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INNOVATION

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AMP/EQUALISER  
VGA CARD**

**BUILDING  
BLOCKS  
PART II**

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ACTIVE  
SUSPENSION**

**VIDEO PIRACY:  
AUSTRALIA'S  
THE TOPS**



**WIN! \$13,500  
AST 386 PC**

# **BOSE**

## The Bose 601™ Series III Direct/Reflecting® Loudspeaker System

Bose engineers have invested more than 25 years of ongoing research seeking one goal—re-creating the realism of a live performance.

The next best thing to hearing music live is hearing it through a Bose Direct/Reflecting speaker.

Drawing on the heritage of the internationally acclaimed Bose 901 speaker, the 601™ speaker gives you the best seat in the house—wherever you sit or stand.

Through our extensive acoustical research into live sound, we learned that focusing on only one musical parameter such as frequency response and expecting realistic sound is like trying to create a lifelike painting by concentrating solely on colour. As with visual images, live sound has perspective, clarity and proportion.

We designed our speakers based on the natural combination of direct and reflected sound. The difference between listening to conventional speakers and Bose Direct/Reflecting speakers is like the difference between viewing a movie on a television versus experiencing it in a theatre.

The 601 system brings a three dimensional sensation to music—giving the sound depth, height and width. In short, it seems to come alive!

In a live performance, the majority of sound reaches your ears after being reflected off the walls, floors and ceiling. With conventional speakers, you mainly hear only direct sound. Bose Direct/Reflecting speakers add the missing elements of music by bringing you the natural combination of direct and reflected sound (see diagrams at right). The result is a lifelike soundstage that's practically like being there.

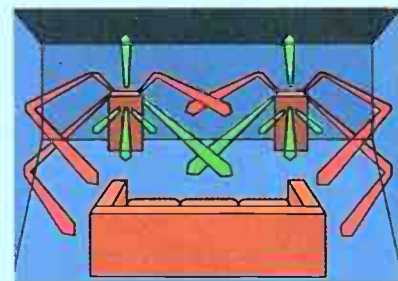
With most conventional speakers, you hear stereo in one or two parts of the room. Everywhere else, you hear primarily one speaker. The 601 system allows you to hear true stereo



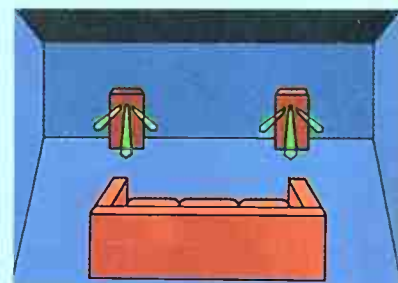
everywhere in the room—even when you are directly in front of one of the speakers.

The 601 system is the ideal cornerstone for a complete home entertainment system. It unleashes the full potential of your sound system, efficiently produces excellent sound and easily handles high power. This rare performance combination allows you to enjoy today's power-demanding sound sources such as digital audio at true-to-life volume levels.

The Bose 601 system also makes it possible to use your stereo system in a new way: as part of a total audio/video system. It is designed to produce greater realism with all video sound sources—especially stereo televisions, hi-fi VCRs and video disc players.



Bose 601 Direct/Reflecting® system.



Conventional speaker system.

Bose Australia Inc., 11 Muriel Avenue, Rydalmere, NSW 2116 Telephone: (02) 684 1022, 684 1255

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Bose-7

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On Heard Island, Antarctica, the Australian Antarctic Division lost one of their IC-M12 portable two-way radios.

Then, with the onset of winter, the base had to be abandoned. And so was all hope of finding the radio.

But the following year, it was found. And though it had seen 12 months of exposure to rain, snow, sleet and seaspray, the scientist

to communicate to and from remote destinations up to 1,000 kilometres inland.

Helicopters as well as search and rescue boats use IC-M80s, often via a pilot's headset.

And ground parties and other personnel carry the IC-M12s because they combine practical, easy to use functions with proven toughness and reliability.

Of course, ICOM's wide range of



**ICOM DIDN'T DESIGN THE IC-M12  
TO SIT OUT HERE FOR 12 MONTHS.  
LUCKILY THEY BUILT IT TO.**

Baill WCRS ICO 0044

who found it decided to put in a fresh battery and see what happened.

Amazingly, it worked like new. And so did another unfortunate IC-M12 that a member of the Division dropped from a tower to the ground 70 feet below.


In fact, it was experiences like those that led to the replacement of more expensive 'military standard' radios with the more reliable ICOM range.

So Australian Antarctic bases and exploration parties use IC-M700 HF transceivers

radio equipment is designed for thousands of commercial and marine applications.

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## Crisis? What crisis?

As we go to press with this issue, which contains the second part of Roger's Test and Measurement feature, voices have been heard in the ETI editorial office pondering the future health of the T & M market. One voice was of the opinion that sales of T & M equipment tended to be cyclical and that we were due for another surge now and this, combined with the unpleasant forecasts of 'certain recession' we're getting with every news bulletin, prompted us to make some enquiries within the industry itself.

From a list supplied by my advertising colleagues I spoke to four people - bullish to a man. Ken Buckley of Anitech set the tone: 'In my experience recessions don't impact on T & M to the extent that they do on consumer products, although conditions in the next 12 months could differ from those we've been through before. Our new products are all doing very well at present.' He added that he thought the lower end of the market was a mite congested, however. 'There are, for example, a great many cheap imported oscilloscopes in the country and a lot of discounting is going on. This part of the market could be said to be saturated but this is not a reflection of any oncoming recession, it is more related to companies climbing onto a cheap import bandwagon and ending up with too much stock.' Although some competitors may be having problems, Anitech was feeling strong and healthy, he concluded.

I then spoke to Tom Nealon at Philips. He, unlike the others agreed with my ad colleague that T & M sales tended to be cyclical and thought that they were now emerging from a bit of a slump overall. 'We are not seeing any real effects of a downturn in the economy at all. The integration of Philips and Fluke has resulted in increased sales in the Fluke range with good spinoffs for the Philips products - there's plenty of business being done. Many T & M products are used for manufacturing and the government's current encouragement of home industries is reflected in good sales for us; the service end of the market is also healthy.' He also foresaw a mini-boom for the high-precision calibration side of things next year as a result of the worldwide standardisation of the volt.

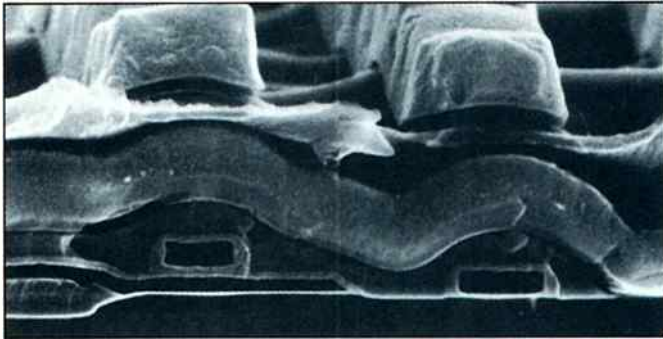
Paul Twigg of Elmeasco: 'The T & M market is traditionally slow and steady so we don't predict either a surge or a reduction; we are definitely not expecting a recession. Although the overall picture is steady some areas will show upswings, for example, fibreoptic test equipment, and a few products will have peak sales, such as the new digital storage oscilloscopes.'

Ralph Brown at Parameters echoed his colleagues: 'Although T & M worldwide could be said to be declining we are holding up well and exceeded our budgets last year. In specialist areas there is always growth and we've got new agencies and new products so we're doing well. In terms of the future, I see that much more PC-based instrumentation will be sold, with multimeter, oscilloscope, etc, functions being added on to Macintoshes, IBMs and their compatibles. People won't necessarily want lots of stand-alone equipment but will prefer a PC-based facility with storage capabilities.'

It's encouraging to hear such a unanimous view coming from four companies; I hope 12 months time sees them as cheerful about current and future markets. They can expect a call from my advertising colleagues any day now!



## World's fastest DRAM



In a step towards manufacturing dynamic random access memory chips (DRAMs) that can attain speeds similar to their more costly high speed cousin, the static RAM or SRAM, IBM has

fabricated an experimental DRAM using the CMOS process which they claim operates two to three times faster than current generation 1 Mbit chips.

As mainframe computers and

microprocessors have become faster, the demand for high-speed DRAMs has grown. IBM's new DRAM is said to herald the advent of very fast memory in supercomputers, PCs and desktop workstations.

Two layers of polycrystalline silicon and two layers of metal were used for the chip's wiring to allow greater density and higher speed than other DRAMs. The CMOS process also allows for cooler operation of the circuits, with the chip dissipating just 500 milliwatts of power during operation.

IBM scientists at the Thomas J. Watson Research Centre, Yorktown Heights, NY, and the Tokyo Research Laboratory in Japan collaborated on the chip's

design. They also co-operated on the development of the CMOS technology used in the DRAM's manufacture at the company's Yasu manufacturing plant.

In the picture, the wavy structure is the first layer of metal (aluminium) wiring. An insulator is located directly above. The large structures on top of the insulator are the second layer of wiring. The two layers of metal wiring are used to achieve high speed.

The memory cell is beneath the lower metal layer, consisting of a transistor (rectangular structure on the right) and a capacitor (long, narrow structure on the left). Two layers of polycrystalline silicon located below the lower metal layer are used to achieve the chip's high density.

**Avo Electronic Systems**  
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Alcatel-STC's Gold Phone (left) and Touchfone 200.

## Alcatel-STC exports

WHAT is believed to be the first export sales of the Australian-designed and manufactured telephone, the Touchfone 200, have been made to Papua New Guinea and to Western Samoa.

Alcatel-STC has also scored sales of its Gold Phone to Fiji. The

total value of these three orders amounts to almost \$600,000.

The Touchfone is being distributed domestically as Telecom's standard telephone. The advanced unit has also been accepted for use in the telephone systems of North America.

## We've changed!

AS from July 1st 1989, specialist transient protection and power conditioning manufacturer, Component Resources P/L, has commenced trading as CRITEC Pty Ltd.

Managing director, Rick Gumley indicated that the change was in keeping with the continued growth being experienced by four companies launched in 1987 under the CRITEC Corporation banner, now

enjoying their respective successes.

These companies are:

- Component Resources (now CRITEC P/L) - lightning and power transient protection plus power conditioning equipment.
- Protel Technology - printed circuit board software development plus photoplotter manufacturer and extensive export marketing world-wide.
- HST Technology - scientific

instruments, measuring equipment and computer hardware marketing.

- Lightning Protection International - international marketing of lightning protection systems for buildings and structures.

Mr Gumley confirmed that the new name, CRITEC Pty Ltd, was more synonymous with the state-of-the-art electronics technology being developed within its R & D laboratories at Tasmania's Technopark in Hobart. The company's core business now extends to built-up products covering the power conditioning, uninterruptable power supplies, short-break standby power systems and support markets, together with a wide range of transient protection devices for data and signalling circuits including specialist devices for protecting electronic telephone PABX's and facsimile machines.

## Industry News



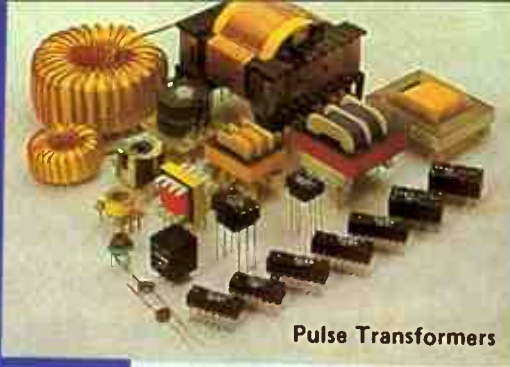
Ron Costagliola

TDK (Australia) Pty Ltd has made a number of new management appointments. Ron Costagliola replaces Mr David Ridley who was company secretary since 1982. Mr Costagliola, previously national credit manager, will oversee all legal and corporate matters, order processing and warehouse procedures. Lisa Staniforth has been appointed promotions representative, a newly formed position, and will assist Eric Wright, TDK's national sales manager. She was previously national promotions co-ordinator for the Speedo Group Ltd for two years. Shane Wedesweiler has been appointed custom service manager. His responsibilities will include liaison with customers and technical support.



In a joint effort, Matsushita and Sony of Japan have joined with Philips to further enhance the technical capabilities of the compact disc-interactive (CD-I) system, including high quality, full motion video, according to JD Timmer, chairman and senior managing director of Philips Consumer Electronics.

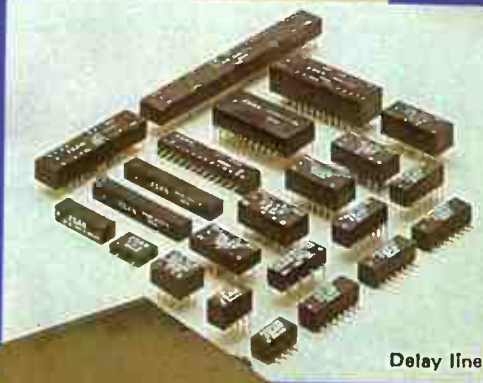
A number of leading publishers and entertainment companies in the USA are already preparing CD-I titles, including Time-Life and the Children's Television Workshop of Sesame Street fame.



Pulse Transformers

**E-SAN**   
**ELECTRONIC**

# PULSE TRANSFORMERS DC-DC CONVERTERS POWER SUPPLIES DELAY LINES



Delay Line



DC/DC Converter



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E-San Electronics Ltd. are a major source of active and passive digital delay lines, pulse transformers, DC-DC converters and switchmode power supplies.

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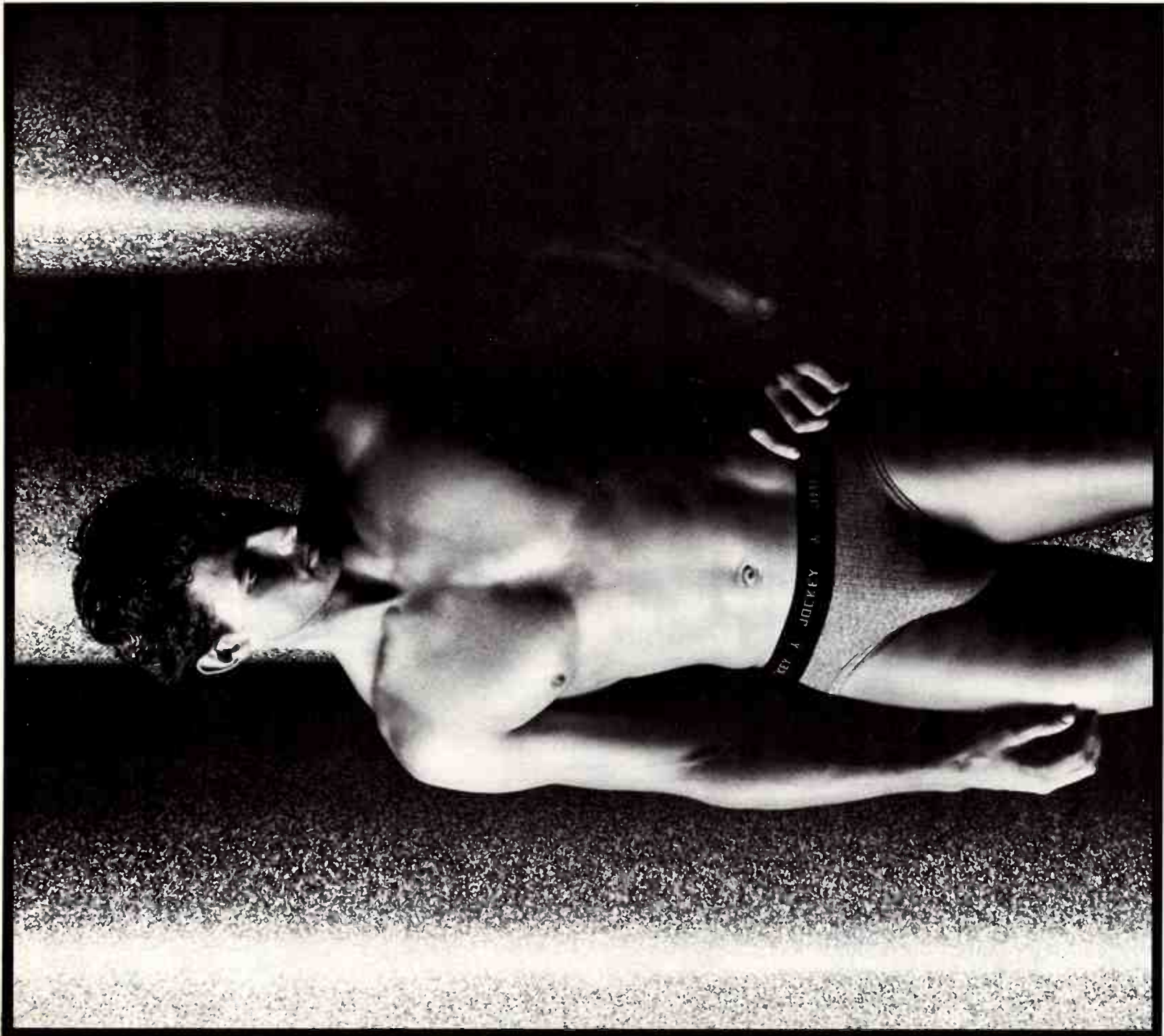
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MARL BIKINI 100% COTTON

*Another famous Australian jockey.*

THE  
BOTTOM  
LINE IS  
**JOCKEY**

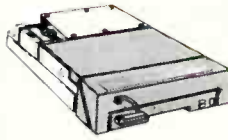
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## REMOVABLE CARTRIDGE HARD DISK

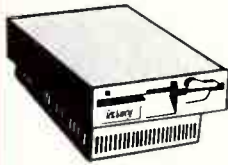
Ricoh R260 20 M/Byte Removable Hard Disk is a sub-system for AT or 386 systems. Extra 20 M/Byte cartridges are available. To enable the end user to build a library that can be safely locked away. Or taken to another site that is using the same sub-system. It's the ultimate in hard disk back up systems or for transport ability of data.

Includes a cartridge  
X20022.....\$1,274

Extra 5 1/4" 20 M/Byte cartridge for disk (Ricoh RH5260)  
X20024.....\$220



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### EXTERNAL PS/2\* COMPATIBLE 5 1/4" DISK DRIVES

Capacity: 360K  
Track/Disk: 40  
MTBF: Greater 10,000 hours  
MTTR: 30 min. or less  
• External 37 pin connector cable  
• Internal 40 pin adaptor cable for PS/2 models  
• 40 pin card edge  
• Installation Guide  
C11907.....\$495

### 3 1/2" 1.44 M/BYTE DRIVE

• Switchable 1.44 M/Byte formatted or 720K formatted  
• Double sided, Double density  
• 5 1/4" mounted  
C11911.....\$225

CONTROLLER CARD TO SUIT  
X18006.....\$139

MOUNT WITH POWER CABLE ONLY  
X11920.....\$19.95

## HARD DISKS

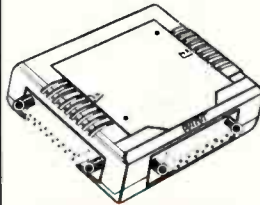
**20 M/BYTE HARD DISK**  
• Drive with controller card, IBM\* compatible, 3 month warranty  
X20010.....only \$449

**40 M/BYTE VOICE COIL HARD DISK**  
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• IBM\* compatible, 18 msec access, ESDI, 3 month warranty  
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## I/O ACCESSORIES

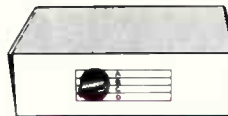


### POCKET AUTO AB SWITCHES

• Pocket size, auto-scanning  
• Allows 2 PCs to share one laser  
• Serial model: MS-201 - Host-powered  
X19150.....\$79.95

### POCKET AUTO AB SWITCHES

• Pocket size, auto-scanning  
• Allows 2 PC's to share one laser  
• Parallel model: MP-201 - Protocol transparent  
X19155.....\$89.95



### DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.

• No power required  
• Speed and code transparent  
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• Three/Five interface connections on rear panel  
• Switch comes standard with female connector

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X19120.....\$69

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X19125.....\$79

**2 Way Centronics**  
X19130.....\$69

**4 Way Centronics**  
X19135.....\$79

**RS232 2 X 2 Crossover**  
X19140.....\$79

**Centronics 2 x 2 Crossover**  
X19145.....\$79

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• Custom mold logo tab  
• FK-3002, 112 keys European version  
• Big-caps calculator function  
Japan Alps Mechanical tactile "Click" keys  
X12024.....\$189.95



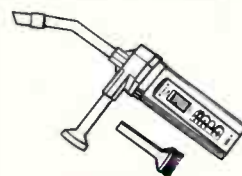
### IBM\* COMPATIBLE EXTENDED KEYBOARD (101 KEYS)

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- Positive feel keys
- Low Profile Design, DIN standard
- Separate Numeric and Cursor control keypads
- Additional Functions: Key-in-Lock, Previous Word, Next Work, Fast Repeat, Line Feed, Pause, Reset, Clear Screen

X12022.....only \$109

## & ACCESSORIES



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Use it to clean:

- Computer keyboards
- Printers
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- Computer circuit boards

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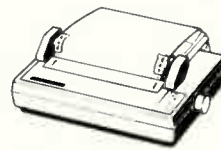
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A working bench for your Mouse.

- High quality ABS plastic and anti-static rubberised top
- Stationary holder
- Includes pull-out shelf for Mouse
- Dimensions: 280 x 260 x 25mm
- Fits over keyboard

C21080.....\$24.95

## PRINTERS



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• 180 C.P.S. & 25 C.P.S.  
• Tractor or friction feed  
• Proportional printing  
• Convenient push button control panel  
• Standard Parallel interface  
C22054.....\$489.95

• 144 CPS Draft  
• 36 Near Letter Quality  
C22049.....\$495

### STAR NX1000C COLOUR PRINTER

• 120 C.P.S. Near letter quality  
• Colours - Red, Violet, Blue, Green, Yellow, Orange, Black  
C22045.....\$695

## & ACCESSORIES



### PRINTER RIBBONS TO SUIT:

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1-9 10+  
C22036..\$19.95 \$17.95

• MX80, FX80, RX80  
1-9 10+  
C22031....\$16.95 \$15.25

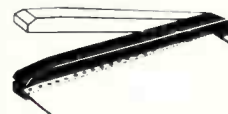
• MX100, FX100, RX100, LQ1000  
1-9 10+  
C22002....\$19.95 \$17.95

• LX80  
1-9 10+  
C22003..\$12.95 \$11.95

• C ITOH 8510-1550  
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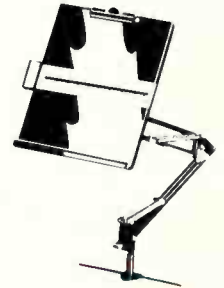
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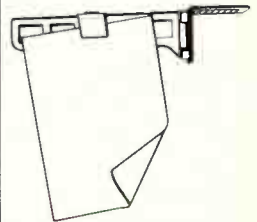
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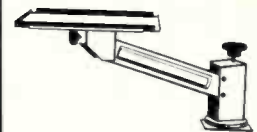
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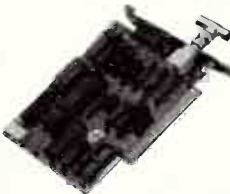
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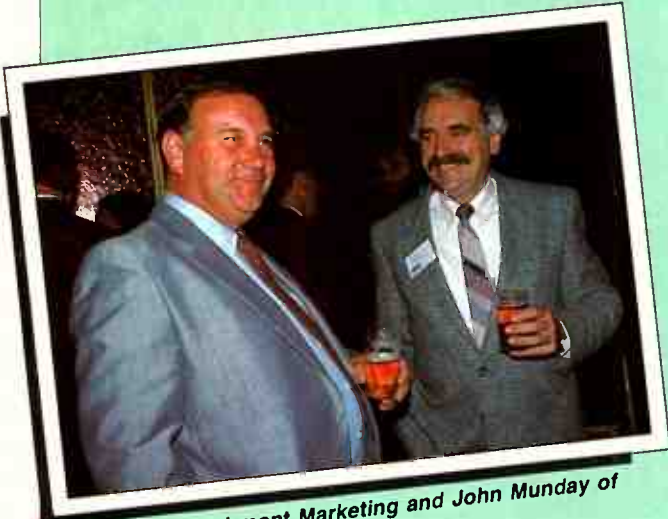
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**ROD IRVING ELECTRONICS**

### ETI's get-together in Vic



Ron Parker, Fairmont Marketing and John Munday of Hy-Q International.



John Thompson, Westinghouse and Ron Jack of Jack Marketing.

Ron Parker, Fairmont, Peter Lloyd, SETEC and John Munday of Hy-Q International.



From left to right: Peter King, Procom, Eddie Vanda, Vandata and Roger Harrison, ETI.



Greg Boot, Rltronics and Software Express and Bob Barrett, State manager.

From left to right: Clinton Graham, Pioneer, Rob Costello, Pioneer, John Fahy, Yamaha, Val Newton, ETI, Roger Harrison, ETI, Lindsey Woodland, Yamaha and David Jacobs, Scan Audio.



## Govt-NEC partnership

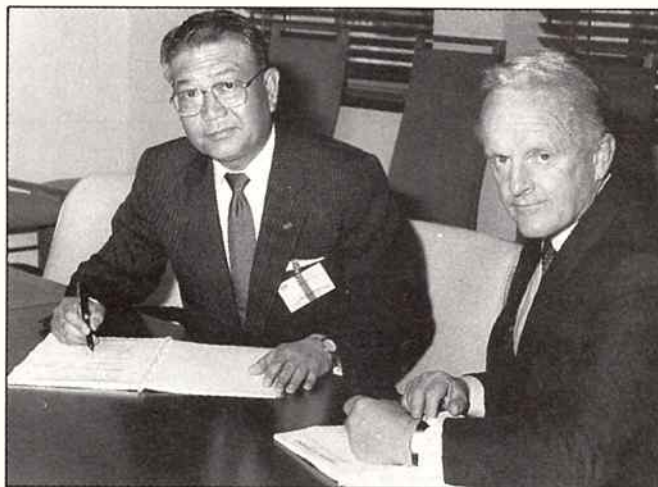
AFTER a wide-ranging review of its business development strategy, the NEC Corporation has decided to pursue partnership status with the Australian Government. In fact, an agreement to this effect has been signed by Mr Akira Miyazawa, Vice President of the NEC Corporation, and Senator John Button, the Minister for Industry, Commerce and Technology.

The agreement was designed to provide a way for NEC to meet its offset obligations. In fulfilling its side of the bargain, NEC will upgrade the role played by NEC Australia Pty Ltd and NEC Information Systems Australia Pty Ltd (both Australian subsidiaries) in NEC's global operations by using them as export suppliers to international markets in this region.

NEC will support and encourage its antipodean offshoots through direct investment, project development contracts, and the transfer of the most advanced Japanese technology. These will be used to develop local Australian products for export.

NEC Australia Pty Ltd has already been developing locally designed products with these resources. A number of Australian engineers sent to Japan for research are now working to implement this strategy.

In addition to this,



*Signing the partnership agreement are Mr Akira Miyazawa (left), vice president of NEC and Senator John Button.*

improvements on existing NEC equipment has resulted in expanded applications available for use in Australia and elsewhere.

Products include the EFTPOS EFG modem for use in the Telecom TRANSEND network and bank retailer carrier facilities, which contains multi-functional software to allow operation in five different modes, including access to Viatel. It will be sold to Europe and North America.

There is also the NA-100 Series Radio System; the Thirty Channel Echo Canceller and an in-house paging system.

NEC's partnership activities will focus on R and D in the export of hardware and software and

services in the areas of switching, line transmission and radio. A number of strategies have been devised for meeting the R and D and export target required by the partnership.

While NEC/A tackles the areas mentioned, NEC/ISA will undertake research into office automation, image processing, mainframe software projects, developing a Point of Sales retailing software system and Unix development.

Both NEC/A and NEC/ISA will conduct programs on technical support, education and training and marketing and management. This agreement made NEC the first Japanese company to make such an undertaking.



**Alan Timmins**

Mr Bob Smith has been appointed NSW State manager - Wholesalers for MM Cables. He is a qualified electrician with many years experience in the sales and wholesale distribution of electrical products in Australia.

Before this he was branch manager for TLE, and Wholesalers manager for Austral Standard Cables, one of the founders of the MM Cables group.

MM Cables has also appointed Mr Alan Timmins, formerly an area manager for Acme Electronics in Australia, as computer market manager. He is a qualified electronics technician with over 10 years experience in the industry.



**Bob Smith**



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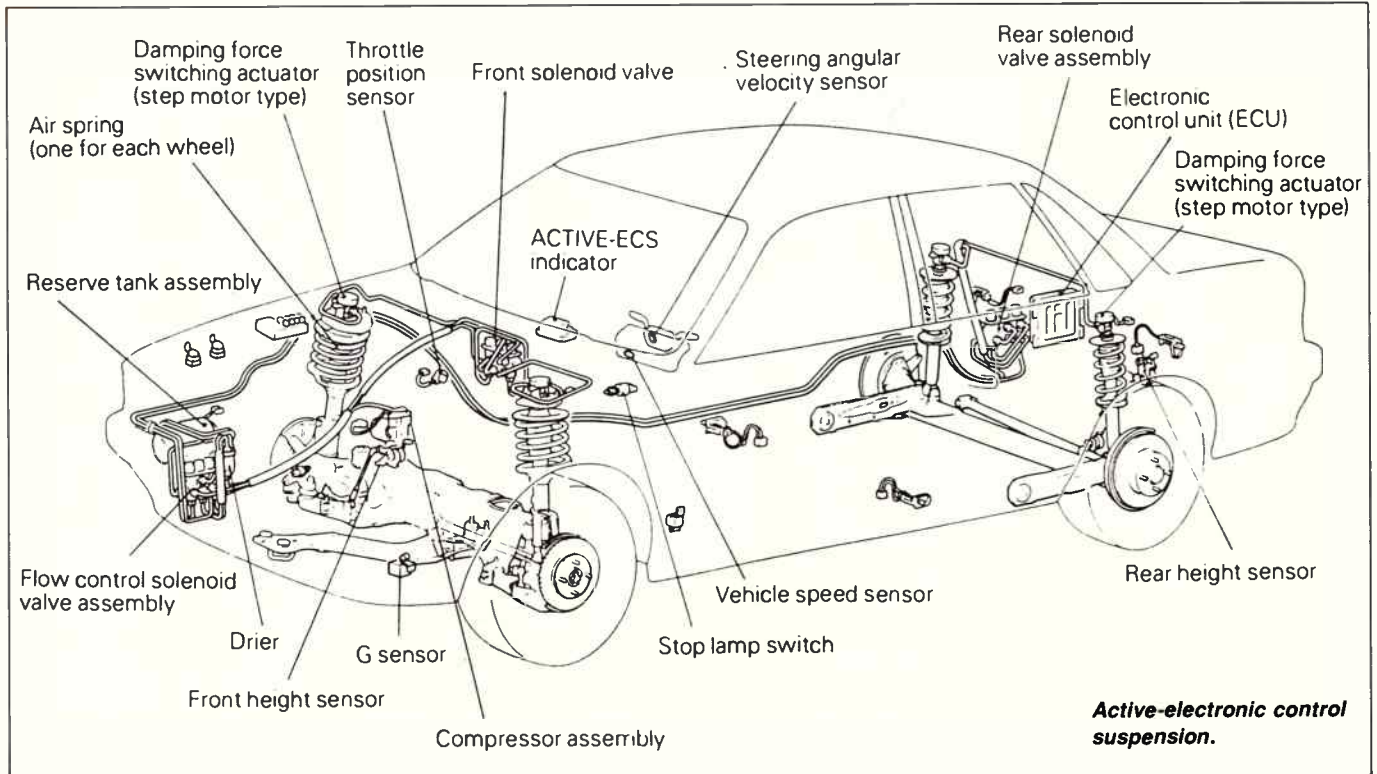
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BRIAN WOODWARD



**L**otus, like Jaguar, MG and Ferrari, is a legendary name in the motor industry. People who have no interest in cars have heard these names. They conjure up images of speed, performance, competition.

Yet the Lotus car company is a pragmatic organisation. The luxury sporting coupes

Lotus sells to customers who want a fast car with a Lotus badge are just the tip of the company's R&D iceberg. Several years ago Lotus was a force to be reckoned with on the Formula One circuits, with a race car notable for its processor controlled inter-active suspension system. The car competed

for several seasons and then, without warning, Lotus dropped its electronic suspension control system, reverting to a more conventional Formula One design. Why?

The race track is no longer a source of glamour for Lotus – it is a test track. The inter-active suspension system fitted to the race car wasn't there to help Lotus win races, it was there to assist Lotus engineers refine the software, improve durability and apply the lessons of this accelerated test program to production vehicles.

**Twofold task**

What is inter-active suspension? Some knowledge of a car's suspension is needed before the full importance of inter-active suspension becomes obvious. The task of a suspension system is twofold – to insulate the occupants and the car's more delicate components from the less desirable examples of the road builder's art (bumps, in simpler terms) and, secondly, to maintain traction – grip between the tyres and the road's surface.

The most frequently used springing

**The omnipresent microprocessor is making the move into car suspension systems. The electronic hardware is relatively simple, but the software is still a can of worms. By Brian Woodward.**

# A STORY OF SUSPENSE

medium is steel, as a leaf, a coil of tempered wire or a straight bar (called a torsion bar). Other mediums have been used – the Mini used rubber for some years and Citroen still uses compressible nitrogen in spheres with hydraulic fluid as the means of compressing it. Steel wins hands down, yet has a number of serious failings. If it is soft enough to give the car's occupants a comfortable ride over smooth surfaces, it is too soft for rough surfaces. If it is stiff enough for rough surfaces it is too rough for normal driving. Also, if the suspension system gives a good ride, cornering is accompanied by wallowing. Making the car 'flatter' when it is cornered can introduce harshness in straight-line bumps.

Perhaps well-tempered steel's greatest disadvantage is that it is a veritable energy saving's bank – you get out almost as much energy as you put in. A wheel which strikes a bump and rises quickly has mass and velocity. The spring stores this energy and then catapults the wheel back down again. As the energy is dissipated the tyre stores it (the tyre is also a spring) and releases it – upwards. Without some controls the car's suspension would need to hit only one bump to start a series of oscillations.

The energy stored by a car's spring during a bump is dissipated by the dampers, more commonly (and incorrectly) called shock absorbers. These are tubes filled with oil. Inside the tube is a piston which has small holes drilled to delay the progress of oil from the compressed side of the piston. The damper's task is to dissipate much of the spring's stored energy as heat.

### Unworkable compromise

A car's suspension system is, basically, an unworkable compromise. It must smooth out a five millimetre deflection over a period of a second or more and yet be able to insulate the car's occupants from a 150 mm bump which, at high speed, may take less than 50 milliseconds. And, if all these contradictory requirements are not enough, the front and rear (and side to side) axles 'talk' to each other by interference as the car's body is thrown around. This makes the formulae used to calculate an ideal compromise even more complicated. Indeed, the ideal compromise simply isn't possible.

One technique used in recent years to cope with the widely varying loads placed on a car's suspension system is to have springs and dampers with variable rates. The springs and dampers are quite soft over short, low suspension speed travel (speed here being the speed at which the car's axle moves up and down, not the speed of the vehicle) and become progressively stiffer as either the amount of travel, or the speed of suspension travel, increases. A length of wire is first ground so that its diameter varies over its length. It is then wound to a progressively tighter coil and then tempered. This is expensive. Dampers are also being made with gas chambers to assist in heat

dissipation and a number of valves which come into operation at varying loads as other means of making a variable rate suspension system. These too are expensive.

It is possible to imagine a suspension system where a microprocessor monitors and alters the mechanical requirements to suit changing needs.

If there is any single, electronic component which has made microprocessor controlled suspension possible it is the linear accelerometer. By measuring the rate at which a suspension system has just started to move (therefore determining the severity of the bump or corner which has just begun) the accelerometer can inform the microprocessor. In turn, the microprocessor

sharing and also to alter the height of the car.

The processor has sensors which detect steering angle, gravity, road speed, the height of the vehicle at the front and rear, the accelerator's position and the rate of movement of various suspension components. While there is some degree of driver over-ride (you can select Soft, Auto or Sport on a dazzling dashboard display unit with many buttons, pictures and flashing lights) the sensors generally control the pump for the air springs and the damper valves.

When cornering, for example, two sets of sensors are used. Either steering angle and vehicle speed inputs determine the processor's instructions to the air springs and damper valves, or a tri-axial G-force accelerometer informs the processor of lateral acceleration so that changes can be made.

Nose dive under braking is not only uncomfortable, it is dangerous. In an accident, a car which has nose-dived severely is likely to go underneath the car in front and the impact could be taken by the car's windscreen. By monitoring vehicle speed, longitudinal G forces and brake pedal application, the processor knows that the car is braking (and how severely) and not just going downhill. It adjusts the ride-height of the front of the car to maintain a level ride.

