Big brother technology

Adjustable PLL
Variable-gain circuits
Tini Java
Windows 2000 review
EEPROM programmer

Circuit ideas:
Phase noise meter
Log sweep generator
Low-power mains SMPS
Drive for valve amps
Hewlett Packard 8642A - high performance R/F synthesizer (500 KHz-1.8 GHz) £4750
Hewlett Packard 8555A - tri-channel DMM £2450
Hewlett Packard 8567A - 100 MHz to 1 GHz portability £8950

Tektronix MSA 4901 - 4-channel high writing speed £2000
Tektronix 24678 - 400 MHz - 4 channel £1500
Tektronix 2455 - 150 MHz - 4 channel £1250
Tektronix 2235 - 100 MHz - dual channel £995
Tektronix 464/466 - 100 MHz with AN storage £1450
Tektronix 2213/2215 - 200 MHz - dual channel £1650

Hewlett Packard 8753D - network analyser (3 GHz) £2500
Hewlett Packard 8753B - network analyser (6 GHz) £3250

RS 'parameter test sets 85046A and 85047A £995
Hewlett Packard 3335A - 2.0 to 1050 MHz £2750
Hewlett Packard 75000 VXI Bus Controllers £POA
Hewlett Packard 8130A - 300 MHz high speed pulse generator £5250
Hewlett Packard 16500A - 8 Log, Analyser Mainframes from £1000
Hewlett Packard 8660D - Synth'd Sig. Gen (10 KHz-2600 MHz) £2750
Hewlett Packard 6033A - £850
Fluke 2620 Data Baskets £500

MISCELLANEOUS
Donner 6030 - £700
Systron 6030 - £995
Packard 778D - Dual-Directional Couplers £650
Packard 3785A - Signal Generator & Receiver £1250
Packard 37900D - Signalling test set £3750

SPEAKERS' CORNER
John Watchman explains the importance of a loudspeaker's off-axis response.

PROGRAMMING EPROMS
If you are still using UV-erasable EPROMs, this programmer should save you on anordinate amount of time. Designed to interface with anything from a 386 PC upwards, Gwynn Ya's parallel port programmer handles popular electrically-erasable PROMs ranging from the 284 to 25264.

VARIABLE-GAIN CIRCUITS
Cyril Bostian has been using the Internet to see what he could find on variable gain circuits, including those featuring in Dobly-B, companders and automatic gain and level controllers.

WINDOWS 2000
Rod Cooper investigates Windows 2000 from the CAD user's viewpoint. He's found that this new NT-based operating system offers major benefits, but it will mean new hardware and software for many users.

ADJUSTABLE PLL FOR RECEIVERS
Darren Heywood's 45 to 70 MHz phase-locked loop module is tuned by simply turning a ten-turn potentiometer. It was originally designed to form the master oscillator of a short-wave receiver, but is easily adapted for other applications.

WEB DIRECTIONS
Useful web addresses for everyone involved in electronics.

LETTERS
New mobile phone health risk, fuel-starved diesels, RF initiative, Class-T...
The so-called ‘New Economy’ has been having a bad time lately with over-greedy backers and bankers pushing their luck too far, and eroding the credibility of the money men behind these ventures. One of the backers of two, recent, ill-fated dot.com (IPOs), was Intel. The company backed both the Dutch WinOnline and the UK’s Lastminute.com, public offerings. Its PR initiatives had helped create lastminute’s high public profile in the months preceding the launch. Both offerings fell below their initial offer price leaving the small investors money — though the original backers profiled greatly.

The chairman of WinOnline sold most of her shares before the IPO even occurred, and US investment bankers Goldman Sachs who managed the launch were warned by Japan’s Ministry of Finance that its record in the WorldOnline and lastminute launches had made it consider dishing the bank from advising on Japanese government privatisations. Suddenly the authorities woke up to the fact that the dot.com boom could get out of hand and bring down the whole house of cards. To most of us it was difficult to take seriously the valuations put by banks, stockbrokers and investors on dot.com companies. Now the credibility of the financial sector is being questioned by the authorities.

The same thing is happening with the credibility of the founders of dot.com companies. At one time we were encouraged to think that dot.com companies were started by sparky young people with nothing except a ‘good idea’; the truth is often very far from that. Dot.com founders are not the innocent young techies operating from a garage of an earlier generation but sharp-eyed marketing men looking for a kill. Venture capital — once something to be jealously hoarded by high-tech start-up companies for innovative product development — tends to be spent by dot.coms mostly on publicity rather than on developing a service or a product.

Some of the dot.com companies are spending on publicity at the rate of £1 a month — the money coming from venture capitalists wanting to make a quick killing through an early public offering on the stock market. Now there is a more realistic attitude emerging: the hangover from the dot.com frenzy is affecting the whole of the high technology industry. That’s because, very often, dot.coms are regarded as high-tech by newspapers, analysts and television programmes — even though they may be purveying cooking recipes. That means the sharp swings of their share prices can affect the whole high-tech sector. For instance, some of this year’s fall of the US NASDAQ high technology stock exchange — from over $5000 in March to under $3500 by mid-May — is attributable to the excessive expectations generated by the dot.coms. It was then designated by the reality of collapsing share prices and even, in some cases, scandal. It seems very hard on real technology companies to have their shares hit by a general disillusionment with ‘high-tech’ brought about by some lack-lustre performance from the so-called dot.com companies. Most of these dot.commers have nothing to do with high technology at all. For instance Lastminute.com is basically a travel agency with some add-on shopping opportunities. Internet-based activities like job agencies or even Internet service providers are not high-tech companies; they simply rely on the technology in order to distribute their product.

You wouldn’t say Harrods is in the transportation business because it uses vans to deliver its goods to customers would you? Real high-tech companies are those that develop and sell high-tech products: semiconductor companies, computer firms, networking companies, software companies, manufacturers of printers, mobile phones, scanners, camcorders, smart missiles, radars and the like.

Anyone making the broadband switch, high-speed optical fibre transmission network systems like dense-wavelength division multiplexers, or making the terminals and appliances that hang on the back of the network, is facing a bright future. But these real high-tech companies don’t want their shares jittered around by association with commercially unproven dot.com companies purveying dubiously useful services over the Internet.

While real engineers may be entering a golden age — able to make money on a scale which earlier generations never dreamed of — they face the threat of being devalued and tarnished by the dot.com community.

David Manners
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**UP DATE**

**Industry warned on environmental policy**

The electronics and IT industries have been warned that ignoring their environmental responsibility could have a serious impact on long-term growth.

"Environmental responsibility is increasingly recognised as one of the key factors sustaining long-term growth," said Dr Belinda Howell, director of Business in the Environment (BIE).

BIE, the business campaign for environmental responsibility, only received a response from six out of the 28 IT and electronics companies invited to participate in its "Index of Corporate Environmental Engagement." These were Racal Electronics, Marconi, STMicroelectronics, Fujitsu, IBM and Sema Group.

The survey assesses performance in five areas: energy, transport, global warming emissions, waste and water consumption.

Set-top box manufacturer Pace Micro Technology was one of the companies which did not participate.

When questioned, a spokeswoman said she was unaware of the survey but Pace definitely had an environmental policy. "It's something we're very, very aware of," she said. "We have some things to be proud of as far as handling the environment is concerned."

Chip design firm ARM also did not participate because it felt the survey was geared towards manufacturing whereas it is an intellectual property company.

"We try to make sure our facilities operate in an energy efficient manner," said John Cornish, ARM's director of product marketing. "We don't regard ourselves as being exceptional but we try to be good citizens where we operate."

**Protection against video-link data tapping could become mandatory**

Companies handling personal information over video links may have to protect against data path tapping, according to Basel-based videoconferencing company AuDeo Systems. This could affect those discussing matters including health, government, defence and legal issues.

"The 1998 Data Protection Act coming into force in March has placed the issue of data security at the top of the business agenda," said AuDeo in a statement.

"Videoconferencing comes under the act, which stipulates that businesses handling personal data must take appropriate technical and organisational measures to prevent backing and data loss through system crashes."

AuDeo is predicting a large growth in the use of video-conferencing technology. "As the costs of such technology reduce, videoconferencing products can be used daily throughout any organisation," said Kevin Wilson, MD of AuDeo.

The statement was made at the launch of a secure videoconferencing system, to be defined in May. Each licence will contain a forward and return channel to send and receive data.

**Government prepares to auction broadband wireless licences**

An auction of the airwaves for broadband fixed wireless access services will follow the success of the £22bn auction for 3rd generation (3G) mobile phone licences.

The government will auction the spectrum at 2GHz in September for services which will allow fast Internet and multimedia access via radio links.

Three licences will be awarded in each coverage area which will be defined in May. Each licence will contain a forward and return channel to send and receive data.

At the time of writing the 3G auction had raised £22bn for the government although it is doubtful this second radio frequency auction will be quite so popular.

"Awards licensing by auction will ensure that they are taken up by those operators best placed to develop services most efficiently," said Patricia Hewitt, e-commerce minister. "The licence package is designed to encourage new entrants and the development of a competitive market."
Excessive mobile licence costs - who will pay the bill?

The multi-billion pound sums generated by bids for third-generation mobile phone licences cannot be justified by the business cases made for the technology before the auction began, according to an analyst involved.

"The licences are now costing more than the business plans will allow," said Andrew Parkin-White, an analyst at Ovum. "They are costing more than the infrastructure."

Ovum worked with several companies on their business case for the licence bids. The figures for the costs of the licence bids were drawn up at the time of the award of the licences.

Experts play down mobile phone health risk claims

A government-sponsored report is set to dismiss claims that mobile phones are a proven health risk.

The Stewart Inquiry, due to report on 11 May, is expected to conclude that there is no evidence to link mobile phones with any known health problems. The committee will also say there must be more research by the Department of Health into the "non-thermal" effects, which some studies have suggested could pose a health risk.

But the committee, chaired by Tayside University Hospital Sir William Stewart, does accept that the children, who own 20,000 of the 24 million mobiles in Britain, could be at greater risk if there is any risk.

The report follows 10 months of research and is expected to call for tighter planning controls on the siting of mobile phone masts and urge the National Radiological Protection Board (NRPB) to conduct regular spot checks on the 500 masts sited near schools. It seems that the committee was struck by the strength of public opposition to the masts.

But as the final drafts of the report are prepared, some critics said the committee had been "captured" by the NRPB and recently had been cast aside on the safety of the hands-free mobiles introduced in response to the health concerns over mobiles.

- According to a BBC on-line news report, Sir William says that he would discourage his grandchildren from using mobile phones until further research is completed.

The sophisticated cursor read outs have 21 possible read outs. Besides the usual read outs, like voltage and time, also quantities like rise time and frequency are displayed.

- Measured signals and instrument settings can be saved on disk. This enables the creation of a library of measured signals. Text balloons can be added to a signal, for special comments. The (colour) print outs can be supplied with three common text lines (e.g. company info) on three lines with measurement specific information.

- The HS801 has an 8 bit resolution and a maximum sampling speed of 100 MHz. The input range is 0.1 volt full scale to 80 volt full scale. The record length is 32K/64K samples. The AWG has a 10 bit resolution and a sample speed of 25 MHz. The HS801 is connected to the parallel printer port of a computer.

- The minimum system requirement is a PC with a 486 processor and 8 Myte RAM available. The software runs in Windows 3.x/95/98 or Windows NT and DOS 3.3 or higher.

- TiePie engineering (NL), Kopperslaerstraat 37, 8901 VL, SNEEK, The Netherlands
  Tel: +31515415416, Fax:+3151518519
  Web: http://www.tiepie.nl
Conventional chips may be viable to 2005

US researchers are claiming that performance limits on conventional transistors might not be reached as quickly as first thought. A transistor’s gate oxide layer was thought to reach a limit at nine or ten atoms thick, but Bell Labs researchers think it could work down to six atoms, or 1.5nm, thick. "Achieving such thin dimensions with the required intrinsic reliability was previously thought to be impossible," said Ashraful Alam, the Bell Labs' scientist that led the research. Alam’s team showed that a 1.5nm gate could, in theory at least, run at 14V for up to ten years. Another Bell Labs team proved the result experimentally. The life extension to silicon dioxide (SiO2) as a gate material, perhaps until 2005, gives engineers more time to develop alternative materials. These include group IVB oxides such as hafnium oxide and zirconium oxide which have leakage up to 100 times less than SiO2. These can match the performance of SiO2, but can be deposited in layers around three times as thick.

Tool eliminates chip noise errors

EDA start-up Moscape has a tool that claims to eliminate chip design errors due to noise. Called GateScope, the tool can identify and correct noise problems caused by cross-coupling, being found more as designs move to 0.18um. "The devastating effects of noise on functionality and timing are typically unrecognised until test chips are produced. Silencing this noise prior to tapeout is possible only with the new analytical and corrective approach embodied in GateScope," said Fuad Musa, Moscape’s president and CEO. "The tool, it said, has the precision to find the smaller errors, reducing the chance that the design fails to meet its timing specification. GateScope operates on Unix, Solaris and Linux operating systems and costs $75,000 per seat, per year.

