from Cross Atlantic at www.crossatlantic.co.uk that lets PC users verify the 'true speed' of a modem connection, update connections to Web browsers and set up their modems easily.

The £29.99 program is designed to solve most PC online problems resulting from internal or external modems and Internet connections. Such problems usually involve initial out-of-the-box set-up, dial-up networking configuration and the inability to dial, connect or recognise fax/modems and Internet browsers.

Microsoft to Buy Hotmail

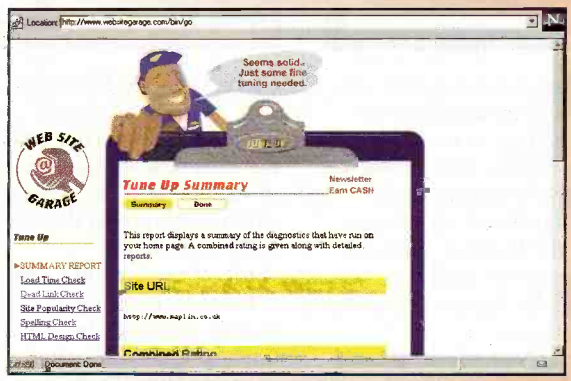
Microsoft is set to acquire Hotmail at www.hotmail.com, one of the leading providers of free e-mail service. The reported deal calls for Microsoft to hand over £180 to 250 million in stock for the service, which boasts 9.5 million subscribers, but has yet to make any cash. To date Hotmail has relied on advertising as its sole source of income.

Hotmail will become a component of the Microsoft Network online communication and information services at **www.msn.com**, which Microsoft offers free to all Internet users.

Speaking to Electronics and Beyond, Laura Jennings, vice president, Microsoft Network said, "Hotmail has been a Web-mail pioneer. It has built a strong following by offering a free, quality e-mail service that lets their members access a permanent e-mail address from any PC with an Internet connection.

"Our goal is to combine the benefits of Hotmail with Microsoft's services and technology to provide consumers the best combination of free and premium e-mail services. We are committed to making it even easier for people to communicate over the Internet from anywhere in the world," added Jennings.

Web Site Garage for Web Site Servicing



For most people – like their car or computer – how their Web site works is often a mystery. As long as they are up on the Internet, they believe everything is running smoothly.

But Web sites are prone to the same problems as cars. Unless serviced on a regular basis, they won't run efficiently; in fact, they can even break down completely. And most Web masters remain unaware of these issues until a major problem occurs.

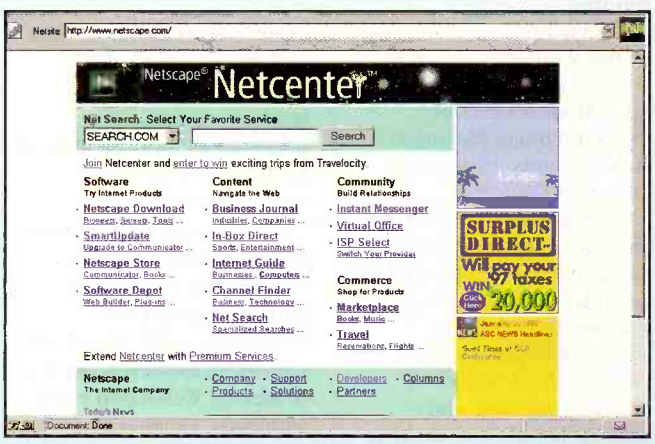
To solve this problem, AtWeb, has launched the Web Site Garage, an online one-stop shop at **www.Websitegarage.com** where Web masters can go to have their Web site serviced. Just as Norton Utilities or Nuts&Bolts optimises PC performance, Web Site Garage is designed to optimise Web site performance.

Given a URL, the diagnostic utilities run a free five point check that analyses the design and promotability of a Web site, including an analysis of load time, dead links, site popularity, spelling and HTML design. The resulting report, presented in minutes by the wisecracking Web Site Garage mechanic, analyses and rates the site, providing suggestions for improvement.

Netscape Frees Browser

Netscape at **www.netscape.com** began its fight back against Microsoft Explorer this month by making the personal editions of Navigator and Communicator products freely available via download. Though for all practical purposes the browser was already available for free to consumers, now it's guilt-free. Where the move will make a bigger difference is in the corporate marketplace, where violating licenses is taken more seriously. Internet Service Providers (ISPs) and Web content companies may now freely redistribute the software.

Netscape has also decided to follow and improve upon a Microsoft's practice by not only giving away its Communicator software for browsing the Web, but also giving away the source code that includes original programming for that product. One reason for the move is to encourage third-party software companies to create improvements on its products, for submission to Netscape and inclusion in the final product.