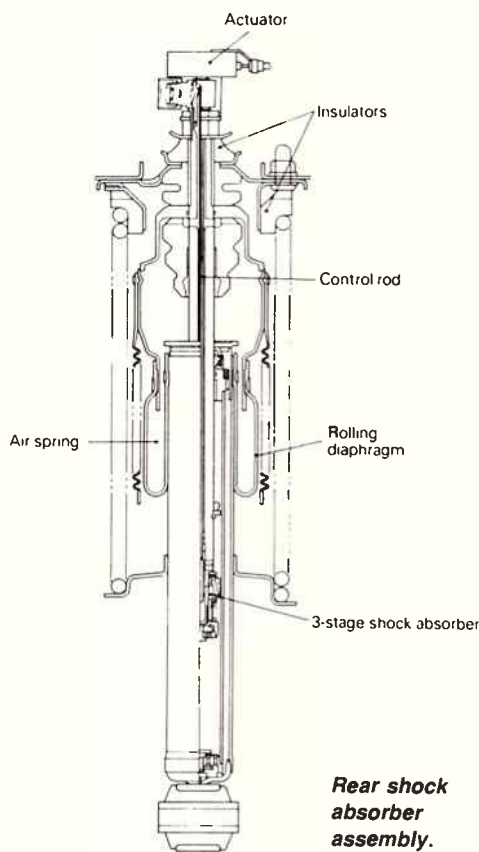
Similar inputs are analysed when the car is being sharply accelerated except that the over-riding factor is throttle position, not brake application. In this case adjustments are made to the car's rear suspension units to keep the back up. This isn't only cosmetic or to keep occupants happy. As a front wheel drive car dips at the rear the front wheels change their angle of contact with the road. If this changes too quickly, the front driving wheels can lose traction.

### Check the load

The sensors which monitor rear suspension height also check on the load the car is carrying and keep the rear up even when Auntie Hilda and her seven suitcases are being collected from the airport.

One of the most uncomfortable side-effects of a soft-riding suspension system is pitch and bounce. The car either bounces vertically over sympathetic bumps or pitches back and forth over bumps which are asynchronous with the car's suspension. By monitoring front rear suspension height relationships and suspension travel the processor can instruct the offending wheel's damper valves to change characteristics and eliminate the unwanted movement.

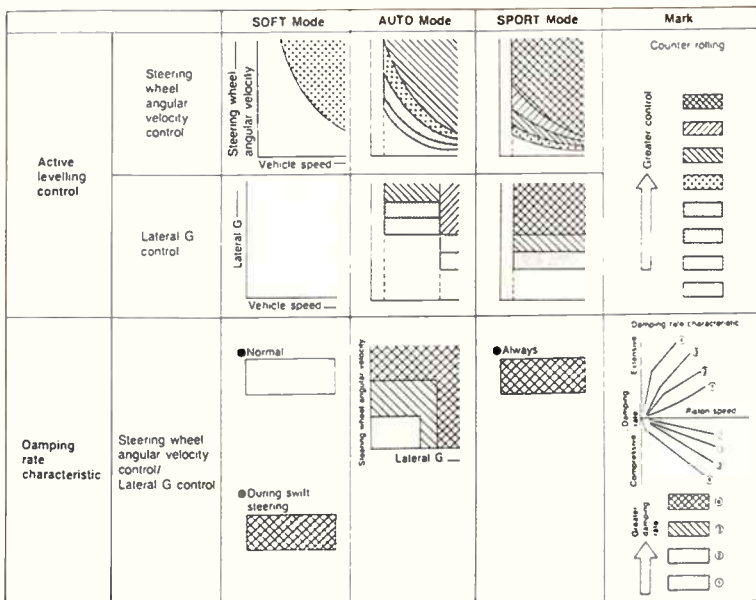
A refinement on the Mitsubishi system which will be incorporated in almost all of the inter-active suspension systems that are just around the corner is speed related ride-height. As the Galant GSR exceeds 90 km/h the car lowers 20mm for a better aerodynamic profile. This also makes the processor's job much easier when analysing corners because, at 20mm lower, the car is more stable and less likely to need



controls either damper valves or ancillary springs to vary the rate of damping or spring stiffness so that the system copes with unpredictable surfaces.

Mitsubishi's system is the first to go on sale in Australia. Fitted to the fully imported Galant GSR it is not overly complex and has a measurable (noticeable) level of suspension enhancement. The Mitsubishi system (with the inevitable acronym ECS – Electronically Controlled Suspension) has been designed to keep the car flat and level when riding over bumps, braking, accelerating and cornering. It achieves this with damper valves that can be independently addressed by the car's suspension computer to vary their damping effect, additional air springs (supplementing the steel springs) for load

## A story of suspense



You can select Soft, Auto or Sport on the dashboard display unit.

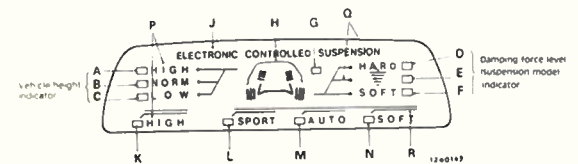
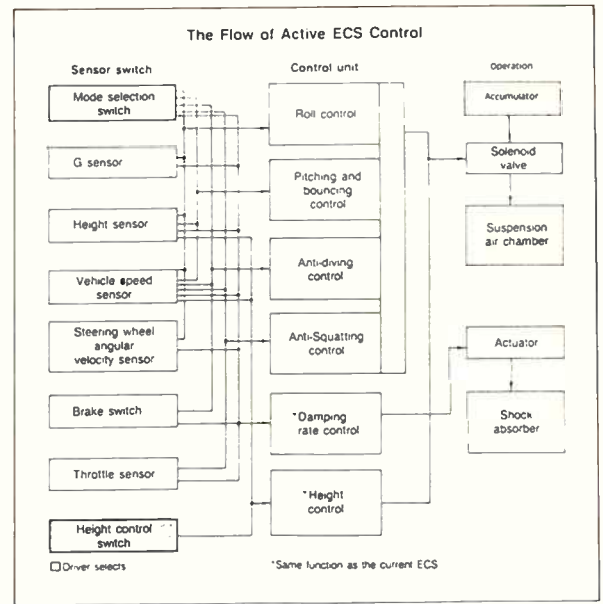
suspension modification. When the car slows down to 70 km/h, it rises 20mm to the car's normal ride height.

The Galant GSR can also be raised 20mm above the normal ride height for driving on very poor road surfaces or a further 20mm to assist in tyre changing.

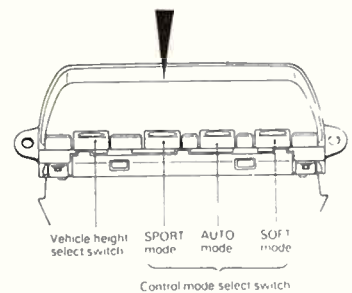
At present, the 'simple' Mitsubishi system is complex and expensive, and, while its advantages can be detected even by disinterested drivers, it makes the Galant a good Japanese car, not a world beater. It is interesting that Mercedes Benz is well down the track towards inter-active suspension on the new SL Sports which will be released in Australia some time in 1990. Citroen also has incorporated inter-active suspension in several new models planned for the next few years. These will probably be the most complex because Citroen is retaining its already complex oleo-pneumatic system, but adding two more gas spheres to the computer controlled system for even more sensor inputs.

The most important breakthrough yet to

come for the Japanese manufacturers is software. The Japanese industry has traditionally trailed in the field of suspension design, mainly because engineers persist in attempting to quantify parameters which, in Europe, are part of a science which



Letter	Function	Lamp color	"Dimming" at night
A	HIGH height indicator	Orange	Yes
B	NORMAL height indicator	Orange	Yes
C	LOW height indicator	Orange	Yes
D	HARD-lighted	Orange	Yes
E	HARD or MEDIUM-lighted	Orange	Yes
F	HARD/MEDIUM/AUTO-SOFT-lighted	Orange	Yes
G	Alarm lamp	Red	Yes
H	ECS symbol mark	White	-
J	ELECTRONIC CONT	White	-
K	HIGH selection indication lamp	Orange	Yes
L	SPORT mode indication lamp	Orange	Yes
M	AUTO mode indication lamp	Orange	Yes
N	SOFT mode indication lamp	Orange	Yes
P	Lighting for night driving (illumination lamp)	Gray	-



approaches magic. Until a person with a European feel for suspension writes the software for the inter-active suspension system's processor, examples are likely to feel like great Japanese cars rather than European equivalents.

### Front runners

Interestingly, Mitsubishi could well be a front runner here. The best suspension engineers in the world work and design cars in Australia. Mitsubishi Japan has long been willing to listen to its Australian suspension engineers. The next generation of ECS Mitsubishis which incorporate Australian developed software will almost certainly give the Mercedes Benz and Citroen systems a run for their money.

In the meantime, four wheel steering, anti-lock braking, anti-skid acceleration control and sophisticated engine management have been joined by yet another microprocessor controlled car function. It is early days yet, but the Galant GSR shows that processor controlled suspension might well be the way of the future.

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Surcharge to South Aust \$4 x 6 = \$24

ITEM	UNIT PRICE	SC	QTY	TOTAL
DISKETTES				
360K X 10	7.00			
360K X 100 (DB)	70.00	1		
1.2M X 10	15.00			
1.2M X 100 (DB)	145.00	1		
1.44M X 10	53.00			
1.44M X 40 (DB)	200.00	1		
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PRINTER STAND 15"	16.00	1		
COMPUTER STAND	16.00	1		
COMPUTER CABLES				
POWER CABLE	7.50			
PRINTER	9.50			
MODEM	10.00			
VIDEO EXTENSION	11.00			
KEYBOARD EXTENSION	8.00			
SERIAL EXTENSION	14.00			
PRINTER RIBBONS				
STAR NX1000	8.00			
EPSON LX800	8.00			
EPSON LQ500	8.00			
SUBTOTAL (1)				

ITEM	UNIT PRICE	SC	QTY	TOTAL
FLOPPY DRIVES				
5.25 360K	170.00		2	
5.25 1.2M	220.00		2	
3.5" 1.44M	250.00		2	
SCANNER	480.00		1	
DIGITISER TABLET	590.00		3	
MOUSE	75.00		1	
JOYSTICK	35.00			
MODEMS INTERNAL	349.00		1	
MODEMS EXTERNAL	395.00		2	
MONITORS				
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EGA COLOR	675.00		4	
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*Space Museum, at the end of Nathan Road, Kowloon. Nearby is a thriving business selling pirate computer software at one tenth the Australian price.*

**A**t an anti-piracy conference relating to copyright in London in 1986, they recognised that we (Australia) have the best counterfeiters in the world! So says Steve Howes, regional director of the Australasian Film and Video Security Office, operating on behalf of Hollywood's powerful Motion Picture Association (MPA). Currently, about 10% of the feature film cassette business is in the shape of illegally produced video tapes – one of the world's lowest figures. In 1984-5 25% of the business was pirate.

As I walked into his aptly-named Hollywood Avenue, Bondi office Howes was preparing to send 3,000 seized cassettes to an industrial incinerator. Dejected, as they spilt out of their cartons onto the carpet, the brightly packaged boxes displayed such titles as *Top Gun*, *Out of Africa*, *Pretty in Pink*, *Coal Miner's Daughter* and *Space Camp*.

"Try and pick the original", Howes challenged, as he handed over two tapes of *Space Camp*.

The full colour sleeve labels were identical, and only by closely scrutinising the small type on the boxes' backs could I detect a tiny imperfection in one of them. But, you would need time, good light and the original and copy together to point the finger.

Hollywood producers are losing billions of dollars world-wide as the pirates become more highly organised. The MPA is slowly working its way through country by country in a determined effort to reduce the problem. Australia's contribution to the illegal trade is \$20m.

Why pirate tapes? Rental of tapes is a ferocious business anywhere in the world. In Sydney, tapes are currently going out for just 50 cents a night. When genuine VHS feature tapes cost upwards of \$100 it becomes attractive to churn out a few copies in the back room for just the cost of a blank tape. This way, a customer craving for a particular title won't leave the shop empty handed.

All that is needed is a handful of VHS machines, some cables, blank tapes, and a few spare hours after closing. Packaging is not a problem, as many rental tapes go out in blank protectors.

Actual sale of a tape creates a different

# VIDEO PIRACY — WE'RE THE BEST!

Barrie Smith takes a look at the lucrative video piracy game, here and overseas. As he says, it's nice work if you can get it, and don't mind a court appearance or two!



**Taipei. Gold Rolexes for \$20-30. Note the fingers of the distraught stallholder, trying to block the author's lens.**

**Kuala Lumpur, Malaysia. Home of pirate audio and video tapes.**

challenge: the tapes may or may not be of indifferent quality, but the packaging should at least look a little like the real thing.

VHS to VHS dubs can be detected, as they display an electronic glitch, visible on screen – but not if the dubs are made using a Time Base Corrector which restores broadcast stability. More sophisticated operators lean towards using 3/4" masters, or go to the trouble of smuggling in 1" masters acquired from legitimate duplicating companies in the USA and elsewhere. VHS copies made from the latter give no indication of their illegitimate parentage.

Packaging is a different story: quantity counterfeits need reproductions of the sleeves in bulk. For this task the pirates need to visit a well-established print shop able to make four colour separations and quality reproductions on paper comparable to the original.

Smaller quantities can be produced by using a laser colour paper print copier. The result is undetectable to the uninitiated.

The economics are attractive. Buy a VHS feature as a master for, say \$90 tops, poor quality, blank tape for around \$5.00, label for \$2.00 and flog it in a shop for \$70. The customer is happy to save \$20, the pirate and retailer split the \$60 or so differential. Nice work – if you can get it – and don't mind a court appearance or two.

*West Burleigh, Gold Coast:* two men were fined a total of \$4,000 on 85 separate charges for dealing in 253 counterfeit tapes. The pair had been covering NSW and the Gold Coast with an organised sell-in to wholesalers and retailers, the latter innocent of the tapes' source until the poor quality of the merchandise became evident. Cost to the pirates: \$15.80 each; cost to the retailer: \$35-40. It was the pair's second offence.

*Corrimal, NSW:* a meagre fine of \$6,000 was imposed on a local video shop proprietor for making and hiring counterfeit

cassettes. Not as well organised as some, he was forced to employ thieves to steal labels and sleeves.

The magistrate blasted the man's action as a 'considerable evil'. Nevertheless, he was back in business the following week – selling pirate tapes.

*Western Sydney:* in 1988, police raided several video shops, printers and homes – pulling in 1,500 illegal tapes. The case against four men is in progress as I write. The possible penalties in this case are a little stiffer: \$50,000 for an individual, and \$250,000 for a company. The severity is due to the case being heard in a Federal Court, under the amended Copyright Act.

*Brunswick, Vic:* a fine of \$10,000 was imposed on a 24 year old man for ten counts of making and ten counts of trading in illegal tapes. Police seized six VCRs, false labels, and 700 tapes. His stock included: *The Boy Who Could Fly*, *Eye of the Tiger*, *Three Amigos* and *Legal Eagles*. The magistrate warned that, if pirating continued unchecked, legitimate marketing of tapes 'would be reduced to near chaos.'

Probably the biggest news story to break in the Australian Bus and Coach journal was in August, 1988, when Steve Howes' office warned coach proprietors that they would be breaking the law if they continued to run tapes on journeys without payment of performance royalties.

You may have noticed that all tapes carry

**KL cinema poster. Pirate prints are used in some of the city's cinemas.**



a notice before the main title warning that the tape is for viewing in private.

All hotels and motels pay a regular fee for public performance based upon average occupancy; airlines and railways are similarly committed to pay an average fee based on passenger figures.

Showing considerable enterprise, if not a great amount of wisdom, many coach lines have been hiring a tape for each journey from the local video shop – paying just a dollar or two.

The warning has gone out: any erring coach owner is liable to a fine of \$15,000, and the driver \$1,500, which should make a hole in the average pay packet. But, a number of coach proprietors replied that everybody is doing it, and because the others weren't stopping, they wouldn't.

In global terms we may be the best, but we're comparatively small fry in the scale of pirate operations overseas – and not only in video tapes.

Taiwan makes no secret of the fact that you can pick up nicely printed copies of best-selling books for a third or fourth of the price in the USA and UK. In this country we pay double or triple the US/UK price – if you can get the book at all. Tourists are warned their bags may be searched on the way out of the airports, but this could be considered a show of deference to its close trading partner, the USA.

In Hong Kong, you can avail yourself of computer software at bargain prices, with most popular programs going out of the shop in Kowloon for around A\$100. The shopkeeper is sometimes a little edgy when dealing with foreigners, but no checks are made at Kai Tak.

The legal price of such software in the USA would be around \$500 – and in Australia, around \$1,000! Which makes the whole business economically attractive, if a touch unsound in the morals department.

## Video piracy

In the SE Asian countries I have bought audio cassettes for one and two dollars – on good tape, with Dolby. I have also bought Star Wars (I) for \$12 – on poor tape, badly dubbed... but two weeks after it was first shown!

People are aware that a blank two hour tape costs around \$10, so they feel quite justified in wondering why, if a feature film is embedded onto the tape it suddenly can cost \$50, \$60 or \$70 and up.

The MPA's Export Division has appointed a Worldwide Director for Anti-Piracy to investigate the problem, and come up with some solutions. William Nix, Vice President, states: 'For every window of opportunity presented to would-be pirates years ago, there are literally thousands of such windows today'.

The scale of the business out there for pirates is staggering. Take these figures for the UK: 1,200 cinema screens; 10,000 retail video outlets (each capable of a bit of back-office copying); over 11 million VCR owners – hungry for cheap rental or purchase of a popular title.

Nix states that over a billion US dollars is lost by motion picture studios because of the pirates' activity and, in Britain alone, 25% of all tapes on outlets' shelves are probably illegal copies. Major movies show up in shops mere weeks after cinema release, and months before video release is planned.

The Bond film 'Living Daylights' hit the world's screens in June/July '87. Even before this, pirate tapes were appearing in the Middle East, Asia and Europe.

Nix argues that film production these days is financially possible only through post cinema release sales via video and TV transmission. Pre-emptive release through

piracy jeopardises these financial arrangements.

One TV network in Jamaica was snaring US pay-TV programming from satellite, and rebroadcasting feature films throughout the country. The station was operated by the Jamaican government!

In Panama, a cable system used similar methods to disseminate US satellite signals, charging \$40 a household.

I recall that Kuantan, a Malaysian town on the edge of the South China Sea, witnessed another form of piracy about four years ago. A smart operator set up a village TV service, distributing cable TV to houses with such diverse programming as US TV series, Chinese martial arts films and such like, all sourced from pirate tapes. As I remember it, he charged about \$15 a house per month. The reason he survived so long was that the country's broadcasting services, heavily regulated, paid no attention to what the audience really wanted, but adhered to the dictates of politics and religion.

Travel by train or bus in some countries of the region and you'll quite often see foreign feature films run via tape – with the odd Australian TV network logo rolling up before the main title, plus a shred or two of the odd Aussie commercial.

The major studios are not passively sitting by, allowing the robbery to proceed. Eighty nations have copyright laws and bi-lateral trade agreements which assist the protection of intellectual property.

The USA placed the weighty right hand of bi-lateral trade on Singapore recently in its efforts to stop audio, video and computer piracy: 'dub my film, and I won't buy your rubber/rice/timber/electronic products'.

Over 3,000 police raids took place worldwide in 1987. In Japan, video piracy is

estimated to stand at 40% of legitimate business – which sounds high, but only two years earlier, the figure was 80%!

In that country, there are 20 million VCR homes and it's estimated US\$200-300m is lost to the pirates by American film-makers alone.

The normally quiet Japanese resort island of Okinawa saw a little flurry as 11,000 tapes, 220 VCRs, 200 laser disc players, 18 TV sets and over 3,000 blank tapes were seized by a team of twenty police in March this year. The customers were primarily US servicemen stationed on the island's base. Titles seized included: Biloxi Blues, ET, The Presidio, Three Men and a Baby, Fish Called Wanda and Beetlejuice.

The raid was the biggest in Japan since a case in 1986 where 44,000 tapes were taken from two duplicating labs and 12 video stores. Which shows that, when the Japanese really apply themselves to a task, they do it superbly!

What to do? Piracy prevention is still a nascent technology. For every advance in anti-dubbing encoding, a rapid answer in decoding appears. It's hard to encode a 35mm colour film with anti-dubbing codes, as much as it is hard to deter a projectionist from accepting a bribe for 'losing' a brand new print for a few hours.

Presently, much of the home video market is by way of rental. Sly back-office dubbing is a financial gold-mine, requiring only two VCRs and a supply of blank tapes. The retailer buys one or two master copies of the title, then illegally duplicates a sufficient quantity to meet his rental needs.

It is predicted that rental will develop into more of a sales market, with customers buying titles outright. This will change the pirate's approach to his business. He will need to make better copies to match the original article, need better duping equipment to be installed, better masters and higher quality labelling and packaging to convince and satisfy the customer.

Exit the back-office dupers – enter the big operators. And, probably the whole business will go international with US, European and Asian participants joining forces and resources.

We'll see heavier padlocks on projection booths in major metropolitan cinemas, more secure dubbing rooms in legal duplication companies to counter the pirates.

But, the complainants should look more deeply into the whole business. The public is value conscious – and perhaps the real, true value of a tape holding an hour or two of home entertainment should be reassessed.

And, perhaps United/Paramount/Columbia and the rest should examine the financial cobweb that supports the dubbing, labelling, packaging and retailing industries that intervene between the Hollywood studio floor and the home VCR.

ETI

**A**ustralian films made before May, 1969 have no automatic copyright protection. Producers are now required to make a statement, or affidavit, as to their ownership of copyright.

Crocodile Dundee II was available on tape before the film's cinema release. To this day, the producers have not logged a claim as to their ownership of copyright. Should there be an attempt to prosecute a dealer or pirate for trading in illegal tapes it's doubtful if the charge would stand.

Some foreign features are re-titled for release in other countries. No copyright protection. One serpentine dealer in Melbourne has tried to re-name some of his stock of features to enable him to pirate the product.

Malaysia is a big problem for Australian film producers. Many titles are shown in cinemas there, using 35mm prints made in Hong Kong laboratories. The country does not subscribe to the copyright conventions ruling in Western countries. The Malaysian courts have ruled that first off the mark applies: first distributor to release the film has exhibition rights and need not pay royalties to the producer.

Pirate 16 and 35mm copies of major films are produced in the USA for export. Small cinemas in Sydney and Melbourne are known to be showing these illegal prints.

Major Australian TV networks have been offered packages of classic features from the 30s and 40s by large US distributors. The titles are out of copyright – no problem; but, copyright in many components of the films still subsists, such as script, music and so on. The ABC itself was nearly trapped by such a deal.

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TECHNOLOGY

**M**edia stories critical of the Government's move for DOTAC to charge a fee to investigate radio and TV reception problems, claim it is a revenue raising exercise and, according to such reports, the elderly and disadvantaged would suffer because they could not afford to pay the planned \$60 fee.

The Department has not attempted to defend or publicly explain the reason behind the plan. Apparently, it fears that publicising the current free investigation service would result in a deluge of complaints.

Delegates to the 1989 Federal Convention of the Wireless Institute of Australia (WIA), who represent Australia's 18,000 amateur radio operators, were fortunate to be addressed by the Director of DOTAC's Interference Task Force, Mr John Higginbotham. He began by correcting what the Department saw as two misconceptions regarding the proposal.

He said the plan to charge a fee was not a revenue raising exercise. Secondly, the Department will continue to investigate genuine interference complaints involving the reception of broadcasting services.

He made the point that interference caused by a radiocommunication service will continue to be investigated free. This kind of interference is a spectrum management problem and its investigation is an overhead built into the license fees.

Mr Higginbotham explained that DOTAC field staff were overloaded with investigations of interference which mostly turned out to be a receiving system problem, or faulty power lines.

"There are 16,000 complaints of alleged interference currently handled free of charge each year. Over 12,000 (75%) are readily found to be not real interference," Mr Higginbotham said.

Statistics show that receiving systems accounted for 58% of complaints and power lines were to blame in 36% of cases. Mr Higginbotham said, of the 58%, some 20% related to immunity problems; that is, the ability to reject unwanted signals.

DOTAC wants its skilled, well-equipped staff to be able to quickly provide assistance to

people who really need it and have nowhere else to go - that is, in genuine cases of interference. The Department cannot do this at present because it is overloaded with requests to fix problems which can and should be dealt with by TV service technicians or electricity authorities.

Mr Higginbotham emphasised that while Departmental officers can give advice on these problems, they are not in a position to fix any of them.

### **Free service costs \$1 million**

In recent years, there has been a growing tendency for members of the public to call on the Department's investigation service, primarily because it is free. Each time the Department's highly skilled staff attends it uses human and equipment resources worth about \$175. This amounts to over \$1 million a year.

Mr Higginbotham said the planned call-out charge is intended to encourage people to go directly to their service technician or to their local electricity authority where appropriate.

In a public education program beginning soon, a glossy handbook will be issued free to help the non-technical person identify the likely cause of their reception problems. In addition to television and radio problems, the handbook will also cover home entertainment equipment.

### **Power line standards**

The handbook will show the effect of power line interference to TV reception, and advise that an approach should be made to the electricity authority where faulty power line devices are implicated.

The Government has not used the Radiocommunications Act to set emission standards for power lines and distribution systems, although it is considering the question of these standards and also for associated equipment. Emissions from power lines cause spectrum pollution which is of concern to the Department.

The handbook will identify other reception problems and their causes such as inadequate or faulty antennas, or poor immunity. The recommended solution in these cases will be to contact a qualified TV service person to check out and fix the antenna or take action to improve receiver immunity.

Mention will be made of typical filters which can be fitted to a TV set to cure some cases of poor immunity. Interference to other domestic equipment including recorders, amplifiers, telephones, and intercoms will be cited as requiring a service person or help from the manufacturer.

Mr Higginbotham said DOTAC is consulting with the TV service industry to highlight the role of TV servicemen in dealing with reception problems, particularly those due to a lack of receiver immunity.

The Department of Transport and Communications (DOTAC) has received some bad press over its plan to charge an upfront fee before investigating complaints of radio and television interference. By Jim Linton VK3PC.

# SPECTRUM POLLUTION PROBLEMS

Power supply authorities were being advised and their help would be sought to overcome complaints of degraded TV reception caused by power line faults, he said.

### Telephone advisory service

In addition to providing the new information booklet, the Department proposes to introduce a telephone advisory service to help members of the public who need further advice. This service will be of particular assistance to the elderly and disadvantaged, we're told.

Departmental officers will also provide a liaison/referral service with electricity authorities, in any cases where direct approaches from complainants do not resolve the problems.

DOTAC hopes these measures will virtually wipe out its involvement in cases of straight-forward power line interference and reception problems in all except the genuine interference problems.

However, a member of the public can disregard the advice in the handbook, or given over the phone by DOTAC, and pay the \$60 fee for an investigation.

### Concern from radio amateurs

The Wireless Institute of Australia believes DOTAC should put in writing its findings after



investigating any complaint where allegations that interference was caused by a neighbouring amateur station were inferred or stated.

If an amateur station is blameless, this information needs to be available in some form of certification for the protection of the radio amateur. This would also help avoid any misunderstanding which can arise when a member of the public is told "it's an immunity problem".

The WIA believes a certification of the

problem will assist the complainant to accurately advise a TV service person of the problem. Without such a document, the general public could continue to wrongly blame a nearby amateur installation as causing interference.

This kind of situation based on ignorance or misunderstanding has the potential to result in a blameless radio amateur facing harassment, or even costly litigation from a disgruntled neighbour, according to the WIA.

eti

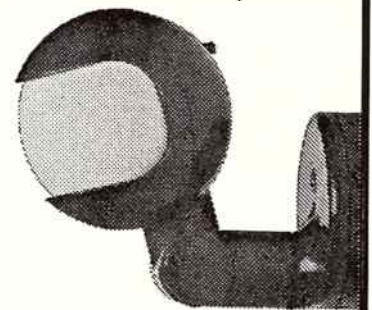
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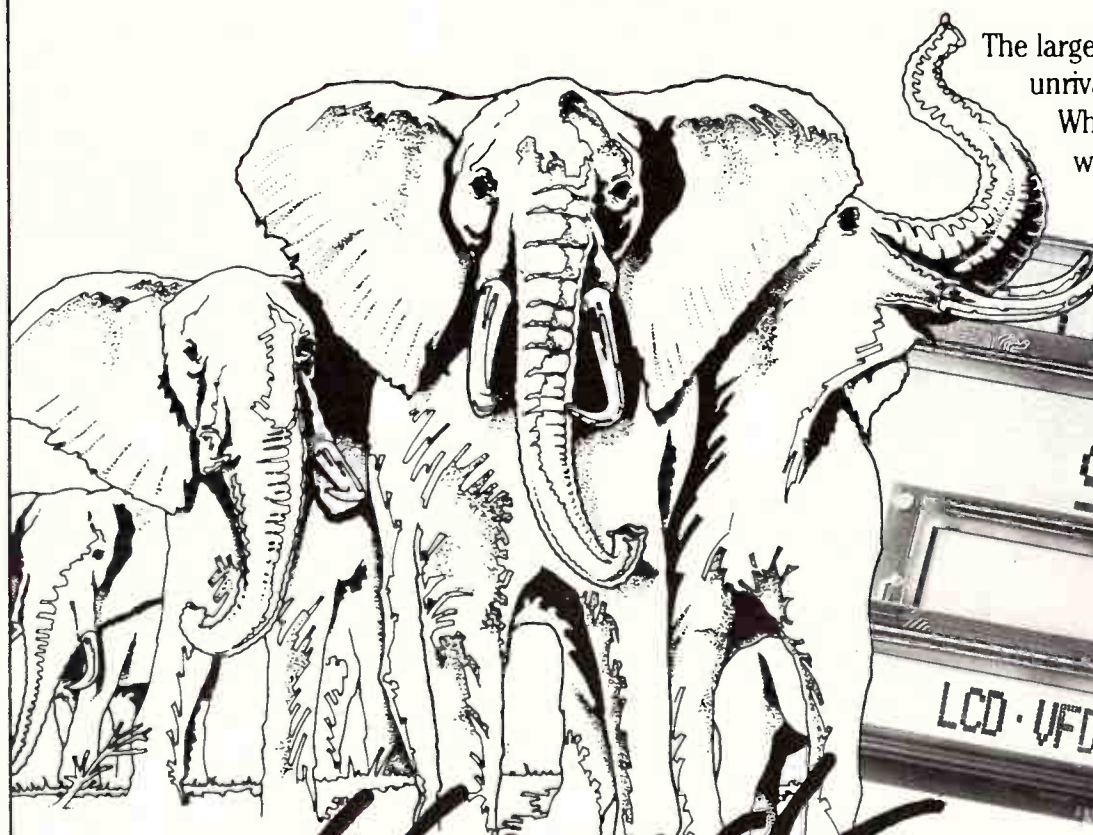
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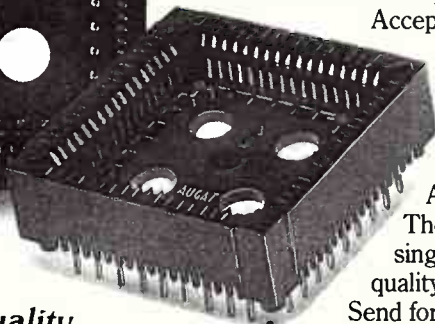
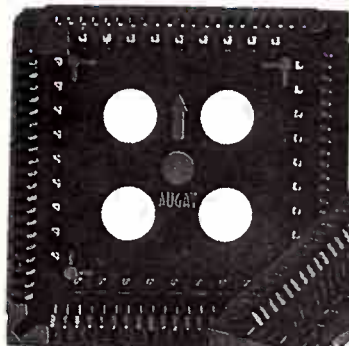
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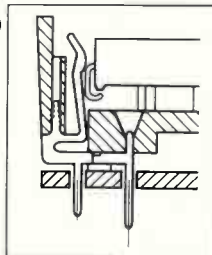
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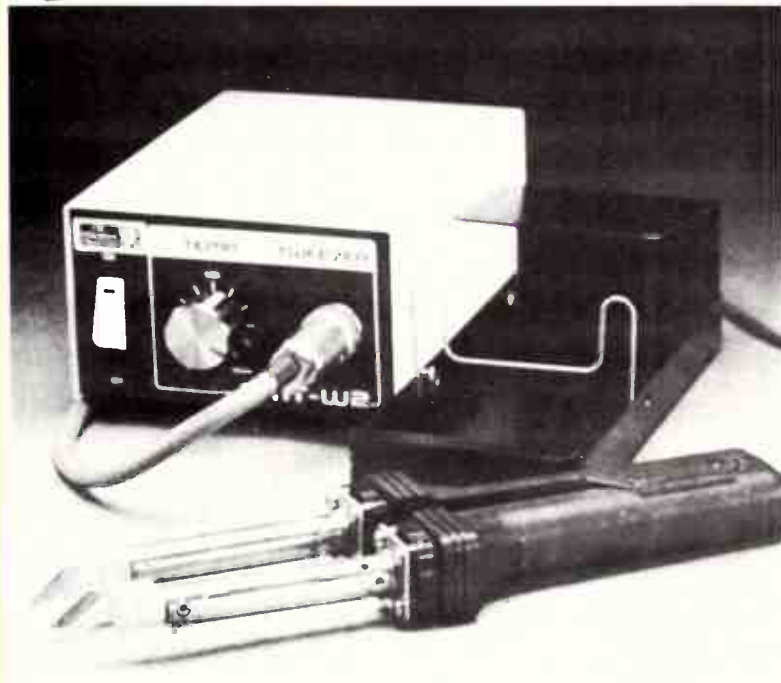
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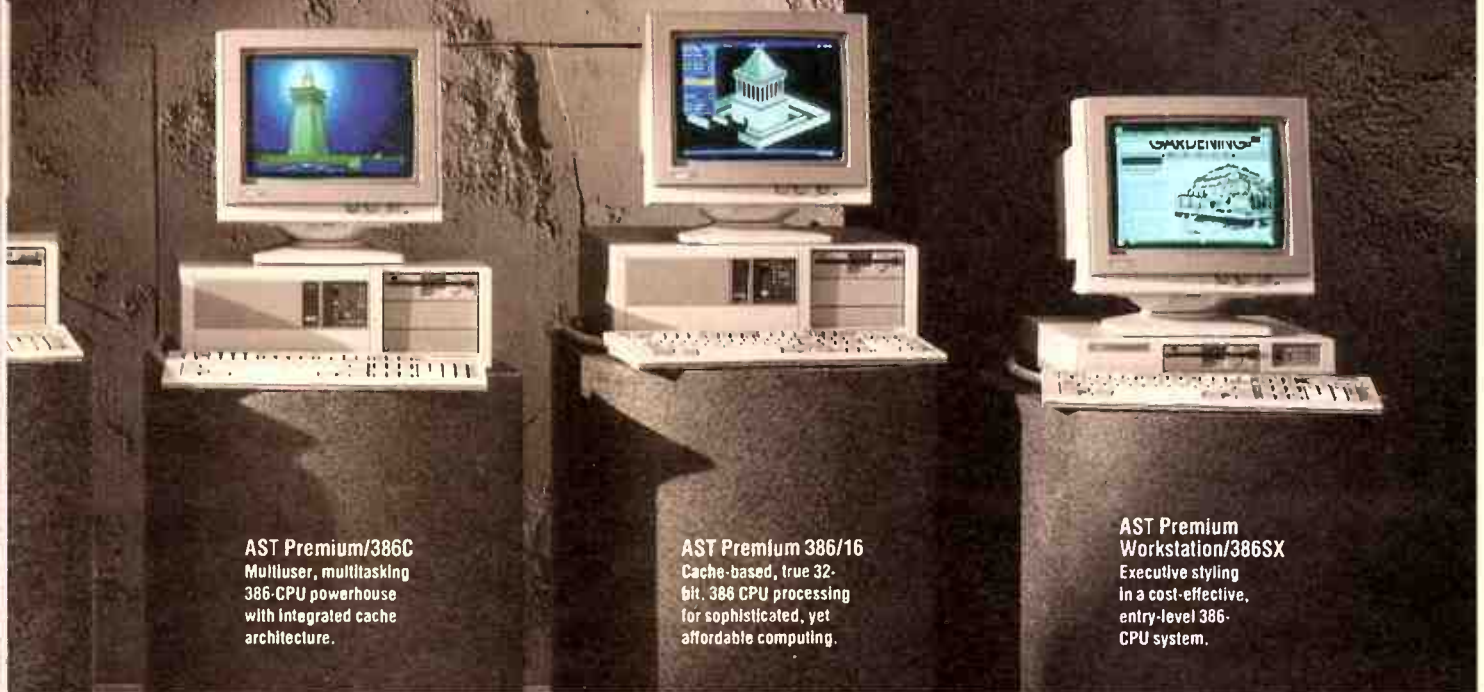
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# TEST & MEASUREMENT

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### Part 2

Concluding our overview of test and measurement instrumentation in electronic applications. By Roger Harrison.