Tory presses labour on e-government issue

A former Tory science minister is launching a Parliamentary campaign to force the government to deliver on its "Information Age" pledge. Robert Jackson believes the government is falling behind in the drive to put its services online. The Wharton backbencher has added a series of questions aimed at discovering exactly how far each Whittington Department has got in bringing in e-government. "The UK’s strategy for online government is flailing," said Jackson. "They have produced a 34-page book that took a year to write but says nothing," the Tories claim. According to Jackson, none of the Inland Revenue’s dealings with citizens or businesses involved the Internet in 1999, and it will rise by four per cent by 2002. "In dealings at the DSS will be Internet deliverable by 2003," he boasts. Although Ministers make grand promises to have services online by 2002 and all suitable services electronically available by 2003 but they haven’t given any indication of how they will do it," added Jackson.

Babbage gets printer after 150 year wait

Engineers worried about shorter development cycles should spare a thought for Charles Babbage who’s printer has just been built, over 150 years after it was designed. Built by the Science Museum, the mechanical printer can output results of calculations with programmable line width, margins and number of columns. The printer can also produce stereotype plates for use in a printing press. When testing a working part of the system, Babbage’s Difference Engine No 2, was built in 1991, but the printer had to wait a few years more. Both devices weigh in over 2.5 tonnes and contain more than 40 parts. They were designed to produce tables used in navigation, engineering, banking and insurance.

Trainee engineers jam military satellite with ham radio gear

Military satellites can be jammed with easily-bought high street stores and radio ham swap meets. The total could be £300. "They have produced a 34-page book that took a year to write but says nothing," the Tories claim. According to Jackson, none of the Inland Revenue’s dealings with citizens or businesses involved the Internet in 1999, and it will rise by four per cent by 2002. "In dealings at the DSS will be Internet deliverable by 2003," he boasts. Although Ministers make grand promises to have services online by 2002 and all suitable services electronically available by 2003 but they haven’t given any indication of how they will do it," added Jackson.

Stress claims triple in six months

Increasing workplace stress is boosting compensation claims on employers – says the Engineering Employers' Federation. Stress related enquires to the Federation have tripled in the last six months. "There is no need to think that there will be a 'long hours' culture in the UK and that can add to pressures," said Howard.

ELECTRONICS WORLD July 2000

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HP3458A DMM • £1500

HP8444A Tracking Generator • 5-1300Mc/s • £450

HP8970A Spectrum Analyser • £4500

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Behind big brother

In theory, Trafficmaster's number plate cameras could be used to report speeding vehicles, but the company insists its data is not passed on to any outside agencies. But pricksly feeling on the back of your neck that you are being watched is generally put down to paranoia. Scientific tests at the University of Sheffield to measure skin resistance certainly failed to detect any change change in the test subjects when hidden video cameras were trained on them. For the public at large though - and motorists in particular - this suspicion may well be justified. Their movements are coming under increasing surveillance. The UK is now said to have Europe's largest market for CCTV equipment, valued at over £385 million per year. With most city centres, banks, shops, airports and main railway stations under 24-hour watch by closed circuit television (CCTV) the suggestion is now made that British citizens - 'subjects' may be a better word - may be spied upon 14 times a day. Headlines are no longer made when news reports state that crime suspects were caught on camera, while the police acknowledge that it takes just four seconds now to alert them if a vehicle caught on their cameras is on the wanted file. Crime rates in CCTV zones have fallen by up to 50 per cent, driving wrongdoers out of town centres and into the suburbs.

Initial concerns over civil liberties has now subsided into widespread acceptance of these high-profile installations. Indeed, according to Strathclyde Police, the public has now become so accustomed to CCTV cameras that they now view them as 'simply part of the street furniture'. But what about the not-so-obvious systems and what are the technologies involved?

Steady as you go

By now, most motorists in Britain will have spotted the distinctive cobalt blue poles carrying cameras and radio transmitters that adorn the majority of trunk roads. Many people give them a careful berth, assuming these are a new generation of speed camera but in fact their purpose is PTFM, or passive target-flow monitoring. The cameras belong to Trafficmaster plc - a company that first made its name by providing information about traffic jams using a network of sensors along main motorways in Britain. PTFM takes the concept much further by measuring the time taken by individual vehicles to cover the known distances between sensors.

These specially developed infra-red sensors, installed approximately four miles apart, 'snap' the number plates of passing vehicles. Computers at each site then transmit this information back to Trafficmaster's national control centre in Milton Keynes. The time taken for a vehicle to travel between each sensor site is calculated. Then, odd spurious results are rejected - for example, drivers who have turned off or stopped along the way - and a pattern is thus built up of the average speed along the stretch of road. This information is then transmitted directly to vehicles fitted with Trafficmaster receivers when they pass the next sensor site.

A potential speed trap

In theory, the system could be used for identifying speeding drivers or for tracking individuals but the company insists the data is not passed on to any other agency. Indeed, to avoid falling foul of data-protection legislation, the first and last characters of each vehicle number taken is discarded. The remaining character string, or 'tag', is still sufficiently unique for processing purposes.

The system is also being developed to use neural networks. This is a form of computer intelligence that allows the software to predict the movement of traffic flows, and recognises when traffic congestion is building up or starting to disperse.

Concern over misuse of data collected is dismissed by a Trafficmaster spokesperson, who told me, "Under the terms of Trafficmaster's licence agreement with the Department of Transport, we must dump the information gathered immediately it has been processed. We only read the central four digits of a car's number plate. In addition, we only read a small percentage of those vehicles that pass by each site. A 100 per cent sample is not only unnecessary, but also not desirable - the equipment needed to process that amount of data would be extremely expensive, and totally unnecessary."

Expanding rapidly...

Trafficmaster's expanded network now covers approximately 4000 miles of motorways and trunk roads in England, with some 5000 cameras in use. The service is being extended to motorists in Scotland and Wales shortly. It provides the most comprehensive, near-instantaneous, live traffic-monitoring network in the world. A further enhancement of the system is under way and Trafficmaster is preparing to launch a geocoding service in the near future.

Information on-line

| CAATS | http://www.octec.co.uk/trackers/caats2.html |
| Magicard | http://www.tsi.co.uk/ |
| Trafficmaster | http://www.trafficmaster.co.uk |
| Visionics face recognition | http://www.faceit.co.uk |
| Conspiracy theories | http://www.geocities.com/NotorCity/2/195/speedtrap_notaprap.html |
Frames from two videos taken from a helicopter fitted with CAATS in south London to record a suspected bank robber; Mandrake says: "The demonstration video samples are available for downloading from Octec's web site."

"Police Stop" programmes on televisions is the aerial view footage of fast- moving felons taken from helicopters. Curious minds may wonder how the cameramen manages to keep the vehicle in that so successfully and avoid judder on the images. The answer is of course a robot and the technology is significantly more sophisticated than the first 'hel-i-tele' systems.

Gir session was all that was available when helicopter-mounted video cameras were first used for public surveillance. That occasion was in 1975, when London's Metropolitan Police ordered the Notting Hill Carnival. Many of today's crime helicopters utilize the compact airborne automatic tracking system (CAATS) developed originally for missile guidance and other defence purposes. Infrared technology tracks vehicle movement through streets and even behind buildings to drive the camera pod and maintain visibility.

How electro-optical tracking works
CAATS is made by Octec Ltd, based in Brookman and one of the leading independent suppliers of digital video tracking and image processing systems to the defence market worldwide. The company's electro-optical tracking system consists of an imaging sensor — either video or infra-red — mounted on a two-axis servo platform. There's also a tracker that controls the position of the platform based on the scene observed through the imaging sensor.

Automatic tracking is achieved by an electronic system that processes video images directly to ascertain the position of a designated object with respect to the sensor bore-sight. This error is then used to control the platform such that the platform and attached sensors accurately follow the target.

Pre-processing, using image enhancement algorithms, is also possible. This allows the target to be enhanced prior to the 'tracking process' and rejecting unwanted elements in the picture, or 'clutter'. A number of selectable options are also available to allow the operator to select 'positive contrast', 'negative contrast', or 'polarity independent' modes of operation.

Thanks to Octec for helping with this description.

Just a face in the crowd?
Even more remarkable than non-specialists in the face recognition capabilities that can be used to enhance CCTV surveillance systems. Notable in this connection is the Mandrake system developed in the UK by Software and Systems International. It is based on neural-network face recognition technology from Visionics in the USA.

The software automatically detects, locates and identifies human faces in live video or static images, using sophisticated algorithms for pattern recognition that mimic how the human brain recognises faces. This is carried out continuously and in real time. Results are tagged with a percentage score of how confident the computer is that the person spotted is one of the individuals in the database.

A high-profile system went live in the London borough of Newham in October 1998, linked to Newham's CCTV street camera — now 240 in number — and a database of suspects supplied by the Metropolitan Police. As Mandrake, who controls the security Bob Lack said bluntly: "We have ten or so active muggers in and around our shopping centres. As the system develops, facial images of known panties may possibly also be added to the automated watch list." He added that the computer had distinct advantages over human officers. If you stare at a screen for hours, you will tend to glance over," he said. "But never forget the need for the human element. None of our cameras has got down a pole and arrested anyone yet," he added.

Applied responsibly, biometrics can be used in this way to combat crime, although civil liberties campaigners have voiced concern over the system's accuracy and what is done with discarded recordings. According to the council, the system does not need registration under the Data Protection Act since personal information is not held on the face recognition system; only photographs and police reference numbers are held.

Digital does it better
New generation digital video recording systems have rendered older analog and video recording systems obsolete, with achievable movements that can be used to enhance CCTV cameras in one or more locations. One solution is a good example of the new breed, providing 'high-motion' digital video and audio recording along with simultaneous playback.

"Digital technology is significant more sophisticated than there are facial parts. How faces are recognised
Face recognition is the process of identifying or verifying a person from images or videos. The approach can be classified based on the availability of data and the required output. There are numerous techniques and algorithms for face recognition, each with its own advantages and limitations.

The two main techniques for face recognition are geometric and appearance-based. Geometric methods use features such as facial landmarks or shape descriptors, while appearance-based methods rely on pixel intensities or patterns. Appearance-based methods are more robust to variations in pose, lighting, and expression.

In the future, face recognition technology is likely to become more advanced, requiring less data and providing more accurate results. This will enable the development of systems that can operate in real-time, track faces, and distinguish between individuals even in large crowds. The potential applications of face recognition technology are vast, ranging from security and surveillance to healthcare and personal identification.

How faces are recognised
Fundamental to any face recognition system is the way in which faces are coded. Visionics' Facet uses Local Feature Analysis, or LFA, to represent facial images in terms of local statistically and building knowledge into the system. LFA is a mathematical technique based on the realisation that all faces, regardless of all complex patterns — can be synthesised from an irreducible set of building elements. These elements are derived from a representative ensemble of faces using sophisticated statistical techniques. They span multiple pixels — but are still local — and represent universal facial shapes, but are not exactly the commonly known facial features. In fact, there are many more facial building elements than there are facial parts.

However, it turns out that synthesising a given facial image to a high degree of precision requires only a small subset — 12-20 characteristic elements — of the total available. Identity is determined not only by which elements are characteristic, but also by the manner in which they are geometrically combined — i.e. their relative positions. In this manner Facet maps an individual's identity into a complex mathematical formula that can be matched and compared to others.

Honeypot for perverts
"The cameras are already intruding into our private lives. Diana Sampson, who monitors CCTV cameras for the London Borough of Sutton says, 'I know for a fact that there is a camera in my women's changing room, monitored by men and they can do anything with those tapes.' CCTV is a honey pot for perverts.

One camera operator in MI5 Clamorgan has been convicted on more than 200 counts of using cameras to spy on women, and making obscene phone calls from the control room."
e-Prophecies

So the revolution in communications has enhanced all our lives has it? Not necessarily so. It could lead to a breakdown in society. Melanie Reynolds explains.

Hollywood has always had a penchant for portraying future civilisation as being a mad, brutal, dangerous place to be. Just consider 'The Terminator' and 'Mad Max'. The movies always seem dark, portraying an existence full of menace where the fight is for survival. But it is, after all, just the movies we think. It will never really be like that. But could it be?

The advance of technology is usually regarded as improving the quality of our lives, but what if it is a catalyst for the deterioration of it instead? Technology does have the capability to increase the gap between the haves and the have-nots that already exists and with the increasing divide comes trouble – for all of us.

With the breakdown in relationships and family life, and the rise in single person households, the way we live our lives is already changing. Adding the buffer zone effect that communications technology can bring to this change gives you a society where people are isolated and personal interaction is made more difficult.

As society becomes more insular, the social pressures that tend to limit anti-social behaviour will be eroded, leading to a breakdown in society and perhaps the post-apocalyptic world of the movies will seem a bit too close for comfort.

Maybe this scenario seems a bit far-fetched and we will never live in a 'Mad Max' world, but is it a possibility the government is considering? The same paper called 'Just Around the Corner' by the DTI's Foresight crime prevention panel.

The report is seeking to provoke people into thinking about the next 20 years where society has evolved along these lines and crime and crime prevention are more technology based.

One of its theories is that technology allows people to choose to be isolated in public places. You can already see this happening with people using mobile phones.

Although surrounded by others they are detached from the environment and even from their immediate group.