IBM goes with Java

Meanwhile Java itself, the programming language that allows programs (called applets) written with it to be run on any computer, with any operating system that supports it, gets a boost with the news that IBM has opened up its support for it further. Over the next few months IBM will replace its network computer NetStations' Unix based NCOS operating system with the Java operating system Java OS. This means that network computers from IBM and Sun (with its JavaStation range of network computers) will run the same operating system. A single operating system based on Java will help Java in its quest to provide a viable alternative to Windows NT. Microsoft (the Windows NT developer, if you didn't already know) on the other hand, is largely dismissive about this, saying that the NC concept is 'flawed". Surprising.

IBM has also just announced PilotBean, a Java interface for the 3Com/US Robotics PalmPilot — a product IBM rebadges as its WorkPad.

Interestingly, while Microsoft's Windows supports Java, in that it will allow Java applets to run within a Java-enabled browser within Windows, Windows CE (the cut-down version of Windows, specifically intended for handheld and palmtop computers such as Hewlett Packard's 620LX) is so cut-down that it doesn't handle Java applets at all. Ho, hum, back to the drawing board, or buy a PalmPilot, eh?

@Internet

INTECO reveals Navigator Decline

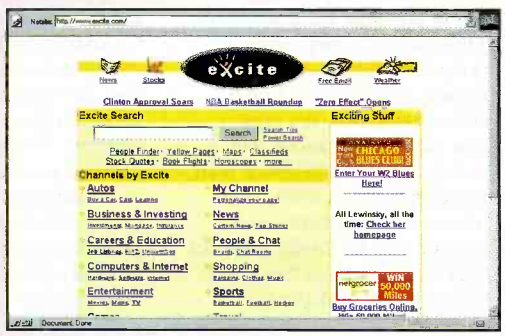
In October 1997 INTECO interviewed over 6,000 people using PCs or Internet terminals in France, Germany and the UK at work about a wide range of technology and electronic commerce issues. This followed a similar survey conducted 6 months earlier with another 7,000 users. The swing in browser market share in favour of Microsoft's Internet Explorer over such a short period of time is dramatic.

	April 1997		October 1997	
	Navigator	Explorer	Navigator	Explorer
France	54 per cent	46 per cent	40 per cent	60 per cent
Germany	49 per cent	51 per cent	46 per cent	54 per cent
UK	56 per cent	44 per cent	42 per cent	58 per cent

Speaking to Electronics and Beyond, Tom Bachman, president of INTECO said, "The evidence speaks for itself. Microsoft had almost caught up in April 1997, but this is the first time we have seen them ahead in all three countries.

"Navigator was able to hold the lead for a while because it was established and was a superior offering in many respects – particularly for users on platforms other than Windows 95 and NT. But times have changed – NT and 95 penetration has increased, Internet Explorer got better and has become the natural selection for more and more users as a result," added Bachman.

Excite To E-mail Entire Generation



Excite is set to issue a free Web-based e-mail address to every school child in Britain as part of the UK government's NetYear initiative to provide Internet connectivity to every pupil in the UK by the end of 1998. Ten million UK schoolchildren are expected to get lifelong e-mail accounts through the year with ExcitePost.

Joining forces with the UK NetYear initiative as the program's exclusive e-mail provider, Excite and its e-mail partner WhoWhere at www.whowhere.com, will provide all UK school children, teachers and schools instant free life-long Web-based e-mail addresses immediately.

UK NetYear anticipates that an estimated 5 million school children, teachers and schools will participate in the first 6 months and will get, at a rate of just under one million a month, Internet access and Web-based e-mail accounts. Excite and UK NetYear will work together to create a registration process to facilitate sign up for service. Students and teachers can get more information about signing up for ExcitePost at www.excite.co.uk.

As more schools continue to get Internet access through the UK NetYear initiative-taking place throughout 1998, Excite will roll out its ExcitePost service of lifelong Web-based e-mail addresses. Excite is also providing training materials so that people know what e-mail is, how to use it, and how to get the most out of the service. This material will also be provided free of charge and will be suitable for use in UK schools. Excite will extend this effort to other countries if they undertake efforts similar to those of the UK government.