**H**aving acknowledged that the oscilloscope is one of the most versatile and useful instruments available, I shall continue from the analogue oscilloscope to the digital storage and sampling type oscilloscopes and waveform analysers. This is where things start to get sophisticated, so let's review a few fundamentals before getting into the details.

Digital technology has really begun to make a significant impact in today's waveform-display type instruments, offering functions and advantages not possible with analogue instruments where the signal amplification and processing path, and the display, employ analogue technology. Digital oscilloscopes – or, more correctly, the digital storage oscilloscope (DSO) – while often

appearing rather like its analogue counterpart, is a beast of an entirely different character.

In a digital storage oscilloscope, the incoming waveform is amplified – the same as in an analogue oscilloscope, then applied to an analogue-to-digital converter (ADC). This samples the waveform amplitude at given intervals, the digital result then being stored in a memory (RAM – just as you find in a personal computer), from where it can be recalled as required. The values of all the points measured may be recalled, or only some of them. Particular values may be sought out – such as peak amplitude – and recalled for purposes of analysis or display in some manner. Digitising the signal and storing it in memory offers versatility not

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available in analogue oscilloscopes.

To display the waveform that has been sampled and stored, the digital information is recalled from the memory and, in lower-cost instruments, is applied to a digital-to-analogue converter (DAC), the output of which then drives the vertical deflection amplifier. The timebase controls not only the sweep, but the ADC, memory and DAC. The

original signal is reconstructed point by point and displayed.

Where a large number of points are used to make up the display, that is – a high sampling rate, your eyes see a continuous line. But, when dealing with high speed signals – fast risetime pulses, very high frequency waveforms etc – you may only be able to use a limited number of samples which can result in a very confusing display of dots. For reasonable visual interpretation, you need at least 25 sampled data points per cycle of signal (for more or less repetitive signals). To overcome this limitation, electronic interpolation is used to join the dots.

Linear, or pulse interpolation is widely used. Literally, it's an electronic version of that old kids' game of join the dots. Some manufacturers refer to it as the dot join mode. This interpolation method requires at least 10 sample points per cycle of the input waveform to provide a display which can be clearly interpreted.

Some instruments offer sine interpolation, which only requires around two-and-a-half samples per cycle minimum. This provides a reasonable approximation, particularly with repetitive, non-square wave signals.

Where the display of high speed repetitive signals is called for, a technique called sequential sampling is included. This reconstructs the signal by sampling it at different points over a number of cycles. The display is progressively built-up with each sweep across the CRT, many cycles of the input waveform being used in succession to build up a single cycle of the display. While this technique can only be employed with repetitive waveforms, and not transient events, note that the input need not necessarily be a sinewave.

A problem unique to digital storage oscilloscopes is the phenomenon called aliasing. The ADC is clocked at a predetermined rate to sample the incoming waveform. Where a high speed signal of complex form is being viewed and the ADC clock rate happens to be lower than the input signal frequency, the signal displayed on the screen will have completely different timing. This phenomenon is called aliasing.

A good example to illustrate the problem is in trying to display an amplitude modulated RF signal. This is a composite signal made up of a high frequency carrier and a much lower frequency modulating signal. The object is to view the overall signal, showing the amplitude variations caused by the modulating signal. However, the ADC sampling rate has to be much lower than the RF carrier frequency and all you're likely to see – because of aliasing – is some representation of the low frequency modulating signal. Not terribly satisfactory.

To overcome the problem, the better instruments employ an analogue signal peak detector circuit which sense the peak voltage of the input. This is used to ensure retention of the signal peak from the ADC



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in order to get a proper display of the composite waveform.

Another problem is jitter. When viewing repetitive signals, there will be some difference between the sampling rate and the sweep trigger signal. This causes an uncertainty of plus-or-minus half the interval between samples. Thus, the trace will jitter due to the uncertain triggering. Jitter

cancelling circuits are employed to correct the problem. It is especially important when viewing an enlarged view of the input waveform.

A particular advantage offered by digital storage oscilloscopes is the ability to get a close-up view of portion of a waveform. Because the samples of the input signal are sequentially stored in memory, you can electronically take out a segment of the stored waveform and display it. Once you've captured the signal, readout from the memory is readily controllable. Thus, you can zoom in on a glitch or transient for closer examination. You can also compress slowly varying events, effectively zooming out for a view of events that occur over a lengthy time interval.

The real power of digital storage oscilloscopes lies in their facility to store a signal without specific regard to the detailed signal parameters or display mode. The processes of acquiring the signal and then displaying it are largely divorced, which does not happen in the analogue oscilloscope. Being able to manipulate the signal once it's captured gave designers considerable flexibility and they have taken advantage of this.

When examining transients, you often need to view events preceeding and/or succeeding it. This can be a great advantage in analysing cause-and-effect situations in a circuit. For this reason, digital storage oscilloscopes provide pre- and post-trigger viewing of transient or one-shot waveforms. This feature is particularly useful

## Test and measurement



**This Philips PM 5110 sine/square signal generator is typical of many low cost audio signal source instruments.**

in tracking down glitches and transients in both digital and analogue circuitry.

Many DSOs include a roll or chart recorder mode which allows viewing of slowly varying signals that may have periods of seconds, minutes or longer. In this mode, sequentially successive bytes of the signal are stored and then displayed, moving them across the screen from right to left at a suitably slow rate. Thus, a complete and more-or-less steady waveform appears to march across the screen. This mode is often used to pick out transient signals that would otherwise go entirely unnoticed.

Part of the original function of the analogue oscilloscope was confirming the normal or correct pattern of a waveform. An important function in production processes is confirming that a signal reaches predetermined parameters, or falls within given tolerances. Now, what is shown on the screen of a digital storage oscilloscope is, in fact, the contents of a block of memory. With electronic cursors (just as on your computer's screen) you can define a certain screen area, and thus an area in the memory. If the incoming signal falls inside it, the instrument can signal yes, if not, it can signal no. Both time and amplitude parameters can be defined here.

Because the incoming signal waveform is sampled and digitised, a DSO is capable of taking precise time and amplitude readings on a signal. A variety of automatic measurements can be taken and displayed on-screen with the waveform, along with operating parameters. Again, cursors can be used to single out particular points for measurement.

Just as the analogue CRO is enhanced by the addition of extra input channels, which allows direct signal comparison, digital storage oscilloscopes are greatly enhanced functionally by the inclusion of extra input channels. But what really puts the DSO head and shoulders above the analogue CRO is

additional memory.

This is usually organised as accumulator memory and secondary memory. The incoming signal is first stored in accumulator memory. The signal, or a portion, can then be transferred to secondary memory from where it can be displayed for comparison with portion of the signal originally stored, or a signal stored later in the accumulator. Each display line can have different input attenuator settings, timebase speeds and trigger delay, making multi-channel, multi-memory instruments very versatile indeed.

Having multiple memory facilities permits the capture of sequential transients with each captured transient being stored in memory and displayed successively. This facility is often referred to as multi-shot.

What I have been describing has largely been the marriage of digital and analogue technologies for displaying of signal waveforms. Five years ago, digital oscilloscopes having completely digital architecture began to emerge – the so-called digitising oscilloscopes. The X and Y amplifiers went, and the analogue-to-digital converter now appears right at the instruments' front end. The display technology has adapted raster-scan technology as used in computer visual displays, the waveforms and other data – including graticules – all being written onto the screen digitally. A



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wealth of information can be, and is, included using this display technology: instrument operating modes and parameters; measured signal characteristics, etc.

The first instruments to go all digital like this were, inevitably, expensive top-line models. But with five years of development, instrument prices have come down and lower level models are appearing.

Here, too, the microprocessor has marched into the technology – why not, with all that digital circuitry? Hewlett Packard has predicted that it won't be long before traditional analogue CROs will be little more than museum curios.

With such development, it was only natural that provision of a computer interface was included, permitting functional control of the instrument as well as the passing of data from the instrument to the computer. But more on that sort of thing later.

Today's digitising – oscilloscopes are largely pushbutton or keyboard operated. With one or more microprocessors, the instruments are largely software controlled, bringing about a radical change to front panel appearance and operation along with all the other features and benefits.

A much more recent addition brought about as a result of the development of microprocessor technology has been digital

signal processing (DSP). This technology allows the manipulation of signals to provide an *analysis* of the waveform characteristics, the most powerful function now appearing being the Fast Fourier Transform.

The familiar amplitude-versus-time oscilloscope display views a signal waveform in what is termed the time domain. That is, the X-axis shows time order of events. Now, complex waveforms are made up of many frequency components, all at differing phases and amplitude relative to one another and the fundamental, or lowest, frequency. It is said complex waveforms are made up of a spectrum of components. To analyse a signal's spectrum, you must view it in the frequency domain – showing amplitude versus frequency. This is what a Fast Fourier Transform (FFT) will do.

### Features and functions

Digital storage oscilloscopes offer many advantages. All displays of single events and repetitive signals are at the same brightness, regardless of sweep speed and signal duty cycle. You can change display parameters after a signal has been captured. Cursors can be placed anywhere on a displayed waveform – single event or repetitive signal – for accurate measurement of waveform parameters because the latter are digitised. Signals can be made available for data processing or hard copies produced. Storage times of captured waveforms is virtually unlimited; conversely, DSOs can wait an indefinite time to capture a signal.

So what are the important performance criteria? The two fundamentally important ones are sampling speed and storage bandwidth. Sampling speed is generally expressed in megasamples/second (MS/s). Vertical resolution, usually expressed in bits, is important as it affects achievable accuracy. Other things to consider are: trigger bandwidth; number of memories available for signal comparison and reference; number of data points per record; measuring capabilities, and I/O facilities.

The simpler digital storage oscilloscopes have many features and functions very much like mid-price range analogue CROs. At the bottom end, typically you get instruments with 400 kHz storage bandwidth and a sampling rate of 1 MS/s. For a 20 MHz,

10 MS/s two-channel unit you'd pay between \$2000 and \$3000, depending on features. For the most part, DSOs at the bottom end of the range are two- or four-channel instruments.

From there, you can go to instruments boasting 10 MHz and 20 MS/s, 50 MHz and 10-20 MS/s to 100 MS/s, on up to 100 MHz and 50-100 MS/s. There are bench, portable and handheld types. You can even get digital storage adaptors as an add-on to an analogue CRO.

Pretty quickly, bandwidth and sampling rates jump and you'll find bandwidths in the VHF region and sampling rates of up to 500 MS/s. Also pretty quickly, asking prices get into the \$5000 to \$10,000 region.

When it gets to the digitising oscilloscopes/analysers, it almost seems the sky's the limit. Bandwidths run into the gigahertz region, and features run amok. Typically, such instruments see service in radar, satellite and fibre optic communications systems, and very high speed digital applications.

However, it seems that, as the instruments get more sophisticated and loaded up with more features and functions, set up and operation becomes more automated and, in effect, using them gets simpler. But your initial learning curve will generally be longer.

### Spectrum analysers

The spectrum analyser is perhaps a special class of oscilloscope. These instruments were devised to display signals on an amplitude-versus-frequency display. In other words, in the frequency domain, rather than the time domain as on the conventional oscilloscope. In RF applications, the spectrum analyser is the counterpart of the oscilloscope in general electronics work.

With a spectrum analyser you can view a narrow or wide segment of the RF spectrum and instantly see all the signals present, and measure their amplitudes. A typical application is viewing the output spectrum of a radio transmitter. You can very quickly determine the presence and number of any harmonics of the transmitter's output frequency, or other spurious emissions, and their amplitude – taking the broad view over a wide spectrum segment. Zooming down for a closer look, over a much narrower segment around the transmitter's output frequency, you can see the modulation components and the presence of any extraneous signals there.

Spectrum analysers are also useful in



**The Huntron Tracker is an instrument that can be used for testing and troubleshooting circuitry with the power off using signatures on the display.**

## Test and measurement

receiver, antenna and filter test applications, determining the spectrum pollution generated by other electronic equipment.

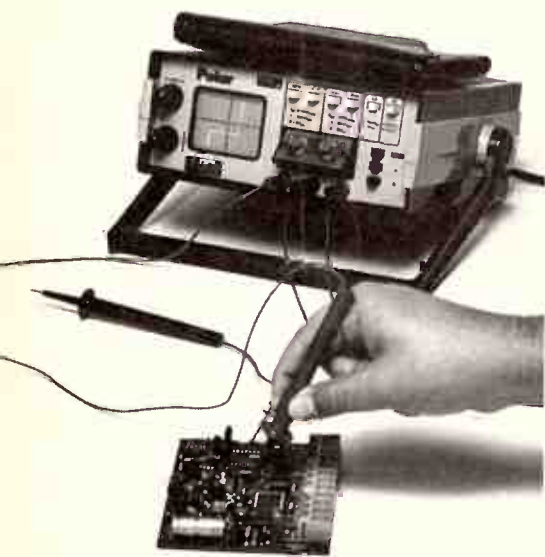
Fundamentally, a spectrum analyser is a receiver whose local oscillator can be swept over a required frequency range. The receiver's IF filter characteristics can be selected (by switch, or electronically) to provide a narrowband characteristic for looking at closely-spaced signals, or a wideband characteristic where a broad frequency sweep is used.

A spectrum analyser is an essential item where RF equipment has to meet standard specifications.

The important criteria include: frequency coverage and sweep range, dynamic range, IF bandwidths and display size. Many include facilities to link them with a companion sweep oscillator, an essential capability where receiver and filter alignment applications are concerned.

You can get audio spectrum analysers and RF spectrum analysers in portable as well as bench models. Some types are modular with plug-in front ends. Typically, audio spectrum analysers have an upper frequency limit that may range into the 100 kHz region, while RF spectrum analysers sport upper frequency limits that may range into the VHF, UHF or SHF (gigahertz) region. Amplitude measurement capabilities range from around -120 dBm up to +20 dBm or so.

And spectrum analysers haven't escaped the march of the microprocessor, either. Digital operation and digitised displays are quite common, although the lower-cost instruments are still largely analogue, in general. Some multi-function RF test instruments available include a spectrum analyser with limited functions, tailored to the general application of the instrument.



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## Signal sources

Now that we've explored instruments that generally view what's happening in a circuit, we come to that class of instrument used to stimulate some action in a circuit.

So many electronic circuits, or circuit blocks, serve to amplify, modify or otherwise deal with a signal or waveform. In order to test circuits, an individual block, stage, or section of a circuit, a stimulus of known characteristics is required.

Take an audio amplifier, for example. To test its operation, a signal of known frequency, amplitude and waveform is required - say, a 100 mV, 1 kHz sine wave. Each stage will have a certain gain and frequency response. Using the known signal, a multimeter and/or an oscilloscope can be used to determine the amplifier's basic operating characteristics. Further details on the circuit's operation can be obtained using more complex signals and measurement techniques.

The audio amplifier is an example of a linear circuit. What about non-linear circuits? Generally, that means circuits meant to deal with pulses or other non-linear signals.

Signal sources can be divided into two general classes: signal or waveform generators, and function generators. The former generally provide a single waveform type, e.g. sine wave. Function generators provide a variety of waveform types - sine, square, sawtooth, triangular, pulse. Either type may generate the waveform directly, or it may be synthesised (more digital technology in the analogue world.)

The straight signal generator can be subdivided into two classes: audio or AF types and RF types; with obvious areas of application.

Low-cost AF signal generators start at around \$200, ranging to \$500 or so. They offer a frequency coverage of typically 10 Hz to 200 kHz, or maybe 1 MHz, covered in four or five switched ranges. Output level control is a potentiometer, with perhaps a switch to bring in an extra 20 dB attenuation. Output level may range to 4 V RMS or so into a 600 Ohm load. Only an unbalanced output is provided; you don't get balanced

output until you get into the higher-price bracket instruments. Distortion may be 0.1%, down to 0.02% for the better instruments in this price bracket. The frequency readout you get on instruments in this class is just a calibrated scale, yielding perhaps 2-3% accuracy. A square wave output facility is generally included, by means of a switch; usually obtained simply by squaring the sine wave. These instruments are quite well suited to general audio work where stringent requirements are not called for.

A rung or two further up the ladder, for around ten times the price, you'll find instruments with frequency coverage extending below 1 Hz and above 1 MHz, much lower distortion figures, calibrated multi-step attenuators and balanced or unbalanced output. You can also get such features as a frequency sweep facility via an external input, a computer interface (often as an option), and perhaps digital frequency readout. In this price bracket you'll also find special low distortion audio oscillators, specifically produced for high quality audio amplifier test and measurement applications where a signal source distortion of 0.001% and lower is required.

When it comes to function generators, choices, features and functions broaden considerably. Prices start in the \$300-\$500 area and rapidly leapfrog to the \$800-\$1100 region, on up to \$2000-plus. Generally, at the bottom end, the functions provided include: sine, triangle and square wave. Frequency range may typically be 0.005 Hz to 5 MHz. Some stop at 1 MHz or 2 MHz. Since distortion is typically 0.5-1%. Output level may be 10-20 V peak to peak. The more expensive instruments may include a metered output.

Most include a sweep input facility with a sweep range of typically 1000-to-1. Some include amplitude modulation facilities, too. Output impedance is generally 50 Ohms and square/pulse output may be externally triggered. A TTL-level output may be included. Frequency readout is still the dial-scale type. Few have digital frequency readout.

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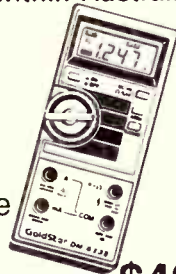


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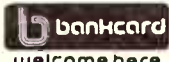
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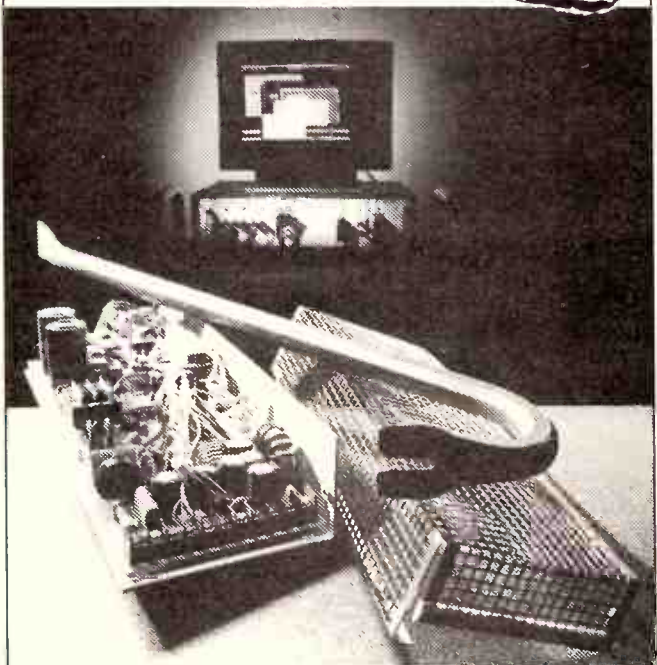
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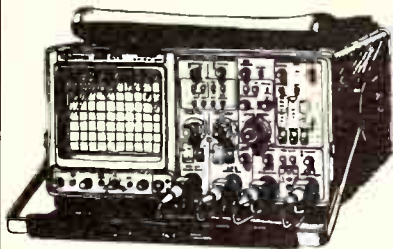
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## Test and measurement

generators with synthesised outputs of five to eight waveform functions, top frequency extending into the low VHF range (typically 50 MHz), comprehensive modulation facilities and programmability via the ubiquitous IEEE-488 interface.

A specialised sub-class are pulse generators which provide only rectangular, or pulse, signals having controllable characteristics and including such niceties as gating, external modulation, etc.

RF signal generators start at around \$200 and climb to telephone-number prices. A very basic, low-cost RF signal generator might cover from 100 kHz to 150 MHz in five or six switched ranges, and have a maximum output level of perhaps 100 mV. The top usable frequency may be extended by making use of the third harmonic output (low-cost oscillators are not exactly clean). Output impedance is typically 75 to 50 Ohms, although some provide a high impedance output of around 500 Ohms (applicable only on the low frequency ranges). Internal AM modulation (usually 1 kHz) is included as these generators are typically used in servicing AM broadcast receivers, car radios etc. An external AM modulation input may be provided.

Once the price range starts to climb, features and functions rapidly grow, as you'd expect. Digital readout becomes mandatory once any reasonable accuracy is demanded and many mid-priced instruments include comprehensive internal and external modulation facilities, precision multi-step attenuator and computer control and programmability via - you guessed it, an IEEE-488 interface.

The more expensive RF signal generators include all of these sorts of features, plus a frequency range that extends well into the gigahertz region, wide range output that may extend from -130 dBm to +20 dBm, memory storage of front panel settings, etc.

### Specialised instruments

Now this covers a whole grab bag of instruments and devices not covered under the other categories detailed so far. Many instruments are purpose designed for very narrow, specific applications whereas others cover applications in a specific field or discipline. I include here multi-function instruments that have been targeted at specific test or service applications

There are a number of audio and acoustic test instruments that fall under this umbrella. Swept-tone response analysers, for a start. These are used to measure frequency and phase response of audio and acoustic systems. Then there are such items as one-third octave graphic analysers which consist of a series of filters spanning the audio band from 16 Hz to 20 kHz, three filters per octave, showing in real time the instantaneous and/or peak sound level in each filter

channel. These are widely used for testing and equalising room acoustics and sound field monitoring. Audio FFT analysers are available that derive an amplitude and frequency versus time plot for a wide range of audio and acoustic testing.

Then we get onto audio distortion test instruments. These range from straightforward THD measurement through to slew-induced and other non-linear distortion measurement devices.

Did you know a compact disc player can serve as a precision audio test set? Special test CDs are available (from Sony, Teac and Philips, for example) which provide a comprehensive range of signals for precision audio testing. Single tones, swept tones, tones at stepped levels, etc. Very handy.

In the field of RF test and measurement, there exists a considerable variety of specialised instruments. The humble dip oscillator is a low-cost (\$100-\$150), yet versatile device. It's simply a wide-range free-running oscillator with a series of plug-in coils and variable capacitor. The oscillator circuit includes a meter; place the dipper's coil near a tuned circuit, adjust its tuning capacitor and at resonance the meter will dip indicating absorption by the circuit under test at its resonant frequency. Conversely, you can set the dipper to a known frequency, couple its coil to a tuned circuit which you then adjust to get a dip. An audio oscillator is included to modulate the dipper, so that you have a crude, but effective signal generator. It's an ideal, low-cost RF instrument where stringent specifications are not called for.

In radio receiver test and alignment applications, one is often required to measure a quantity known by the handle of SINAD, or signal-to-noise-and-distortion ratio. SINAD meters are used in conjunction with an RF signal generator. They provide an AF modulation signal of known frequency (usually 1 kHz) and distortion and a metering circuit which measures the audio output. The signal generator may be set to a given level and the receiver adjusted to give the required SINAD ratio, or the receiver SINAD ratio measured by adjusting the signal generator.

Then there are a whole range of very specialised antenna and transmission line test instruments - the list goes on and on, and I fear I'm running out of space.

Video and television equipment testing commands a whole field on its own, with specialised pattern generators that provide, digitised these days, signals for testing, alignment and adjustment of circuitry and displays. Pushbutton selection and microprocessor control feature on the top models.

Component testers also loom large as a category of their own. These may range from



*This Rohde & Schwarz RF signal generator, model SMX, is one of their economy instruments. It covers 100 kHz to 1000 MHz in frequency and -137 to +13 dBm output level. AM, FM, pulse and two-tone modulation is included.*

simple handheld digital capacitance meters through to automated LCR meters, semiconductor testers and in-circuit test instruments or fault locators.

Low-cost handheld digital capacitance meters first appeared a few years ago and currently available instruments offer anything up to ten ranges spanning 200 pF full-scale to 20,000 uF full-scale, featuring pushbutton range selection 3.5-digit LCD readout, etc. Prices? - around \$120-\$150. Similar style digital inductance meters are available, too. For the odd grand or two, you can get a fully-automated digital R-C-L meter featuring autoranging and providing a wide range of component parameter measurement - like Q factor, loss, series and shunt resistance, etc. Great for precision component selection, production tolerance sorting and the like.

Semiconductor testers range from humble transistor testers which give a crude current gain measurement, to sophisticated characteristic curve tracers.

### **Power-off testing**

One method of isolating faults in a system is to hook up a variety of test equipment, turn the equipment on and then analyse it's functions and performance. This is called functional testing.

A multimeter can tell you if the voltage or current levels are correct, an oscilloscope tells you about waveforms and a logic analyser provides information on bit patterns. From the data gained, an experienced technician attempts to deduce where the fault might lie. This sort of approach is quite valid but has the disadvantage of being rather time consuming.

The US-designed and made Huntron Tracker range of instruments is designed to provide a fault-finding technique which overcomes these limitations and operates on a principal similar to a semiconductor curve tracer. The Tracker generates a current-limited sinewave voltage signal which is injected across two points of the device under test. The voltage across the device produces a horizontal signal to drive a CRT display, while the current through the device produces a vertical signal for the CRT. In this way, the Tracker displays the current-voltage

characteristic or analogue signature of whatever the test terminals are connected to.

The test signal is bipolar (both positive and negative) so that, if the Tracker is connected to any kind of semiconductor junction, both the forward bias and the reverse bias characteristics are displayed. Because of the current-limited signal, this technique is non-destructive. To troubleshoot a circuit in the power-off state, you would typically clip one lead onto the supply or ground rail and use the other lead to test components, probing various points in the circuit and observing the different signatures produced. Leakage, shorts and opens can be easily detected.

If a known-good board of the same type is available, then troubleshooting is made even easier. By clipping onto the same reference (e.g. supply or ground) on both boards and then checking the same points on each, you can find differences in the signatures. All Trackers feature a Compar-A-Trace feature to aid in this kind of comparative testing. The signatures from each channel are alternately displayed on the CRT so that differences are obvious.

Huntron Trackers are easy to learn to use and greatly improve the speed and efficiency of servicing work, according to the makers. Huntron Instruments are represented in Australia by ECQ Electronics Pty Ltd. A similar type of instrument is made by Polar of the UK, represented in Australia by Emona Instruments.

### **Computer interfacing**

With so many instruments employing digital technology internally, from multimeters through counters and generators to oscilloscopes, it came to pass that many people pondered as to why such instruments couldn't talk to, or be controlled from, a computer. Answer - no reason. Thus it was written that such instruments be provided with a bus interface or a serial interface.

Including a serial interface posed little problem - the common RS232 interface as widely used on personal computers was adopted/adapted. Most manufacturers include it as a serial control and data exchange interface, while a few give it a multiple role, permitting data to be sent to

a printer, or a modem, all organised from the instrument's front panel. (e.g. the Fluke 45 bench/portable DMM).

The bus interface required a different approach. This involves a multi-wire parallel signal path. The US-based Institute of Electrical and Electronic Engineers (the IEEE) adopted a standard for such an interface some years ago, dubbed the IEEE-488 interface. There have been subsequent updates, generally signified by an extension, e.g. IEEE-488.2. Hewlett Packard referred to it as their General Purpose Interface Bus (GPIB). In Europe, the standards body there - the International Electrotechnical Commission (IEC) dubbed it the IEC 625 bus.

Whatever handle you know it by, this interface permits computer control of an instrument and the exchange of data.

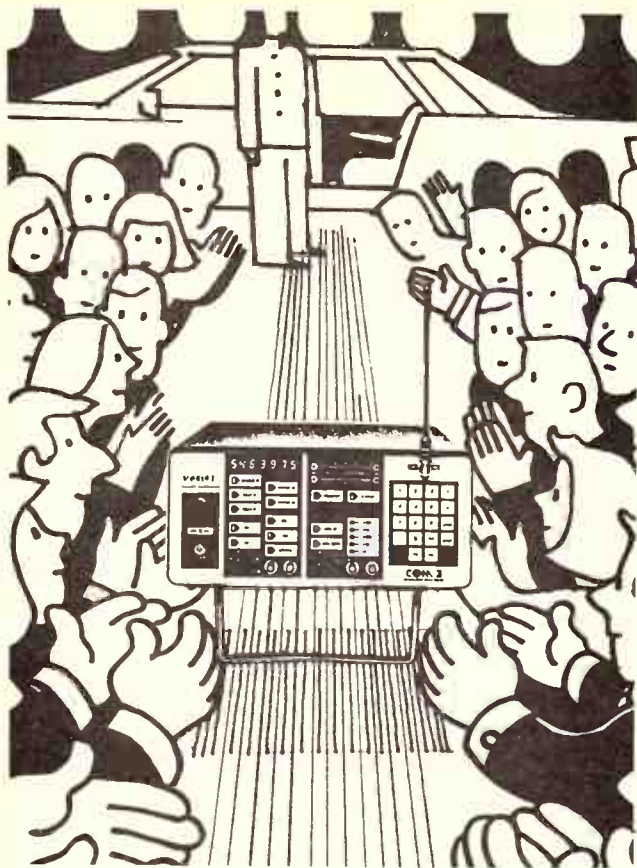
The inclusion of an IEEE-488 interface on a digitising oscilloscope, for example, permits the transfer of memory contents to another device or a computer, where the data can be manipulated or otherwise processed. It also allows the reading of measurement and display parameters. This sort of facility can turn the instrument into a powerful diagnostic tool and/or data logger. It can be used to provide output to an X-Y plotter or chart recorder for hard copy output.

### **Computer-based instruments**

The features and facilities of every desktop personal computer mirror the display and control facilities in a digital oscilloscope - so why can't you turn a PC into a digital oscilloscope? Answer - you can! The recipe says, just add analogue-to-digital conversion, a few grams of software and - hey presto!, a test instrument.

PC-based test instrumentation is a rapidly growing area. Add-on cards and boxes for IBM PCs and compatibles are appearing weekly, offering quite sophisticated features - most of which is software-based. Multi-channel, 100 MS/s sampling rate wide-bandwidth oscilloscope front ends for PCs have appeared offering sophisticated features like waveform storage and comparison (with software generated waveforms, no less!).

Automated test sets, totally software driven, capable of stand-alone operation or with facilities to link to programmable signal sources, etc are appearing. This is an exciting and quickly growing field and the next year or two will see some very interesting developments.



## A Service Monitor recognised for its reliability and performance.

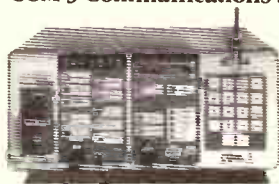
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### Suppliers

The following listing of distributors and suppliers of tests and measurement instruments is as complete as we could make it at time of going to press. As they say: errors and omissions excepted.

Note that while we have just listed a single address for each firm here, quite a few have interstate offices so check with the office listed here for branches in your state.

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Fax: (03) 690 6750  
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### WANDEL & GOLTERMANN

Wandel & Goltermann is internationally recognised as one of the foremost manufacturers of test equipment for telecommunications and data communications. The company was founded in 1923 by two engineers, who gave it their names. Head office is located in Germany and the company employs 2600 people worldwide. Production and development facilities are located in Germany, US and UK.

Wandel & Goltermann test equipment has been well known in Australia for over 25 years. Until 1984, the product range was handled by agencies, when the Melbourne office was set up. A Sydney office followed in 1986.

### TEST & MEASUREMENT SYSTEMS P/L

Melbourne-based Test & Measurement Systems Pty Ltd represents in Australia the Emil Haefely company of Switzerland. Founded in 1904, Emil Haefely specialise in the manufacture of test sets for carrying out impulse voltage and insulation tests, electrostatic discharge and energy absorption tests on electronic components and systems, simulating a wide range of international and military standards.

### INSTRUMENTATION & COMPUTER RENTALS

ICR, a subsidiary of Imagineering Technology Ltd, is new to the field of instrumentation and equipment rentals. The company maintains offices in Sydney and Melbourne and rents products from leading suppliers, including: Apple, Compaq, Epson, Hewlett Packard, Hioki, IBM, Marconi, Philips, tektronix and Ultra.

ICR is committed to competitive, professional service and support.

### RFI INDUSTRIES

RFI Industries Pty Ltd, formerly Scalar RFI Industries, is a wholly-owned Australian company headquartered in Bayswater, Victoria. The company has been in operation for 13 years and specialises in EMI/EMC instrumentation and engineering.

The company's Technical Services Department offers sales and service for a complete range of EMI/EMC instrumentation and accessories, as well as maintaining a fully equipped RF shielding EMI/EMC testing and engineering laboratory complex.

Among the overseas principals represented by RFI Industries are: Electro-Metrics, Solar Electronics, R.F.I. Corporation, Holiday Industries, all of the USA, and Inco Electronic Instrumentation of Poland.

### VICOM AUSTRALIA PTY LTD

The Vicom group is an Australian-owned, broad-based electronic communications company with a wide range of capabilities including consulting, engineering, R&D and the supply of high quality products.

Probably the best-known of Vicom's test & measurement product lines is the I.F.R. range of communications service monitors, avionics test equipment and spectrum analysers.

Vicom also distributes products from Helper Instruments of the USA, Schlumberger RF test instruments (from France) and microwave test equipment from Giga Instruments (France).



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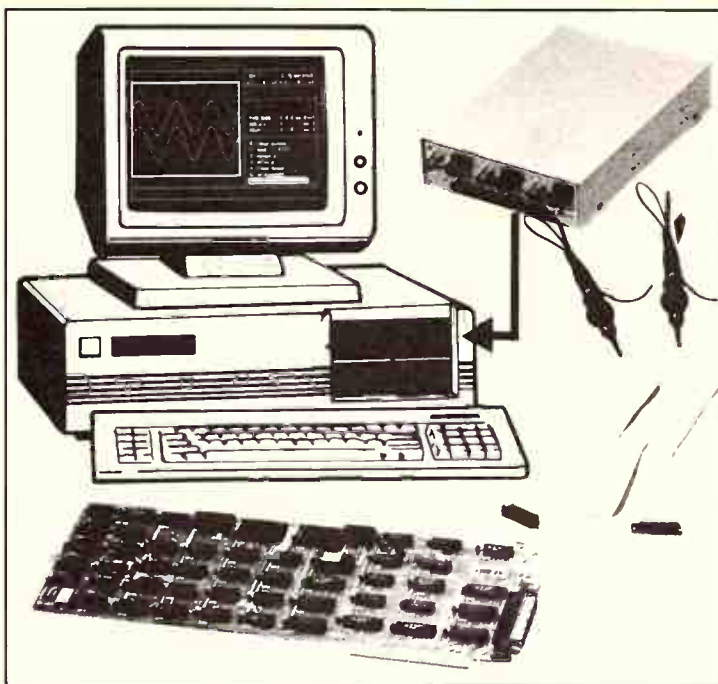
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INSTRUMENTATION

**A**sk around the electronics industry about who would be the top manufacturers of quality, high performance multimeters and three names always head the list: Hewlett Packard, Datron and Fluke, not necessarily in that order.

For many years now, Fluke has held a commanding position in the digital multimeter market, from handhelds through to system multimeters.

### General features

The Fluke 45 is a bench/portable digital multimeter that features a dual display with a standard 4½-digit, 30,000 count, readout with a 5-digit, 100,000 count, high resolution mode. The dual display is a vacuum fluorescent type which shows, along with the measurement readings, a variety of annunciators and messages.

It measures 216 mm wide by 93 mm high and 286 mm deep. The carry handle can be locked in any one of the four positions: straight up, where it's out of the way, enabling the instrument to sit on a shelf; straight out, for carrying the instrument around; down for use as a stand that tilts the display upwards for ease of viewing; and fully back, where it sits out of the way flat against the underside of the case, allowing the instrument to sit flat again. A set of probes with finger guards and shrouded plugs is supplied with the instrument, along with a 240 Vac IEC mains cable.

The instrument boasts nine dc voltage ranges from 100 mV to 100 V, nine ac voltage ranges (true RMS reading, ac-coupled), five dc current ranges from 10 mA to 10 A, four ac current ranges from 10 mA to 10 A (true RMS reading, ac-coupled), fourteen resistance ranges from 300 Ohms to 100M, diode and continuity test with audible tone output, and five frequency

ranges from 1000 Hz to 1 MHz. You can operate the Fluke 45 in autoranging mode or use pushbutton manual range selection.

In addition, the Fluke 45 allows you to compare measurements within pre-determined limits, to make readings relative to a reference measurement, to take decibel readings with selectable reference impedances from 2 Ohms to 8000 Ohms, 1 milliohm to 16 Ohms, and you can record minimum/ maximum measured values. A Touch Hold function is also included.

The dual display allows you to measure and display any two functions at the same time! Accuracy and resolution is the same on both displays.

Resolution is quoted as 1 µV on both ac and dc voltage (100 mV ranges), and audio/power measurements up to 1000 W referred to impedances ranging from 2 Ohms on Ohms (100 Ohm range). On ac and dc current, resolution is quoted as 100 nA (10 mA range). Decibel resolution is quoted as 0.01 dB.