Where meetings would once be social and noisy, the progress of technology means they can now be personal and mobile, meaning people have a greater choice about who they meet and how. The down side of this means there is less social interaction.

The report says this could result in physical society becoming a more hostile place which people pass through and do not interact with. In this dehumanised environment, people seem less real to each other, which leads to 'more extreme reactions, interactions and a reluctance to intervene in conflict' when they happen.

Although technology will empower people, it could also further divide society into those who have the technology and those who do not.

This technological divide underclass would have limited access to mainstream society and be a breeding ground for dissent and crime.

The Foresight report offers extreme scenarios of the future where we view strangers with suspicion and feel deeply unsafe when we venture beyond the walls. The outside world is full of danger – the result of the division of society.

Crime in the e-world

Technology will result in crime taking on a different face. The theft of physical property could simply be stopped by technology, for example, by electronic tagging or by tying the operation of an item to an individual's location. The item then has no value to a thief.

However, if property has no value, that does not mean crime will go away. Technology will be the facilitator of crimes instead.

Fraud is one crime ideally suited to the Internet. It could simply be for financial gain or to get information to facilitate this. False websites could record credit card details or personal and financial details which could be used for identity theft – identity and the way we prove it will become increasingly important in the future.

As individuals become more adept at using the technology, less knowledgeable about how it works, there is a danger of being at the mercy of a small knowledgeable elite and those criminals without the knowledge may turn to violence or disorder.

The Internet being global also means that crime can go global, making traditional law enforcement useless for policing it.

The speed at which technology crimes can be committed also makes catching the culprits far harder. To stand any chance against the criminals, the police will have to acquire suitable skills.

Traffic observation on one hand and for crowd and security control on the other. The trigger for security surveillance was the terrorist threat; in 1994 a network of more than 100 street cameras were installed in the City of London for anti-terrorist surveillance purposes.

Installations established since then have targeted theft and public disorder in shopping centres, car parks and in the streets of large cities.

Northampton: CCTV centre of excellence

Unlike as it may sound, the otherwise unexceptional Midlands town of Northampton is the most densely surveyed town of Britain. Its streets and car parks are scanned by 200 cameras – rising to 250 within 12 months – outnumbering those of any other town in Britain and making it the largest urban system outside London.

Car park cameras are interfaced to the Police National Computer for the detection of up to 100 arrests a month. And study teams have come from the USA, Canada and Canada to see this remarkable centre of CCTV excellence.

CCTV evidence is legally conclusive

Legal history was made in March this year when confirmation was given that digital CCTV recordings had provided the crucial evidence that secured the conviction of three killers.

The case concerned Bradley Bolton, murdered in July 1999 in High Wycombe town centre. This is one of the first times that footage from a local authority-run digital CCTV system has been used as evidence in a major prosecution case.

Wycombe District Council installed the equipment from NicaVision in 1999 to record a number of public areas. Detectives Inspector Ashley Smith, who led the murder investigation, commented, 'CCTV recordings are a crucial weapon in criminal investigation, and we always view them immediately whenever they are available.'

These digital CCTV recordings provided excellent evidence and some of the clearest CCTV images we have seen. They allowed the jury to have clear sight of the incident itself, providing a brutal, yet conclusive picture of the event.

The government's view on CCTV

CCTV works as an effective crime reduction and detection tool – particularly when used as part of a wider crime reduction strategy. It has helped to reduce crime in many parts of the country and the current CCTV initiative will bring the benefits of CCTV to a wider community.

Under the Crime Reduction Programme, some £153 million is available for schemes in England and Wales for the period up to March 2002, with another £17 million available for Scotland and Northern Ireland.

Closed-circuit TV must also retain public confidence, operating under detailed codes of practice to protect individual rights to privacy and adhere to the principles of the Data Protection Act 1998. It must also meet the requirements of The Human Rights Act 1998.

Behind big brother

...continued from page 523

July 2000 ELECTRONICS WORLD

Illustration: Dave Bell
Beginners' corner

Ian Hickman has produced a number of circuits for electronics undergraduates—or anyone to build, troubleshoot and test. Biased towards RF applications, the circuits become gradually more complex and are chosen to be interesting, as well as instructive. This month's circuit is simple and suitable for those with little or no prior experience of constructing and troubleshooting hardware. Apart from the components themselves, all that is needed is a dual power supply or batteries, and an oscilloscope—the electronic engineer's magic lantern.

This month's project is an audio oscillator. Oscillators of one sort or another are key components in so many electronic applications, from PCs to mobile phones to a simple superhet radio such as the humble pocket 'transistor'. Traditionally, an oscillator used a single active device, such as a single transistor, or in earlier times, a valve.

The following circuit uses an operational amplifier or 'op-amp', resulting in an audio oscillator of good performance but low circuit complexity. A typical op-amp contains a dozen or more transistors, plus a handful of other components such as resistors and the odd capacitor, all implemented in the same tiny slice of silicon.

With semiconductor manufacture and testing so highly automated, an op-amp, while still more expensive than a single transistor, really costs very little. And four op-amps in a "quad" package cost little, if any, more than four individual transistors.

The integrated circuit

Op-amps were produced originally as modules built up from discrete components. The first readily available integrated circuit op-amp was the 709, produced in bipolar technology. I remember pouncing on it with glee in the 1960s, when it first became available. It provided me with a replacement for a discrete op-amp, in a 752L, 1402L and 6002A standard milli-watt test set I had designed and was bought by the Post Office in large quantities.

Subsequently, the IC became available from many manufacturers as the LM709, the µA709, and various other types. It was widely used, despite various shortcomings, such as its tendency to 'latch-up'.

With this device, the sign of the gain reverses if the limited common-mode input voltage range is exceeded, turning negative feedback into positive!

How this comes about is explained in a little more detail later on.

The connections shown are almost universally standard for single, dual and quads, and almost invariably compensated op-amps, from the 741 onwards, should work in this circuit.

Op-amp alternatives

This circuit was designed to use a TL084-JFET-input quad op-amp integrated circuit, but the TL082 single op-amp version, or the TL082 dual op-amp would do equally well. Pin connections of all three are shown in Fig. 1; there is even a TL084/2 octal op-amp in a 30-pin package, though I have never actually used one.

At this frequency, the voltage drop across C2 must numerically equal that across R9. But whereas the drop across the resistor is in phase with the current, the voltage drop across C2 will lag the current through it — and the voltage across R1 by 90°.

The impedance of the R9+C2 series arm will be the sum of the resistance and the reactance. Although those values have the same magnitude, being in quadrature, they must be added root sum of squares-wise (RSS), giving the value 141.4 kΩ, i.e. 100kΩ×1.4.

For the C2/R9 parallel arm, the admittance is given by RSS adding the conductance and susceptance, hence both equal to 1/100kΩ. Converting the answer back to impedance gives 70.74kΩ, or just half that of the series arm. So, since the same total current flows through each arm, the voltage drop across the shunt arm is just half that across the series arm.

Furthermore, since both arms present a phase angle of 45°, the voltage at their junction will be in phase with the applied voltage. Thus assuming there is a sine wave of 1.59kHz at the op-amp input, the output will be a sinewave of 1.59kHz at the output—just as before.
amp's output, there will be a one third size replica at its non-inverting input. All the parts are much closer from Fig. 4.

Creating a vector diagram
When drawing a vector diagram such as Fig. 4, to analyse the action of a circuit, the secret is to start at the right place.

In this case, V2 is definitely the wrong place. Start with a voltage that is simply related to 0V ground, in this case, V3/2 in Fig. 4a).

1. Initially, the currents i1 and i2 through R2 and C3 are shown in Fig. 4b), giving also the total current i3. This flows through R2 and C3, so the voltage drop across R2 and i2 across C3, where R2 is the reactance of C3 at R3, namely:

\[ V_2 = \frac{R_2}{2 \pi f C_3} \]

2. Now the negative feedback exceeds the positive, and the amplitude of the oscillation cannot build up much further. In fact, the amplitude will settle at a level where the negative feedback attenuation at the fundamental frequency component of the output is very close to, but marginally greater than three, averaged over the course of a complete cycle.

The trick therefore, to provide just enough net drive to give a modest, stable value of output voltage, is to make the attenuation of the resistive arm adjust itself to a value marginally less than 3 at the frequency in question.

When the circuit is first switched on, before it has a chance to start oscillating, the resistor attenuation factor is:

\[ A = \frac{R_2}{2 \pi f C_3} \]

As it increases as you move away from f, either up or down in frequency. In fact, the attenuation of the \( R_1 C_1 R_2 C_2 \) arm is infinite at \( f_2 \), due to \( C_2 \) and also at infinite frequency, due to \( C_1 \). So with the attenuation to the inverting input marginally in excess of 3, the current at the frequency at which oscillation is possible oscillates.

The circuit is thus a 'slightly out-of-balance' Wien bridge, the out of balance voltage being amplified for driving the input to the bridge.

Now try making one...

The circuit can be built up in various ways. A scrap of 0.1 inch matrix copper strip-board, cut from RS stock number 433-505 or 433-602 can be used; the same material, in different size sheets, is available from all the usual electronic components catalogues. Alternatively, you can produce a dedicated printed circuit board, making sure you have the necessary facilities.

But probably the most convenient way is to make the circuit up on 0.1 inch matrix strip type prototyping board, after the style of RS stock number 438-618 or 488-933. This has the advantage that the component leads do not need to be cut. They can therefore be straightened out again after use, and the components returned to stock to live another day.

With a circuit operating at low frequency the negative feedback can easily be employed to plug to wherever convenient.

...and getting it to work
The circuit may not work first time, so short-circuit the non-inverting input, and this could conceivably damage the IC. The first-time power-up can be safely achieved in various ways. For example, a twin power supply unit, or PSU, having an output voltage adjustable right down to zero, and an adjustable current limit is ideal.

First select output tracking — also called master/slave operation — where a single knob controls both the +15V and -15V output. Set the master to +15V and check the output.

Now, the current limit can be set to minimum, full anti-clockwise. This will cause the output voltage to collapse to zero. The circuit is then connected to the PSU's switched on, advancing the current limit control cautiously while keeping a close eye on the current meter. If the current does not exceed the expected ten milliamperes or so as the voltage rises to the preset ±15V levels, then all is well. If the circuit is not initially working, at least it is safe to leave on while trouble-shooting. If on the other hand, the current increases alarmingly when the supply voltage is still only a volt or so, it is wise to switch off and recheck the circuit.

If you don't have a suitable power supply, then use the procedure outlined in the separate panel entitled, 'An alternative safe start-up method'.

In this series
As explained in a preliminary article in the May 2000 issue, this series is intended to help students — and anyone interested in getting to grips with RF design — a background in practical electronic circuitry and troubleshooting.

The series was originally developed as a response to the government's RF Engineering Education Initiative. Below is a list of the two tutorials that have already appeared, together with my plans for future articles in the series — 'Beginners' corner'.

1. Timer circuit using the 555, June issue
2. Audio oscillator — Wien bridge based, this issue
3. HP test
4. Radio-frequency oscillator, Colpitts type
5. Audio-frequency oscillator, state variable based
6. Capacitance meter
7. Radio-frequency oscillator/ receiver involving negative resistance

Add-ons
- When using a TL084, it is good practice to look at any unused sections properly, as indicated in Fig. 5.
- But once you have got the oscillator section working, the spare sections can instead be employed in one or two extensions to the circuit.
- Such enhancements are shown in Fig. 5, and include a squarewave output stage, and a buffered passive integrator giving a triangular output.
Java expert Les Hughes has been experimenting with a tiny controller designed for Internet connection. Although very low cost, this controller is a complete computer with Internet, network and serial I/O capabilities, giving it huge potential for remote I/O and telemetry applications.

much noise has been made concerning Java. Although originally conceived as a technology capable of powering embedded systems, it is only recently that Java devices have appeared on the market. One of the most interesting of these is the Tiny InterNet Interface - or TINI - from Dallas Semiconductor.

TINI executes a Java Virtual Machine, which in turn executes Java "bytecodes" - in a similar manner to any other Java platform. However, TINI runs Java as a software implementation of a VM. Instead, the current TINI hardware is based on the Dallas 80C190 microcontroller.

The TINI VM, operating system and various user programs are loaded into flash memory. This enables simple updates, which are freely downloadable from the project web site - www.intet4.com/TINI. The current TINI board incorporates a plethora of external interfaces: 10BaseT Ethernet, Dallas one-wire PC and RS232. Besides the processor, the TINI board also holds 512byte of flash memory, 512byte of RAM and an AC/DC power supply.

Of course, as with any beta product, revisions often occur and APIs and specifications change, based on

Free software

All of the software required to develop applications for TINI is available free of charge from various Internet sites. Installing and configuring your environment is therefore complex and time-consuming. However, a number of vendors, including Guillaume Fournier's excellent guide at http://www3.syspacts.co.uk/guillaume/fournier/ describes in detail the process that you should follow in order to be boot your TINI.
Establishing a network

While it is not necessary to reflect TIN on a network in order to start experimenting, you will be missing out on the whole idea that makes TIN so special -- an embedded network node that runs Java.

Networking hardware has reduced in price dramatically in recent years. Borrowing from the school magazine, shows a whole host of network cards for less than £15.00 and small 'remote' hubs -- for less than £50.00.