Site Survey

The month's destinations

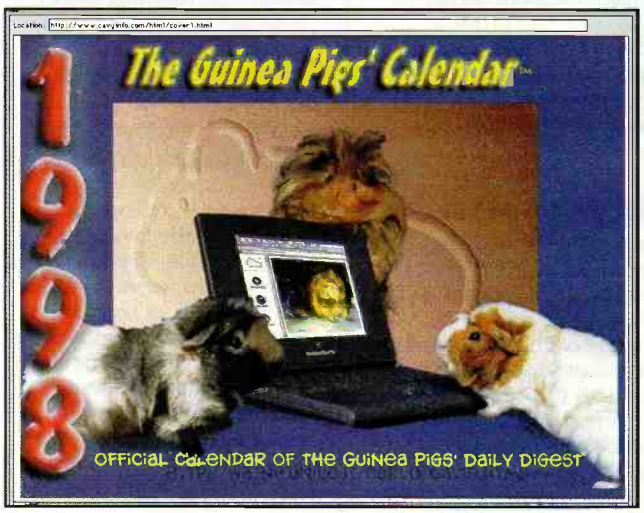
Visitors to and residents of Northern Ireland lick your lips and bear in mind that other readers won't know what we're talking about here, but Maud's Ice Cream is on the Internet. Well, not the ice cream itself, but the Maud's Ice Cream Web site at least. Go to: **<http://www.globalgateway.co./ggtv/index.asp>** and follow the Maud's Ice Cream link. If you've ever had a Maud's (try Pooh Bear — the editorial favourite — slu-u-u-rp) you'll appreciate the site. If you've never had the fortune to try one; tough! Maud's has ice cream shops throughout Northern Ireland, and the range and flavours of ice cream you can have is legend. Apart from this, Maud's is now found on the Global Gateway Television site — itself worth a visit.

Hamster-lovers have a field day on a new Web site (in development at the time of writing) promoting the furry 'ickle creatures at: **<html://www.cavyinfo.com>.**

Don't let us hear you say that we don't get the most interesting sites for you to browse. Note also that Macintoshes must be easy to use, 'cos even cavies can use 'em <grin>._

Finally, for one of the most entertaining Web-reads you'll ever have, look at **<http://www.winblows.com>.**

A parody of some other software company's Web site, this one will have you in stitches, being far more humorous than the real thing, of course.



in the pipeline

ELECTRONICS and Beyond

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

Issue 125 on sale Friday 3rd April

Projects

Get to grips with building a PC

Bench Power Supply

Midi Thru Box

On Screen Video Level Meter

Features

Electronics in Agriculture

– Driverless Tractors

Solid State Relays

ADVERTISERS' INDEX

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 27th April (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.

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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.

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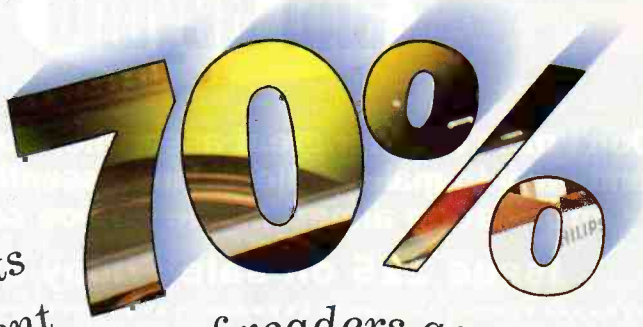
If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with 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.

of our readers thought our feature articles are good to excellent!

Readers were asked if our news reports are good to excellent



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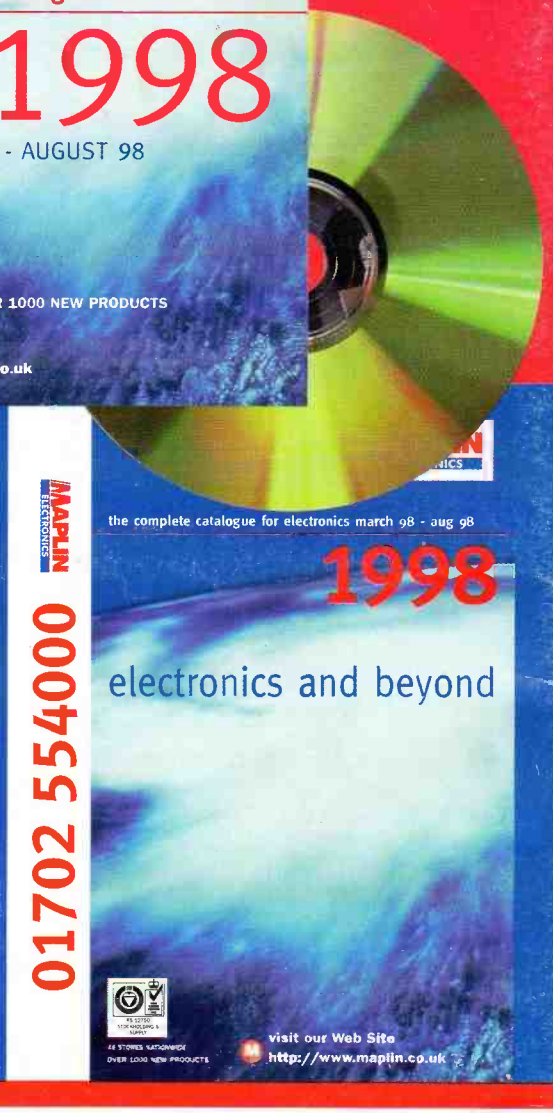

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