Best dc voltage accuracy is quoted as plus/minus 0.02% + 2 digits; best dc voltage accuracy as plus/minus 0.2% + 10 digits. The best current range accuracy is listed as plus/minus 0.05% + 2 digits on dc, 0.5% + 10 digits on ac. Best accuracy on resistance measurement is quoted as plus/minus 0.05% + 2 digits.

On frequency measurement, best accuracy is given as plus/minus 0.05% + 1 digit. Resolution is quoted as 0.01 Hz (1000 Hz range), and best sensitivity is given as 30 mV RMS, 5 Hz to 100 kHz. The specifications indicate the instrument will measure frequency above 1 MHz, but sensitivity and accuracy are not specified.

Selectable count resolutions of 100,000, 30,000 and 3000, are included, with reading speeds of 2.5, 5 and 20 readings per second, respectively.

Input impedance on dc volts is 10M in parallel with 100 pF; on ac volts it's 1M in parallel with 100 pF.

The Fluke 45 includes an RS232 interface as standard, which allows measurement to be printed, filed, manipulated or transmitted by modem. The QuickStart 45 accessory software package facilitates RS232 communications between the Fluke 45 and an IBM PC or compatible. It also allows easy set-up of the 45 via pull-down menus and the automatic recording of data in Lotus 1-2-3 format.

Two important options are offered for the Fluke 45, along with a range of accessories. The IEEE-488.2 interface can be added without removing the RS232 port, and provides full programmability and automated calibration facilities. Its command set is identical to the RS232 interface commands wherever possible, according to the manual.

The second option is a Battery Kit which consists of a rechargeable 8 V lead-acid battery, with a bracket and charger assembly. It provides an operating time of typically eight hours, according to Fluke, and will operate over the temperature range from zero to 50 degrees Celsius.

Accessories available include a soft carrying case (supplied with our instrument), a rackmount (19-inch) kit, an RS232 terminal interface cable, an RS232 modem cable, QuickStart software package (previously mentioned), and three IEEE-488 cables one, two or four metres long.

Additionally (phew!, will it never end?) the Fluke 45 boasts built-in self-test facilities with closed-case calibration requiring no internal calibration adjustments. Closed-case calibration can be performed manually over either the standard RS232 or optional IEEE-488.2 interfaces.

### Basic checkout

Not that I'd question Fluke's veracity, but in order to get some quantitative idea of the Fluke 45's performance, I thought it would be informative, instructive even, to get a measurement of at least the instrument's basic dc accuracy. Fine idea... but! With a 5-digit - 100,000 count - readout in high resolution mode, I needed to find a standard with an accuracy two orders (that is, 100 times!) better than that. In other words, being able to read 9.9999 volts (say) I needed a voltage standard of 9.999999 volts

"Might as well hunt the wumpus as find one of those," I mused, pondering the problem. Aha, the National Measurement Laboratory! I thought, in a flash. But, with an inkling of the cost, I knew I needn't even pick up the phone.

Finally, my hunt led not to the wumpus but Rod Tuson of Statronics Power Supplies in Sydney. All my 'playing' with the Fluke 45 had led me to form an opinion of its quality, and I was determined to 'put numbers to it,' as Lord Kelvin was reportedly accustomed to

# A LEADING EDGE

The recently-released Fluke 45 Dual Display Multimeter probably represents the leading edge of today's bench/portable multimeters when you take into account the features and facilities it offers. Review by Roger Harrison.





say. In some foggy back corner of my mind, I remembered from some years back a product release on an Australian designed and made voltage standard, produced in fact by Statronics Power Supplies.

Eureka! The VS4 was still in production, how many would I like to order?, Rod enquired. "Ten!", I said. "Good," said he, "that's the best order we've had all month!"

But first, a little on the VS4 Voltage Standard. Designed and developed in collaboration with the CSIRO and the National Measurement Laboratory, the VS4 was released in 1987. Briefly, it offers four independent outputs of 1.018 V and close to 10 V, with low noise, low drift and low leakage, and accuracy in the microvolt region. The VS4 is portable, robust and simple to use. And the latest production models are improved on the first ones. VS4s are now found in important establishments the world over. A heart-warming success story for one little Aussie electronics entrepreneur.

So, what did Rod find?

"On 9.915643 volts, it displayed 9.9166/9.9167 (last digit unstable). The error is 9.9167 - 9.915643, or about 0.01%, which is comfortably within specification.

"On the low range, on 15.4339 mV, 15.430 to 15.433 mV was displayed, indicating a small amount of input noise, but very acceptable accuracy - 0.025% peak total, compared with plus/minus 0.025% + 1 digit specified. The meter doesn't pretend to be optimised for very low dc voltage measurements, so these results are good."

## Commentary

The Fluke 45 is a delight to use! The vacuum fluorescent display is clear, well laid out and easy to read. The primary display is larger than the secondary display, the latter being located to the right of the primary display. The display is very comprehensive indeed, I

just don't have the space to describe it here in depth. The function and unit annunciators are repeated on the secondary display, so there's no confusion when you're making use of the dual display feature. Manual ranging and the function modifiers (REL, dB, HOLD and MV/MX) cannot be selected in the secondary display. Measurement ranges for the secondary display are autoranged.

The dual display feature has wide application. For example, you can simultaneously measure the dc output and ripple voltage of a power supply. You can simultaneously measure volts ac and frequency for frequency response measurements. And you only need two leads for such measurements. With three leads you can measure, for example, dc volts and current for power supply line and load regulation tests.

The front panel is well laid out, with the seven function keys grouped together on the left beneath the display, the six modifier keys grouped together on the right beneath the display, and the three ranging/editing keys linking the two. The keys have a positive action and a short beep is emitted when you operate them. The power switch is at lower right on the panel, on a recessed ledge that runs along the lower edge of the front panel.

Unfortunately, no software was available for me to try the 45's computer control and communications functions. However, you can use the instrument as a simple data logger, setting up measurements to be taken at suitable intervals ranging from every 50 milliseconds to every 5.6 hours, and print the results on a serial input printer via the 45's RS232 port. Incidentally, you can set the RS232 port's baud rate and data parameters from the front panel.

Internally, the Fluke 45 is well engineered and beautifully constructed. There is a 'main' board, with the IEEE interface 'piggy-backed'

onto it, another board behind the display (to which is mounted the small piezo beeper) and a power supply/regulator board. Much use is made of surface-mount components. All boards multi-layer plated-through hole types with solder masking and silk-screened component annotation. All boards are interlinked with ribbon cable and IDC-type plugs. The battery is a four-cell, fully-sealed type.

Talking of the battery, the literature says it supplies up to eight hours of use and requires 16 hours to recharge.

The front and rear panels are mouldings of high impact plastic, the case itself is of aluminium and the internal chassis is folded and anodised aluminium. It appears to be quite sturdy.

The soft carry case supplied with the review instrument includes a pouch for leads and, internally, a divider that accommodates the handbook beneath the instrument. An adjustable shoulder strap allows you to take the weight on your shoulder or, shortened, to carry it in your hand. The 45's handle was not meant for lugging the instrument great distances. I'd say. This case seems to offer good protection for an already sturdy instrument, saving it from the inevitable knocks and scratches it would suffer simply being lugged around naked. The top flap, which covers the instrument's face, attaches with Velcro strips. A similar bottom flap allows access to the 45's rear apron, so you can actually use the instrument while it's in the carry case.

Fluke provides a very instructive, graphically illustrated Quick Reference Guide that takes you through all the modes of operation. The handbook supplied is very comprehensive, well laid out and clearly written - a joy! Warranty offered is 12 months.

## Summary

The Fluke 45 would be one of the finest instruments in its class that I have ever had the pleasure to play with. Rod Tuson summed it up well, as he said, "There's no doubt a lot of measurement capability is packed into a compact and versatile tool."

The basic instrument costs \$1190 ex. tax. As supplied, with the IEEE interface and battery fitted, plus C40 carrying case (known as the 45-15), cost is \$1828 ex. tax (the C40 is a \$98 accessory, included in that price). If you want the QuickStart 45 software, it'll set you back \$190.

When you consider the features and functions offered, the accuracy and construction - all with regard to the price, you'd be hard pressed to find another instrument in the same league.

If you're in the market for a bench/portable multimeter, the Fluke 45 warrants very serious consideration.

*Review instrument kindly supplied by Philips Test & Measurement, Unit F1, 25-27 Paul St, North Ryde, NSW 2113. (02) 888 8222.*

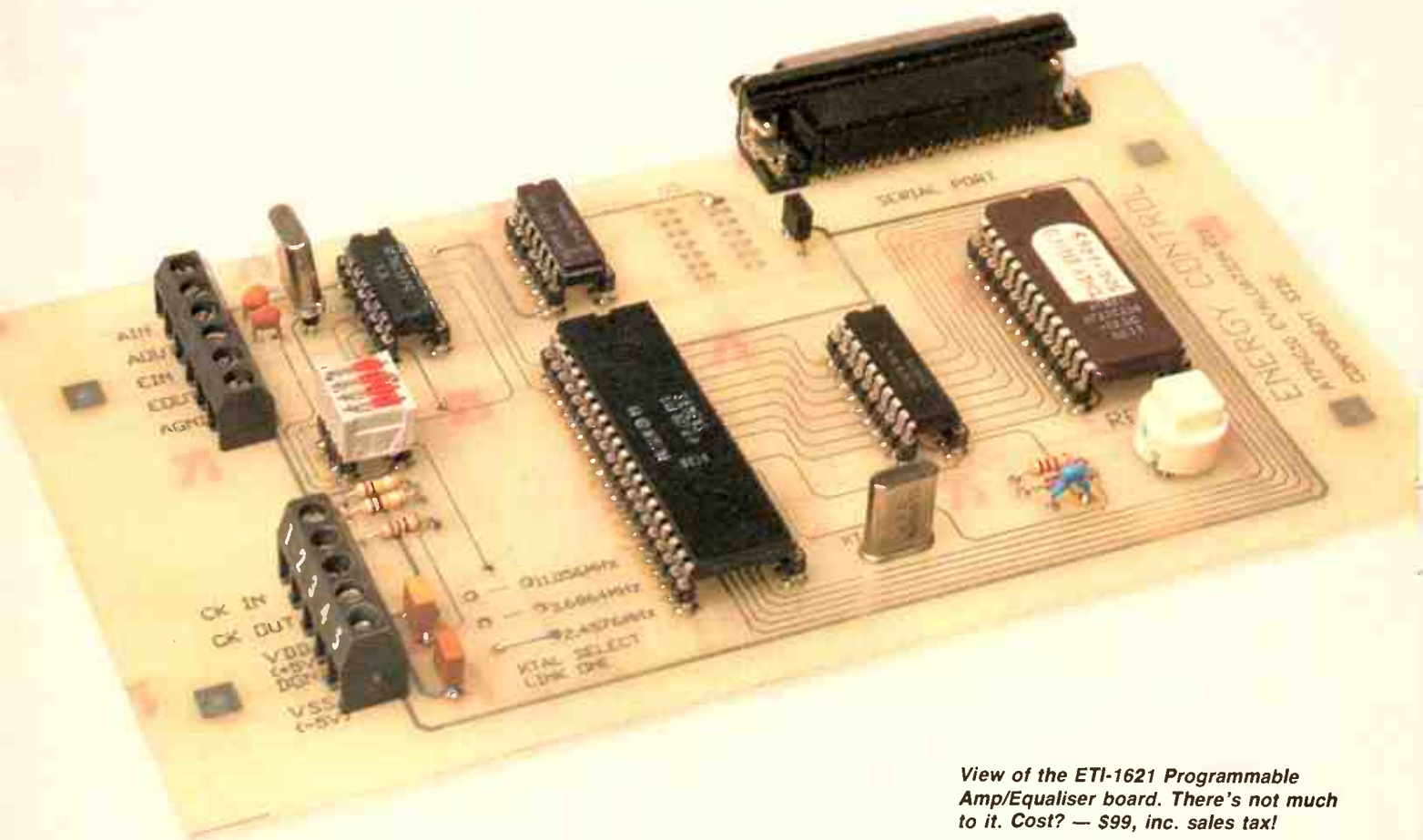
***For data communications, try this***

# **PROGRAMMABLE AMP/DELAY EQUALISER**

This unusual, yet practical, project has applications in improving data communications over telephone lines, or even in radio data transmission applications. By Stephen Gale.



ELECTRONICS  
ETI - 1621



***View of the ETI-1621 Programmable Amp/Equaliser board. There's not much to it. Cost? — \$99, inc. sales tax!***

**D**ata communication over a telephone line is not a simple business. Telephone lines have limited bandwidth and poor signal-to-noise ratios. The gain and frequency response characteristics are subject to change depending on which twisted pair the exchange has selected. In spite of these difficulties users demand ever increasing data transmission rates.

To help cope with these difficulties some form of line conditioner is frequently employed. The conditioner introduces some form of equalisation and frequently, automatic gain control (AGC).

Line equalisers may be of two varieties, namely:

a) Fixed compromise. The response of a fixed compromise filter is set during manufacture or installation and left.

This system is very common when leased lines are in use; Or:

b) Adaptive. The response is determined in use, or prior to each transmission. Such schemes are expensive but frequently necessary for data transmission over the public switched telephone network (PSTN).

### Group delay response

A telephone line is a form of balanced line having characteristics best defined by group delay. This is the time delay a transmission line introduces to a propagating signal. An ideal transmission line has a constant group delay versus frequency response which implies that no distortion will be introduced, other than time delay.

A practical line may have a response resembling Figure 1a. Such a response will play havoc with the phase modulated systems used almost universally in high speed data communication systems (See *Modern Modem Technology*, May and June 1989 issues).

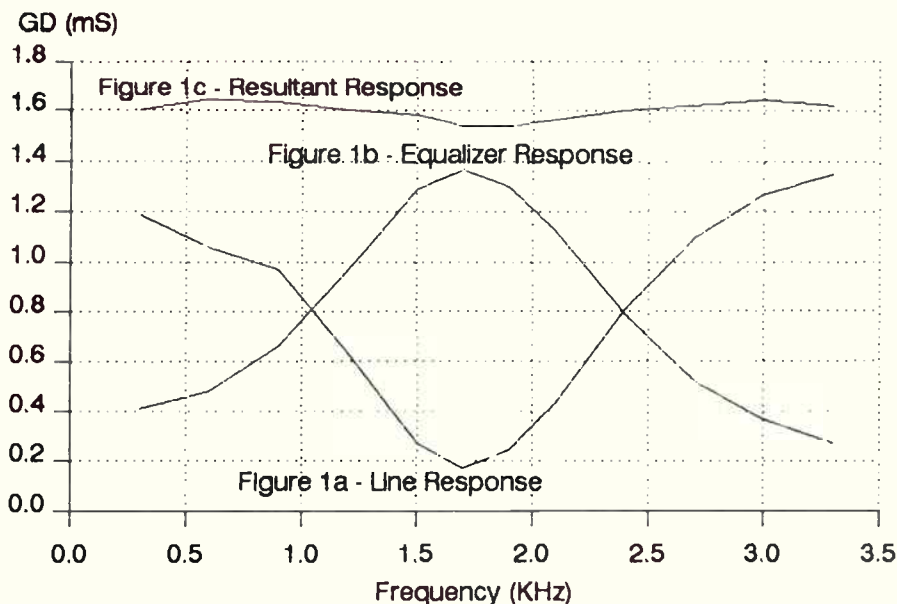


Figure 1. Group delay equalisation.

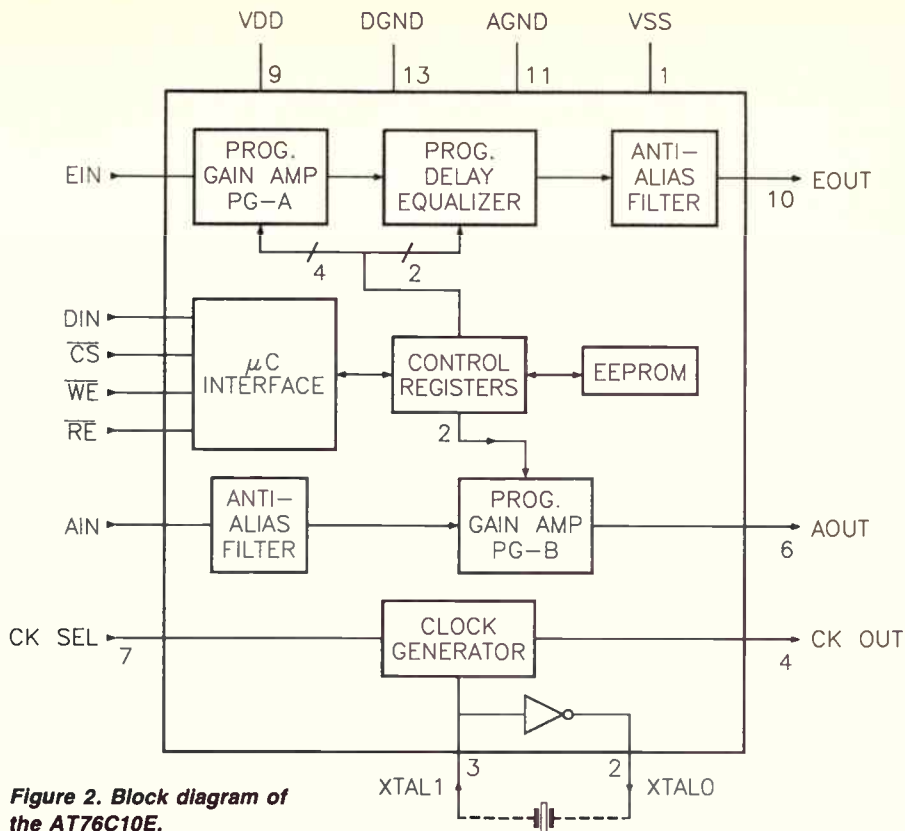


Figure 2. Block diagram of the AT76C10E.

A group response delay equaliser attempts to compensate for the line's poor response by introducing a group delay response similar to Figure 1b. The overall group delay response is the sum of line and equaliser delays and is shown in Figure 1c. While this is not an ideal response, it will permit low bit error rate data communications.

This project is based on a programmable group delay equaliser and amplifier chipset produced by US semiconductor

manufacturer, Atmel, and known as the AT76C10 (the amplifier) and AT76C10E (the equaliser). Atmel is represented in Australia by Brisbane-based distributor Energy Control International. The unit described in this article has been designed here and is basically a technology evaluation project, rather than a technology demonstration project, such as the ETI-1615 VGA Card from Energy Control, for example.

### The Atmel chipset

While a complete description of the chipset is given in the appended data sheet, for the sake of continuity, I'll give a brief description of them here.

The Atmel AT76C10 and AT76C10E are programmable amplifier/delay equalisers for the conditioning of two-wire bidirectional communications lines, such as a telephone line, employed by data communications equipment. The devices will find applications in modems, facsimiles, or other data communications equipment. The devices are controlled by a 7-bit serial word, which makes them ideal for microprocessor based equipment.

Figure 2 is a block diagram of the AT76C10/E. The AT76C10/E contains two programmable gain amplifiers (PGA and PGB) and a programmable equaliser. The PGA amplifier can provide -8 dB to 16 dB of gain in 8 dB steps. Both of the amplifiers use switched capacitor techniques to achieve a gain tolerance of  $\pm 0.05$  dB (0.02 dB typical).

## Programmable/amp delay equaliser

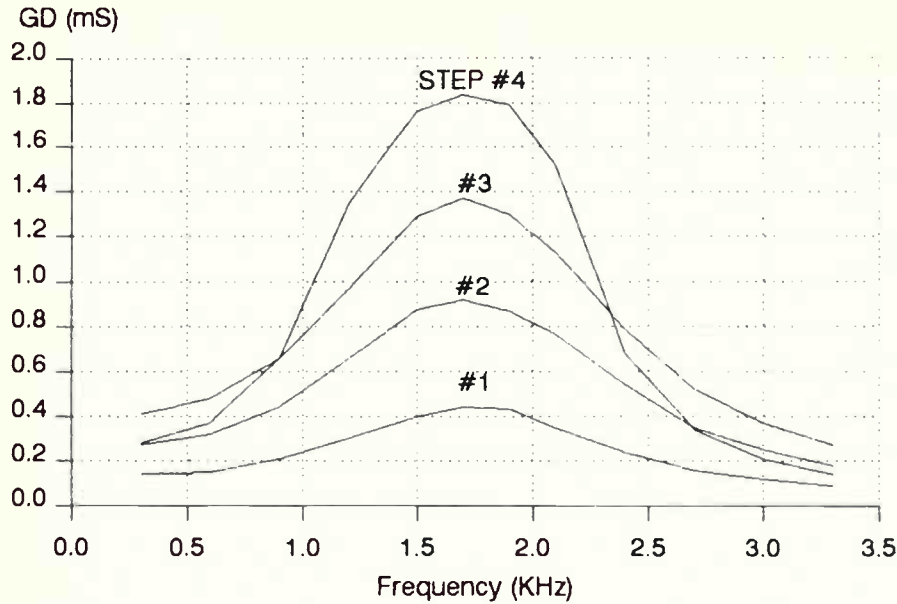


Figure 3. Group delay response curves.

The programmable group delay equaliser was designed to achieve low bit error rate (BER) data transmission. Figure 3 shows the four group delay responses provided by the AT76C10/E. Should further equalisation prove necessary, additional AT76C10/Es may be cascaded.

The gains of the amplifiers or delay step of the equaliser are controlled by a 7-bit configuration code. When a configuration code is entered in the device, the new characteristics will be updated in real time. The code can optionally be stored in the internal nonvolatile memory (EEPROM) and updated periodically (AT76C10E only). The EEPROM's update is determined by the state of the configuration code's seventh bit.

Finally, an option is provided to power-down the device. By entering the appropriate configuration the device will enter the powered down mode. In this mode the device will typically draw only 1 mW.

### The project

The kit, provided by Energy Control allows,

## DATA SHEET — CMOS PROGRAMMABLE AMPLIFIER/EQUALISER AT76C10/AT6C10E

### Features

- High accuracy programmable gain amplifiers with a typical accuracy of  $\pm 0.02$  dB; 31.5 dB range in 0.5 dB steps.
- Software programmable group delay equaliser for leased and dial-up lines.
- High dynamic range - over 90 dB.
- On-chip anti-aliasing filters.
- On-chip EEPROM configuration code memory (AT76C10E only).
- Microcomputer interface with serial data port.
- Three convenient clock options:  
11.0592 MHz  
3.6864 MHz  
2.4576 MHz (or 2.56 MHz).
- Operates from  $\pm 5$  V supplies.
- Low power standby mode - typically 100  $\mu$ A.
- TTL and CMOS compatible digital interface.
- Economical 16-lead package.
- Full military, commercial and industrial temperature ranges.

The Atmel AT76C10E integrates two programmable gain amplifiers and a programmable telephone line group delay equaliser on a monolithic substrate. It is fabricated in a state-of-the-art, low power CMOS process.

The gain and group delay steps are controlled by a 7-bit configuration code which can be programmed in real time and can also be stored permanently in on-chip EEPROMs (AT76C10E only). The AT76C10E is implemented in an advanced switched-capacitor technology and is designed to provide precise gain and group delay compensation for low bit-error-rate data transmission over dial-up and leased lines.

Anti-aliases and clock filters are included on-chip as the AT76C10E employs sampled-data techniques, and external filters are not required for most applications.

### Absolute maximum ratings

Temperature under bias -55 degrees to 125 degrees C

Address D1 D0	Control Code D5 D4 D3 D2	Equalizer Step No.	Recommended for Line Condition
0 0	X X 0 0	1	C2
0 0	X X 0 1	2	C1
0 0	X X 1 0	3	C1
0 0	X X 1 1	4	3002

Table 1. Equaliser selection.

Storage temperature -65 degrees to 150 degrees C

Voltage on pins AGND and DGND

(wrt Vss) -0.6 V to 6.25 V

All voltages with respect to Vss -0.6 V to Vdd +0.6 V

\* Notice: Stresses above those listed under Absolute maximum ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### Device operation

The Atmel AT76C10E is designed for use in the signal paths of a modem or voice/data phone to minimise the bit-error-rate over dial-up and leased lines. Gain and group delay response of the AT76C10E is controlled by a serial 7-bit configuration code. The LSBs D1 D0 of the configuration code are the address bits which select one of the three control registers.

Bits D2 to D5 of the configuration code set the gain and delay equaliser steps. MSB D6 is an option bit which determines whether the configuration code will update one of the control registers only, or also be stored in on-chip nonvolatile memory (EEPROM) of the AT76C10E. All the functions associated with the configuration code are summarised in Tables 1 to 4.

This chip can be used as part of an

adaptive equaliser for medium to high speed modems (1200 bps to greater than 19.2 bps). The configuration code is loaded into the chip at a serial data input port and updated in real time. It can also be stored permanently in on-chip EEPROMs (AT76C10E only) and updated periodically.

The high performance Atmel EEPROM process together with redundancy circuits allows over 10<sup>6</sup> write cycles. Upon powering up the AT76C10E, the EEPROM code sets the delay and gain steps. In the case of the AT76C10, all control registers are reset to '1'.

The amplitude response of the equaliser is nominally at 0 dB with negligible ripple. The AT76C10E can also be used as a fixed compromise delay equaliser and programmed permanently in the factory or field.

### Programmable gain amplifier

The AT76C10E provides two high dynamic

Address D1 D0	Control Code D5 D4 D3 D2	PG-A Step No.	PG-A GAIN (dB)
0 1	0 0 0 0	1	0.0
0 1	0 0 0 1	2	0.5
0 1	0 0 1 0	3	1.0
0 1	0 0 1 1	4	1.5
0 1	0 1 0 0	5	2.0
0 1	0 1 0 1	6	2.5
0 1	0 1 1 0	7	3.0
0 1	0 1 1 1	8	3.5
0 1	1 0 0 0	9	4.0
0 1	1 0 0 1	10	4.5
0 1	1 0 1 0	11	5.0
0 1	1 0 1 1	12	5.5
0 1	1 1 0 0	13	6.0
0 1	1 1 0 1	14	6.5
0 1	1 1 1 0	15	7.0
0 1	1 1 1 1	16	7.5

Table 2. Programmable gain amplifier. PG-A

for example, someone involved in modem design or development to evaluate the AT76C10E without the hassle of breadboarding and circuit proofing. The kit includes an AT76C10E and an interface to allow the device to be controlled by an ASCII data terminal or an IBM PC/AT-compatible computer. A floppy disk is included with control software for a PC/AT-compatible.

Refer to Figure 4, the circuit of the project. An 8031 microcontroller-based interface accepts ASCII data input from an RS-232 port and produces the serial control signals compatible with the AT76C10/E. By choosing the appropriate ASCII character, any mode of the AT76C10/E can be commanded on.

The 8031 microprocessor contains three 8-bit parallel I/O ports and a serial I/O port. Two of the ports, PO and P2, are used for external memory addressing, while three bits of the remaining port are used for the Not Write Enable (WE\*), Not Chip Select (CS\*) and Data In (Din) pins of the AT76C10/E.

A 27C256 EPROM is supplied with code for the 8031 in the interface application. However, the EPROM may be recoded for

alternative applications. The 8282 is an octal latch for high order memory address decoding. The MC1489 accepts RS-232 level signals and translates these to TTL-compatible signals. Provision for an MC1489 level translator has been made on the pc board to allow the 8031 to communicate with the host computer. Since in this application the 8031 only receives data from the computer, an MC1489 is not supplied with the kit.

Switches 1b and 1c permit the CS\* and Not Reset Enable (RE\*) pins to be forced low. This action will cause the configuration code stored in the EEPROM to be loaded to the control registers. In stand-alone applications the CS\*, RE\* and Din pins should be tied to DGND (digital ground), while WE\* should be tied to Vdd.

Internal timing of the AT76C10/E is generated by the crystal XTAL1, or by applying an external clock to the CLK IN terminal and opening SW1a. While the XTAL1 is used, the CLK IN terminal should be left disconnected. Three clock frequency options are available: 2.4576 MHz, 3.6864 MHz or

11.0592 MHz. One of these options is selected by tying Clock Select (CLK SEL) to Vss, DGND or Vdd respectively. A clock frequency of 153 kHz is available for other devices at the Clock Out (CLK OUT) terminal.

Figure 5 is the flow chart of the software used in the controller.

The serial port is initialised to read incoming data into the accumulator. On receiving a complete word, the following steps take place to write this word to the AT76C10/E:

- The P1.1 (CS\* line) port is brought low.
- The first data bit is rotated from the accumulator to the P1.3 port (Din line).
- The P1.2 port (WE\* line) is toggled low then high. This clocks the data bit into the control register of the AT76C10/E.
- The remaining six data bits are cycled into the control register.
- The P1.1 port (CS\*) is returned high.

This procedure occurs every time a data word is received by the RS-232 port interface.

## Construction

The kit is constructed on a 183x102 mm

Address	Control Code		PG-B		PG-B Gain
D1 D0	D5 D4	D3 D2	Step No.	(dB)	
1 0	X X	0 0	1	0	
1 0	X X	0 1	2	8	
1 0	X X	1 0	3	16	
1 0	X X	1 1	4	-8	

Table 3. Programmable gain amplifier. PG-B (x = Don't care)

range amplifiers for maximising signal-to-noise ratio. Amplifier PG-A offers 16 dB of gain in 8 dB steps. The two amplifiers can be cascaded to provide 31.5 dB range of programmable gain in 0.5 dB steps. The programmable amplifiers can be used as an automatic gain control circuit or as a fixed gain adjustment.

### Programmable group delay equaliser

The group delay equaliser is designed to provide programmable compromise group delay compensation to achieve low bit-error-rate data transmission. Four group delay responses are provided to accommodate the majority of conditioned as well as unconditioned lines.

The first three responses are recommended for line types C2 and C1, while the fourth response can be used for 3002-type of lines. Two or more AT76C10Es can be cascaded to obtain additional group delay compensation.

### Control registers

Four control registers are used to store the configuration codes for the gain steps of PG-A and PG-B, the delay steps of the delay equaliser, and the control bit for the power-down mode. All the control bits, except the power-down bit, can also be programmed into on-chip nonvolatile memories of the AT76C10E.

## Microcomputer interface

Control inputs CE\, WE\, RE\ and serial data input DIN allow the AT76C10E to be easily interfaced with most popular microcontrollers. All digital I/Os are TTL as well as CMOS compatible. For stand alone operation, CE\ should be tied to Vdd while WE\, RE\ and DIN should be tied to ground.

### Write operation

To program a configuration code into a particular control register, the voltage at CE\ has to be brought low while the data bits appearing at DIN are strobed in at the rising edge of WE\. At the rising edge of CE\, the last 7 input data bits are latched into the control registers. Therefore, if the first bit of an input byte is a start bit, it will be ignored. If a 0 was inserted at D6 of the input code, the configuration code will also be immediately written into on-chip EEPROM of the AT76C10E.

As all timing signals and programming voltages are generated internally, writing the EEPROM is transparent to the user. However, while the EEPROM is being programmed, which takes 1.5 ms, any further attempt to initiate programming will be ignored until the first operation is completed.

### Reset operation

When the AT76C10E is powered up for the first time, it performs a RESET operation automatically. The configuration codes which have been pre-programmed in the EEPROM of the AT76C10E are loaded into the control registers.

In the case of the AT76C10, all control registers are reset to 1. A RESET operation can also be initiated any time during operation by bringing both CE\ and RE\ low simultaneously.

### Power-down mode

To minimise power consumption for battery powered applications and in certain linecard applications, the AT76C10E provides a low

power standby mode of operation. In the power-down mode, the analogue outputs go into a high impedance state. The power-down mode is initiated by writing 0 into the power-down register.

Once in the power-down mode, the 76C10E can be reactivated by either writing a 1 into the power-down register or performing a RESET operation. It should be noted that upon powering up the AT76C10E for the first time, it automatically goes into the normal active mode of operation.

### Crystal oscillator

Internal timing of the chip is generated either by connecting a crystal across pins XTAL1 and XTAL0 of the on-chip oscillator, or by applying an external clock at pin XTAL1. In the latter case, pin XTAL0 should be left unconnected. To accommodate different applications, three clock options: 2.4576 MHz, 3.6864 MHz and 11.0592 MHz, can be selected via control pin CK SEL.

For applications in a linecard environment, a 2.56 MHz clock can be used instead of the 2.4576 MHz clock. The 153.6 kHz (160 kHz with 2.56 MHz clock) sampling clock is available as an open drain output at CK OUT for synchronisation or driving other circuits, eg the transmit or receive filters, or A/D and D/A converters.

Address	Option Bit		Function
D1 D0	D6		
0 0	0		Writes Control Code into EEPROM
0 1	0		and updates Control Registers
1 0	0		(AT76C10E Only)
0 0	1		
0 1	1		Updates Control Registers Only
1 0	1		
1 1	0		Power Down Mode
1 1	1		Active Mode

Table 4. Option selection.

# Programmable/amp delay equaliser

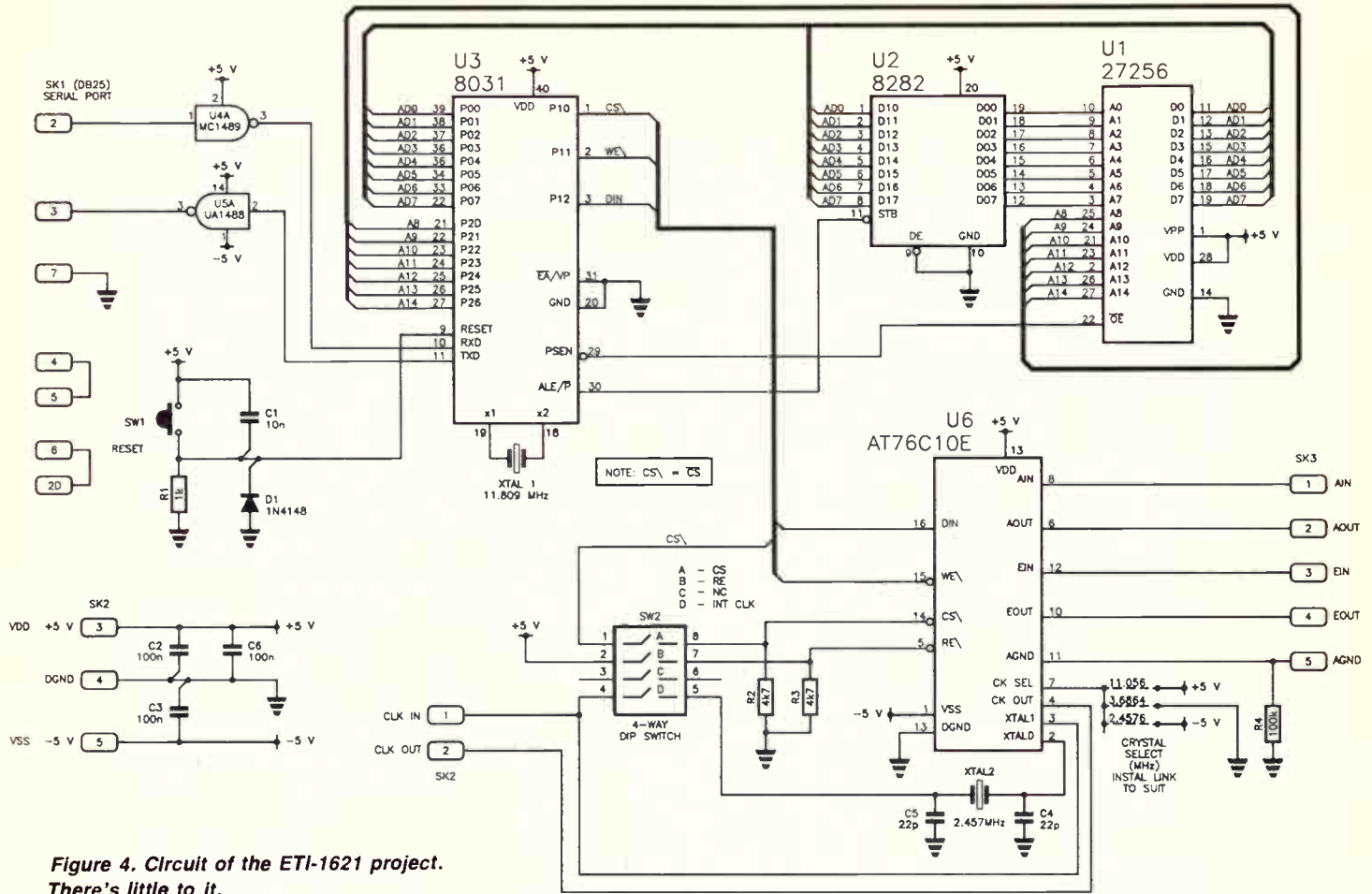
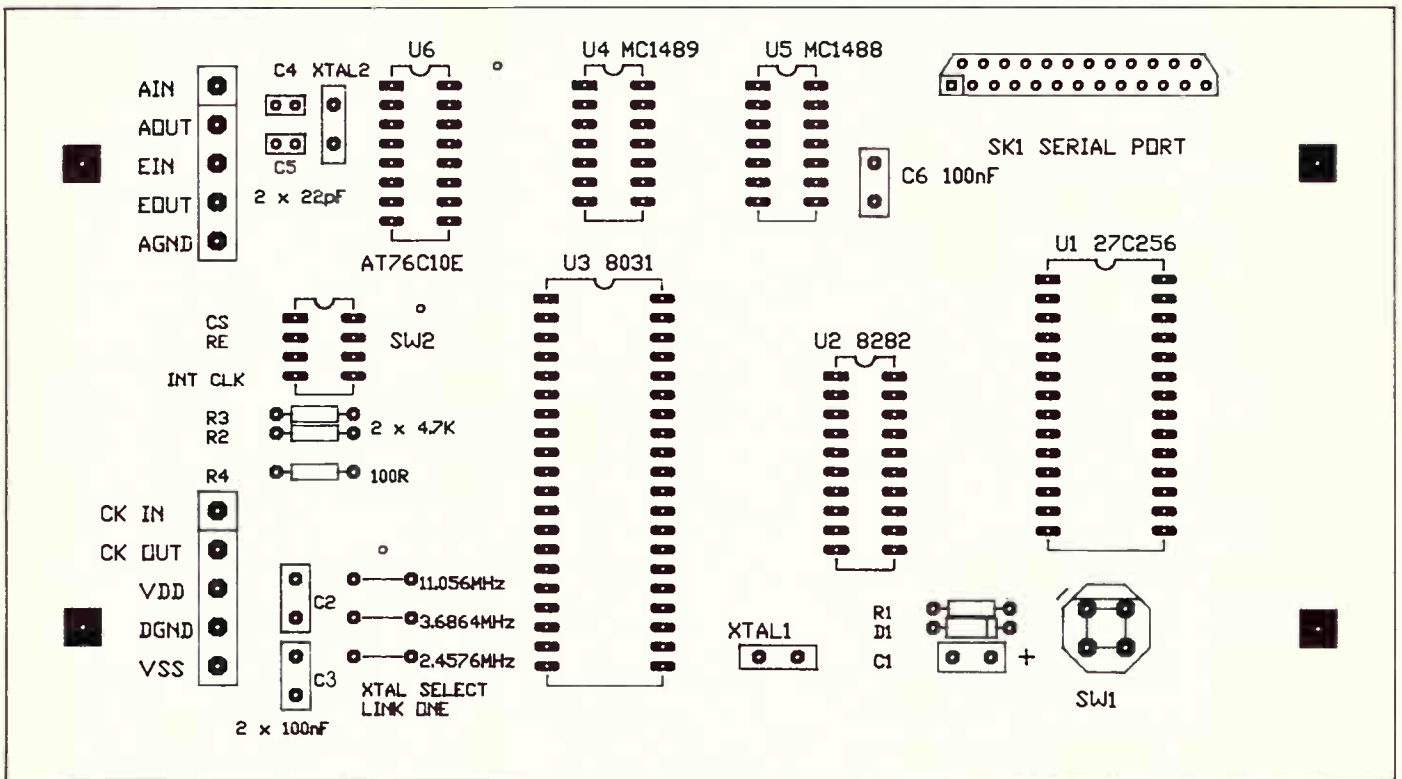
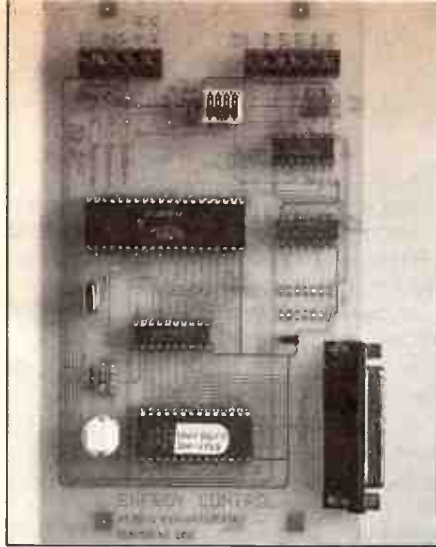


Figure 4. Circuit of the ETI-1621 project. There's little to it.





double-sided pc board, but plated-through holes are not used. A right-angle pc-mount DB15 socket provides for the serial port connection. All other off-board connections are provided by two pc-mount screw-terminal connectors, one 5-way and one 6-way.