While it is beyond the scope of this article to delve into the intricacies of TCP/IP networking, and the selection of networking hardware, we can examine the steps required to establish a simple TCP/IP network at home.

Of course you will need a network card for your PC, I use a £10 NE2000 clone. Any 10Base-T card should do, as long as it's supported by your chosen operating system.

You have two basic hardware options for connecting TIN to your personal computer. You can either use a crossover network cable or buy a small networking hub and plug TIN into it.

Setting up your network

Firstly, you'll need to make sure that you have TCP/IP networking installed for your chosen development platform -- but this is the easy part as most systems come pre-configured with this option. If you dial into the Internet, you almost certainly have TCP/IP installed. If you're using a Windows platform, you can add this option in Control Panel > Network > Protocol. Once you have all of the hardware installed and connected, you will need to configure each of the machines on the network with an address. If you use your PC for surfing the net then you should assign a network address from the range 192.168.0.0 to 192.168.255.255. These addresses are from a range of special addresses that, if they 'escape' from your private network onto the Internet, can't cause any damage. Addresses ending in '0.0' or '255' should not be used as they have special meaning on the network. For the rest of this article, I'll assume that you've chosen 192.168.0.0/16 for your PC and 192.168.1.0.0 for TIN.

Addresses are managed by your ISP, so if you're on an ISP and have not been given an address, you should obtain one from your network administrator.

So what can I do with it?

Interestingly, TINA's manufacturer, Dallas Semiconductor, is still a technology driven company. From the outsider's view -- and this is often overlooked in Dallas engineers' posts to the TINI mail list -- it seems as if the company produces numerous clever solutions just waiting for a problem to come along.

TINI is more than just a rather cool toy though. It is a near-complete implementation of the J2ME platform albeit in pre-production, beta form.

At present, judging from the 'TINI-users' list, real-world TINI applications range from data loggers, security systems and network server monitors to GPS-aware systems and simple dial-up gateways. TINI could be implemented in any scenario requiring a networked controller, from remote surveillance with a GSM modem and Linux technology to home automation using a DS1920 and Tesco Direct to ensure that you always have a good supply of cold beer!

Leaving 1. HelloServer.java

This is a simple server that says 'Hello' to any clients.

```java
public class HelloServer implements Runnable {
    public void run() {
        //HelloWorld classic. Groans aside, this simple application
        //is the tiny Internet interface after all -- you
        //can, e.g. He!loServer. The main method forms the
        //entry point to the program; this method is called by the
        //TCP/IP protocol that maps to your
        //IP network card in order to start, as usual, with a simple and cheap
        //server that can be hard-coded.
        //As has become traditional in the world of computing, our
        //main method is a network version of the
        //Hello World classic. Groans aside, this simple application
        //serves a number of purposes.
        //Firstly, the procedure to compile, build and load an
        //application onto TINI is somewhat different from that of
        //a normal Java application. A simple application can help
        //with establishing that all is working correctly before we
        //attempt something more extravagant.
        //Secondly, the program demonstrates a standard way of
        //writing a multi-threaded network server.
        //Next, we'll be looking at something far more interesting but not
        //until then..
        //Listing 1 is the source code for our Hello Server.
        //As mentioned, this program simply waits for a network
        //connection, says Hello to the connecting machine, then
        //closes the connection. Most Internet services such as
        //webservers, etc. operate in a similar way.
        //Back to the example. Since this program uses Java's
        //network and input/output libraries, these are imported at
        //the top of the file. Next, define the name of the application
        //-- i.e. HelloServer. The main method forms the
        //entry point to the program; this method is called by the
        //virtual machine when it starts our program.
        //Our main method defines a Socket field called
        //client, which is used for incoming connections.
        //However, in order to receive client requests from clients, we have to use a ServerSocket
        //to manage the process.
        //A ServerSocket binds to a particular port and
        //listens for connections. When a ServerSocket accepts
        //a connect request from a client, it passes the
        //connection on, in the form of a socket object, and goes
        //back to listening. In this way, you don't have to wait for a
        //client to finish using the Server program before others
        //can connect.
        //It's a bit like ploning your bank's call center.
        //You dial a single number and your call is routed through
to
        //any available operator, allowing more calls to come in.
        //In order to process multiple connections
        //simultaneously, you can take advantage of Java's 'threaded' and
        //multi threaded.
        //This is what's happening in the statement
        //HelloServer(client).
        //Our main method takes the return by the
        //ServerSocket and creates a new
        //HelloServer object to handle the
        //connection. This object automatically
        //starts a new thread upon creation and
        //starts talking to the client.
        //This action can be seen in the constructor
        //methods.
        //serverThread = new Thread(this);
        //serverThread.start();
        //method calls.
        //The start method eventually calls run method. The run method
        //asks the socket for something to write to
        //the OutputStream and then turns this into something that can be
        //printed to. You then simply print a message to this writer.
        //Once we've sent our message we wait for a second, to allow you to read
        //the message, and then, rather quickly, we close our
        //output channel and the socket, thus
cutting off the client before they can
        //respond to our Hello.
        //Building the application
        //Once you have entered the HelloServer
        //code, you will need to turn it into a
        //format suitable for the TINI.
        //First, compile the HelloServer.java
        //file using.
        //javac -bootclasspath
        //<TINITAPATH>\TAP\TAPclasses.jar
        //HelloServer.java
        //replacing the <TINITAPATH> tag with the location of
        //your TINI installation, for example: G:
        //The -bootclasspath directive allows the compiler, which is written in Java,
        //to use a different set of core classes from
        //those compiled into the application. You won't be running under the standard JVM
```
remember, you'll be using the special TINI VM so special core libraries are needed.

This should produce a file called helloserver.class. Now we need to convert this class file into a .jar file,

```
java -classpath <TINI PATH>/tinijer TINIComponentuator -f helloserver.tini -o helloserver.jar
```

again replacing the <TINI PATH> tag with the location of your TINI installation.

This command should produce a HelloServer.jar file.

You will now need to FTP this class onto your TINI board. Windows and Linux both include command-line FTP clients, or you might like to use something like CuteFTP.

Nearby there? Telnet to your TINI board:

```
C: \>telnet 192.168.0.100
```

That's all for now. Next time, I'll be looking at some of the more useful features of TINI, including the various web-enabling technologies available. I will be showing how to hook up the one-wire Illusion interface to a web-server, an RS232 terminal and an I2C port to create a simple web-enabled security system.

Resources

http://www.ibutton.com/TINI
http://www.t.lsymposion.ca/william.fournier
http://java.sun.com/

TINI homepage – hardware, firmware, mail lists etc.

Source of all things Java inc. JDK, java.comm. required for use with TINI

Another good TINI resource site

C:\>telnet 192.168.0.100

(use the standard username root and the password tini)

After logging in, start the HelloServer with the command

```
java helloserver.tini
```

Now open another telnet window and connect to your TINI on port 1234:

```
C: \>telnet 192.168.0.100 1234
```

TINI should say Hello and then, after a second or so, disconnect you.

Until next time

That's all for now. Next time, I'll be looking at some of the more useful features of TINI, including the various web-enabling technologies available. I will be showing how to hook up the one-wire Illusion interface to a web-server, an RS232 terminal and an I2C port to create a simple web-enabled security system.

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CIRCUIT IDEAS

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Don’t forget to say why you think your idea is worthy.

Clear hand-written notes on paper are a minimum requirement: disks with separate drawing and text files in a popular form are best — but please label the disk clearly.

Low-power switch-mode mains power supply

Small mains transformers of about 1W rating tend to run hot and produce a large external hum field. This switching power supply provides an alternative.

Keeping the pulse length very short in the output device allows the use of a low inductance toroid normally found in low voltage regulators. Obtaining a suitable output is simply a case of winding a few turns of insulated wire over the top of the original winding. Thus this circuit is especially suitable where an output with a very high degree of isolation is required, perhaps up to several kilovolts.

Omitting the high-voltage smoothing capacitor after the bridge rectifier saves one somewhat undesirable component and increases efficiency — although reducing output; however this means the low-voltage outputs will need smoothing to low-frequency standard.

About one watt can be expected with the values shown, but output can be increased to the point where heating of the toroid becomes a problem by increasing the value of the capacitor coupling the Schmidt oscillator to the tripled buffer.

If supplying low power — perhaps as a built-in battery eliminator or nickel-cadmium battery charger — the circuit can easily be built into a 35mm film container. The 4093 was used because several were to hand. More logical choices might be 40106 or 74C14 hex Schmitt inverter.

A surprisingly small ferrite toroid of the type normally used in supply filters proved perfectly adequate, with a primary of 60 turns and a secondary of 7 turns.

A small load should always be connected to this type of circuit. The original circuit had a second diode in place of the 2mm inductor. If the circuit does not work, reverse the connections from the second secondary, as only one way round is correct.

A Ziemacki
Rotherham

£50 Winner!

Very small mains transformers tend to run hot, and they produce a significant hum field. This circuit was designed to overcome the problem.

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E L E C T R O N I C S W O R L D  July 2000

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Solid-state drive circuit for valve amplifiers

This solid-state drive circuit was developed to replace the earlier valve stages in my Quad 22 amplifier, leaving just the KT06 output valves and the GZ34 rectifier. Referring to the circuit diagram, T12 and T31 form a long-tailed pair phase splitter.

The op-amp on the right establishes a virtual earth at the top of RL. So any change in T4's collector current is exactly mirrored, in antiphase, at the collector of T12. Thus the drive to the output valves is completely free of any common-mode component.

Components R11, C4 form the usual 'step network' or transition lag, the values being optimised empirically to produce the best compromise at 30kHz at the amplifier output.

K. Downie
Castle Green,
Isle of Wight
D13

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Leslie Green presents an overview of useful oscilloscope features. He also highlights areas where errors can occur in this final article describing how to use your oscilloscope to the full.

Regardless of the type of oscilloscope you are using, there will be an error as the measured signal approaches the bandwidth/rise-time of the scope. A convenient number to remember is that a 100MHz scope has a rise time of 3.5ns. All other bandwidths can be scaled from this; for example a 50MHz scope has a rise time of 7ns.

This is expressed by:

\[ \text{Rise time} = \frac{1}{\text{bandwidth}} \]

where bandwidth is in megahertz. If you can believe the bandwidth of your oscilloscope, then you can get an idea of the possible error at any frequency by using the normalised amplitude factor, which is the factor by which the oscilloscope’s factor is 0.7071 - a 29.3% error. Values shown in Table 1 illustrate the point.

Note that values below about 1% are probably an unreasonable expectation of the general flatness of the frequency response of the oscilloscope. An even more important point is that the scope badge of 100MHz says that the bandwidth should not be below 100MHz; it is possible that you have got a "good" one with 150MHz bandwidth, or even 200MHz.

There is another way to view the measurement errors introduced by using an oscilloscope and a probe, each having a finite bandwidth/rise-time. The measured value of rise time is the root-of-the-sum-of-the-squares, or RSS, of the individual rise-times of the scope, probe and signal.

Using this theory, a 1ns edge measured on a 350MHz/1ns scope would read 1.6ns. This is not always a good approximation though, as the formula relies on the overshoot on each of the individual step responses not exceeding about 3%.

It is often possible to evaluate the response of your system using this formula and decide that your circuit has more than an infinite bandwidth. For example, your scope has a measured rise-time of 3.5ns (100MHz). You measure the rise-time of your circuit as 3.4ns. And you conclude from the mathematics that your circuit’s rise-time is therefore 0.8ns; the real answer is that your circuit is overshooting heavily.

There is not much point in going too mad specifying a high bandwidth conventional probe for your scope; a 250MHz probe may be adequate for a 200MHz scope. The probe is adjusted to optimise the response of the pair and the result is adequate, within the limitations of measurement with this type of probe.

High-speed measurements

It is not easy to say when a measurement becomes 'high speed'. Certainly, 500MHz/700ps signals are high speed and 1MHz/350ns signals are not - as far as measuring them with a scope is concerned.

Note that the technique of using a probe socket, or tinned copper wire, to connect to the circuit is also appropriate for high-frequency measurements. Fig. 2. Trying to use the probe hook and loop earth-leads supplied with the probe is just not workable at high frequency.

A normal 1:1 scope probe has an input impedance of typically 1MΩ/60pF. The capacitance is so high because it contains the capacitance of the scope input, which is generally 10-30pF, and a long length of coaxial cable. This is no use at all at even modest frequencies.

People generally use 10:1 probes, which have input capacitances in the range of 10-15pF. These capacitances do not depend strongly on the scope input capacitance because of the long coaxial lead. But these probes can not be used to very high frequencies either. The problem is that the 15pF of the probe is too low an impedance at high frequency and it lowers the perceived bandwidth.

The probe may be displaying an accurate representation of what is occurring at its tip, but it has caused the edge to be much slower than it would be in its unloaded condition. It is important to bear in mind that modern high-speed logic systems can not be considered "verified" until the logic transitions have been viewed on a high-speed scope and the timing has been measured and tolerated; it is not sufficient just to verify that the prototype works.

Modern CMOS technology can easily produce 1ns edge speeds. These can be a real liability. If they are not correctly terminated and have to travel more than a couple of inches, then the reflection can cause logic failure. This is a particularly pernicious problem as the logic may work most of the time, but then fail over at high temperatures once every two weeks or so.

The source impedance of a CMOS gate may be around 100Ω to the 15pF probe gives a time constant of 1.5ns and a rise-time of 3.3ns. All the wiggles, bumps and foldbacks on the edge become invisible and you can no longer find the problem in your circuit.

The answer is to use a probe with a much lower capacitance. It is possible to obtain 100Ω probes that have a low input capacitance of around 6pF. But then it becomes difficult to look at low-level signals and the probe bandwidth itself may be a limiting factor.

Conventional 1:1, 10:1 and 100:1 probes are "passive" probes. A better answer is to use an "active" probe. This way you can get plenty of bandwidth at a high signal sensitivity.

There are only two drawbacks with active probes. Firstly because of this source impedance loading problem, active probes may be necessary to make accurate measurements below 100MHz and/or signal levels below IV. Passive 10:1 probes with bandwidths up to 300MHz are also available and can be of use on low impedance circuits in their simplest form, they consist of a 450Ω resistor in series with a 50Ω coaxial cable, terminated in the 50Ω input resistance of the scope.

Floating inputs

Engineers sometimes want to measure circuits that are mains referenced. This would occur in off-line power supplies, for example.

Some people have a "solution" for this; they remove the earth from the scope. But manufacturers clearly state that this is not an acceptable connection mode. Also, considering that a manager could be used from a health and safety viewpoint for allowing this activity, removing the earth connection is out of the question.

In order to meet emission limits, it is common for scopes

![Image](image-url)
MEASUREMENT & TEST

The common-mode input voltage is the average voltage, this is at low frequencies, but there is still a common-mode charging current. Fortunately this current is much less than for a whole scope as the input guard boxes are physically quite small.

Note that the output scope input's 0V - i.e., the one connected to the scope's internal guard box - is connected to a high impedance point in the circuit under test then the common-mode current will have a much greater adverse effect.

Differential inputs

Another solution to the same problem is to use a scope with differential inputs. A probe with differential inputs is virtually the same thing as its use is concerned. Remember that this type of probe is for high-side and low-side drivers of an off-line switcher can be viewed at the same time; this is vitally necessary to make sure that the timing is set up correctly.

Differential probes are available that convert conventional scope inputs into differential inputs. These cost anything from a few £10 to over £100, depending both on the performance and the performance badge.

The same thing is true in scopes; the input of a mains bridge meter - the same circuit as the instrument under test - will have an earth connection to the mains live, which is also known as the earth connection. This live line is essentially referenced to earth and the common-mode voltage is roughly 240V±33V peak. Always use peak voltages for common-mode input levels.

With 80dB CMRR, the output voltage, referred to the input, is 339/1000, which is 34mV peak. This is a fairly low noise level for the measurement of a 15V gate drive waveform.

The situation gets a whole lot better when probing after a bridge rectifier. The common-mode voltage is now a half-wave rectified sine wave and therefore contains significant harmonics that may cause more trouble than the scope. Also, systems involving large mains would need the earth of all isolation transformers to power them!

If there are floating cases as scopes with individually floating inputs; there are also floating input converters that take a floating input and transfer the signal across an isolation barrier to the measuring equipment. This is OK at low frequencies, but there is still a common-mode charging current. Fortunately this current is much less than for a whole scope as the input guard boxes are physically quite small.

CMRR versus frequency

Caution is needed with isolated inputs. CMRR versus frequency may not well be given as a parameter of the equipment but this does not mean that it is invariant with frequency. In fact it is high frequency dependent. The effective common-mode current increases linearly with frequency. This is because the admittance of the guard box to earth capacitance increases linearly with frequency. It is therefore quite likely that any one-time measurement will give rise to a better effective CMRR than a differential system at even moderate frequencies - perhaps as low as a few kilohertz.

Buyers’ tips

I have often seen test gear left on the shelf because nobody wants to use it. Some manager or accountant bought it because it had a good specification and made a very good value. On a real-time scope this isolation transformer specification might just be bandwidth; on a DSO it would include sampling rate.

But when it comes down to using the instrument, you find out why it's so cheap. Try to move the traces and change the ranges and you will find that your way through the maze of the user interface is simple like changing the trigger level! Having once used a scope that has trigger level select, you cannot guarantee that you would not want to go back to randomly wigging the trigger control about, trying to get the scope to trigger. This is especially true when you want to set the scope up to capture a transient event; you have to set the trigger level half way between where the trace is now and where you expect it to go - a tedious task with many different level markers.

Try before you buy is the key here. If the manufacturer is too mean to give you a decent demonstration of the equipment, then you can always try it for a week for a reasonable fee. You can find out a lot about how a scope really performs or whether it is user friendly.

It is necessary to convince managers and accountants that the cost of a piece of equipment does not start at the initial purchase. A new scope should last for years; this is so much the case that several manufacturers will give you a five-year warranty.

The total cost of the equipment has to be considered. This definitely includes selling costs and total downtime. When checking out a supplier it is wise to see what their service facilities are like and how long their service times should affect purchasing decisions.

Another rising consideration in purchasing considerations is the law. Some more domestic legislation becoming more significant to employers, there are growing concerns about test equipment and the relevant IEC/EN61010 safety specifications.

Managers purchasing equipment that is not certified as ‘safe’ to some international safety standard may get prosecuted if something nasty happens. Within Europe, it is illegal to buy equipment unless it is CE marked.

Calculating the resultant output voltage is not possible simply because the nature of the output voltage, referred to the input, is not specified by a plot of CMRR versus frequency alone. A worst-case analysis would add the harmonics, assuming them to be in-phase.

Bandwidth-resolution trade-off

Most digital scopes have the ability to zoom into the signal, either by a zoom function, or by a memory function. If the data is stored in high-resolution form, it is then also possible to zoom in on fine detail after the signal has been acquired. This is useful for some transient events - particularly where the expected signal level is relatively unknown. Given that the scope is in high-frequency resolution, it is then also possible to zoom in on line detail after the signal has been acquired. This is useful for some transient events - particularly where the expected signal level is relatively unknown.

By setting the amplifiers to a less-sensitive range, the higher resolution accuracy is not improved by this technique. The main advantage is that the signal is first captured at a high resolution and then displayed at a lower resolution. This is useful for some transient events - particularly where the expected signal level is relatively unknown.

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DMMs and timer/counters trade off number of digits against accuracy product. This is because the test equipment sold without the initial purchase. A new scope is suitable for your application. The only problem is that the specifications don’t tell you about test equipment sold without the initial purchase. A new scope is suitable for your application. The only problem is that the specifications don’t tell you how a scope really performs or whether it is user friendly.

Measuring the performance and the name badge. On a floating system, the scope itself can be used to reference. The same thing is true in scopes; the input of a mains bridge meter - the same circuit as the instrument under test - will have an earth connection to the mains live, which is also known as the earth connection. This live line is essentially referenced to earth and the common-mode voltage is roughly 240V±33V peak. Always use peak voltages for common-mode input levels.

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One advantage of a long store is that you can acquire a screen full of data then zoom-in on a particular area to look at some of the fine detail. This is only particularly useful if the event is difficult to reproduce. If you can just re-run the test with the trigger delay set to a different position then this is the easiest way to view detail. If, however, your test is to blow up an ocean liner then you may want the acquisition system running for an hour before the test until an hour after the test to make absolutely certain that you get the data you need.

Another use of long stores is for signal processing applications. The longer the acquisition length, the lower the potential noise floor in an FFT. Fast Fourier transforms allow you to convert a time-related signal that you have acquired to a frequency-related signal, of the kind seen on a spectrum analyser.

Note that even if your scope does not handle FFTs itself, it is often possible to download the data to a pc to get some serious processing power on the job.

Digital games

I have described certain basic measurement situations and illustrated which ones are best made on a real-time scope as opposed to a DSO. In summary, the point is that with a real-time scope all you can do is look at the waveform. The more you can do by way of signal processing is to invert the trace and/or perhaps add it to another trace that is occurring at the same time on another channel. However, the possibilities of data manipulation, once the data has been digitised using a DSO, are limited only by your imagination. Automatic measurements of rise-time, overshoot, pulse width, frequency and production limit-testing are just the obvious, everyday ones. The conversion of the time-domain data to a spectral response using an FFT is likewise common place.

Having downloaded the data into a computer, however, you are then free to apply the most hideously obscure filtering algorithms to convert the complete pile of unrecognisable rubbish that you acquired into some meaningful result. It is this ability to play digital games, with what was once a real signal, that will inevitably mean that the intelligible rubbish that you acquired into some meaningful result.

Round-up

In this short series of articles, I hope that I have given you some hints about making better and more meaningful measurements — with or without an oscilloscope. Sometimes a scope is not the correct measuring device, but always the method of connection of the scope to the circuit is crucial.

In this modern world, an engineer who cannot use an oscilloscope is effectively like an adult without a driving licence. If you feel that this applies to you, then you should read your scope manual carefully and play with the instrument until you are comfortable and competent with it.

Once you master the basics of measuring using a DSO, you can go on to more advanced measurements. Did you realise that it is useful to deliberately under-sample (alias) signals on a pair of DSO inputs? The DSO then acts as a frequency transfer standard with sub-ppm accuracy, regardless of the absolute timebase accuracy of the DSO.

Understanding the basics means that you will be able to devise your own tricky ways of getting the most from your oscilloscope.

Elusive noise spike with no definite repetition rate

Random noise will produce the leading pulse shown. Adjusting the trigger level seems to show that there is a spike of both polarities present. This is a characteristic of random noise, a rising or falling edge will always occur somewhere and the scope will trigger on it. In this case the random noise was obtained by setting channel 2 at 20mV/div and feeding the C12 output (10mV/div) into channel 1. Channel 2 is acting as a wideband amplifier with a gain of 5, so that the noise level is more easily viewable.

Note that the rubbish after the leading pulse is constant between the two traces. This is usually indicative of either a start of sweep or trigger-breakthrough effect on the scope.

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Development system for CPCI
The Vanguard is an off-the-shelf CPCI development system from APW Electronics. The thermally-managed, EMC screened, wired and powered modular unit lets the system integrator specify the combination of components needed. Conforming to IEEE101, the 19in. unit can be fitted with a centrally-mounted eight-slot backplane, allowing for left and right-hand system slots. It can also have a 16-slot CPCI monolithic backplane, in which two eight-slot backplanes share power and ground planes and can be linked by a bridge module to give a system with 16 usable slots. It conforms to PICMG CPCI 2.1 rev 3.5 or, for telecoms, to PICMG CPCI 3.0 or, for telecoms, to PICMG CPCI 3.0. It is compatible with 32 and 64-bit data transfers and supports 33 and 66MHz operation with 3.3 and 5V signalling.

VDSL transformer
Two VDSL transformers from Pulse, for use with Broadcom's BCM6510 scalable DSL transceiver chip, support data transfers up to 25.92Mbit/s. The transformers are available at surface mount devices (84020) or in through-hole packages (84028) and are used in Broadcom's VDSL transceiver reference design (BCM65011). Pulse

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Four true channels and acquisition speed up to 50GSa/s on the Matrix OCX2000 digital oscilloscope from Chauvin Arnoux enable testing of complex signals up to 150MHz bandwidth. Measuring four signals at once, it has autozoom and undo functions, extended memory, analysis capacity, including FFT function, and a 17cm high/low fast-scan display. A VGA output provides the full display on a colour computer screen. A dual-time base function allows zooming in on part of the reference signal while displaying the whole recording and up to eight curves on the screen.

Single board computer
The MAT919 PICMG processor card supports flip-chip PGA Pentium III processors in speeds from 500 to 750MHz. It also supports multimedia AGP video, flat panel and analogue video, Ethernet, SCSI and CompactFlash disk. Features include a parallel port, two serial ports, infra-red port, keyboard, mouse, USB, IDE and floppy. Support of AGP video allows dual independent display outputs—TV, flat panel or CRT—with video input and capture. Options include 8 or 100MHz video memory and PanelLink for digital flat panels. The video input channel supports composite or S-video input as NTSC or PAL, with a switching decoder. It can also be used with the Celeron 300 to 466MHz processor and suits OEM and embedded applications. Features include the fast boot effort, automatic recovery and a customisable Award BIOS. There is a choice of Adapter or Symbio SCSL both providing Ultra2 LVD SCSI Connectors to 50-way connections are also available. Microtech Tel: 01629 537333

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An integrated synchronous buck converter IC for powering baseband and PA circuitry in satellite phones and other mobile communications handsets is available from Vishay.