The pc board is quite spaciouly laid out; all the ICs are socketed and face the same way for ease of orientation and pin identification. The DIP switch has been socketed, too. Note that single-in-line strip sockets have been used to allow soldering on both sides of the board. The reset pushbutton is a pc-mount, momentary action type. Crystal XTAL2 is socketed as this needs to be selected according to the clock frequency chosen (2.4576 MHz on the prototype).

Construction is very simple and may proceed in any order as there is nothing

critical about it. However, you should first go over the board and note where through-links need to be placed and where component leads need to be soldered on both sides of the board.

Naturally, it is wise to check your work following assembly. Note that fully-built evaluations kits are available.

### Application — modem line conditioner

This application makes use of the AT76C10 or AT76C10E in an AGC and fixed compromise line equaliser. Apart from achieving the benefits of group delay equalisation, the system automatically adjusts its gain to provide the demodulator with a constant amplitude signal. This will achieve the minimum possible bit error rate.

In this system, both of the amplifiers are cascaded and inserted between the line transformer and the demodulator. The cascaded amplifiers can provide between -16 dB and 31.5 dB of gain. By providing the AT76C10/E with a dedicated controller, the system is virtually self contained and will require only simple modification in an existing system.

Figure 6 is a schematic of the components used in addition to the CPU and memory of the evaluation kit. Apart from the AT76C10/E, the system uses an LM3914 LED bargraph driver for level detection, and switch inputs to the CPU for equalisation selection.

U1, the AT76C10/E is interfaced to the CPU as it was in the evaluation kit, except in this application there is no need for switches on

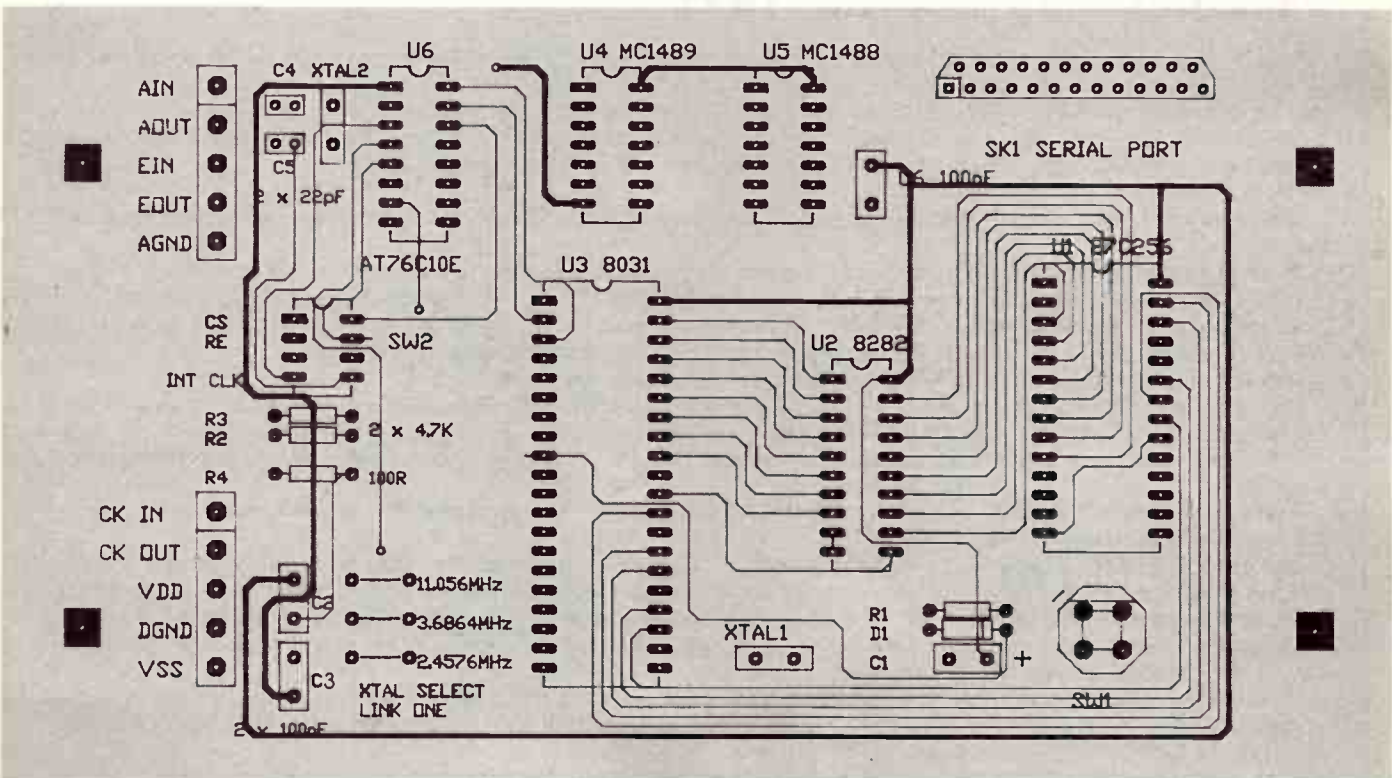
### PARTS LIST — ETI-1621

SEMICONDUCTORS	
D1.....	1N914, 1N4148
U1.....	27C256
U2.....	8282
U3.....	8031
U4.....	1489
U5.....	1488 (optional)
U6.....	AT76C10E
RESISTORS all 1/4 W, 5%	
R1.....	1k
R2, R3.....	4k7
R4.....	100R
CAPACITORS	
C1.....	10n ceramic
C2, C3.....	100n bypass
C4, C5.....	22 pF ceramic
C6.....	100n bypass

### MISCELLANEOUS

SW1 - pc-mount momentary action pushbutton; one 5-way and one 6-way pc-mount screw terminal blocks; SIL strip sockets as required; 4-way DIL switch (horizontal); pc-mount right angle DB25 socket; 1x11.0592 MHz HC36/U crystal; one HC36/U crystal - either 2.4576 MHz, 3.6864 MHz or 11.056 MHz.

The AT76C10E evaluation kits are available from Energy Control International for \$99, including sales tax. Contact them at 26 Boron Drive, Sumner Park, Qld 4074, ☎ (07)376-2955, or their offices in Sydney ☎ (02)555-7659, or Wellington, NZ 85-8742.



Component overlay for the ETI-1621.

## Programmable/amp delay equaliser

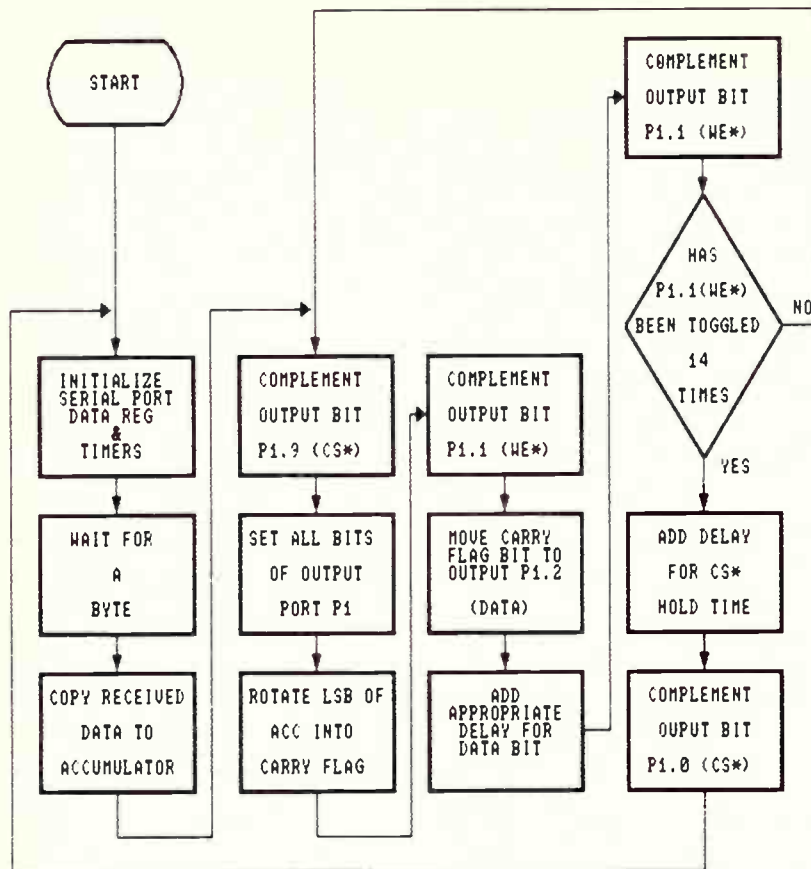


Figure 5. Flowchart of the Amp/Equaliser project's operation.

the CS\* or WE\* lines.

The level of the signal applied to the demodulator is detected by U2, an LM3914 LED bargraph driver. Its outputs are arranged such that any signal level:

- between 10% and 79% will drive LED1 (LOW),
- between 80% and 99% will drive LED1 and LED2 (OK), and
- greater than 100% will drive LED1, LED2 and LED3 (HIGH).

These outputs are also applied to the ports P1.3, P1.4 and P1.5 of the CPU. Note that a signal level of less than 10% is indicated by the absence of any active transmission and prevents AGC action from occurring.

Switches SW1 and SW2 are the equalisation select switches and determine what group delay the AT76C10/E is to use. Switch SW3 applies a false LOW indication to the CPU causing AGC action regardless of signal level. This function initiates AGC action if the initial gain of the AT76C10/E is too low for data transmission to be detected.

Figure 7 contains the flow chart of the software to be used by the 8031. The source code has not been written for this application. However, this should not present difficulties for likely AT76C10/E users. The program relies on a lookup table containing the AT76C10/E configuration codes for all gains between -16 dB and 31.5 dB. In operation the program increments or

## Experimenting with the 1621

The following equipment is recommended for basic experimentation with the ETI-1621 Programmable Amp/Delay Equaliser: an IBM PC/XT/AT or compatible computer having one 5.25" floppy disk drive and monochrome or colour monitor with respective video graphics card, with serial (RS-232C) port (with COM1 as an available port) an RS-232C cable, a pulse generator, a power supply capable of producing +5 V and -5 V, a function generator, and a dual-trace (recommended) oscilloscope. Note that a 5.25" disk of operational software is provided with the kit by Energy Control.

Proceed as follows:

Set the frequency of the pulse generator output to a specific frequency (3.6864 MHz, for example) and its amplitude to 5 V peak-to-peak.

Set the frequency of the function generator to approximately 1 kHz, its amplitude to 0.5 V<sub>p-p</sub> and its function to sine wave.

If you want to use an externally generated timing clock for the AT76C10E, connect the pulse generator output to the CLK IN input and set SW2D to the OFF position. If, instead, you want to use the crystal to clock the AT76C10E, then set SW2D to the ON position. For either case, insert a link in the appropriate position for the clock frequency you're using.

Connect the output of the function generator to the AIN terminal of the board.

Connect one of the oscilloscope probes to the AIN terminal to view the input. The grounds of the function generator and oscilloscope should be connected to the AGND terminal.

For maximum achievable gain the two amplifiers can be cascaded. This is readily achieved by linking the AOUT and EIN terminals together.

Connect the other oscilloscope probe to the AOUT or EOUT output terminals to view one of the outputs. If more than two probes are available both may be viewed simultaneously.

Connect the serial cable between the COM1 port of the PC and the DB25 connector on the board. For normal operation set SW2a and SW2b to the closed position. Connect the power terminals on the PCB to the appropriate outputs of the power supply.

Turn on the computer and monitor. Insert the supplied disk into the A: drive of the computer. The disk should be self-bootable.

Wait until the first menu screen appears. Follow the instructions on the screen. To view another screen, simply press the RETURN key. To exit the program, press the ESCAPE key.

To program a particular gain or delay pattern into the AT76C10E, press the particular key or keystroke combination indicated in the appropriate menu screen. View the input and the output waveforms of the AT76C10E on the oscilloscope. For example, to obtain a 6.5 dB gain from PG-A, type 'u'.

To recall a previously EEPROM-stored configuration code, set both SW2a and SW2b to the open position.



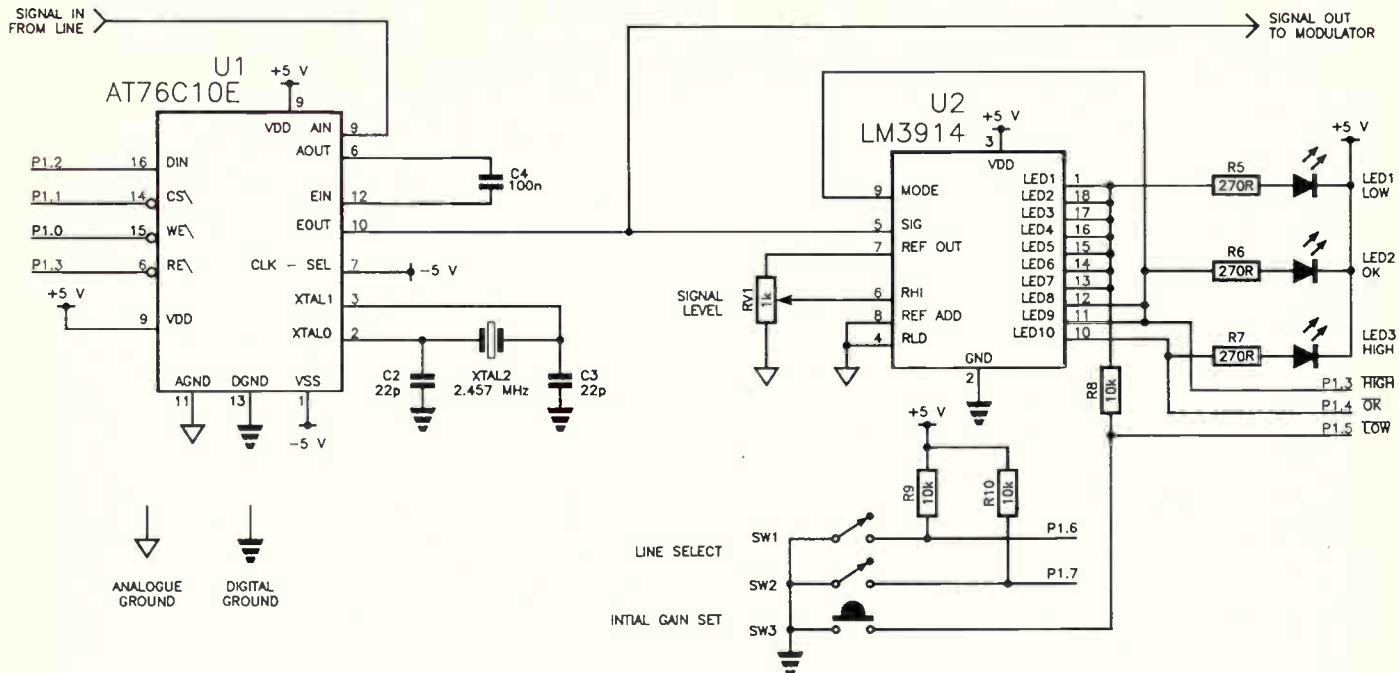


Figure 6. Applications circuit for a line conditioner.

decrements the position of a pointer if the signal level applied to the demodulator is too low or too high respectively.

During initialising the following procedure occurs:

- a) the parallel port is configured,
- b) the gain pointer is set to a nominal gain setting, and
- c) the equalisation settings are read from the switches and programmed to the AT76C10/E.

In operation, the level detector's output is polled and the gain pointer is stepped 0.5 dB up or down. This procedure is repeated until the signal is within the OK level (80%-99%). The HIGH and LOW flags are used to shift the gain an extra 0.5 dB after the OK threshold is reached. This action prevents the signal level settling near a threshold and hunting. The 20 ms delay allows a settling time for the amplifiers and level detector. This is necessary to prevent any overshoot.

During each cycle the equaliser switch settings are read and compared to the EQ register. If any difference exists, the EQ register is updated and the AT76C10/E is reprogrammed with a new group delay setting.

### Summary

Data communications over a telephone line is likely to suffer unless some form of line conditioner is employed. The Atmel AT76C10/E was designed for line conditioning applications requiring programmable line equalisation and programmable gain.

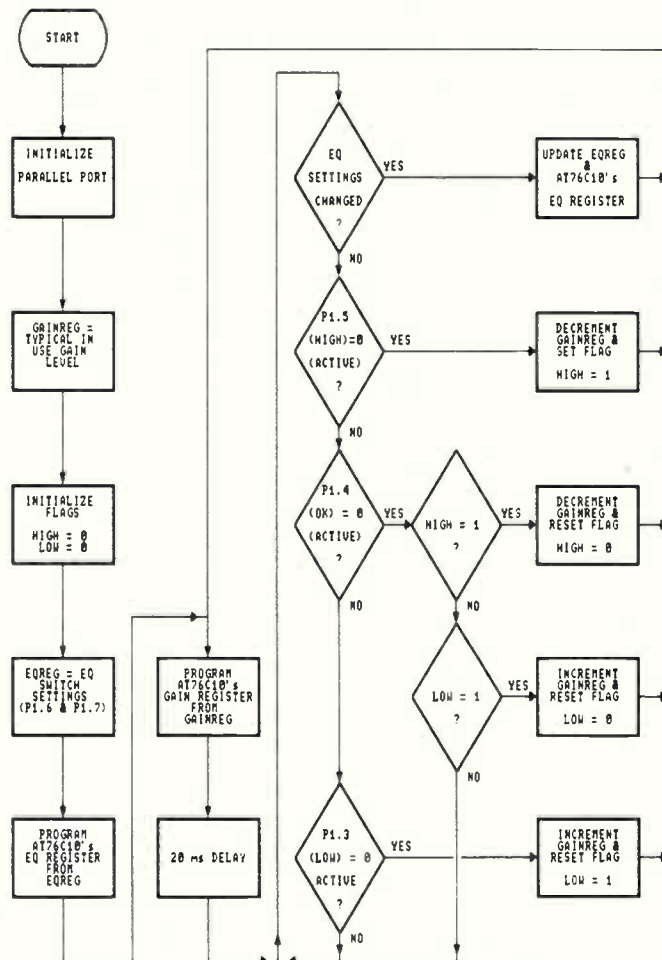


Figure 7. Flowchart of line conditioner (Fig. 6) operation.

# A 16-BIT VGA CARD FOR YOUR PC-COMPATIBLE



ELECTRONICS  
ETI - 1615

Here's how to go about installing your VGA card and how to take advantage of its features with various software packages. Part 2, by Roger Harrison.

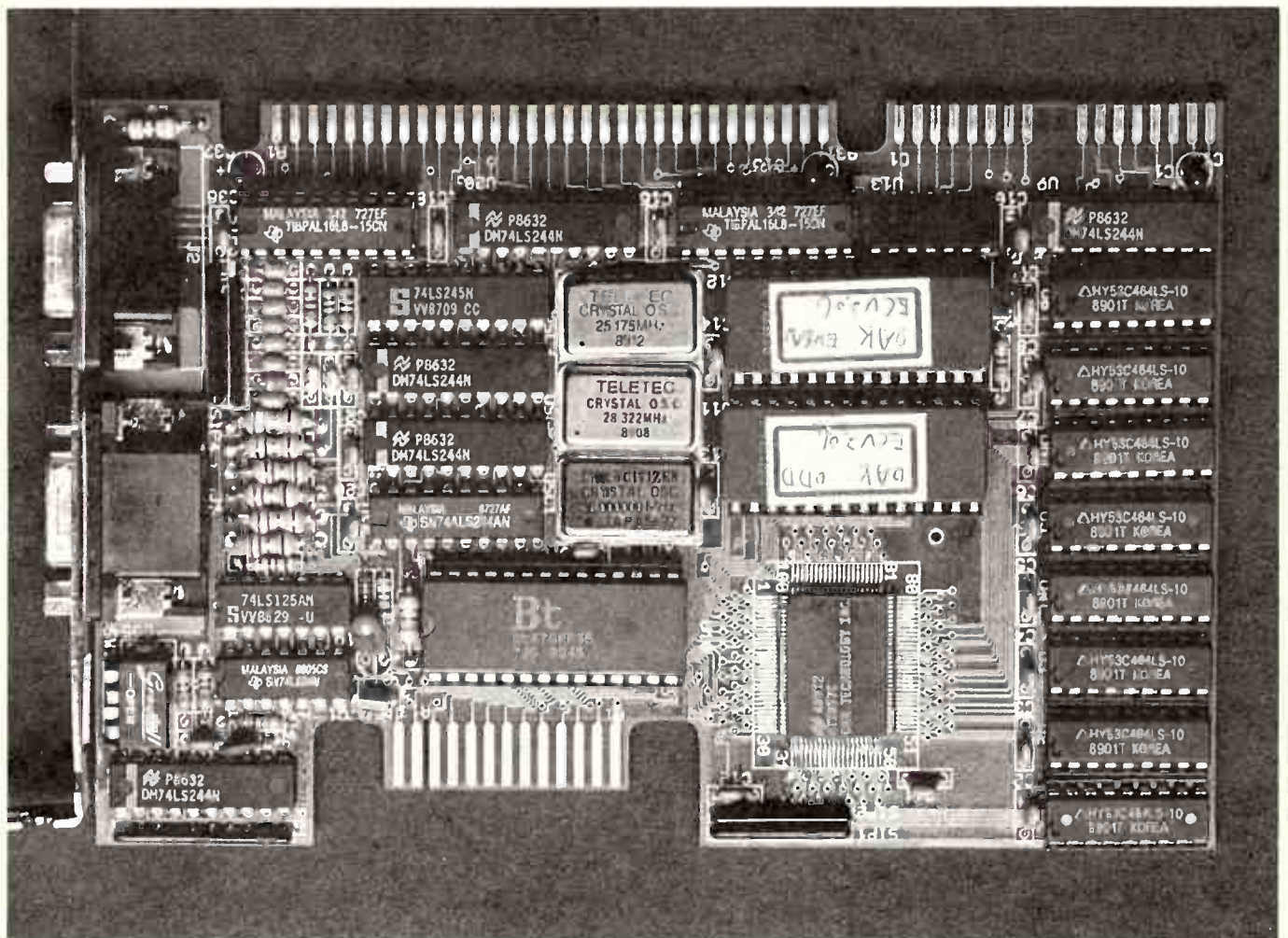
**H**aving assembled your VGA card, now you'll be wanting to know how to go about installing it, software and hardware wise. Two 5.25" floppy disks are provided with the VGA card, containing utility and special driver installation software. I'll

cover hardware installation considerations first, then the software.

## DIP switch settings

The DIP switch located in the top right hand corner of the card affects the hardware

setup for the monitor you'll be using. For multifrequency monitors, use the analogue multifrequency switch settings (such as NEC Multisync). For IBM 8503, 8512, 8513 or compatible colour single frequency monitors use the PS/2 switch setting (X X X on for SW1,



Close-up view of the top right hand corner of the board, showing the location of the video output configuration DIP switch (see Table 2).

2, 3 and 4). The switch settings are listed in Table 2.

## Hardware installation

Once you have set the switches you can install the VGA board in any open expansion slot of your computer system as follows.

Turn off the power to the computer system and unplug the power cord. Disconnect all cables connected to the computer system. Using a screwdriver (or nut driver), remove the cover mounting screws then the cover.

If you are installing the VGA board in a PC, PC/XT or PC/AT, configure the computer system for the type of monitor you'll be using. (If you're using a PS/2 Model 30, skip this step and go on to the next step.) The computer can be configured for monochrome or colour, or no display can be used to enable a VGA or EGA board to boot up properly. Refer to your system manual and follow these steps.

Locate the monitor selection switch(es) on the computer's motherboard. In an IBM PC, locate switches 5 and 6. They are located in switch block 1, which is the DIP switch on the left (closest to the expansion slots). In an XT, locate switches 5 and 6. They are located in the switch block near the slot J8 connector. In an AT, there is only one switch for monitor selection. That switch is labelled SW1 and is located next to the 80287 socket in most ATs.

If you are using a PC or PC/XT, set switches 5 and 6 to ON. This configures your PC for no display. Do NOT change any other switches. CAUTION: Failure to set switches 5 and 6 on PC and XT motherboards to the ON position may result in severe damage to your monitor.

If you are installing the VGA board in an AT and want to use a colour monitor, set Switch 1 back (toward the rear of the AT), and set switch 2 forward (toward the front of the AT).

Insert the VGA board into your computer. For PC, PC/XT and PC/AT systems, find an empty expansion-slot for the VGA board. If the slot still has the cover attached, remove it with a screwdriver or nut driver. Hold the VGA board firmly at the top edge of the board, and press the gold connector into the

## VGA PERFORMANCE REPORT

### Test environment:

System: AT, 10 MHz system

BIOS: Award 3.03

VGA: Paradise VGA1A — 8 bits

Trident TVGA — 8 bits

OAK OTI-037 REV C — 8 bits

Cirrus GD510A GD520A — 16 bits

OAK OTI-037 REV C — 16 bits

Test program: Power Meter REV 1.2

Test results:

	Test 1	Test 2	seconds Test 3	Test 4
Cirrus — 16 bits:	798.665 PMU	4.364	22.491	101.591
OAK — 16 bits:	731.502 PMU	4.756	23.364	94.719
Trident — 8 bits:	404.671 PMU	8.045	43.048	185.703
Paradise — 8 bits:	330.959 PMU	9.952	47.956	188.703
OAK — 8 bits:	330.534 PMU	9.698	49.460	198.471

NOTES: Test 1 — Aggregate Video Test

Test 2 — Character Write Test

Test 3 — Line Drawing Test

Test 4 — Area Fill Test

The above table shows a comparison between various VGA systems, both 8- and 16-bit. This project is represented in the second row of the table.

empty expansion slot. Line up the VGA board retaining bracket with the screw hold in the rear plate of the computer system. Using a screwdriver or nut driver, screw the retaining bracket tightly against the rear plate of the computer system.

For a model 30 system only, find an empty expansion slot for the VGA board. If the slot still has the metal expansion-slot cover attached, remove the cover with a screwdriver (or nut driver). Save the screw to install the VGA board. At the rear of the case, remove the plastic insert from the location desired for the VGA board. Hold the VGA board by the edges and align it with the system's support brackets. Firmly press it into the expansion slot. To secure the board, reinstall the expansion-slot screw.

Reassemble the computer system and reconnect all cables that were previously attached to the rear of the computer.

## Monitor cables

The VGA board has a 9-pin cable connector (commonly referred to as a DB-9 or DE-9

connector) for TTL (digital) monitors, and a 15-pin connector for analogue monitors. Multifrequency monitors can be connected to either connector if the monitor is configured to accept the type of signal (TTL or analogue) present at the 9-pin connector; however, analogue is the recommended configuration. Colours displayed on a TTL-configured monitor may not be the same as those displayed on an analogue monitor, and it is possible to display only 256 colours simultaneously on a TTL-configured monitor.

Note: Some multifrequency monitors have a switch that must be set to specify connection to either a digital or analogue connector. For example, if you connect a multifrequency monitor to the DB-9 connector on the VGA board, you must set the monitor switch to reflect a digital connection. Analogue is recommended for best results.

A note of caution here: The VGA board has the same 15-pin connector available from monitor manufacturers to interface with IBM PS/2 computers. Using an incorrect cable may result in damage to the monitor and/or adapter. If you have an older multifrequency monitor with a 9-pin analogue connector, you must purchase a 9-to-15-pin converter. Attaching a 9-pin cable from an analogue connector on your monitor to the 9-pin (TTL) connector on the VGA board will not work.

Please also note that different cables from different monitor suppliers are not interchangeable.

The pin assignments for the various configurations of the DB9 output connector are given in Table 3 A-B-C-D. The pin assignments for the DB15 output connector are given in Table 4. The supported monitor modes are listed in Table 5.

## Backward compatibility

Backward compatibility is provided through hardware/firmware emulation. All previous

Table 2: DIP switch settings.

SW1	SW2	SW3	SW4	Configuration
x	x	x	on	IBM PS/2 Monitor or Compatible MDA Attached CGA Attached EGA Attached
on	on	on	off	
off	on	on	off	
on	off	on	off	NEC Multisync or Compatible NEC Multisync Plus or Compatible NEC Multisync 2A
off	off	on	off	
on	on	off	off	
off	on	off	off	

NOTES: MDA = Monochrome Display (Hsync = 18.4 kHz)

CGA = Colour Display (Hsync = 15.75 kHz)

EGA = Enhanced colour display (Hsync = 21.85kHz 15.7 kHz)

X = Don't care

Off = Open

On = Close

Only IBM VGA modes and 800 x 600 graphics models (mode 52) are supported on NEC Multisync 2A monitors.

## 16-bit VGA card

**Table 3: DB15 output connector pin assignments.**

PIN	I/O	OUTPUT	MONOCHROME	COLOUR
1	O	RED	NO PIN	RED
2	O	GREEN	MONO	GREEN
3	O	BLUE	NO PIN	BLUE
4	NA	RESERVED	NO PIN	NO PIN
5	NA	DIGITAL G	SELF TEST	SELF TEST
6	NA	RED RTN	DUMMY PIN	RED RTN
7	NA	GREEN RTN	MONO RTN	GREEN RTN
8	NA	BLUE RTN	NO PIN	BLUE RTN
9	NA	PLUG	NO PIN	NO PIN
10	NA	DIGITAL G	DIGITAL G	DIGITAL G
11	NA	RESERVED	NO PIN	DIGITAL G
12	NA	RESERVED	DIGITAL G	NO PIN
13	O	HSYNC	HSYNC	HSYNC
14	O	VSYNC	VSYNC	VSYNC
15	NA	RESERVED	NO PIN	NO PIN

**RED RTN, GREEN RTN, BLUE RTN = ANALOGUE GROUNDS**  
**DIGITAL G = DIGITAL GROUND FOR SYNC RETURNS AND SELF TEST**

video standards: monochrome graphics, colour graphics and enhanced graphics modes are emulated. To activate/deactivate the emulation modes, a program called VGAMODE.EXE is provided on one of the disks.

When VGAMODE is entered at the DOS prompt without any parameters, a menu will be displayed that allows the selection of the emulation modes as well as the display modes. There is a message at the bottom of the screen which explains the action item at the current cursor.

A lock/unlock feature allows locking and unlocking of the emulation mode. Locking an emulation mode will cause the VGA to remain in the chosen mode even after a warm reboot (but not a cold boot). This feature is ideal for the running of self-bootable game programs.

VGAMODE can also be executed from the DOS prompt with parameters in order to automatically enter an emulation mode. To select an emulation, type: VGAMODE, followed by a C, M, E or V to switch to CGA, MDA, EGA and back to VGA respectively.

C VGAMODE C (switch to CGA emulation mode)  
 C VGAMODE M (switch to MGA emulation mode)  
 C VGAMODE E (switch to EGA emulation mode)  
 C VGAMODE V (switch back to normal VGA mode)

To select a display mode, append the mode number (in hex) after VGAMODE.

C VGAMODE 3 (select mode 3 - 80 x 25 colour text mode)  
 C VGAMODE 51 (select mode 51 - 132 x 43 colour text mode)  
 C VGAMODE 13 (select mode 13 - 320 x 200 256 colours graphics mode)

Note that VGAMODE is not a memory resident program. The emulation firmware is embedded within the VGA BIOS. If the switch setting is set to digital monitor, such as EGA, CGA etc, then the emulation will be automatically brought up right after system boot up. In this case, you don't have to run VGAMODE to turn on the emulation.

### Installing the hi-res drivers

The two disks contain installation software that enables the VGA card to be used in 800 x 600 mode with a number of popular programs. Here are the various installation procedures for these programs.

### Windows

The 800 x 600 high resolution driver is supported for Windows version 2.0x and Windows/386. The installation procedure is as follows:

1. Insert WINDOWS set up diskette in drive A and run the Setup program. Type in: A SETUP (ENTER)
2. Run the Setup program according to the instructions on the screen and Microsoft Windows documentation.
3. When Setup asks for type of display adapter, select Other.
4. Insert appropriate driver disk in A drive, and hit (ENTER). Use DRIVER DISK #1 for Windows 2.0x, and the DRIVER DISK #2 for Windows/386.
5. You should see: 'Here are the display drivers on your disk.' Select 'VGA 800 x 600 colour display'
6. After 800 x 600 driver is installed, just follow the instructions to finish the installation and Setup procedure.

### AutoCAD

The 800 x 600 driver is supported for

AutoCAD Version 2 and Release 9. The drivers DSVGA9.EXE and DSVGA.EXE are for AutoCAD Release 9 and Version 2.18 or above. Before you start running AutoCAD you must load the driver into your computer's memory. This procedure must be done every time you power up your computer, or when you do a warm boot. If you are a frequent user of AutoCAD, you may want to add the load driver command to your AUTOEXEC.BAT file.

The procedure to bring up the 800 x 600 driver is as follows:

1. Install your AutoCAD first by following the instructions provided by AutoCAD.
2. Insert DRIVER DISK #1 in drive A. Copy AutoCAD driver DSVGA.EXE for AutoCAD Version 2, or DSVGA9.EXE for AutoCAD Release 9 to your AutoCAD subdirectory if you have a hard disk.