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Linear Technology has introduced the LTC2402 two-channel 24-bit no latency delta-sigma AD converter in a 10-pin MSOP. It is for applications where an extra channel is needed for sensor compensation, cold junction compensation and monitoring ambient temperature in pressure sensors. The extra channel also allows sensing and compensating for voltage drops in remote RTD connections. It provides automatic channel

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Tektronix has added Dragonfly grammé, bringing the number announced products at the junction temperature sensor. It addresses an addressable memory architecture, it performs up to introduced a packet forwarding transmission systems. Sibercore Technologies has announced oscillator. Two or three wire I/O allows wires for isolated measurements such as smart sensors. It includes an in-chip oscillator. Lower Technology: Tel: 01276 677876

2Mb tennary CAM
Sibercore Technologies has introduced a model forwarder engine, the Siberian Ultra-2M. Based on a ternary content addressable memory (CAM) architecture, it performs up to 100 million multiplier, multi-protocol look-ups per second and can support OC-768 (40Gb/s), OC-192 (10Gb/s) and OC-48 (2.5Gb/s) transmission systems. Sibercore Technologies: Tel: 0161 271 8160

Logic analyser software
Tektronix has added Dragonfly Software Development LLC and Synaptiv to its embedded systems tools partners program, bringing the number of partners to 26. Also several embedded systems tools partners announced products at the recent Embedded Systems Conference. These support various applications on the TLA logic analyser family. Tektronix: Tel: 01344 392043

RJ45 connector
A thinner version of the RJ45 single-line data socket has been introduced by Honda. The MOD connector is 10mm deep. With a mating plug, it can be used for connecting a modem, printer or data PBX at up to 12kHz with untwisted wire. Faster transmission protocols, such as Ethernet, can be handled via twisted-pair wire. It has a standard eight-pin interface with gold plated contacts. Honda Connectors: Tel: 01793 523398

MOST/FETs
Fairchild has announced Powerwrench MOST/FETs at 60, 80, 100, 150 and 200V. For use in d-to-d converters, servers and PC-power supplies, they are suitable for 48V input d-to-d modules, such as those used in telecoms. They come in SO-8 and DPAK packages with different on resistances. They are also available in TO-220 and TO-263 packages. The 60, 80 and 100V units are in production and the 150 and 200V models are sampling. Fairchild Semiconductors: Tel: 01793 856819

Brushless dc motor
An EMA brushless motor from Papst, the 833 7032 100 EMA, provides an output of 400W and maximum 500mm diameter by 68.5mm long. Efficiency is 74 per cent and weight less than 1.8kg. The motor is also available as an OEM platform in basic or custom form including different shaft configurations, application specific performances, connection options and factory fitted gears. Drive electronics allow speed control from 300 to 5000rev/min, variable direction of rotation, and active braking using an external resistor network. Papst: Tel: 01264 333989

Power supply
Lambda has introduced a 300W version of its JPS power supply for use in process control, industrial ATE, telecommunications and industrial computer applications. It accepts an input of 85 to 265V ac or 120 to 330V dc and comes in seven versions from 2 to 48V dc with 60 to 6.2A respectively. Power factor correction is fitted and is rated at 0.99 typical at 100V ac full load and 0.85 at 200V ac. It is suitable to support parallel operation, it has an output current balance circuit for multiple unit designs. Features include current and overvoltage protection, thermal shutdown, remote sensing and remote on-off control. Fan cooled, it operates between -30 and +60°C and measures 120 by 92 by 190mm. Lambda: Tel: 01271 866068

Digital multimeter
The 2700 digital multimeter from Thurlby Thandar also works as a data acquisition system or data logger for an IEEE488, RS232, PC-based or stand-alone system. It allows temperature characterisation, data logging, precision measurement and control and mixed-signal data acquisition. There are 13 measurement functions including signal selection and min-max scaling. The unit has up to 80 differential analogue input channels, each individually configurable, in one half-frame system with built-in I/O and 240MIz and 45 PPM sound and video outputs. The 452 includes Diagnostic, Basic, and ATE and all components, software 5.5.7.7.8.

Per PIC1664 microcontroller PIC board
The PIC1664 is a microcontroller with a mesh structure that is optimised for compactness and power consumption. The PIC1664 is designed for microcontroller based applications for which the traditional PIC16xx family of microcontrollers is too large. The PIC1664 incorporates a number of features that make it highly suitable for applications such as industrial automation and test equipment. It is available in a SOIC-18 package. Microchip: Tel: 01353 666709 Fax: 01353 666710

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Texas Instruments Tel: 01604 665000

**Touch-screen controller**

Burr-Brown’s ADS7846 is a single-chip touch-screen controller for battery-powered systems such as PDAs, paper and mobile phones. It provides onboard voltage reference, temperature sensing, battery monitoring and touch-pressure measurement. It measures a change in resistance as the screen is touched. The resistive change is then used to determine the location where contact was made. Power consumption is less than 60μW with power-down control and touch pressure and supply operation of 2.7 to 5.25V.

**Yokogawa CA 11** is a battery operated voltage and current calibrator for the field calibration of process measurement and control instruments. The unit combines automated assembly techniques with新华社 tolerance classes. Temperature compensation is positive and complete with DIN EN60751. Maximum drift over 1000 hours at 130°C is 0.06% per day. Sensors come in blister packs that are compatible with automated assembly techniques. Yokogawa Tel: 01444 454849

**Temperature sensor**

A temperature sensor on a 1206-sized surface mount chip has been developed by Heraeus. For –50 to +130°C use, the sensor can replace a thermistor in temperature measurement or temperature compensation applications. Based on thin-film platinum technology, it is available as a 100 or 1000Ω device in two tolerance classes. Temperature coefficient is 0.06% per degree Celsius and complete with Din EN60751. Maximum drift over 1000 hours at 130°C is 0.06% per day. Sensors come in blister packs that are compatible with automated assembly techniques. Heraeus Tel: 01793 518000

**Mite!** has launched the MT9161 programmable current sink for the field calibration of process measurement or temperature compensation applications. The MT9161 can be controlled by a single channel or dual n channel devices. The p-channel devices perform high-side load control switching in AC/DC circuits and notebook, PCs, such as battery disconnect switching and battery charge switching. The n channel devices perform low-side load control switching and can be used in switching regulator circuits such as power control circuits in notebook PCs. The 7.8mA on-resistance single n-channel version is for 5 and 3.3V supply rails switching in laptop applications such as servers and RAID. The ITF861xx sub logic-level range includes single and dual p channel and dual n channel devices.

**Temperature sensor**

Intersil has announced the temperature sensor. They provide power management in notebook PC, mobile phones and lithium ion battery pack protection applications. The 30V ITF861xx and 20V ITF867xx come in TSSOP8 and TSSOP16 packages. The ITF861xx is logic level MOSFETs are either single p channel, single n channel or dual n channel devices. Temperature sensor Tel: 01344 350500

**Java virtual machine**

Sercis has introduced a virtual machine (VM) for embedded applications that are programmable in Java. For use with the company’s VX communications controller.

**Burr-Brown’s ADS7846** is a single-chip touch-screen controller for battery-powered systems such as PDAs, paper and mobile phones. It provides onboard voltage reference, temperature sensing, battery monitoring and touch-pressure measurement. It measures a change in resistance as the screen is touched. The resistive change is then used to simulate a two-wire transmitter and a swfry function increases or decreases the output level at a constant rate. Measurement ranges are from 10µV to 30V and 10µA to 26mA. Accuracy is ±0.05% for measurement and source functions.

Yokogawa Tel: 01444 454849

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ELECTRONICS WORLD July 2000
In this third article on the topic of room acoustics, John Watkinson explains the importance of a loudspeaker's off-axis response.

In the first two parts of this debate, I showed that the room and the speaker are inseparable and ideally should be considered as a system. This is not always possible — especially in domestic installations where the speaker designer has little control. However, there are certain criteria that loudspeakers need to meet. Whatever the domestic acoustic conditions, John Watkinson explains the importance of a loudspeaker's off-axis response.

Achieving reality

If realism is to be achieved the direct sound and the reverberant sound must both be uncoupled. Figure 1 shows that most of the reverberant sound in a listening room is due to excitation by sound radiated in directions other than the central axis of the loudspeakers. It is thus clear that the quality of the off-axis sound is just as important as the quality of the on-axis sound. Concentrating on the on-axis performance to the detriment of the off-axis performance produces a loudspeaker with a coloured reverberant field. An uncoupled reverberant field requires that the loudspeaker should produce the same level and have the same frequency response over a wide range of directions. The output may fall at the off-axis angle increases, but it must do so gradually.

Figure 2 shows that the directivity function or polar response should be broad and independent of frequency. If the directivity varies with frequency, the frequency response off-axis will not be the same as it is on-axis. It follows that for realistic results the polar diagram of the loudspeaker and its stability with frequency is extremely important. The necessary accuracy is difficult to achieve. The most accurate commercially available units in this respect are the Quad ESL-63 which use an electrostatic phased array and the Manger planar speaker (produced in Germany) which achieves the same result using propagation delays in the diaphragm.

Crossover problems

A common shortcoming with most loudspeaker drive units is that output becomes more directional with increasing frequency. This is the reason for the multi-way speaker with a frequency-dividing crossover between the units. Unfortunately if the individual drive units are not appropriately spaced, crossing over between them produces a step in the directivity.

Figure 3a) shows that although the frequency response on-axis may be quite flat, giving a good-quality direct sound, the frequency response off-axis may be quite badly impaired as at Fig. 3b). In the case of a multiple drive unit speaker, if the crossover frequency is too high, the LF unit will have started beaming before it crosses over to the tweeter which widens the directivity again. Figure 3c) shows that the off-axis response is then highly irregular. As the off-axis output excites the essential reverberant field, the tonal balance of the reverberation will not match that of the direct sound. The skilled listener can determine the crossover frequency, which by definition ought not to be possible in a good loudspeaker. Figure 3 also shows why the listening-from-the-next-room test, mentioned last month, is important. The radiation leaving through the open door of the listening room will have the frequency response of Fig. 3c) and the colouration will be audible.

Subconcious effects

In the listening room, the resultant conflict between on- and off-axis tonality may only be perceived subconciously. It may cause listening fatigue where the initial impression of the loudspeaker is quite good, but after a while one starts looking for excuses to stop listening. The hallmark of a good loudspeaker installation is that you can listen to it indefinitely and that of an excellent installation is where one does not want to stop.

Unfortunately such instances are rare. More often loudspeakers are used having such poor off-axis frequency response that the only remedy is to make the room highly absorptive so that the off-axis sound never reaches the listener. This has led to the well-established myth that reflections are bad and that extensive treatment to make a room dead is necessary for good monitoring. The dead-room approach has no place in professional monitoring. The result is a serious notch in the frequency response of Fig. 3c). This is then impaired. The resultant is a serious notch in the frequency response of Fig. 3c) and the colouration will be audible.

Fig. 1. Reverberant sound is produced off the axis of the speakers.

Achieving reality

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Coloured ears

A worse consequence of monitoring using speakers with a poor off-axis response is that the user's ears become first accustomed and then imprinted with the coloured reverberant sound. In other words prolonged exposure to a poor speaker actually distorts one's ability to assess the quality of another speaker. I discovered this the hard way when a prototype speaker with a ruler-flat frequency response was loaned to an experienced audio engineer who had worked for years with the same pair of standmount speakers. The loaned speaker was returned because it was said to have a peak in its response — which it did not have. After a polite enquiry, the frequency of the peak was estimated. This turned out to be exactly the crossover frequency of the loudspeakers to which this engineer was accustomed. He was using a two-way speaker having a small dome tweeter. This requires a high crossover frequency at which the woofer is beaming badly. The result is a serious notch in the off-axis frequency response. I haven't named the speaker concerned because there are any number of speakers like it and they all sound pretty much the same. These are called "bookshelf" loudspeakers because by putting a plank across one of them a useful bookshelf can be made. The transducers are best left disconnected.
Programming EPROMs?

When developing microprocessor and microcontroller systems, you usually need external memory ICs. Ultra-violet erasable PROMs and electrically erasable PROMs, i.e. EPROMs and EEPROMs, are two major non-volatile memory alternatives used for storing data or control code in a digital system. They hold what is referred to as the “firmware.”

The main advantages of EPROM over EEPROM are that it requires no erasure before reprogramming, and it requires only one 5V, or lower, rail. The only disadvantage that EEPROMs still cost more than their equivalent EPROMs. But the price gap is becoming narrower or insignificant, especially for the low-capacity components.

When you begin developing a project, you might have to modify your code frequently. If that is the case, then you would be better off using EEPROM rather than EPROM. If you opt for EPROM, although the device may be slightly cheaper, you will have to buy an ultra-violet EPROM eraser and wait 15 minutes for erasure. During such a design phase, an EEPROM programmer is invaluable as a quick and economical project development tool.

Programmer for electrically erasables

The PEE-1 parallel port EEPROM programmer described here, and shown in the photograph, is just for that purpose. It programs the most popular:

- 28C024
- 28C16
- 28C64
- 28C256

EPROMs, and it accepts both binary and Intel hex format files.

The programmer also contains a unique feature that lets you demonstrate some of your programming results using the programmer itself, so you won’t have to build a lot of prototypes. This is particularly helpful to the beginning user.

Talking to each other

How do the PC and the programmer communicate each other? One solution involves a special control/status signal line between the PC and the programmer that operates a ‘polling’ scheme. This special line on the programmer side is connected to port 3, bit 0. On the PC side it connects to the parallel-port control register D0, which is pin 1 on the DB-25 connector shown in the separate panel.

The line has a special property in that if, and only if, both sides are logically high, then the line is logic ‘high’, otherwise, if any side becomes ‘low’, the entire wire will be ‘low’. Such a property is usually implemented using inverter gates with open-collector outputs.