To install the AutoCAD driver, type in: DSVGA.EXE (ENTER) for Version 2 or DSVGA9.EXE (ENTER) for Release 9.

- Now the driver is loaded into memory and you can set up your Mouse driver as usual.
3. Bring up AutoCAD by typing in: ACAD (ENTER)

When you see the main menu on the screen, Select 5, Configure AutoCAD.

It will show your current configuration on the screen. If your current video display is ADI display then you are set up to run AutoCAD with the 800 x 600 driver. Now you can go back to the main menu and do your work. If your current video display is not ADI display, then press RETURN to continue.

4. Now you will see the configuration menu displayed. Select 3, Configure video display.

After you select 3, it shows your currently selected video display again and asks you: 'Do you want to select a different one? N>-'

Answer 'Y'es to this question.

5. The screen then shows 'Available video displays.' For your new selection select (!) ADI display V2.0 (or V3.0).

6. After this you may have to answer several difficult questions about your desired configuration.

7. Once these questions are answered, the display returns to the configuration menu again. Select 0 to exit to main menu.

8. Then answer 'Y'es to the question, 'Keep configuration changes.'

9. Finally, go back to the main menu and now you are ready to do your normal work with the VGA 800 x 600 resolution display providing a professional, high quality visual interface.

### GEM/3

The 800 x 600 driver is supported for GEM/3. The driver name is SDVGA8.VGA. Follow the procedure below to set up the 800 x 600 driver:

1. Make a copy of the original System

Master and Screen Disk No. 2. Keep the original and use the copied disks for installation.

2. Insert DRIVER DISK #1 into A: drive and run GEM install batch file:

A>GEMINSTL (ENTER)

3. Follow the instructions displayed on the screen until finished and then exit.

4. Insert System Master (not the original one) in A: drive and type in:

A>GEMPREP (ENTER)

Select 'Install new configuration' (ENTER)

Select the hard disk drive according to your configuration.

Select '16-colour VGA 800' (ENTER)

Select the mouse you installed, then select the communications port for your mouse. If you have a printer installed, select 'Continue'; otherwise select 'Save and exit from GEM setup'.

Follow the remaining instruction to finish the

GEM setup.

### Ventura

The 800 x 600 driver is supported for Ventura version 1.1. The driver name is SD-VGA-5.VGA. The 800 x 600 driver installation is as follows:

1. If you have not installed Ventura on your system, then follow steps 2 through 4. If you have already installed Ventura, skip to step 5 for driver installation.

2. Insert the Ventura Application Disk (disk #1) into A drive and run VPPREP A> VPPREP (ENTER)

3. Follow the instructions to continue the installation until you see this question in the selection menu: 'Which graphics card and display do you have?'

Select any one of them. The driver you select here will be replaced by the 800 x 600 driver later on.

4. Continue the installation until it is finished and exit. Go to step 5.

5. Insert DRIVER DISK #1 into A: drive. Run the Ventura 800 x 600 driver installation batch file: A>VP11 (ENTER)

6. Continue the installation procedure until you see: 'Which graphics card and display do you have?'

Select VGA800 16-colour Display.

Type in 'A' to the question: 'Type the letter of the graphics card you have:-'

7. Continue the remaining installations procedure to the end.

8. Now you can run Ventura with the 800 x 600 driver.

### Framework II

Several drivers are included to support many different configurations with the VGA card and its extended capability. There are drivers that support both 132 columns and

Table 4

PIN	SIGNAL NAME
1	Signal ground
2	Secondary red/signal ground
3	Red
4	Green
5	Blue
6	Secondary green/intensity
7	Secondary blue/monochrome video
8	Horizontal sync
9	Vertical sync

A: DB9 general pin assignment.

PIN#	ASSIGNMENT	PIN#	ASSIGNMENT
1	Ground	6	Intensity
2	Ground	7	Video
3	N/A	8	Horizontal Sync (+)
4	N/A	9	Vertical Sync (-)
5	N/A		

B: Monochrome display pin outs.

PIN#	ASSIGNMENT	PIN#	ASSIGNMENT
1	Ground	6	Intensity
2	Ground	7	N/A
3	Red	8	Horizontal Sync (+)
4	Green	9	Vertical Sync (-)
5	Blue		

C: Colour display pin outs.

PIN#	ASSIGNMENT	PIN#	ASSIGNMENT
1	Ground	6	Green
2	Red	7	Blue
3	Red	8	Horizontal Sync (+)
4	Green	9	Vertical Sync (-)
5	Blue		

D: Enhanced colour display & multi-frequency pin outs.

Table 5: Monitor modes

Supported Modes	Digital Monitors			Analogue Monitors	
	Monochrome	CGA	EGA	Multi-Frequency	Fixed-Frequency
0		Y	Y	Y	Y
1		Y	Y	Y	Y
2		Y	Y	Y	Y
3		Y	Y	Y	Y
4		Y	Y	Y	Y
5		Y	Y	Y	Y
6		Y	Y	Y	Y
7	Y		Y	Y	Y
D			Y	Y	Y
E			Y	Y	Y
F	Y		Y	Y	Y
10			Y	Y	Y
11				Y	Y
12				Y	Y
13				Y	Y
50				Y	
51				Y	
52				Y	

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## 16-bit VGA card

800 x 600 graphics mode, shown in Table 6.

If this is your first time doing installation, you can follow the instructions in the Framework II *Getting Started Manual* and select one of the standard IBM EGA, VGA and PS/2 display drivers. Make sure your Framework II is functioning properly before proceeding with the installation of any of these drivers.

1. Run the SETUP program on the Framework II SETUP disk or from your Framework II subdirectory on your hard disk.  
Type:

SETUP [ENTER]

2. At the 'Welcome to Framework II's Setup Program' menu select option (2): All other uses of the Setup program.

3. Now you need to tell the Setup Program the location of the FWSETUP file that stores

the current configuration. If you are using a floppy system, insert your SYSTEM DISK 2 into drive B and press 1. If you are using a hard disk system, select option 2 since FWSETUP should be in the current directory.

4. At the 'Main Menu' select (2) configuration.

5. Now you are in the menu of Change Configuration: select (1) Primary hardware, select (1) Screen driver, and select (7) I want to enter my own driver's file name.

6. Enter the name of the driver you like to use from Table 10 above and hit [ENTER]. The complete driver name including the .SC extension is required.

7. Type 'M' to return to the main menu.

8. At the main menu select (7) Save all new settings.

## DATA SHEET — VL82CO37/OTI-037 VGA CHIP

The VL82CO37 VGA-compatible Video Graphics Controller is a single-chip, high-integration, high resolution graphics device intended for use in IBM PS/2 Model 30-compatible systems as well as PC/AT- and PC/XT-compatible systems. It provides high resolution graphics up to 800 x 600 elements with 16 colours.

The VL82CO37 is fully compatible with IBM VGA in all modes, as well as being fully compatible with Hercules graphics. VL82CO37 compatibility also extends to IBM EGA BIOS (basic input/output system), CGA and MDA, and supports an external digital-to-analogue look-up table. The VL92CO37 comes in an industry-standard plastic 100-pin flatpack.

Features include a single-chip VGA video graphics device that is completely compatible in the following systems: IBM PC/AT-compatible, IBM PC/AT-compatible and IBM PS/2 compatible; fully compatible with IBM VGA in all modes; provides 800 x 600 element high-resolution graphics with 16 colours; flicker-free operation in all video modes; supports 132-column text modes; supports both digital and analogue monitor.

The VGA single-chip is a standard video controller for PS/2 line machines including Models 50, 60 and 80. With the same architecture, it can be used on Model 30 and PC/XT/AT systems too.

Several new things supported by IBM VGA include higher resolution (640 x 480), new video mode, 256 colours support for 320 x 200 graphics mode, up to 64 shades of grey display for monochrome monitor, and eight fonts loaded into RAM simultaneously. In the VL82CO37 chip, even more functions are added to gain performance.

The host can access both VGA registers and video memory by setting up bus address and read/write commands to read or write

8-bit data. Video RAM and screen refresh activities occur concurrently and independently by assigning appropriate memory access cycles to each of them.

Most registers are readable so that BIOS and driver software can determine the current state of video. In the basic configuration, 256 Kbytes of memory is needed as the display buffer. Four planes of video memory are controlled by four different RAS (Row Address Strobe) signals, one CAS (Column Address Strobe), one WE (Write Enable), and one OE (Output Enable) signal. The video data bus is time multiplexed with the video address bus in a way that outputs RAS and CAS address early in the memory cycle and inputs 8-bit data for read or output for write late in the memory cycle.

NMI (Non-Maskable Interrupt) is generated by trapping accesses to certain I/O ports so that backward compatibility can be achieved through software emulation. The VGA chip provides a DiREctional signal to control data flow to the system bus for CPU Read or Write.

There are four major components:

### CRT Controller

The CRT Controller provides synchronisation control, timing generation and supplies video memory addressing to display memory. Flexible timing configuration options are allowed by accessing I/O registers through software control. During the blanking period, an 8-bit refresh counter is placed on the memory address lines.

### Sequencer

The Sequencer takes care of basic memory timing for the display memory and the character clock for the control of memory fetches. The state machine in the sequencer automatically assigns appropriate memory access cycles to the CPU and CRT Controller during active display. The sequencer can also protect the entire memory plane by

DRAM	120 ns	120 ns	100 ns
CLOCK	28 MHz	25 MHz	36 MHz
RESOLUTION	720 x 400	640 x 480	800 x 600
COLOURS	16	16	16

Table 1. Resolution requirements.

9. You will then be prompted to insert your Setup Disk into drive A. At this time you insert DRIVER DISK #1 which contains Framework II's drivers. Press the space bar when the disk is in drive A.

10. The Setup program is going to save the current configuration to the FWSETUP configuration file. Select: (1) for floppy disk system, (2) for hard disk system. Then strike any key.

You have now installed Framework for the new driver.

### Lotus 1-2-3, V.2

The drivers support both 132 columns text modes and high resolution graphics mode for Lotus 1-2-3. In text mode, it supports 132x25 and 132x43 modes. In graphics

mode, both 600x480 and 800x600 modes are supported. To install the new driver for Lotus 1-2-3, step through the following procedures:

1. Make a backup copy of the 1-2-3 INSTALL disk. Use only this backup disk throughout these steps.

2. Copy the following files from the DRIVER

DISK #1 to the 1-2-3 INSTALL disk:

- OAK25V2.DRV
- OAK43V2.DRV
- OAK64OV2.DRV
- OAK80OV2.DRV

3. Insert the 1-2-3 UTILITY disk into drive A and type:

INSTALL (ENTER)

Driver	Desktop Format	Zoom (F9) Format
OT11.SC	132 x 25 text	640 x 480 graphics
OT12.SC	132 x 43 text	640 x 480 graphics
OT13.SC	132 x 25 text	800 x 600 graphics
OT14.SC	132 x 43 text	800 x 600 graphics
OT15.SC	640 x 480 graphics	640 x 480 graphics
OT16.SC	800 x 600 graphics	800 x 600 graphics

**Table 6:**  
**Drivers for**  
**Framework II.**

Register Group	R/W	Mono Emulation	Colour Emulation
<b>General Registers</b>			
Miscellaneous	W	03C2	03C2
	R	03CC	03CC
Input Status 0	RO	03C2	03C2
Input Status 1	RO	03BA	03DA
Feature Control	W	03BA	03DA
	R	03CA	03CA
VGA Enable	RW	03C3	03C3
DAC State	R	03C7	03C7
<b>Sequencer Registers</b>			
Address Registers	RW	03C4	03C4
Data Registers	RW	03C5	03C5
<b>CRTC Registers</b>			
Address Register	RW	03B4	03D4
Data Registers	RW	03B5	03D5
<b>Graphics Registers</b>			
Address Register	RW	03CE	03CE
Data Registers	RW	03CF	03CF
<b>Attribute Registers</b>			
Address Register	RW	03C0	03C0
Data Registers	RW	03C0	03C0
	R	03C1	03C1
<b>Extended Registers</b>			
Address Register	RW	03DE	03DE
Data Registers	RW	03DF	03DF
<b>DAC Registers</b>			
PEL Address (Write)	RW	03C8	03C8
PEL Address (Read)	WO	03C7	03C7
PEL Data Register	RW	03C9	03C9
PEL Mask	RW	03C6	03C6

Table 2. VGA registers.

selectively masking out planes through the Mask register.

#### Graphics Controller

The Graphics Controller provides a data path for both CPU Read/Write and CRT Read access to the display memory. For CRT access it directs data to the Attribute Controller while for CPU access it directs data to the system bus. It handles two basic modes - alphanumeric and graphics. In alphanumeric mode, data is sent in parallel directly to the Attribute Controller. In graphics mode memory data is shifted out serially to the Attribute Controller.

Data formatting and manipulation are implemented for the various modes. A colour comparator is provided for fast colour comparison in the application of colour painting modes. Since the Graphics Controller can process 32-bit data (8-bits from each plane) at a time, fast colour presetting and area fill operations can be achieved.

#### Attribute Controller

The Attribute Controller provides video shifting, attribute processing and an internal palette of 16 colours selectable from a possible 64 colours. Pixel panning is also provided for both graphics and text modes. Underline, cursor and blinking logic are interpreted and manipulated here. The final output of the Attribute Controller is 8-bit wide colour data to be sent to the external colour look-up table for final colour mapping.

#### Memory and Clock Considerations

In basic configuration, eight 64K 4-bit dynamic RAMs should be used to configure 256K byte of video memory. The supplanted speed of DRAM and CLOCK are related to the graphics resolution as shown in Table 1.

#### VGA registers

All the registers in the VGA can be categorised into six groups for the different function blocks in the hardware. In the VL82CO37 VGA chip, the system microprocessor data latches are readable for faster save and restore of the VGA state in the VGA BIOS. The VGA also provides the system microprocessor interface for the video DAC (external colour palette chip). The DAC has one address register which can be accessed through address hex 03C8 for write. Table 2 lists the registers and the I/O address where they are located. It also lists whether or not they are read/write, read-only, or write only.

# SPECIALS

<b>FLASH A/D D/A</b>		<b>85 SERIES</b>	
MP786AJN 8 Bit CMOS		065SC22P-2 8 Bit Micro	\$3.96
Flash ADC	\$22.86	065SC22P-2 Via	\$3.82
MP786SJD 11 Bit CMOS		065SC51P-2 Uart	\$3.85
Flash ADC	\$39.60	<b>CRYSTALS</b>	
MP7828JN 8 Bit CMOS		XL06.0000 MHz HC18/49	\$ 74
DAC	\$11.43	XL04.0000 MHz HC18/49	\$ 72
MP7814JN 10 Bit CMOS		XL04.9132 MHz HC18/49	\$ 87
DAC	\$22.86	XL11.961350 MHz HC18/49	\$1.05
MP7662JN 11 Bit CMOS		32.768 MHz 3 x 8mm Round	\$ 47
DAC	\$9.76	<b>XICO MAG CARD</b>	
HDAC 7543ABCN 12 Bit		<b>READER/ENCODER</b>	
CMOS DAC	SPECIAL \$7.50	INSERTION READER	
MP7506JN 18 Ch Mux	\$10.56	7702SA \$154.80	
MPREF01DP 10V Pre Ref	\$2.85	INSERTION ENCODER	
Wide range of A/D D/A ex stock		7702SA \$531.60	
<b>VLSI LOGIC &amp; SRAM</b>			
VL82C50 Uart	\$6.30	<b>COMPUTER CABLE</b>	
VL18C450-PC Uart	\$8.50	PRINTERCABLE 1.8M \$7.86	
300/1200 Modem Kit	\$60.00	RS232 CABLE 1.8M \$7.86	
VT7132-90 Dual Port Ram		<b>CONNECTORS</b>	
90NS	\$20.00	DB25F St \$ 52	
VL82C37A DMA Controller	\$7.00	DB25M R + PCB \$15.52	
VT8286-35PC 18K x 4		DB25M St \$ 48	
SRAM	\$17.00	DB9F R + PCB \$1.24	
VT20C18-35PC 2K x 8		DB9F St \$ 44	
SRAM	\$12.85	DB9M St \$ 40	
<b>EPROM</b>			
AT27C256-15DC Eprom	\$7.85	<b>MULTIMETER MM8810</b>	
150NS		3 1/2 DIGIT DC AC OHM \$49.95	
AT27C512-15DC Eprom	\$13.95	PUSH BUTTON SELECT	
150NS		<b>ALL PRICES TAX INC PRE-PAID</b>	
AT27C010-20DC 1 Meg	\$30.00	<b>DEM PRICING WELCOME</b>	
Eprom 200NS		Min order \$20.00	
VT27C84-25DC Eprom	\$3.50	P&P \$6.50	
250NS		OrNight Serv inc packing \$10.00	
		No Rain Checks	

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## 16-bit VGA card

4. Follow the instructions on the screen to the Main Menu.

Select Advanced Options (ENTER)  
Select Add New Drivers to Library. Follow the directions to add the OTI drivers.

5. Upon completion, you will return to the Advanced Options Menu.

Select Modify Current Driver Set (ENTER)  
Select Text Display (ENTER)

All available drivers are listed including:

- a) VGA Super Text (132 x 25)
- b) VGA Super Text (132 x 43)

Select the driver you want, then press (ENTER)

Select Graphics Display (ENTER)  
All the available drivers are listed including:

- a) VGA Graphics Driver (640 x 480)
- b) VGA Graphics Driver (800 x 600)

Select the driver you want (ENTER)  
Select Return to Menu (ENTER)

6. The display now returns to the Advanced Options Menu. Select: Save Changes

Follow the instruction to name the new driver set or, if you wish, leave it the same as the default name.

7. After changes have been saved, follow the instructions to exit the INSTALL program. Now Lotus 1-2-3 can be started in the mode you selected.

## 132-column text mode

The following is a general guideline on how to prepare installable application programs to run in 132-column text mode. First, backup the application before installation. Then run the application's installation program and set the display dimensions to 132-columns. Save the changes. For convenience, create a batch file to switch video mode to 132-column text mode and then run the application.

The VGA card supports 132 x 25 and 132 x 43 text modes, and their mode numbers are (in hex) 50 and 51 respectively. A utility program called VGAMODE.EXE can be used to switch to those modes. For example:

VGAMODE 50 (will switch to 132 x 25 mode)

VGAMODE 51 (will switch to 132 x 43 mode)

VGAMODE 3 (will switch to 80 x 25 mode)

## Wordstar Professional Release 4

Copy WSEX.E to, for instance, WS132.EXE. Then run WSCCHANGE using WSVG.BAT, to do the following:

VGAMODE 51

WS132

VGAMODE 3

When all these steps are performed, type WSVG to start Wordstar 4 in 132-column mode.

## Wordstar 3.30

To modify this version of WordStar to operate in 132-column mode, a utility called PATCHWS.EXE is provided (the original installation program WINSTALL.COM is incapable of setting screen dimensions.)

Copy WS.COM to, for instance, WS132.COM, then run PATCHWS.EXE on WS132.COM. Create a batch file similar to WSVG.BAT above.

## Word Perfect 4.2

Use the setup option of Word Perfect to set the new display dimensions. Create a batch file WSVG.BAT to do the following:

VGAMODE 51

WP

VGAMODE 3

## Circuit description

It is beyond the scope of this article to give a blow-by-blow description of how the circuit works. However, the following provides an overview and explains salient details and circuit features so as to provide some understanding of the circuit and how it functions.

The whole of this section should be read with reference to Figure 1, the block diagram, given in Part 1. Owing to its size and complexity, the circuit of the VGA Card has been broken down into a number of constituent sections. The best place to start, like the most jobs, is at the bottom: the bus interface.

## The bus interface

Two edge connectors on the bottom of the card, J4 and J5, provide connection to the PC's bus. There are three signal groups to interface with the main bus connector, J4: address (SA0-SA19), data (SD0-SD7) and control.

The lower eight system address lines (SA0-SA7) are buffered by U20 and drive the card address/data bus DAO-DA7. The next eight system address lines (SA8-SA16) interface directly to the VGA Processor, U10. Two PALs, U14 and U24, decode various other system address signals to provide a number of system control signals (U24) and ROM section control signals (U14). The upper four AT bus local address lines LA20-LA23 from J5 are decoded by U13 and U14. Jumper JP1 must be set for the type of system the card is to be used in. When the card is used in an XT (8-bit system), J5 is unconnected and U14 will disable U11 and the VGA card will only operate in 8-bit mode.

The system data lines from J4, SDO-SD7, are interfaced to the local address/data bus via a bidirectional octal transceiver, U19.

## The VGA processor

Three hybrid crystal oscillators - OSC1, OSC2,



and OSC3 – provide the required clock frequencies for the different video modes.

The O37's I/O read (IORD – pin 21)) and I/O write (IOWR – pin 20) signals are supplied by the system address decoder, U24. Pin 13 of U10, ASEL, is activated to select a VGA address to decode; U22D inverts the decoded signal from U24 because the PAL's outputs are active-low.

The video memory read (VMRD – pin 19) and video memory write (VMWR – pin 17) signals are driven by the system memory read (SMR ) and system memory write (SMW ) signals from J4.

Pin 98 is the enable external address buffer (EABUF) line and it selects U20 when an external address is required. Pin 99 is the enable external data buffer (EDBUF) line

which toggles U19 in conjunction with the DIR (directional) signal from pin 100. When both are low, data from the system data bus is written to the card data bus (that is, SDO-SD7 to DAO-DA7). When EDBUF is high, U19 isolates to two data buses.

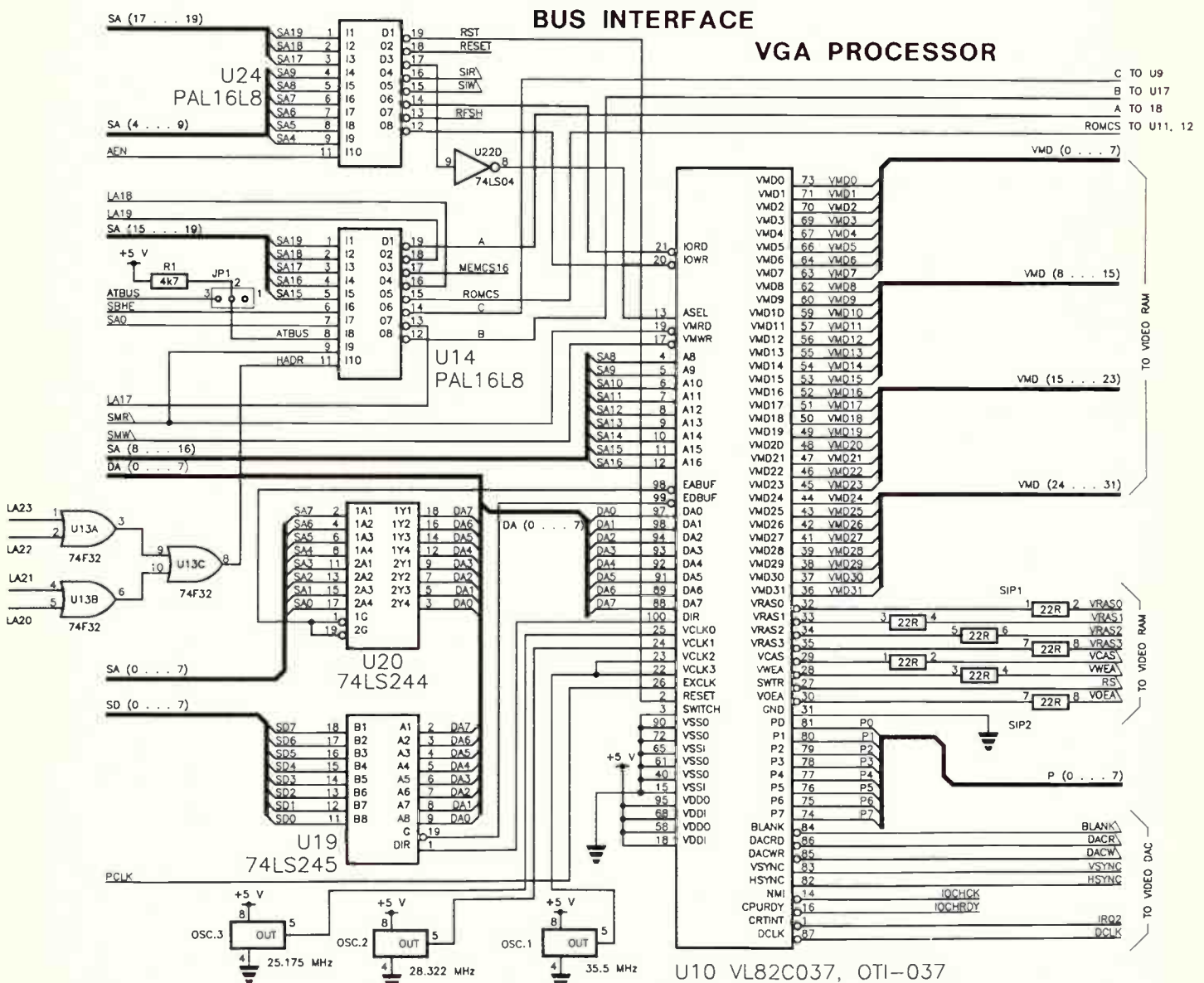
The VGA processor accesses the Video RAM via 32 bidirectional data lines, VMDO-VM31. These are organised in four groups of eight lines to access the four Video RAM planes, in conjunction with the row address strobe (VRAS0-VRAS3), column address strobe (VCAS), output enable (VOEA) and write enable (VWEA) lines, as described later. The 22 Ohm resistors from SIP1 and SIP2, in series with the video control lines, provide some current limiting on these outputs from U10.

Pin 27 (SWTR) is the read DIP switch control signal, RS . It activates U21, a 74LS244 buffer, in the Video DAC circuit section which transfers the hardware setup data from the DB15 analogue video connector (J1).

The VGA processor provides a group of control signals for the Video DAC circuitry – blanking, synchronisation, read/write and dot or pixel clock signals, all of which are explained later. The O37's non-maskable interrupt (NMI – pin 14) and memory access ready (CPURDY) signals drive the system bus's IOCHK and IOCHRDY lines (A1 and A10 on J4), respectively.

### ROM section

This section comprises two 128K (16K x 8-bits) EPROMS (U11 and U12) which contain the



# 16-bit VGA card

entire VGA BIOS for either 8- or 15-bit operation. EPROM U12 is connected to the lower system data bus (SD0-SD7) via a 74LS244 buffer, U18. EPROM U11 has its data bus connected to the lower system data bus

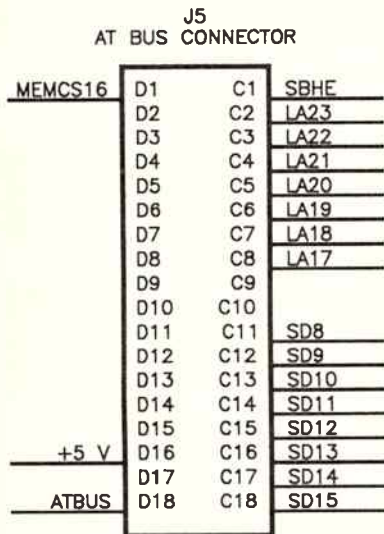
for 8-bit operation, via buffer U9, or to the upper system data bus (SD8-SD15) for 16-bit operation via buffer U17.

U14 in the Bus Interface section provides the decoded ROM chip select (ROMCS) signal to both U11 and U12, and data buffer enable signals for U9, U17 and U18 (C, B, and A, respectively). The EPROMs' output enable (OE) pins are driven from the system bus (J4) memory read (SMR) signal.

page mode read/write access.

The RAM access speed is a function of the video modes supported. As the O37 VGA processor supports the 800 x 600 pixel mode, 100 ns DRAMs as a minimum are required.

The supply and ground lines for the DRAMs have been left off this circuit for the sake of clarity, but general supply rail details are provided on another circuit here.



## Video RAM

The video or local display RAM is organised in four planes of 64K locations by eight bits using eight 4464 4-bit dynamic RAM chips (DRAMs), U1-U8. The VGA processor (U10) accesses the four planes in parallel as a single 32-bit word via VMDO-31. These are bidirectional data lines arranged in four groups: VMD 0-7 for plane 0 (U7-U8), VMD 8-15 for plane 1 (U5-U6), VMD 16-23 for plane 2 (U3-U4), and VMD 24-31 for plane 4 (U1-U2). The arrangement provides very wide video memory bandwidth resulting in a very high performance card.

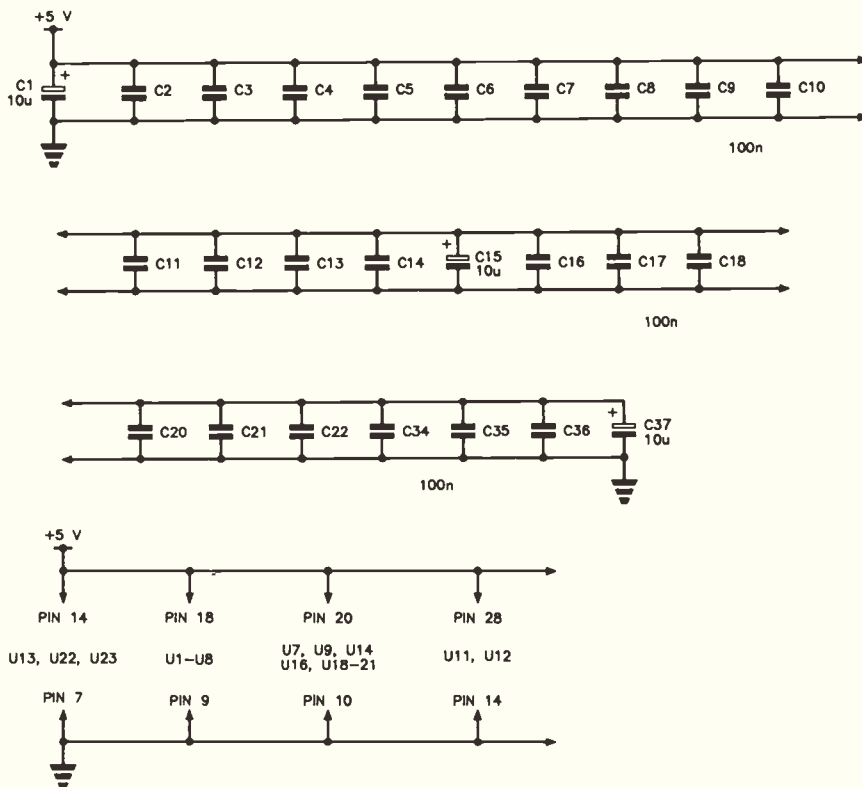
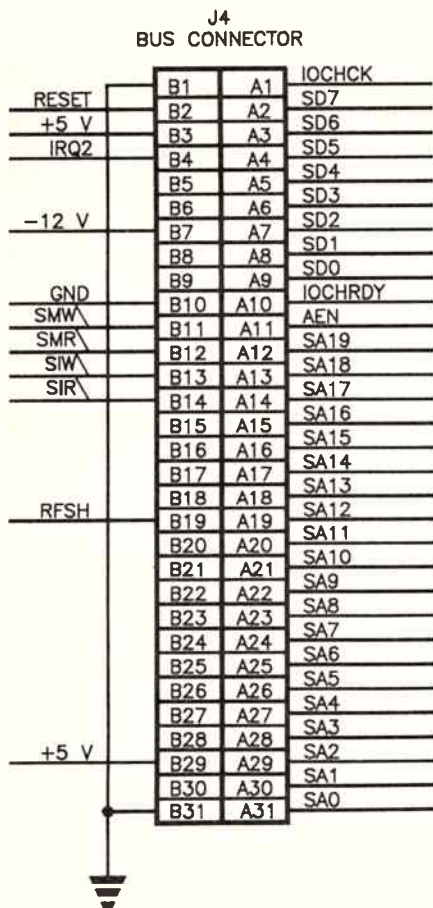
The VGA processor controls the Video RAM via seven control lines. There are four row address strobe (RAS) lines - VRAS0\ to VRAS3\ (the \ signifies the NOT function, or active low) - a single column address strobe (CAS) line, VCAS\, a write enable (VWEA\1) line and a chip enable (VDEA\1) line. The O37 VGA processor performs standard RAS-before-CAS memory read/write cycles and

## Video DAC and video output

There are two external video output connectors, J1 and J2. The first is a DB15 connector for analogue high resolution multi-scan type monitors, while J2 is a DB9 connector for digital TTL-input monitors. The IBM auxiliary video connection is provided via an edge connector on the top of the board, J3.

The O37 VGA processor provides an 8-bit direct output to J2 from lines PO-P7 which are the video colour lookup table address bits. SIP resistor packages 4 and 5 provide series current limiting for the lines while capacitors C26-C33 provide some risetime limiting.

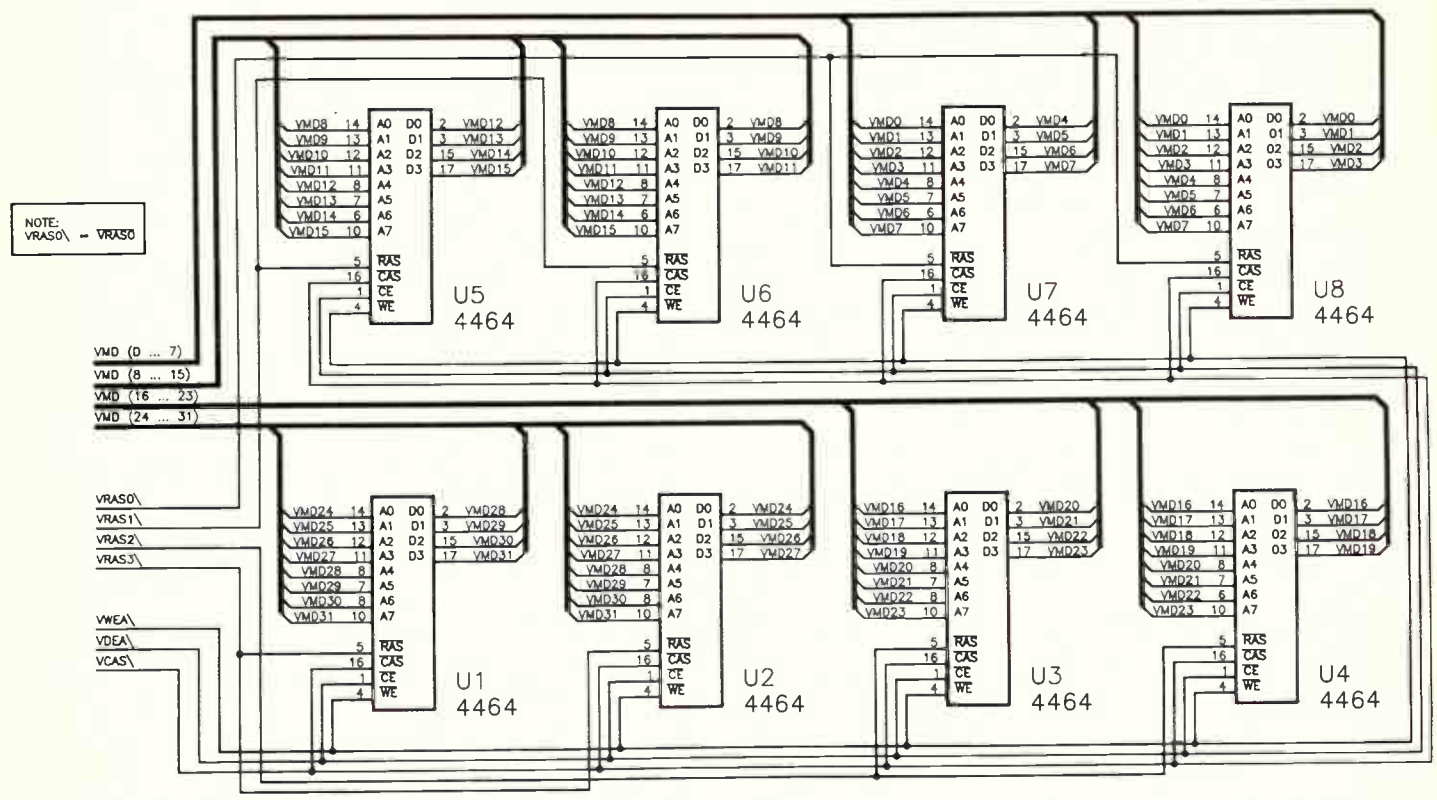
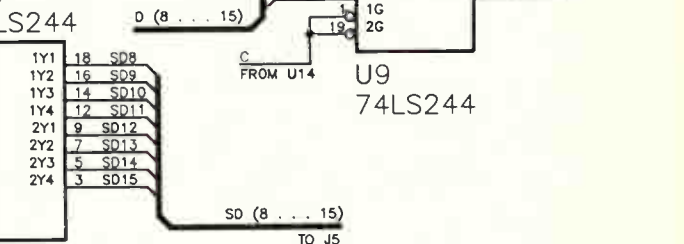
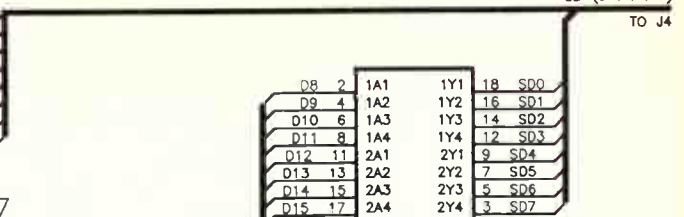
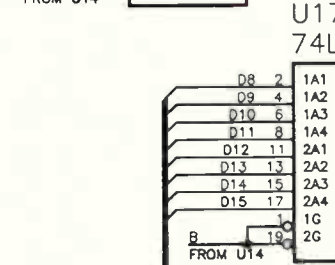
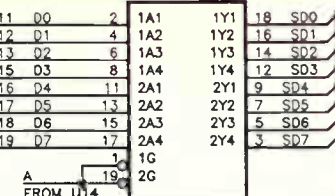
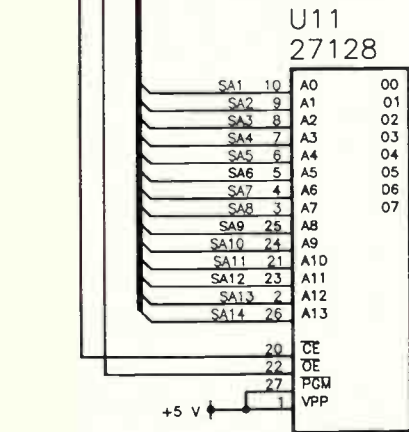
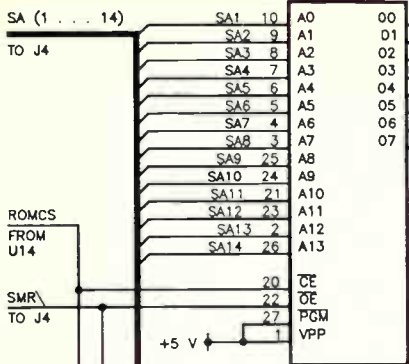
The colour palette or Video DAC chip, U21 (Bt464 or OT1-O37), is a combination of internal RAM and digital-to-analogue converter, or RAMDAC. Colour data from the VGA processor is remapped into the internal RAM and then converted from digital to



ROM

U12  
27128

U18  
74LS244



NOTE: VRAS0 = VRAS3

VIDEO RAM

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analogue data for output to the monitor.

The RAMDAC is driven by the VGA processor via the 8-bit colour lookup bus (PO-R7) via a 74LS244 octal buffer (U15), a dot or pixel clock line (DCLK, buffered by U23A, a 74LS125), DAC read/write lines (DACR\ and DACW\), and a blanking signal (PBLANK\), buffered by U23B (74LS125). In addition, the RAMDAC is interfaced to the card address/data bus DAO-DA7 and the two least significant bits from the PC/AT bus, SA0 to SA1.

The VGA processor provides the vertical and horizontal synchronising signals for the video monitor (analogue or digital), VSYNC and HSYNC respectively, buffered by U23C and U23D. The RAMDAC provides red-green-blue (RGB) colour output signals, directly driving the analogue display monitor's RGB inputs via J1.

Output levels are 0V for black and around 0.7 V for maximum brightness. This is determined by the reference current provided to the RAMDAC's IREF pin (4) by Q1, a TL431 voltage regulator. This maintains a voltage of between 2.44 and 2.55 volts across R3, a 365 Ohm resistor, giving a reference current of around 6.8 mA. This will ensure a 0.6 V maximum signal on the RGB outputs for monitors with 75 Ohm inputs because the resultant load on the RGB outputs will be around 43 Ohms as the monitor inputs are in parallel with R6, R7 and R8. If your monitor requires a higher voltage for maximum brightness, R6-7-8 should be changed to 150 Ohms.

Note that U15 is always activated because pin 5 of U22C is pulled high by R9, except when J3, the auxiliary video connector is in use. In the latter case, pin 10 of J3 is pulled low to disable U15, allowing the PDO-PD7 lines to be directly driven from J3. Also, the ESYNC and ECLK lines from J3 are pulled low, causing the outputs of U22A and U22B to go high, disabling the U23 buffers so that the dot clock (DCLK), blanking (BLANK\), and sync (VSYNC and HSYNC) signals from the VGA processor are isolated from the RAMDAC, U21.

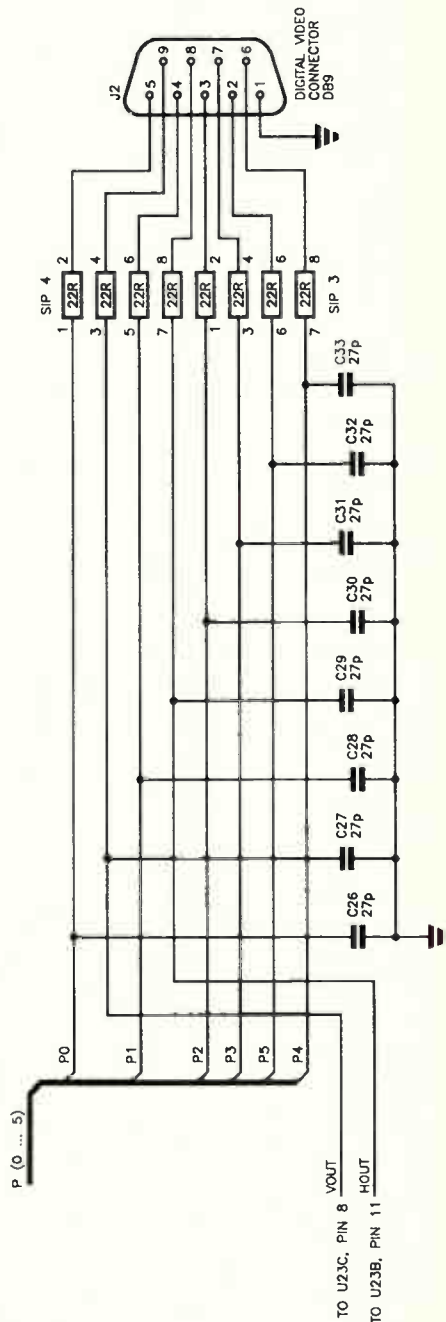
Monitor sensing and hardware setup is provided by data from three lines - MSO-1-2 - on J1 and four switches (DIP switch SW1), buffered onto the local 8-bit address/data bus, DAO-DA7 via U21, a 74LS244 octal buffer. The monitor plugged into J1 sets the three monitor setup bits, MSO-1-2; RP1-/8/9/10 provide pullups for these lines. Resistors R4-R7 provide pullups for the four DIP switch lines. The VGA processor interrogates this data when RS\ (pin 27) goes low.

The RAMDAC's supply is isolated from the other circuitry by L1 and C19/C25, to obviate digital noise on the 5 V rail from affecting the video output.

When the auxiliary video connector is used,

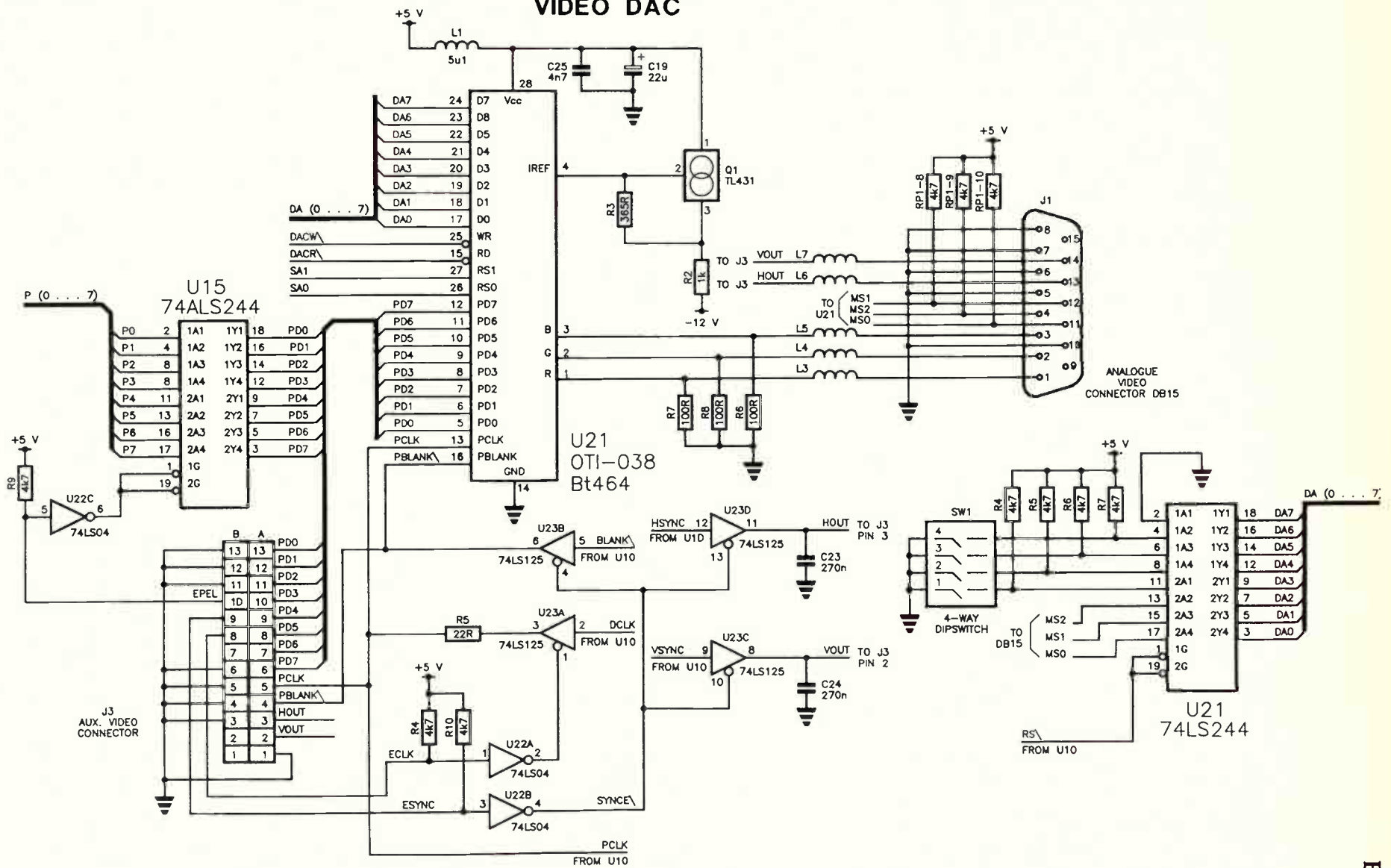
the Video DAC, U21, is isolated by an external video card to drive the display monitor connected to J1. J3's B8, B9 and B10 pins are toggled low to effect this. The auxiliary video card must provide dot clock and blanking signals (pins 5 and 4, respectively, on J3), plus vertical and horizontal sync signals (pins 2 and 3, respectively, on J3). The colour video data is interfaced to U21 via data lines PDO-PD7 (pins 6 to 13 on J3).

ETI



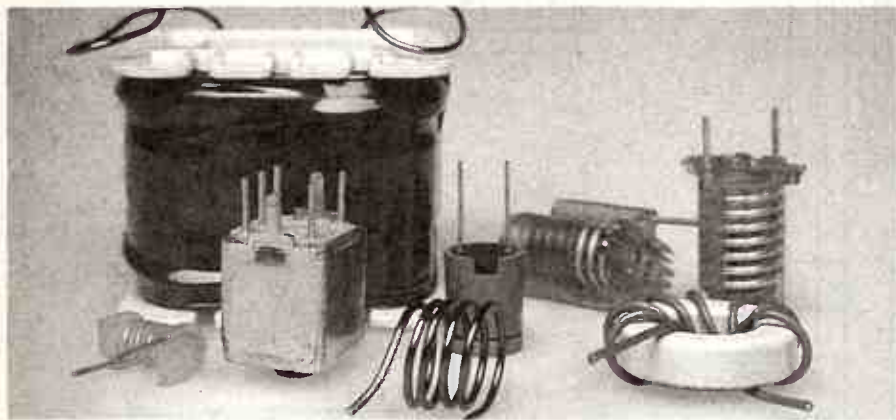
# VIDEO DAC

ETI SEPTEMBER '89  
61



ETI-1615

# BUILDING BLOCKS OF ELECTRONICS



Some inductors, or coils to the cognoscente. As you can see, inductors can take a wide variety of forms, shapes and sizes. The largest here is from a loudspeaker crossover filter or network, and has quite a large inductance value being wound with many turns on the square plastic bobbin. Also shown are several prewound coils on plastic formers (two have an adjustable slug to vary the inductance), an air-wound coil, a toroidal (circular) inductor, and an adjustable inductor in a pc-mount assembly with metal shielding can.

## The plot thickens

This month, Jack Middlehurst delves into the mysteries of attenuators, pads and inductors.

Having covered fixed resistors in Part 1, an application for them which you will run across often in electronics is in attenuators or pads. So, that's what I'll cover first in this part, then introduce you to inductors - coils, chokes etc.

### Fixed attenuators

Where there is any chance of the available signal overloading an amplifier stage, design engineers install a fixed resistive attenuator to reduce the signal to the maximum allowable level. The circuit symbols for these are shown in Figure 2.1. At (a) and (b) are single-ended versions; the balanced version is at (c). Typical circuits for the single ended case are the T network shown in (d) and the  $\pi$  network shown in (e).

The resistors are designed so that the impedance looking into the input terminals of the attenuator is the correct value for the circuit, the output resistance is the same value, and the attenuation is the amount written on the circuit diagram. Occasionally you will strike an attenuator that is designed to be used without a load. If no impedance is given for the attenuator, it can usually be assumed to be 600 Ohms.

The best way to check a fixed attenuator is to disconnect it and apply a signal to its input using the injector in series with a resistor equal to the attenuator resistance marked

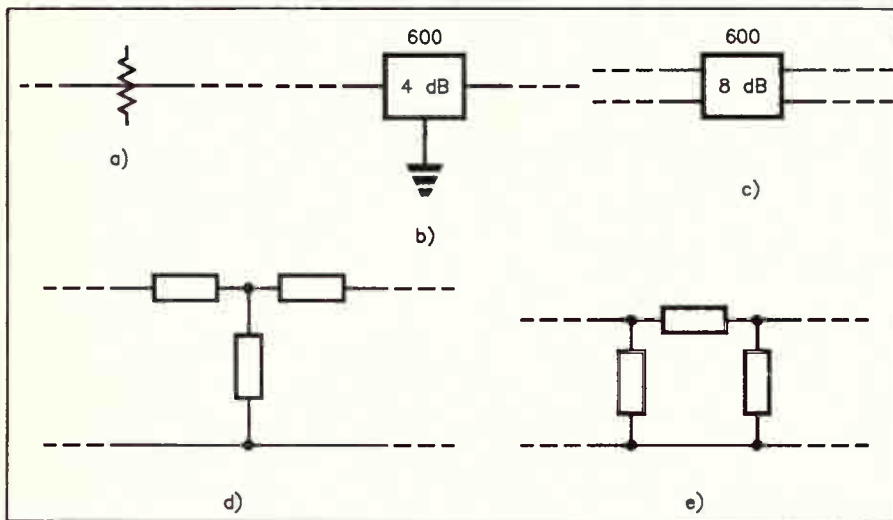


Figure 2.1. (a) and (b) symbols used for unbalanced fixed attenuators, (c) balanced type, (d) circuit of T type attenuator, and (e)  $\pi$  type.

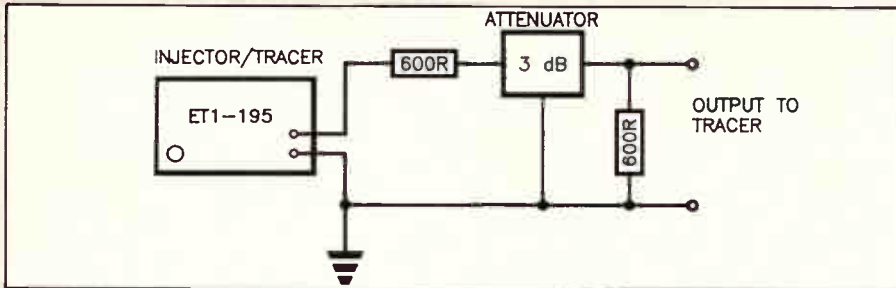


Figure 2.2. Circuit for testing attenuators using the ETI-195 signal injector/tracer.

on the circuit (probably 600 Ohms).

Connect the tracer to the output and put another 600 Ohm resistor across the tracer input as shown in Figure 2.2. Check that there is an output and that it is appropriately less than the input. Table 1 gives the output voltage as a function of the dB loss of attenuators.

Often, the attenuation marked on the circuit does not allow for the minimum loss of 6 dB of loaded attenuators, so a marking of 4 dB can represent a loss of 10 dB when measured with the correct source and load resistors. Some designs use the convention that a marked loss less than 6 dB infers that the attenuator is to be used without a load. Such attenuators are always the TT type.

### Resistive pads

It often happens that one circuit block needs a particular value of load resistance and the input circuit of the following block needs a different value of resistance driving it, so they can't be directly connected together. In this case, a resistive pad can be designed that satisfies both criteria and has a minimum of signal loss when placed between the two circuit blocks. It is the design engineer's job to calculate the values of the resistors to be used.

The symbols used for fixed resistive pads are the same as those for fixed attenuators

except that sometimes the circuit is helpful and will tell you the input and output resistances of the pad.

The safest plan when presented with a resistive pad that you suspect is faulty is to measure its resistors, and, if the values are according to the circuit diagram, leave well alone. Do not try and improve on the engineer's design.

If the circuit diagram only has a block symbol such as those in Figure 2.1 but without any resistance figures, and you are sure the problem is in the resistive pad, then life is a bit difficult. The only thing to do is to try and read the colour codes on the resistors and then check their values. This is a little easier on balanced pads since the resistors on each side are identical, which means that you get two chances to interpret the colour codes. If you find one resistor in a balanced pad higher than the corresponding resistor on the other side, the best hope is that the lower value may still be correct and the high one is faulty.

Elderly carbon or composition resistors that have no dc current flowing through them usually drift high in value. If the resistors are wire-wound and there is corrosion (often a green deposit) on one, its resistance will be high. If there is no corrosion, wire-wound resistors usually go suddenly open-circuit or develop a few shorted turns and go a bit low.

Wire-wound pads in professional equipment rarely give trouble unless they are exposed to salt air, in which case the resistors can corrode and go high in value. In this case it is probably best to consider replacing the whole pad.

### Compensated attenuators

There are many occasions where it is essential not to load a circuit, and if a volume control or attenuator is needed in this position, a high resistance has to be used. The problem is that with, say, a 1M volume control, stray circuit capacitance can turn the control into a low pass filter, the cutoff frequency of which depends on the setting of the control. For mid settings, the high frequency loss can be quite severe. It is common to find, particularly with high resistance stepped controls, that small capacitors are placed across each resistor, as in Figure 2.3. You will find that, throughout the resistors of the control, the product of each resistor and the capacitor connected

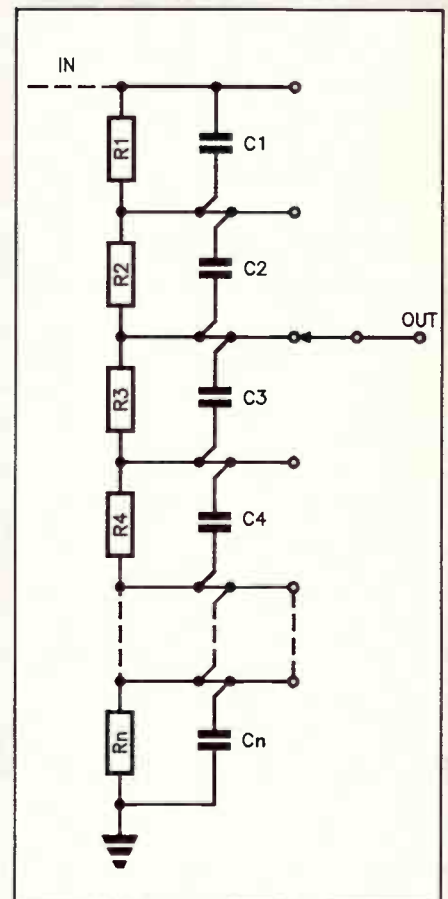


Figure 2.3. Compensated stepped resistive attenuator.  $R1C1 = R2C2 = R3C3$  and so on.

TABLE 1

dB	Output/Input
1	0.8913
2	0.7943
5	0.5623
10	0.3162
20	0.1000

Ratio of output voltage to input voltage as a function of dB loss of an attenuator. To calculate other values, multiply the outputs. e.g. for 8 dB, since  $8 = 1 + 2 + 5$ , multiply the outputs for 1, 2, and 5 dB loss. So, the output for 8 dB equals

$$0.8913 \times 0.7943 \times 0.5623 = 0.3981 \text{ times the input.}$$

Likewise, 60 dB gives  $0.1 \times 0.1 \times 0.1 = 0.001$  times the input.

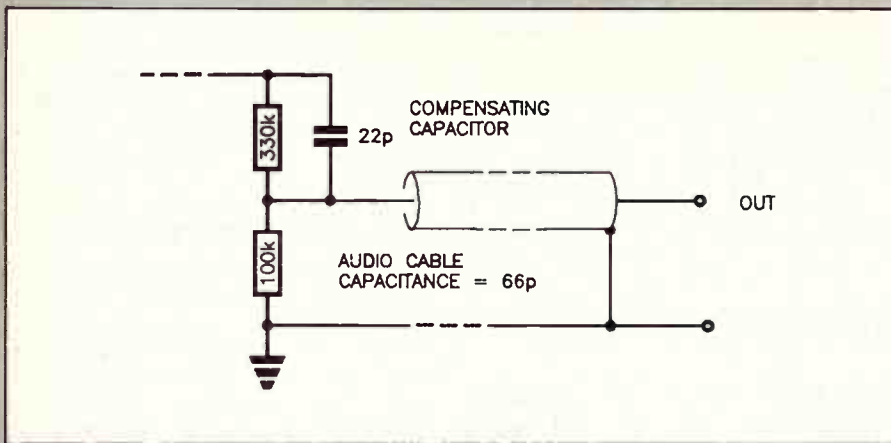


Figure 2.4. Single stage compensated attenuator-with audio cable capacitance across the bottom divider resistor.

across it is a constant, i.e.

$$R1 \times C1 = R2 \times C2 = \dots = Rn \times Cn.$$

If this is the case, the frequency response is independent of the setting of the control. Such attenuators are used in the input switch of CROs and are common in high impedance stereo controls. Just one open circuit capacitor in such an attenuator can cause some pretty weird effects, with the stereo image jumping about depending on the volume control setting.

Fixed attenuators are often compensated in this way. In older circuits, much use was made of audio cable, this being a shielded cable with a capacitance of about 22 pF per foot (to use the old system, 72 pF/m in modern terminology). It was common to have lots of this cable, particularly to and from volume controls and attenuators.

Figure 2.4 shows the capacitor values to be expected if a 600 mm length of cable was used with the 12.7 dB attenuator shown. Notice that 100k by 66 pF for the cable is close to 330k by the 22 pF compensating capacitor. The frequency response of this attenuator would be within 0.1 dB to about 2 MHz, whereas without the 22 pF capacitor the response would be down 6 dB at 21 kHz!

### Inductors

The symbols for inductors are many and varied, depending more on the available drawing stencils than anything else (or graphical blocks in computer drafting systems). A representative sample is shown in Figure 2.5. Air-cored inductors are used in VHF and many RF circuits. RF inductors are also used in series with the load resistor of AF amplifiers to help improve their frequency response.

Modern designs of RF inductors use Litz\*\* wire and ferrite cores, but older designs use single strand cotton covered wire and no

core. Consequently they tend to be rather large by modern standards. Iron-cored inductors, or chokes as they are known, use cotton covered wire in early designs and self-fluxing enamelled wire later. (Self-fluxing enamel on copper wire is a special insulation that, when heated to soldering temperature, melts and acts as a flux, boiling off oxides and other contaminants from the copper wire.)

Inductors are now rarely used in mains power supplies, but in valve equipment that runs on the mains, the power supply filter unit invariably uses one or more iron-cored inductor. Because the dc current through the coil produces a magnetic field that tends to saturate the iron and reduce the inductance, the cores of these chokes often have a considerable air gap and consequently tend to produce a buzzing noise when they have a lot of ripple to filter.

Old loudspeakers are generally of the

electromagnetic type since Alnico and ceramic permanent magnets were not available when they were designed. This simply means that their magnetic field is generated by using an electromagnet, i.e. an iron core surrounded by a coil containing many turns of wire. A dc current through the coil creates the required field.

Since this coil behaves as an inductor and is needed anyway, it is common practice to use the loudspeaker field coil as a power supply filter inductor. This means that the loudspeaker's magnetic field has some 100 Hz ripple in it. To remove this, some designs use a small 50 Hz voltage injected into the voice coil to give partial cancellation of the hum produced.

The first test on any inductor is to measure its dc resistance. For air core and ferrite-cored inductors you simply use an Ohmmeter. These types of inductor have low resistances, e.g. from 0.1 to 100 Ohms. Some iron-cored inductors and a few older air-cored types have resistances as high as a few thousand Ohms.

The measurement of the dc resistance of iron-cored inductors presents two problems. Firstly, if the inductor is intended for audio work and is designed not to have any dc flowing through it, the core is often made of mu-metal or permalloy. These materials saturate easily, so if you put any dc current through this type of inductor, you will ruin it. Such inductors can only be measured on an ac bridge. If you examine the circuit, you will find that these inductors are isolated from any dc by capacitors. This is usually a warning sign to treat such inductors with extreme care.

The second problem is a more personal one and concerns iron-cored inductors. One

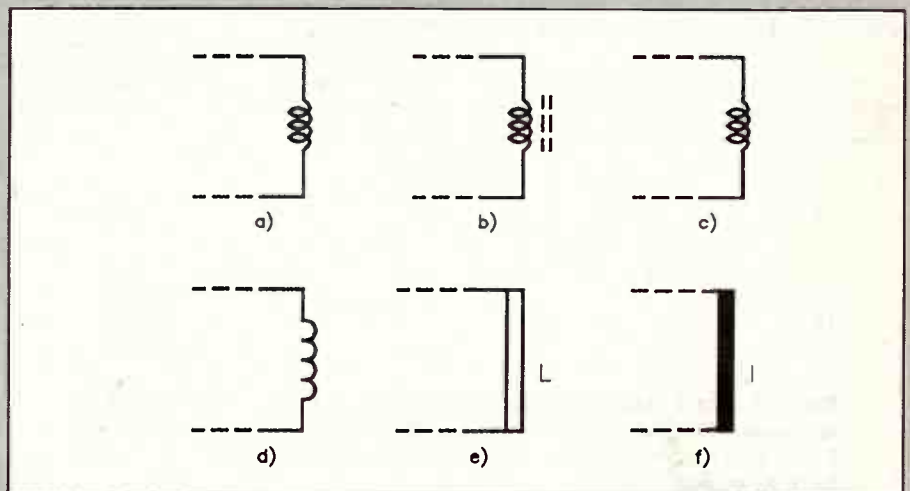


Figure 2.5. Some of the symbols used for inductors. (a) and (d) are RF inductors, (b) is a type with a ferrite core, and (c) is iron-cored. (e) and (f) are occasionally found in audio filter circuits, (f) being iron-cored.



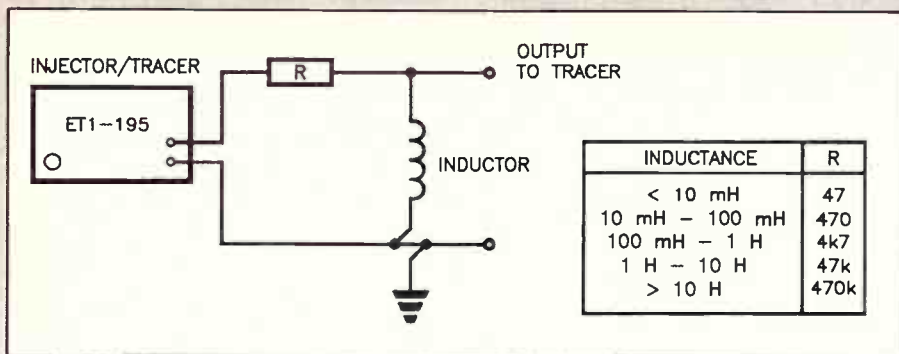


Figure 2.6. Circuit for measuring inductance using the ET1-195 signal injector/tracer. The values of R to use are shown in the table.

of the properties of any inductor is that, if you change the current through it, a voltage will be generated across it proportional to both the inductance and to the rate of change of the current. This means that, if you break the current through a large inductance very rapidly, a very high voltage indeed is developed.

If you put your resistance meter probes across such a large inductor, and happen to touch the inductor's leads as you disconnect the probes, you can get such a jolt that you involuntarily throw the meter across the room! This very unpleasant effect is called an *inductive kick*.

The correct way to take the measurement is to make sure that no part of you touches the connections as you are disconnecting the Ohmmeter. If you look closely you will see quite a spark as you disconnect the meter from a large inductor. It is this property of inductors that is used in the design of motor vehicle ignition coils.

Measuring the inductance of iron-cored inductors is an engineer's nightmare. The inductance varies with the frequency, the test signal level, and the amount of dc current flowing through the inductor. The measured value is usually dependent on temperature, and in older types, depends on the value of the dc current and signal level that happened to be present just as the equipment was last turned off.

Happily, with most power supply circuits, a change in inductance of 2:1 is not terribly important. Air core and ferrite-cored inductors, particularly those using potcores, are much more stable and are comparatively easy to measure provided their inductance is not too low. A circuit for measuring the inductance of inductors, other than iron-cored ones through which dc has to flow, is shown in Figure 2.6. It is a simple inversion of the circuit for measuring capacitance. Again the injector level is set at 300 mV and the output voltage is measured with the tracer. The inductance

can be calculated using the formula:  
 $L = 0.159 \times R \times (E/E_{in})^2 / (1 - (E/E_{in})^2)$   
 where

L is the inductance in mH (NOTE: millihenries not Henries)

R is the series resistor used in Ohms

E is the measured output voltage

E<sub>in</sub> is the input voltage (0.3 in this case).

In practice, this method cannot be employed for measuring RF coils for use above the broadcast band. In addition, the

accuracy of the calculated value is poor above 10 H because of resonance effects, and loading by the signal tracer.

For those inductors that are used for power supply filtering, if a measurement using the circuit of Figure 2.6 gives an inductance value considerably greater than the value marked on the circuit, then all is well. The inductance of such inductors without dc flowing through them is always higher than with. The common problem with old inductors is a shorted turn somewhere. This lowers the inductance considerably, so a low measured value can be taken as confirming other evidence that a unit could be faulty.

**\*\*Litz.** For those who haven't met the word before, it is short for the German word *Litzendraht*, literally *stranded wire*. This wire is made up of many individual fine wires, each separately insulated, then twisted together rather like a rope, and finally insulated overall. Since RF current only flows in the outside skin of a wire, many strands in parallel have a much lower RF resistance than one solid wire of the same cross-sectional area.

ETI

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READER INFO NO. 20

Australia's major professional electronics exhibition and convention this year will be addressed by a keynote speaker from the USA and among the exhibitors from around the country there will be a substantial group from West Germany.

**T**he 22nd International Electronics Convention and Exhibition organised by the Institution of Radio and Electronics Engineers of Australia (IREE), will highlight the extent to which this major Australian event has acquired an international flavour.

Among the exhibitors will be a large delegation from West Germany while the convention's keynote speaker will be a world-renowned American in the forefront of communications research, Dr Irwin Dorros, Executive Vice-President - Technical Services of Bell Communications Research (Bellcore).

IREECON '89 will be held at the Royal Exhibition Building in Melbourne from September 11 to 15. The site alternates between Melbourne and Sydney, which hosted IREECON '87. The biennial event, which dates back to before World War II, is now the largest professional electronics exhibition and convention in the southern hemisphere.

In recent years, a number of companies have been participating under the umbrella of State government departments. This year the States represented will include Tasmania (the Tasmanian Development Authority) and Western Australia (the Ministry for Economic Development and Trade), which has been a regular participant since IREECON '83.

The delegation from the Federal Republic of Germany, which has been organised by AMK Berlin, is so far expected to be the biggest exhibiting group, with a booking for 650 square metres of space. A record number of early bookings were received this year and exhibition space rapidly filled.

Interest in the convention has been similarly strong and a large number of papers for the lecture program are to be presented by participants in response to the invitation extended by the IREE.

### **Convergence theme**

The theme of this year's IREECON is 'Convergence', which reflects the increasing integration of technology in the areas of communications, computing and entertain-

ment. In his address, Dr Dorros will focus on the integration of electronic services and the resulting social and business implications.

As Executive Vice-President - Technical Services of Bellcore, he is responsible for all technical activities, comprising applied research, systems engineering and software development, on behalf of the seven client owners.

Dr Dorros began his professional career with Bell Telephone Laboratories in 1956 after graduating from MIT with a Bachelor of Science (BSc.) and a Master of Science (MSc.) degrees in electrical engineering. In 1962, he was awarded the Doctor of Engineering Science degree from Columbia University.

In 1978, he left Bell Telephone Laboratories to join the parent AT&T Company as Assistant Vice-President - Network Planning. In that role he was responsible for the evolution of the then Bell System nationwide network.

Dr Dorros is a member of the board of directors of Bellcore, the Microelectronics and Computer Technology Corporation (MCC) and Vertex Industries Inc. He is chairman of the Systems Subcommittee of the Federal Communication Commission's Advisory Committee on Advanced Television Services.

He is also a member of the board of the Columbia University Engineering Council, the Industrial Advisory Board of the Columbia Centre for Telecommunications Research and the Board of Overseers of the New Jersey Institute of Technology.

In addition, Dr Dorros has also served on the National Academy of Engineering Committee on electronic mail and is a Fellow of the Institute of Electrical and Electronics Engineers Inc (IEEE) USA. He holds five patents and has published numerous technical articles on telecommunications.

It seems this year's IREECON is set to be a landmark event.

ETI will be there - drop into our booth for chat!

**ETI**

**More next month . . .**



# **INTERNATIONAL FLAVOUR FOR IREECON '89**

ETI SEPTEMBER '89

66

## Exhibitors

The exhibition traditionally attracts leading Australian and overseas manufacturers of professional electronic equipment for broadcasting, telecommunications, information technology and associated activities.

Among the exhibitors this year (at time of going to press):

Abekas Australia,  
AC & E Sales,  
Adilam Electronics,  
Advanced Automation,  
ADX Systems,  
Alcatel STC,  
Amber Technology,  
AR Audio Engineering,  
Audio Sound Laboratories,  
AUSSAT,  
Australia Tel-Tec,  
Automatic Edit Controllers,  
A/V Applications,  
Belden Electronics,  
Robert Bosch,  
Broadcasting General Electronics,  
George Brown Group,  
CIMA Electronics,  
Caltronics Trading Company,  
Comsyst,

Consultant Technology,  
Critec Corporation,  
Daisy Systems,  
DB Audio,  
Editron,  
Elmeasco Instruments,  
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IRT Electronics,  
Jacobs Radio,  
Jacques Electronics,  
Jands Electronics,  
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JESEC Components and Equipment,  
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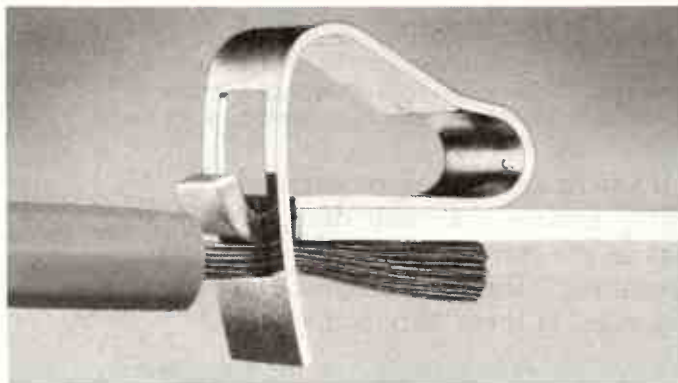
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MITEC,  
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Philips Scientific and Industrial,  
Philips Components,  
PKE International,  
Practel Sales International,  
Precision Power Products,  
PSI Computer Systems,  
Quinto Communications,  
Radio Frequency Systems,  
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Richardson Pacific Metal Systems,  
Scientific Devices,  
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ELECTRONICS

Everyone knows there are several types of generating plant: nuclear, coal, oil-fired generators, etc. These generate high voltages that are distributed around the country on super and national grid networks. As the networks get closer to their destination they are transformed from thousands of volts to a few hundred.