Another scheme for data communication between a PC and a programmer is through the 8031’s external interrupt sources. The 8031 has two external interrupt pins: INT0 on pin 12, or P3.2, and INT1 on pin 13, or P3.3.

When a low external signal is applied to either pin for some period of time, the 8031 suspends its current instruction execution and jumps to the instructions written for that specific interrupt service routine. Data transfer between a PC and programmer under such an interrupt-driven scheme can take much faster than the normal polling scheme, so this is what I’ve implemented here for EEPROM programming.

Specifically, interrupt 0 is employed for EEPROM writing and erasing routines, while interrupt 1 is used for EEPROM reading routine.
Demultiplexing the address and data

The 74L573 octal D-type latches, ICs, de-multiplex the 8031's data and low-byte address. At the beginning of each machine cycle, the 8031 outputs the low-byte address information to pin 32-39, along with a logic 'high' signal at its address latch enable (ALE) pin. This pin connects to the latch-enable pin, LE, of the 74L573, so the octal latches are enabled and the low-byte address appears at its outputs (pin 12-19).

Later, when the 8031 outputs its data information to the same pin 32-39, the ALE signal is changed to logical 'low', so the latches are disabled. Now the data can only go to the data bus.

In the next clock cycles the 8031 outputs its high-byte address information. This is combined with the low-byte information latched at the 74L573 output pins. By this way the 8031 acts just as if it has 16 address lines.

EPROM IC3 is shown as a 2716 but it could just as easily be a 28F16 EEPR0M if the project were just under development. This device stores the system control program.

Finally, the 28-pin zero-insertion-force socket is used to hold the EEPR0M chip to be programmed. For the 28/C916, the chip is placed in the socket with pin 1 to the socket's pin 1, and the slide switch SW is set to the position where A13 is tied to 5V rail. For the 28/C64 or 28/C256 chips, the slide switch SW is set to the other position to provide the additional address lines.

Commissioning tips

A double-sided, plated-through hole printed-circuit board is recommended for this project. You can make your own board, or you can get one from the information source given at the end of this article.

Without inserting any IC, turn the power on. Use a DMM or voltmeter to check the voltages at the LMT805 regulator output pin, and at each IC socket's VCC pin. All should be about 5V. If this is the case, then your board seems okay.

Now turn off and carefully insert all ICs in their sockets. Make sure that no pins are bent outside their sockets. Also pay attention to prevent static discharge damage to the CMOS devices. Turn the power on again. You should see the LED light. This indicates that you've done a good job. You can now proceed to turn the power off and connect a DB-25M/F cable between your programmer and the PC.

Using the programmer

The programmer software is an easy-to-use menu-driven system. There are two programs available to make the PEE-1 programmer work with the host PC: the communication program PEE1.EXE which resides in the PC's memory (supplied on a 3.5in disk) and the controller monitor program PO/1WX.BIN which resides in the ZIF socket of the programmer.

With both your PC and the PEE-1 programmer power off, connect a DB-25M/F straight-through cable between the PEE-1 and your PC's printer port LPT1. Make sure the connection is firm and good at both sides. Otherwise you may get erroneous data when you run the programmer.

There are two example program files, LED1A.BIN and LED2A.BIN, supplied on disk with the programmer. These are the sample programs to light up and blink the LED mounted on the programmer board. It's best to try them out to see if they work as expected when you first run the PEE-1 programmer.

To start using the PEE-1 programmer, put a 28/C916 or 28/C16 EEPR0M in the ZIF socket and set the slide switch as mentioned earlier. Then turn the power on for your PC and the programmer. From your hard disk or any floppy drive containing the supplied programs, type: PEE11 and press <return>.

A menu now appears on the screen. From there you activate the 'Device Select' submenu to select the device you've already put in the ZIF socket. Then you can proceed to program the device.

Suppose you choose the option 'Write a File Disk to EEPR0M'. When you press <return> you see another line appearing on the screen asking you about the file name and extension you are going to write. Type in LEDA.BIN or LED2A.BIN as you like. After pressing <return> in just a second the EEPR0M 'Programming Successful' message appears indicating that the programmer works fine.

To demonstrate your success, turn the PEE-1 power off and temporarily remove the 2716 EEPR0M from its socket, then replace it with the newly programmed EEPR0M. Then power it up again.

If now you see the LED blinking (for LED1A.BIN) or double blinking (for LED2A.BIN), then you have been successful in EEPR0M programming and demonstration. You don't have to build your own circuit but simply use the programmer itself to demonstrate your result; this is a unique advantage of this PEE-1 programmer.
Variable-gain circuits

Cyril Bateman has been using the Internet to see what he could find on variable gain circuits, including those that feature in Dolby B, companders and automatic gain and level controllers.

**Bugs**

As I write, Microsoft has just released a patch to eliminate yet another security weakness in its Windows 95, Windows 98 and Windows 98 SE operating systems. This most recent bug is called 'DOS Device in Path Name'. It is so called because it has been found that when the operating system attempts to read or write to a file which contains certain reserved DOS keywords within its name, it crashes, showing the 'Blue screen of death'.

This file access can be maliciously triggered when you download a Web page that has been embedded with malicious code, when you open an e-mail message on Hotmail, or similar Web-based e-mail service, or simply when you type the code at a DOS prompt. When the computer encounters the sequence of characters and tries to process them, it crashes.

Internet users with the above operating systems - especially those who use a Web based e-mail service - are advised to download this security patch from Microsoft.

Web E-mail breach - 'DOS Device in Path Name'
http://www.microsoft.com/technet/security/bulletin/MS00-17.asp

In the December 1999 issue, I introduced a wide-bandwith AGC circuit based on the OPA660 IC from Burr Brown. This circuit provided a constant output voltage when presented with a varying input. Other circuits provide a similar automatic gain-control mechanism to dramatically boost low-level input signals. Some also reduce high-level inputs, to allow a steadily increasing output voltage with input increase.

When a known input signal is to be processed, a gaging circuit can be used to 'clamp' or 'key' the circuit's output voltage levels to a reference in the signal being processed. One early widely used IC that I recall, the Motorola MC1352, was used to key the video IF stages of domestic colour television receivers almost 30 years ago. This circuit effectively eliminated 'aircraft flutter', which plagued early receivers.

Today, similar specialised functions are common for a range of RF signal processing applications. A simple search for AGC on the Global Semiconductor Data sheet site produced 43 application notes available for download. These covered both specialised and general purpose functions.

**Dolby B**

Another early variable gain circuit was used to reduce noise levels rather than control circuits. The ubiquitous 'Dolby B' circuit was responsible for the universal acceptance of the compact audio cassette.

During recording, loud signals were recorded unchanged, but lesser signal levels received a degree of high frequency boost. A sliding band filter was used to control the frequency and degree of boost. Both varied depending on the immediate spectrum being processed, Fig. 1.

This system's success resulted from a perceived quality improvement playing 'Dolby B' processed tapes on all cassette systems - even those not incorporating the Dolby B playback circuits.

Commencing May 1975, Wireless World published in a three part article a Dolby B design, suitable for home construction by the way.

**Companders**

For professional recording systems, an alternative system called DBX was often used. This compressor-expander, or compander, system achieved significant noise reduction without needing frequency boost or cut. Using compression techniques, it reduced the dynamic range of signals recorded to tape in a controlled manner. The DBX system used the rms rectified input signal as its control voltage.

Tape recordings suffer from two dynamic-range restrictions. Tape can overload when presented with high-level signals. Secondly, tape noise becomes intrusive with low level signals. These combine to restrict the usable dynamic range.

On playback, DBX control circuits were used to reverse the process, expanding signals back to their original levels, offering a much increased dynamic range. The system could produce a 130dB dynamic range, subjectively free from noise.

**Fig. 1.** Depicting the frequency and amplitude of selective boost, applied during the Dolby-B recording processing.

**Fig. 2.** A 100dB dynamic-range signal compressed to 50dB for transmission (recording), then expanded back to its original dynamic range when received (playback).

A low cost IC, the Signetics NE570/571, was developed to improve the signal-to-noise ratio on crowded telephone circuits. It used exactly the same companding approach, providing a 2:1 compression/expansion of signals. This allows an original dynamic range of 100dB to be transmitted as a 50dB range signal. Reversing this control, it is expanded back to the 100dB range of the original signal, in the process attaining up to 45dB of noise reduction, Fig. 2.

The 570 and 371 each comprise two channels containing a full-wave averaging rectifier, a variable gain cell and a summing node operational amplifier. While this variable-gain function could be provided using conventional OTA circuits, gain of an OTA varies with temperature. Philips designed a low noise, low distortion and temperature independent, linearised transconductance multiplier gain cell.

Capable of operating well above audio frequencies and introducing little distortion, this IC became
Fig. 4. An RF levelling loop suitable for use up to 25MHz. The circuit maintains a constant 2V pk-pk output, with inputs varying from 0.6 to 1.3V rms.

Fig. 5. The TL026 is easily set at 100mV. This device is intended for hi-fi studio-quality systems. The SA72578W provides a resistor-programmable dB reference level, adjustable between 10mV and 1V.

Fig. 6. The CLC520 amplifier internal block diagram, together with the external circuit components provided on the CLC73020 Evaluation printed circuit board.

Fig. 7. This simple 100MHz tuned AGC amplifier, provides 15dB of power gain and 70dB gain control. It is detailed in application note AN45.
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- **Input channels:** 7 internal, 2 internal
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<table>
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<tr>
<th>Channel</th>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
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<tr>
<td>Sound waveform</td>
<td>±100dB</td>
<td>0.2</td>
<td>Not calibrated</td>
</tr>
<tr>
<td>Sound level</td>
<td>55 to 100dB</td>
<td>100mV</td>
<td>3% fsd</td>
</tr>
<tr>
<td>Voltage</td>
<td>0-5V</td>
<td>5mV</td>
<td>3% fsd</td>
</tr>
<tr>
<td>Resistance</td>
<td>0-1kΩ</td>
<td>100Ω</td>
<td>3% fsd</td>
</tr>
<tr>
<td>Temperature</td>
<td>0 to 100°C</td>
<td>0.1°C</td>
<td>3% @ 25°C</td>
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<tr>
<td>Light</td>
<td>0 to 100V</td>
<td>0.1</td>
<td>Not calibrated</td>
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**External sensors**

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<th>Range</th>
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<td>pH</td>
<td>0-14pH</td>
<td>0.02pH</td>
<td>Calibration dependent</td>
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<tr>
<td>Temperature</td>
<td>-10 to 105°C</td>
<td>0.1°C @ 25°C</td>
<td>0.3°C @ 25°C</td>
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Rod Cooper has been investigating Windows 2000 from the CAD user's viewpoint. He's found that this new NT-based operating system offers major benefits, but it will mean new hardware and applications software for many users.

Now that the hype and confusion surrounding the launch of Windows 2000 is over, it is a good time for a measured examination of what this OS offers those in the field of CADD/CAM.

As most potential purchasers will already know, there are two versions of Windows 2000, one for servers to challenge Unix and the like, and the other for general business use.

The business version is called Windows 2000 Professional, and is the topic of this review. Of the huge amount of money spent on developing this system, I think it likely to amount to at least five times the Server version, and the new and much talked about Active Directory. A lot of investment seems to have gone into networking generally, and into administration tools, Fig. 1.

The Professional version is an updated version of NT, with most of the best features of Windows 98 fused in to create what amounts to a hybrid NT5.

The concept of using the existing Windows 95/98 interface with the more robust NT kernel is an excellent one, but Windows 2000 is clearly not the all-purpose definitive version of Windows that the pundits were predicting. It is aimed squarely at the business sector, with what amounts to a hybrid NT5.

Typically, Windows 2000 takes up about 600 to 650MB of hard disk space. There is less opportunity to customise this with components of this version of Windows. For example, I always left out screen savers, Paint, the accessibility tools for the disabled, the games, and a few other things because the RAM on the PC I used with Windows 2000 you get them whether you want them or not. It is possible to leave out some Internet and networking tools. You can also retroactively delete some of the things you do not want.

If you have 64MB of RAM, don't be surprised if Windows 2000 consumes 50MB or more. This doesn't leave much memory for heavy-duty applications like CAD. Autocad, for example, like plenty of memory.

Hard disk space and RAM are cheap. But for a small business with a few machines to upgrade and staff to retain, the costs can mount rapidly. In this case you will do well to assess the benefits of Windows 2000 carefully and weigh them against the overall costs.

Table. Comparison of boot-up times from various systems.

<table>
<thead>
<tr>
<th>PC</th>
<th>Pentium, 133MHz</th>
<th>32 MBt RAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIN3.11</td>
<td>40 seconds</td>
<td></td>
</tr>
<tr>
<td>WIN95</td>
<td>1 minute 20 seconds</td>
<td></td>
</tr>
<tr>
<td>WIN98</td>
<td>1 minute 35 seconds</td>
<td></td>
</tr>
<tr>
<td>WIN2000</td>
<td>4 minutes 30 seconds</td>
<td></td>
</tr>
<tr>
<td>AMD K6-2-500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>128MBt RAM, Dual Pentium 400MHz</td>
<td>266MHz RAM</td>
<td></td>
</tr>
<tr>
<td>WIN2000</td>
<td>1 minute 30 seconds</td>
<td></td>
</tr>
<tr>
<td>NTL4, SP4</td>
<td>2 minutes 90 seconds</td>
<td></td>
</tr>
<tr>
<td>MacOS 8.6</td>
<td>1 minute</td>
<td></td>
</tr>
</tbody>
</table>

Human requirements

If you use Windows 95 or 98 regularly, then you will take to Windows 2000 easily. Although several changes have been made to the interface, most of the familiar features are still there, albeit in an upgraded and altered state.

If you are trained in NT4 with no experience of Windows 95/98, then no doubt you have some catching up to do.

The CD player, sound recorder and media player. Comments in the computer press on the lack of support for such things as video, sound card and graphics may cards can give only basic functionality under Windows 2000.

Contrary to what was expected prior to the launch of Windows 2000, Windows 98 is to be developed further with another version currently under development, code-named Millennium. It is expected to appear later this year. But Windows launch schedules are, as everyone realises by now, variable quantities.

Fig. 1. Windows 2000 provides much more information about the system as a whole than Windows 95, which omits the means to configure and adjust, like these "administration tools". But as you may be able to see from the lower screen capture, it seems to run fine by the way.
Windows 2000 is a useful addition – especially if you are looking at a frozen screen with just an error code on it. It should forestall some calls to technical support.

**General view**

If you come from a Windows 95/98 background then the desktop will seem reassuringly familiar. You might be forgiven for thinking you were in Windows 98, but closer inspection will find many small changes. In transferring the Windows 98 interface, almost every aspect has been given an overhaul, generally for the better. Strangely though, small features that were criticized in Windows 95/98, are still there. These may be minor gripes, but they have a tendency of becoming major irritations when they are encountered every working day.

For example, the sheer illogicality of using the 'start' button on the task bar for dragging down the PC, is anathema to logically-minded people – i.e. most engineers – and has become something of a joke. But it remains. It's as though Microsoft is displaying its ignorance in its critics.

Another one is the close/minimise/restore buttons at the top right-hand corner, which are still too close together for some people to click on easily. The 'My Computer' logo which many found rather childish – I admit I reasoned this immediately – still persists, as well as 'my documents'. Now, for good measure, there's also 'my network'. Strangely for a business-oriented operating system, four games are included, and the rather elementary Paint program, as well as a splendid choice of wallapers. Will the average business user welcome these? On the other hand, most of the changes to the Windows 98 interface that have been made are clearly improvements.

**Improved driver handling**

Although the plug and play is a feature carried over from Windows 98, NT-4 users, still welcome, there are bound to be times when a third-party driver will still be needed. In the past, drivers for software such as modems, video cards, etc., tended to be a bit of a mixed bag. Some were excellent, but others were a source of built-in instability and unpleasant problems with the operating system. Of course, you could say that a well-designed operating system would fend off such badly-written third-party drivers, and in a sense this is what Windows 2000 does.

Third-party manufacturers can now have their software approved for use in Windows 2000 by being given a digital signature. This system, approved drivers are installed easily. The system administrator can set the drivers so that some drivers can be halted on installation, or a warning message displayed to the effect that, if you go ahead, you do so at your risk.

What a shame this simple system for sorting the sheep from the goats was not introduced years ago. It would have enhanced the reliability and the reputation of the previous versions of Windows no end. Perhaps the obstacle was one of cost, as a fee is charged for this approval.

**Help**

The help files are much improved and expanded, with better and longer explanations, better links, and more detail. Some of the help text is written with the assumption that the user knows the difference between FAT and NTFS. It also delves into the basics of working with the WIN98-style desktop – essential reading if you are a NT4 convert – the basics of ANS and Internet connections, and adding hardware.

In the appendix are the most important Stop Error Codes, and what to do about them. In the WIN98 manual there was very little in this respect, including these codes with Windows 2000.
Adjustable PLL for receivers

Darren Heywood’s 46 to 76MHz phase-locked loop module is tuned by simply turning a ten-turn potentiometer. It was originally designed to form the master oscillator of a short-wave receiver, but it is easy to adapt it for other applications.

This phase-locked-loop module was designed to be the master oscillator in a short-wave receiver. The most common method of overcoming image channel interference is to up-convert the first IF to 45MHz. This PLL spans 46 to 76MHz in 500kHz steps or increments and so covers the entire HF band. It can easily be adapted to cover other frequency ranges simply by adjusting the zero/span potentiometers and/or changing

Assuming correct set-up, stepping through the frequency range involves the user simply turning a ten-turn potentiometer.

Circuit overview

The module accepts an unregulated 12V supply, regulating it to 8.3V via IC2 in conjunction with Tr1, Tr2, and Tr16. It is capable of delivering up to 300mA. A 5V regulator, IC1, supplies 5V to the various TTL chips. A 74HC4060 oscillator/divider produces the reference frequency, outputting a very stable 125kHz on pin 4. There’s a 250kHz signal available at pin 5. This feeds a Class-C amplifier, Tr3, that generates about 60V. Regulation by ZD2 limits the output across C14 to about 33V. This voltage is needed to drive the BB909B varicap diode.

Transistor pair Tr7 and Tr8 are designed to have a voltage gain of about 6. As a result, output from the linear phase 74HC4046 detector, IC4, is 0 to 5V. When amplified by a factor of 6, the 0-5V signal produces a linear 0 to 30V dc error voltage for the varicap diode. This arrangement allows the module to produce very wide span ranges. Resistors R29/R30 and C34 make up the loop filter, which in this case is a single-order lag/lead filter type.

An FET, Tr9, is at the heart of the free-running voltage-controlled oscillator, or VCO, which is a Hartley variant. Where L4 and L5 are concerned, it is easier to talk of wire lengths than inductance values, so L4 and L5 are 180mm and 100mm respectively. To make these two inductors, simply cut two lengths as stated from ordinary single-core hook-up wire and wind them around a pen, etc.

Output from the VCO is lightly coupled to Tr9 which amplifies the signal. Further amplification takes place in

Fig. 2. Main PLL board includes a step-up voltage converter for supplying the 33V needed to operate the varicap over its full range.

Fig. 1. PLL board linear voltage regulators. In the 8V supply, three medium-power transistors are used in parallel, giving an output capability of about 300mA.
Fig. 3. Frequency of the PLL is set via the ten-turn potentiometer. Its adjustment determines the digital word on the output of the a-to-d converter. In turn, this word determines the division ratio of the two binary counters.

**Setting up**

To calibrate this PLL, connect a frequency meter to the counter output. Rotate \( VR_1 \) to its earthy end and adjust zero, via \( VR_2 \), as required. Then rotate \( VR_2 \) for maximum and adjust the span, \( VR_3 \) for the upper frequency limit. Repeat this procedure a few times until you obtain the correct lower and upper frequencies.

Since the ADC0804 is a successive-approximations type a-to-d converter, it requires continuous active-low strobe pulses on its pin 3. This is achieved by \( IC_8 \).

As the circuit stands, it is possible to tune the PLL to just on its switching threshold. Note that \( IC_8 \) is actually used as a divide-by-four prescaler, the "VHCT" TTL family is capable of working up to 16MHz.

Transistor \( TR_{15} \) provides an output to a frequency meter while \( TR_{17} \)'s output can be fed directly into a mixer, such as the NE402.

Output from pin 9 of \( IC_8 \) is then fed into \( IC_9 \). This device, together with \( IC_8 \), makes up the programmable dividers. The output of \( IC_9 \) at pin 13 is fed back to \( IC_8 \) pin 9 for comparison.

Transistor \( TR_{14} \), combined with \( ZD_3 \), generates a stable 3.3V reference. This reference is buffered by \( IC_{27} \) and then fed into pin 9 (\( V_{EE}/2 \)) of the ADC0804 analogue-to-digital converter. Potentiometer \( VR_1 \) affords span adjustment while \( VR_2 \) adjusts zero.

In my application though, I only needed 60 steps of 50kHz to cover a 30MHz range. This covers the entire HF band.

Output frequency of the PLL circuit is found using,

\[ f_{out}=4\times125kHz\times N \]

where \( N \) is the eight-bit binary number generated by a-a-to-d converter.

As a result of this, the PLL should span 50kHz to 127.5MHz, but the VCO, \( TR_{9} \), would probably run out of range. As shown, with \( L_1 \) 180mm and \( L_4 \) 190mm, 46MHz to 76MHz is achieved with plenty of spare capacity.

Capacitors \( C_4 \) and \( C_5 \) should be mounted as close to the ADC0804 as possible.
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- Resolution: 12 bit
- Channels: 1
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Letters to the editor

New mobile phone health risk?

I just read an article in the May issue regarding the new Blue Tooth wireless network technology.

I note that the frequency at which it will operate is the same as that used by domestic microwave ovens, namely 2.4GHz. Does anybody really think that, in light of the recent mobile phone debates, this is a wise choice of frequency?

Alan Jeffrey Marcy

Worcestershire

Sharing knowledge?

I notice pieces such as Ian Hickman’s ‘An RF initiative’ in the May 2000 issue plot along regularly in the electronics literature. Indeed, similar explanations and initiatives appear in the scientific community’s literature in general.

Leon and mean

I have a question regarding the electronic computer control system, or ECCs, of my car. Can anyone help please?

I would like to modify my ECCS and/or emission control module (ECM) to make the engine more compatible with driving conditions in my part of Australia.

The Nissan Patrol 2.8-litre turbo diesel is my car. I have approached Nissan but the company refuses to make any modifications.

They are starved of fuel at low revs, and refuse to make any modifications.

Can anyone help please?

I have a question regarding the electronic emission control module (ECM) for my car. Can anyone help please?

I note that the frequency at which it will operate is the same as that used by domestic microwave ovens, namely 2.4GHz. Does anybody really think that, in light of the recent mobile phone debates, this is a wise choice of frequency?

Alan Jeffrey Marcy

Worcestershire

Mobile Internet - who wants it?

The April 2000 features Ian Hickman’s article on the Tripath approach to switching amplifiers. In ‘Class-T’-ish’ on pages 274-279, Hickman properly applauds the Tripath scheme for exhibiting lower crossover and IM distortion than conventional class-D designs. But this is achieved at the cost of reduced efficiency due to higher switching-frequency components, albeit distributed in their proprietary fashion over a range of frequencies.

A method that involves none of these components has been around for a while now, but perhaps owing to its use in professional audio has received little attention by audiophiles.

It is Crown International, Inc.’s ‘Opposed current power converter’. This patented topology and associated pulse-width modulation scheme uses two switches and two diodes in an ‘opposed current half-bridge’. The bridge is intrinsically free of the shoot-through current fault path of the basic half bridge. As a result, various zero dead-time operation and the elimination of the finite dead-time crossover distortion mechanism is possible.

Stanley and Bradshaw conclude ‘PWM amplifiers have traditionally been deemed unsuitable for studio-quality sound reproduction and other precision applications. Such a judgment has been premature. It is possible to have both efficiency and fidelity at the same time.’

Brad Wood

California

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<table>
<thead>
<tr>
<th>Model</th>
<th>Name/Number</th>
<th>Description of internal ISA length</th>
<th>Construction of external</th>
<th>Frequency range</th>
<th>Models</th>
<th>Tuning range</th>
<th>IF bandwidth</th>
<th>Audio output on card</th>
<th>Available ISA cards</th>
<th>Dynamic range</th>
<th>IF with (optional)</th>
<th>Proprietary spectrum</th>
<th>Purchaseable</th>
<th>Cost of ISA card</th>
<th>Price</th>
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<tbody>
<tr>
<td>WR1000e</td>
<td>WR-1000e</td>
<td>0.15-300 MHz</td>
<td>0.15-1500 MHz</td>
<td>AM, SSB, FM, NFM, W</td>
<td>10 Hz</td>
<td>1.5 dB</td>
<td>5 Hz</td>
<td>100 Hz (2)</td>
<td>No option (ISA card)</td>
<td>Yes</td>
<td>£99 inc vat</td>
<td>Yes (other ISA card)</td>
<td>£1169.13 inc VAT</td>
<td>£99.99 inc VAT</td>
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<tr>
<td>WR1550e</td>
<td>WR-1550e</td>
<td>0.15-300 MHz to 1300 MHz</td>
<td>0.15-300 MHz to 1300 MHz</td>
<td>AM, SSB, FM, NFM, W</td>
<td>10 Hz (6)</td>
<td>5 Hz (FM)</td>
<td>2.5 kHz</td>
<td>2.5 kHz (SSB), 8 kHz (FM)</td>
<td>Yes (ISA card)</td>
<td>Yes</td>
<td>£119.05 inc VAT</td>
<td>Yes (other ISA card)</td>
<td>£139 inc VAT</td>
<td>£139 inc VAT</td>
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<tr>
<td>WR3100e</td>
<td>WR-3100e</td>
<td>0.15-300 MHz to 1300 MHz</td>
<td>0.15-300 MHz to 1300 MHz</td>
<td>AM, SSB, FM, NFM, W</td>
<td>10 Hz (6)</td>
<td>5 Hz (FM)</td>
<td>2.5 kHz</td>
<td>2.5 kHz (SSB), 8 kHz (FM)</td>
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<td>£139 inc VAT</td>
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