The local power source for most consumers is derived from a delta/star substation, where the HV network (high-voltage) is transformed to the LV (low-voltage) distribution network. The centre of the star system is bonded to ground and is also carried along the neutral cabling. There are therefore three power cables (ie, three phase) each with a phase voltage of 240 V. The power engineer who designs and installs the system is ultimately trying to balance the loads equally on each phase so that there are no circulating currents and volt sags. These are known as 'brownouts' in computer jargon, where the end result is too low a voltage for the regulator to work, thereby corrupting the target equipment.

Unfortunately, the distribution system loading is never constant and can change suddenly as electrical machinery is used; it can also vary over a period as users grow in size and hence loading requirements. Another problem is that although the Electricity Board boasts that the average reconnection time in the event of a power failure is around 8 seconds this is far too long for a computer power supply to sustain its

load and the electricity supply has not kept up with the technology it feeds. This total loss of power is called a dropout. Dropouts can be caused by electrical storms or even by motor vehicle accidents.

### Spikes and glitches

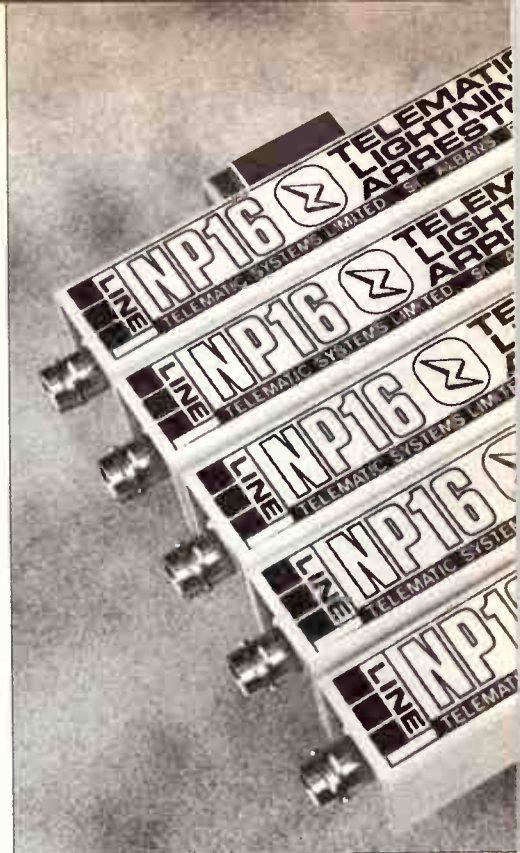
Unbeknown to many people, if the power distribution is shared by a neighbour who has inductive loads, the chances are that to reduce his electricity bill he will have fitted a power-factor correction unit. This is effectively a giant capacitor across the supply at his end. As soon as the power is interrupted, the energy stored in this capacitor will resonate with the existing inductance causing severe overvoltages on the network. The results can be expensive, ranging from a blown fuse through to complete carbonisation of electrical fittings.

Other problems such as spikes, glitches and noise can be grouped, since they all have a similar effect on the target system, ie, lock-out in a computer, shut-down in a process plant or just annoying loss of stored numbers in a telephone system. Electronic regulators cope with fast fluctuations of the supply and can overreact causing overvolting on the electronic circuitry with disastrous results.

Is this really a new problem? Electronics would appear to be more susceptible to the surges described. This could be partly because of electronics' widespread applications. Another reason is that the electronic power supply is not as robust as it could be and it is not uncommon to find manufacturers fitting small filters and spike suppressors. Almost at the twinkle of an eye, technology has spawned an efficient, low cost, small size and portable power regulator used by everything from fax machines through to mainframe computers. This switching regulator is not as reliable as its early counterpart, the linear regulator.

### Regulators

The linear regulator developed with the valve era and also worked well for transistors. Common-mode surges were blocked by the



screening of the input transformers. The regulator had a good high frequency response and could react quickly to residual surges. Unfortunately the transformer added cost and weight to the unit while the series regulator used power and hence reduced overall efficiency.

The switching regulator overcomes those disadvantages. In simple terms, the power is rapidly switched by a solid state device and when required to give an average output voltage via a low pass filter. As technology improved, the switching device could be run direct from the mains supply and as the frequency of operation became faster with each generation, the output filter could also be reduced in size. Switching regulators by their very nature do not tolerate glitches or spikes. They can break down the switching devices themselves or merely cause the output to overshoot. To compound the problem, not many users realise that the regulators themselves are a source of noise as large gulps of current are demanded from an inductive distribution system. Perhaps some readers have already seen this effect when a photocopier or other device is plugged next to a computer and

With giant strides being made in computing power and intelligent systems, you may assume that their designers are aware of the shortcomings in the power distribution network. Not so, says Graham Clarke of Telematic Systems. Here he discusses the problem and asks, is there an effective cure?

# BROWNOUTS AND DROPOUTS



*Telematic's lightning arrestor.*

the VDU shows a snowy picture.

Other causes of noise and glitches are welding and industrial heating systems such as ovens, etc. To control the power to these systems, the mains supply is often switched in bursts, or parts of each cycle are used to provide a controlled supply. Again, because the distribution current is fed from a finite impedance, instantaneous changes in loading result in noisy voltage spikes.

Another potential problem is the growing use of mains signalling. Here, signals are deliberately injected into the mains supply and these can cause interference to adjacent systems or cause poorly designed regulators to malfunction. Systems that use this technique range from modems, local area networks, alarms, communications to lightning control systems. The effect of lightning should not be ignored. A growing practice is to use the actual reinforced steel on buildings as a lightning path to earth and this can cause havoc to equipment within the building. Even loader current is often in excess of 30,000A and the voltage gradients across adjacent earths within a building can exceed tens of thousands of volts. The ground surge will cause severe

disturbance to electronic systems as the earth potentials rise. Also, surges can enter via LANS and telephone lines since Telecom only protects between the telephone wires at the subscriber end and not between subscriber and ground.

Well, is there a solution? Yes, but it really depends upon the problem. This may not be as daft as it sounds because not everyone has the same problem. People in the inner cities rarely suffer lightning while those in suburbia turn off their systems when the cumulo-columbus develop. Those in the country rarely suffer from industrial noise while inner city banking institutions inadvertently find their security and lighting systems interfered with by their neighbours.

What devices are currently available and do they work? Careful thought should be given to each application. If you are worried at system level, (are people's lives at risk or is it desirable to have the programmers working in the event of total power loss? What about the fax, heating, printers, lighting, tools, franking, meter, even vending machines?) If so then the ubiquitous UPS is the obvious choice.

UPS systems are available for powering the factory right down to the personal computer.

Basically they fall into two types: voting (offline) and continuous (online). Voting types are potentially the most reliable because they only switch over to auxiliary power when the mains supply fails. This means two things: the inverter is only used and hence electrically stressed when required and the condition of the unit can be monitored before it is required to be used in an emergency. The main problem on the lower-cost units of this type is that they have a transition time between the mains supply and the inverter. This changeover time is often unacceptable for most computers. On higher priced units this transition time is negligible and is sometimes buffered by a CVT (constant voltage transformer).

Online UPS systems are becoming more popular since there is no inherent change over time. Unfortunately, the most unreliable block is the switching element and in the event of a failure everything is lost with no backup. It is also not appreciated that the mean time between failures (MTBF) of the actual public mains supply may be better than the low cost online UPS.

Complete mains dropout and power cuts may not be a serious problem to some users since it is unlikely that the disc drive was actually writing to the disc during the failure. With disc accesses becoming faster with each generation of computer the probability is further reduced. The most probable event is that the program crashes with the consequential loss of hard work because the back up was going to be done after tea break.

Another device to consider is the line-voltage conditioner (LVC). An LVC is basically a UPS but without the storage

batteries. In practice it is a little cleverer since it controls output to a high degree. Again you get what you pay for and low cost units can themselves fail as a direct result of a severe mains disturbance.

Next on the agenda to be considered is the constant-voltage transformer (CVT). This has been around a long time and in essence it is a tuned transformer. It will compensate for slow fluctuations in the mains supply and there are no moving parts. Sometimes the user buys the wrong type and some switching regulators do not work well when powered from a CVT. The main problems with this device are that it consumes power on no-load, produces audible noise, runs hot and the output is often distorted on load.

In many cases lower cost devices may be the required solution. The most popular devices currently available are filters and varistors. Filters are low-pass devices that provide a high impedance to the mains disturbance. Most filters start to attenuate at around 50kHz so they are ideally suited for protection from high frequency surges or spikes with fast edges.

## Filters

High line currents require thicker conductors in the windings and good filtering requires more turns, so again the user gets what he pays for. Lightning surges are often common-mode in origin and this can saturate the core of the filter and reduce its effectiveness. It is often a good idea to compensate for this by fitting varistors as well as the filter. Another good reason for fitting extra line clipping varistors is that filters do not tolerate high voltage spikes and flashover can occur.

Varistors are also known as voltage dependent resistors (VDR) or metal-oxide resistors. These are made from compressed metal oxides fired under high temperatures.

They are wired in parallel with the incoming supply and when a surge exceeds their rating they break down and absorb the energy of the incoming pulse. Provided that the designer or user has specified the correct rating for the device, this breakdown is nondestructive and the VDR is ready for the next surge. These devices do not eliminate noise or low voltage glitches and should be used in conjunction with a filter.

For the majority of applications and pockets the lower cost devices may be adequate and the user should go through a checklist of his real and potential problems. Those may, of course, be obvious if he has just recovered from storm damage. To cover potential problems may be expensive but, if you are going for UPS, make sure that it has been prefitted with adequate lightning protection. With a myriad of devices available and a mains supply that can only get worse it is no surprise that there are many 'black boxes' for sale.

**eti**

*Telematic Systems are distributed in Australia by Westinghouse Systems ☎ (03) 397 1033.*



ROGER HARRISON

## ANSWERS & ARGUMENTS

This column is intended as a forum for exchange between you, the readers, and the magazine. I'll answer queries on projects, general questions on electronics and related subjects that may puzzle or concern you, engage in a little argument on topics of interest, or discuss subjects you might like raised. It's up to you! Short letters will be appreciated, long ones may be edited; if asking questions, confine your letter to one or two topics please. Send your letters to Locked Bag 888, Rozelle, NSW 2039.

### Component quality

It's good to see your happy smiling face once again gracing the pages of ETI. Seeing that you've asked us to keep things short, I shall try.

Firstly, Mr Dicker's Digi-125 Audio Amp Module contribution. Great, and out of all proportion to his component count! I trust we will see more of his audio projects. At least his are tried and proven. What about a semi-elaborate stereo mixing desk? Say, up to eight inputs, modular construction, allowing for any degree of features to be built-in or omitted. Perhaps an elaboration of his June offering, the Audio Toolkit?

Graham Dicker takes a passing swipe at inferior quality components. I can only agree. It's not just dual pots - have you checked on the quality of hook-up wire? Or 1% resistors from the big retailers? I've found some of the latter to be over 10% out of tolerance. It's enough to make one stick to photography and forget electronics! I don't mind buying rubbish as long as the price is commensurate with the product. But I would sooner buy top quality stuff.

I take it that your section of ETI will be looking at the top end of the electronic project market - i.e. the really useful, well-designed, proven gadget.

I can commiserate with L.C. of Melbourne (June column) with his XLRs. In fact, I can go one better.

I used to be called on at times to interface mikes and other equipment with the installed sound systems in a couple of school halls. It's bad enough coming up against male chassis sockets as the microphone input, but when it is wired up with pin 3 as earth, and pins 1 and 2 as the (balanced) signal in, then something is amiss! Perhaps they were thinking of 3-pin DIN plugs! I merely made up a couple of adapters, both labelled SANE at one end and INSANE on the other.

One more thing. Where does one get those top-notch components, e.g. Beyschlag resistors? You may as well tell us, especially if Mr Dicker is going to feature more and more quality projects.

J.L.,  
Gosnells, WA.

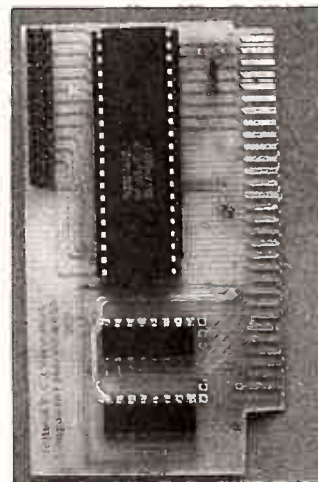
*Thanks for the encouraging words, which I have passed on to Graham Dicker.*

*If you're looking for quality components in Perth, I suggest you check out RS Components, PO Box 502 Subiaco 6008; ☎ (09)244-3667. They stock a range of quality and precision passive components, listed in their positively voluminous catalogue.*

*So far as the projects are concerned, I'm not quite sure exactly what you mean by the top end of the electronic project market. However, rest assured we will be presenting "...really useful, well-designed, proven..." projects,*

*including as many as we can that present fresh, new ideas, break new ground even, rather than a continuous array of cosmetic rehashes of earlier projects. We won't be forgetting the newcomer, nor will we ignore the more advanced, experienced enthusiast.*

*I invite readers, one and all, to let me know if and when you think we might have strayed from this philosophy.*



### ETI-1623 I/O Card ▲

I am writing to pass an opinion on a project published in the June issue of ETI, called *Getting In Touch, A 24-line Input/Output Card For Your PC*.

This is the first letter I have ever written to a magazine for this purpose. I usually just make my

mind up and leave it at that.

For some background on myself, I am a Technical Officer and have worked for the Defence Department for the last twenty years. This letter is not meant to be in any way derogatory about the article, but merely to offer suggestions.

I think the idea of I/O cards for IBM PCs and clones published in magazines such as ETI is great as their cost is becoming within reach of enthusiasts. There are also many institutions like universities, CSIRO et al, that may appreciate the availability of locally made, cheap interface boards for small projects.

The IBM PC is a magnificent machine for many tasks but ease of interfacing to the outside world is a problem. The main shortcoming of these units as I see it is the physical problem of accessibility to printed circuits inside the unit. It is most desirable to operate these units with the computer's lid down.

As I see it, this can't be done with the ETI-1623. The only solution I have to this is to cut a hole in the side and hang a right-angle extension on the bus for debugging hardware. Failing this, an extension card is the only way, so the manufacture of one of these is my first suggestion. It would also be preferable to make one for the AT unit that could be cut down for XT's.

It would be great to learn the techniques of programming the ETI-1623, but once done the card

is virtually useless and would be dumped in the junk box.

I understand the cost of the pc board etc, but I would have liked to have seen it with the ribbon cable connector mounted at 90 degrees and in such a way that it was accessible from the rear of the computer. Now, this is okay, but it means that any final circuitry must now be housed externally when finished.

Ideally, this card should have been made several times larger with some form of input and output connector mounted on the rear panel and with loads of general-purpose building space for the lamp or relay drivers or A-D or D-A converters.

If this technique was not adopted, i.e. a mass of pads with nails etc, an alternative is to leave just straight blank boards with connectors such that a piggy-back card could be attached. The end result would be something useful, completely self-contained within the PC. Couple this hardware with a fast, powerful compiler like Turbo Pascal or Turbo C, and a useful tool starts to evolve.

Keep up the good work with interfaces for PCs as they are here to stay for a while and they will be the work-horses for R&D for some time to come, putting most other systems in the background. This is due to the abundance of hardware and software available and the ease of interchangeability of software and hardware, as well as their power capabilities.

I would like to see programs written in Pascal or 'C', and I think it is a shame that schools teach BASIC as I do not think it is any more difficult to learn Pascal straight off. It teaches structuring from the word go.

Looking forward to more interface material.

**T.T.,  
Para Hills West, S.A.**

*While it is certainly convenient to have everything under the one roof, so to speak, with a project such as the ETI-1623 I/O card, there will be many circumstances where it is a distinct disadvantage. It was to allow maximum flexibility that the output lines were taken to the*

*26-way IDC header. To get the lines to the outside world only requires taking a ribbon cable via one of the rear apron slots. This cable can quite happily be a metre or so in length.*

*I can imagine a number of situations where there would be insufficient space inside the computer if all, or even a considerable number of I/O lines were used in some applications, particularly where the 8255 is programmed in Mode 0 with lots of individual lines in use. You'd have a lot of trouble fitting, say, 16 low-cost relays in there!*

*For example, the ETI-1623 I/O Card might be used as the interface in a PC-based multi-sector intruder alarm system, with up to 20 inputs and one-to-four outputs (Mode 0, control word #11 or control word #14). You'd need all those inputs buffered, perhaps current-loop driven via optocouplers; the output or outputs may drive a TTL input to an alarm module or a transistor relay driver (as in Figure 1 on page 50 of the June issue), switching a siren, etc.*

*Apart from that, if an application called for switching 240 volts ac mains-operated circuits via a relay or an array of relays, I would want the relay(s) to be located outside the computer's case! One reader reports using this board for a PC-based programmable stage light-show controller, using a combination of opto-coupled triac switches and relays on all 24 outputs - switching 240 Vac mains circuits.*

*For obvious safety reasons, not to mention the mechanical difficulty of getting all those 240 Vac mains cables and/or connectors in and out of the PC's rear apron (!), this circuitry was located outside the PC's case.*

*For breadboarding and debugging interface circuits, it's much more convenient to have the I/O circuitry located outside the case, at the end of a ribbon cable. A 24- or 26-way screw terminal block mounted on perf-board or matrix board is ideal for terminating the ribbon cable.*

*The ETI-1623 I/O Card is really just a peripheral driver, the interface circuitry itself - in*

*whatever form it takes - is the peripheral which is properly located outside the computer's cabinet.*

*I don't deny that there will be plenty of applications in which having the I/O circuitry inside the PC's cabinet would not only be useful, but necessary. But for the widest application of this project, the 26-way header was chosen so that constructors gained the most flexibility from the arrangement.*

*As for more interface projects, yes, more are on the way - and not just for the IBM PC-compatible either, for those enthusiasts who may think we're biased that way.*

*Your comment on the teaching of BASIC in schools is interesting. I think the exercise of learning a computer programming language as such should be viewed more as an exercise in learning to learn and learning clear, organised thinking, rather than as gaining a skill in a computer language.*

*Each computer language has its advantages and its drawbacks, its protagonists and its detractors. For myself, I first learned Algol (aaah! - he must be ancient, I can hear the screams now!). Later I learned Fortran and Kwiktran, a Fortran derivative. Much later, when the personal computer revolution came along, I taught myself a little BASIC and CHIP8.*

*Personally, I think, the rudiments of at least two programming languages should be taught in schools, to demonstrate in a practical, hands on way, the differences and similarities in programming techniques. I'd plump for Forth as the other language, alongside BASIC, but I concede your point about C.*

## Cover conundrum

*I loved the May issue front cover picture (the big one, not your portrait!). What I want to know is, as there was no cover credit, who did it and how was it done? Great stuff, keep it up.*

**L.D.,  
Melbourne, Vic.**

*Well, the picture was conceived by yours truly, and set up and*



*photographed by a Sydney commercial photographer, Richie Nicholson. His speciality is light painting. I can't reveal his trade secrets, but it sure was a lot of fun to watch it being set up and photographed. Richie also took the shots used in the turbo modem project (ETI-1622) that issue.*

## ETI-1500 Metal Detector problem

*I built the ETI-1500 Metal Detector (December 1979) some time ago and never had much success with it. I believe there were some errors in the design. Could you enlighten me on these?*

**J.E.,  
Ballarat, Vic.**

*The ETI-1500 has enjoyed considerable popularity and remarkable longevity. There were no errors in the design of this project, as a prototype was entirely constructed in ETI's laboratory at that time and brought to fully-working condition in order to write the original article. However, a few errors crept into the article as it was originally published. These were quickly discovered and published in the February 1980 issue on page 15. These errata have since been reproduced in the cumulative project list published in the January 1989 issue. You'll find them (in very small type!) on page 147.*

*In addition, we published the contribution of a reader, G.N. Vayro, who had considerable experience with the ETI-1500*

Metal Detector, in the April 1980 issue on page 43, titled "Notes for Constructors of the ETI-1500 Metal Detector".

Among suggestions for various cosmetic improvements, Mr Vayro made a number of practical points concerning the construction, which I shall reiterate here:

1) Carefully check the orientation of the CA3130 if the one used is an 8-pin circular metal can (TO-5) type. If so, looking down on its top you'll notice a small spigot or tag projecting from the rim. Pin 8 is beneath this tag. Pin 1 is the next leg anticlockwise from pin 8, and so on anticlockwise all the way round.

2) The search head wiring is colour-coded, as noted in the errata, and the transmit and receive coils can be differentiated with an ohmmeter - the transmit coil measures around 12 Ohms, the receive coil around 50 Ohms. I suggest you get in touch with the kit supplier, All Electronic Components of 118-122 Lonsdale St, Melbourne 3000, ☎ (03) 662-1381, for the colour-coding of the search head wires.

3) Sort out the contacts of the two pushbuttons, PB2 and PB3, with an ohmmeter and see that they are correctly wired, otherwise they will not operate as you expect.

4) If the front panel is metal Scotchcal (which I expect it would be), it should be connected to the circuit's common (earth). Insert a star washer beneath the nut of the Discriminate control (RV2) to provide a good contact to the panel and then solder a length of hookup wire from this pot's case to pin 9 on the board.

5) The non-component side of the pc board should be cleaned thoroughly with a flux-removing solvent, which many electronics retailers stock as a spray, but methylated spirits applied with a stiff, short-bristled brush will also do the trick. Flux can degrade the operation of high impedance circuits, such as that involving IC5 in this project.

6) The wiring to the pushbutton

in the handle should be done with shielded cable, passed through a hole drilled through the rear of the case so as to avoid fouling the telescopic shaft in the retracted position.

If you can make a visit to Melbourne, I suggest you go and see the kit supplier, All Electronic Components (address and phone number given above). They have the relevant back issues in stock and should be able to supply you with any additional information you may need.

I trust all the above sets you well on the way to getting this very sensitive, high performance metal detector project successfully on the air.

### A hot tip

I am in trouble. I have built the ETI-1532 Soldering Iron Temperature Controller and the iron heat is okay, but I have no control over it. No matter the position of the watts or temperature control, I get only direct control, using a Weller 250 volt, 25 watt iron.

The light comes on alright, but it never goes off on any position. Would you please let me know what I can do to fix the problem.

Many thanks in anticipation.

R.J.

Springwood, Qld.

From the symptoms you describe, it's quite clear that the SCR is on all the time. There could be several reasons for this. There are a couple of things you can do. However, if, after reading this, you don't feel confident about carrying out any of these tests, by all means seek out someone qualified and experienced who can do it for you. It's a mains-operated project and the mains is lethal. And we don't like losing readers.

Firstly, as the gate of SCR1 is controlled by transistor Q1, clearly, this is not turning on. WITH THE MAINS INPUT ENTIRELY DISCONNECTED, check that this transistor is correctly oriented and that it is, in fact, OK. (Use your multimeter to check the base-emitter and base-collector junctions).

If Q1 checks out, see that R10 is OK and of the right value. If

nothing's amiss here, your next step is to check out IC1. This is a little trickier.

You'll need hook type probes for your multimeter. What you need to do is measure the voltage between pins 14 and 12 of IC1 (output and -10 V rail). Hook the meter's positive lead to pin 14, the negative lead to pin 12, set the range to, say, 50 V, or 20 V.

You need to set this up very carefully, with the mains input lead entirely disconnected still, and take the measurement without going near the multimeter, but be able to operate the two controls, RV1 and RV2. When you do need to adjust them with the project operating and live, only use one hand, AND PUT THE OTHER HAND FIRMLY BEHIND YOUR BACK.

Initially (before applying power), set the POWER control to 25 W and the temperature control to minimum (fully anticlockwise). With the iron cold initially, turn the project on and note the reading on the multimeter. After a period, when the iron has warmed up, the multimeter reading should increase. If not, try varying the POWER control, running it over the full range. If the multimeter reading does not increase, switch off and entirely disconnect the mains input lead. Check the wiring of the two pots, if that's OK, then suspect IC1, change it for a new one and try again.

You should be able to find the problem from these tests. Good luck - and TAKE CARE!

### Sine-shaper problem with the ETI-166

I have recently finished construction of the ETI-166 Function and Pulse Generator. There were a few minor problems that were easily sorted out and the instrument does everything that it should do except for the sine wave.

More specifically, it would appear that the sine shaping network does not work as it is intended to do. Tracing the signals with a scope showed that

the triangle wave into pin 3 of IC3 (CA3100) is correct as is the output on pin 6 at about twice the amplitude of the input. It is still a perfect triangular wave form at the junction of the emitter resistors R40 and R41 (2R7).

It is from this point that things start to go wrong. The signal emerges at point BD (junction of D15, D16, R64 and C16) as a low amplitude clipped, almost square, waveform.

I have checked the values and orientation of all the components with the supplied parts list and overlay and all are as specified.


Tracing the signal through the network with a scope did not help either. All it showed was that the signal was being clipped symmetrically about 0 V, i.e. at opposite points of the circuit about the 0 V rail the signal looks exactly the same, except it is inverted. This in itself would seem to indicate that it is not a component failed.

Please, could you tell me if there has been some modification to the circuit that I have missed. Although I have been receiving copies of ETI for over twelve years now, every so often issues fail to arrive at the newsagent where my agent is placed and when I query the missing copies I am told that insufficient were sent from Australia.

Any assistance to help solve the problem with the function generator would be greatly appreciated.

G.L.G.  
Lyttelton, NZ.

Well, this is a bit of a baffler. However, I suggest you check that the earthed ends of R62 and R63 are both soldered TOP and BOTTOM sides of the board. If these are not effectively earthed, then the whole network, and the bias currents, will be upset, diodes D13-D14 and D17-D18 being effectively out of circuit, altering the bias currents through all the other diodes - not what was intended!

If this is not the case, with no power applied, check the orientation of each diode in situ, using an ohmmeter or the diode test function on a DMM. 





ELECTRONICS

# ETI BUYERS' GUIDE

*Shoparound* lets you know which firms are stocking kits for current projects published in the magazine, those firms stocking printed circuit boards, and companies that carry components used in projects we've published, along with interesting and useful snippets of news about products and services of interest to electronics enthusiasts.

Electronics retailers and other suppliers are circulated with information on projects to be published in ETI some three months in advance of publication but many things can transpire in that time that may affect the availability of a particular component and thus the availability of a kit. This is something entirely beyond our control, and often beyond the suppliers' control. The information supplied in this column is as accurate as we can ascertain at the time of writing, so please understand if the situation is different by the time you check with suppliers.

## PCBs — general

Printed circuit boards for ETI projects are generally obtainable from three suppliers:

All Electronic Components  
118-122 Lonsdale St  
MELBOURNE Vic 3000

☎ (03) 662-1381

Acetronics

112 Robertson Rd  
BASS HILL NSW 2197

☎ (02) 645-1241

RCS Radio

651 Forest Rd  
BEXLEY NSW 2207

☎ (02) 587-3491

However, these firms are not able to supply boards for projects where the pc board copyright is retained by the author or kit supplier. Check the details in the article first or, if they're not to hand, check with one of the suppliers above to see if they do stock it and that they have stocks on hand.

Don't forget that Scotchcals of front panels and meter scales, etc can also be supplied, where available, by the above firms.

## ETI-1615 VGA Card

This project, wrapped up this issue, is another technology demonstration project courtesy of Energy Control International, which is offering it in both kit and built-up form. Contact them at 26 Boron St, Sumner Park Qld 4074. ☎ (07) 376-2955. It's also available


from FT Promotions in Sydney; PO Box 547, Rozelle NSW 2039. ☎ (02)818-4838.

## ETI-1621 Programmable Amp/Delay Equaliser

One for the data communications experimenter! Simple to build and use, and low in cost, this project is another offering from Energy Control International, 26 Boron St, Sumner Park Qld 4074. ☎ (07)376-2955.

## Smorgasbord of semis

Melbourne retailer, The Electronic Component Shop, is well worth a perambulating perusal (walk-in visit, according to our Funk & Wagnell) any time you're in the city, if for no other reason than to check out the blackboard specials on semiconductors.

Suspended prominently above the counter at the rear of the shop is a large blackboard with a list of devices at discounted prices. Just as the restaurants up the local lanes change their blackboard prices according to market fluctuations and what was left over in the freezer from last week, so proprietor Michael Petkovic takes the duster and chalk to his blackboard from time to time, marking down semis — and we don't mean scrapings from the bottom of the silicon barrel either, but current stuff like memory chips, microprocessors, op-amps and the like. Check it out, as they say. 

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Yamaha	114/IBC

# T.S.D.

## Telephone Safety Device

Protect yourself, your Modem, Fax, Answering Machine from STATIC ELECTRICITY or from LIGHTNING which will destroy your equipment in a FLASH and cost you big dollars to fix. Simple to install just plug in. \$59.95

Modem Kit 300-1200-2400  
Auto Hayes and much more.  
Yes it does it and has it.

PC Internal version \$220.00  
External version add \$30.00

Modems for Viatel, Elders, White pages, Ciers, Stock Exchange. We can help with everything including software. Ring and ask for Max.

Teco 180 C.P.S. printer with NLQ with six fonts and 4 different type styles SUPER SPECIAL \$420.00



## COMPUTERS

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# THE ICELOCK ADVANTAGE

With the popular acceptance of the PC compatible came the problem of software piracy. David Looke and Paul Marrington take a look at IceLock, one of the latest offerings in software protection.

**T**here is a growing public awareness of the problems associated with software piracy. Companies that sell software have had to compete for market share with illegal versions of their own software packages. A survey made several years ago of WordStar by MicroPro found that for every legally purchased copy of WordStar, there were 10 illegal copies in everyday use. Consequently, these companies have had to price their products higher in order to get the necessary returns against this form of market competition.

## Historical solutions

Software piracy only became a severe problem with the popular acceptance of the IBM PC. Before this, microcomputers were not in common business use. In addition, every brand of microcomputer had its own disk format and these two facts effectively minimised piracy. PC compatibles are now common in both the home and in the office. Given that software is even easier to copy than cassette music tapes, the instances of use of illegally copied software has risen to immense proportions.

Until about two years ago, many firms used copy protected diskettes to restrict unauthorised copying of licensed software. This scheme used the standardised behaviour of PC compatibles by creating a floppy disk that had sections that could not be read without modifying the behaviour of the floppy disk controller. Many of the protection techniques failed on the faster computers like the PC/AT and the more recent 80386 based machines. Although many of these techniques allow a copy of the software to be made to the hard disk, these programs often require the protected diskette to be placed in the A: drive. Also, copy protection completely disallowed the making of backups, and, without backups, there is always the possibility of losing software that has become crucial to the day-to-day running of the client company. Because of the inconvenience, and dangers, of copy protection, there was a general outcry against the technique by both the users and the press, forcing most manufacturers to

remove copy protection from their products. In addition, most bulletin boards contained methods for overcoming most copy protection schemes. In spite of this, copy protection still has a place since a very high proportion of games manufacturers still use this cost effective technique.

Some software development companies turned to the perfect bound manual as a way to deter the pirates. (A perfect bound manual is one that looks like a paperback book.) It is hard to copy such a manual without destroying the spine of the book and the size makes it inconvenient to copy on to A4 or letter sized paper. Unfortunately for these companies, but fortunately for the pirate, one of the requirements for user friendly software is for it to be easily run without reference to a written manual.

Companies producing higher priced packages started using boards called key cards. These key cards plugged into the bus of an IBM PC compatible, and the software had to detect their presence before executing. This method was short lived, for many reasons. First, a PC board, with its gold contacts, is relatively expensive, thus defeating the benefits gained by stopping piracy. Most PC compatibles have only between 6 and 8 slots - this is a valuable resource. To insert a key card requires that the end user opens the PC; many people do not like to attack their computers with a screw driver. In addition, it is very inconvenient to move a key card from one computer to another. When IBM introduced the PS/2 with a new bus architecture, the requirement for 2 separate bus connection schemes made this method obsolete overnight.

## Dongles

The latest weapon being used against software piracy has been nicknamed the "dongle". A dongle is a device that plugs into a port on the back of the computer while still allowing normal use of the port. The protected software tests for the dongle before executing. There are dongles available for serial ports, parallel ports and keyboard ports and it is rapidly becoming the

dominant form of piracy protection. It is easy to use, can be transferred between computers with a minimum of difficulty, and does not use any computer hardware resources at all.

A new Australian designed and manufactured device, called IceLock, is a recent development in dongle technology. It can protect virtually any software program from the threat of software piracy.

Most dongles require applications to have protection routines added to the source code during development. IceLock, on the other hand, works directly on the .EXE or .COM file, making it beneficial to a wide variety of computer users, not just developers.

IceLock has been extensively field tested to ensure its reliability and integrity. No problems have been found in running peripheral devices off the serial or parallel ports while IceLock is installed. It's low power circuitry enables it to work on many portable and laptop computers and it will run on any DOS environment, even networks, Desqview and Microsoft Windows.

## IceLock hardware

IceLock is a small, electronic device, not much bigger than a matchbox, encased in a protective resin with an outer case of high-tensile plastic.

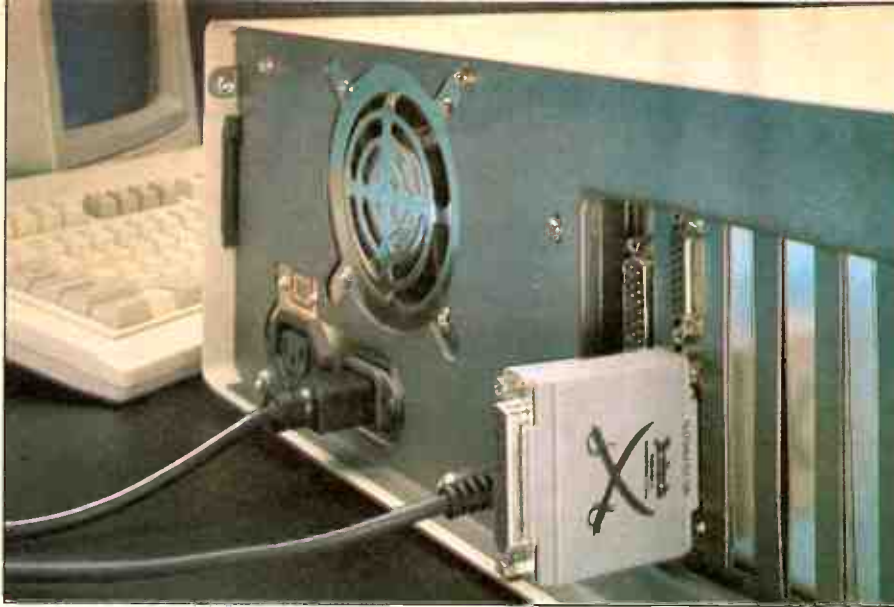
On one end is a DB25 female, while on the other is a DB25 male. IceLock can operate on either the serial or the parallel port by simply turning the device around.

Each device is identified by a serial number and an internal code manufactured into the lock. The serial number on the outside provides no clue about the internal code. Due to the encryption technique used, even a locked program does not have this code number recorded into it. A code is typically allocated to a product, providing for easy updates while ensuring that there are only as many copies of the product running as there are IceLocks with this code released.

## IceLock software

Anyone wishing to protect software packages must first purchase an IceLock master kit. This kit includes the software locking program and a yellow master IceLock for protecting the locking program. This master can also be used to test-lock the client's software.

Most other dongles require the addition of special routines to the code, which require the source code thus making it easier for the pirate to unlock the program by isolating and eliminating the code portions that relate to the lock. By comparison, the IceLock program encrypts the target EXE or COM file. Not only does this not require the program source code, but it also further deters a potential pirate since the lock code number is not recorded in the resultant program, and large portions of the locked programs (up to 64Kb at both the top and bottom of the



program file) are not in an executable format, and so cannot be disassembled.

If the correct IceLock is not present when a locked program is run, the program will display a text window. The text can be defined when creating the locked application. Apart from a message to insert the correct IceLock, this window can display the product name, release version, serial number and any other information that is required. The window can also be displayed at any time by using a special command line switch.

Removing the IceLock during execution of a protected program will cause the program to stop working and sound a distinctive tone. The program will continue normal operation when the IceLock is replaced.

### How safe?

As any cryptographers would say, there is not any data protection scheme in common use that cannot be broken. A computer program is just another form of data. IceLock is designed to restrict software piracy, but

neither it nor any other protection scheme can guarantee that it will not be broken.

Most praxies are perpetrated by people making copies of programs for their friends and associates. These people may have the software capabilities to disassemble a program. Because IceLock encrypts the EXE or COM file, it is virtually impossible for any but the most technically competent programmer with large resources in computing power and time to unlock the software. The value in lost time for such an individual is such that he/she could purchase the locked package many times over for the cost involved in unlocking it.

The IceLock hardware is encased in a resin that cannot be dissolved without destroying the components and the circuit board itself. Of course, if the IBM EGA chip can be reverse engineered, then any hardware protection device can also be copied. Again, this would require expensive commercial effort.

The only other way to create unauthorised copies would be to monitor the interface between the IceLock and the computer and attempt to duplicate the hardware from this. Because of the rapid reading sequence and the timing constraints placed within the hardware, this would require very sophisticated knowledge and machinery. **eti**

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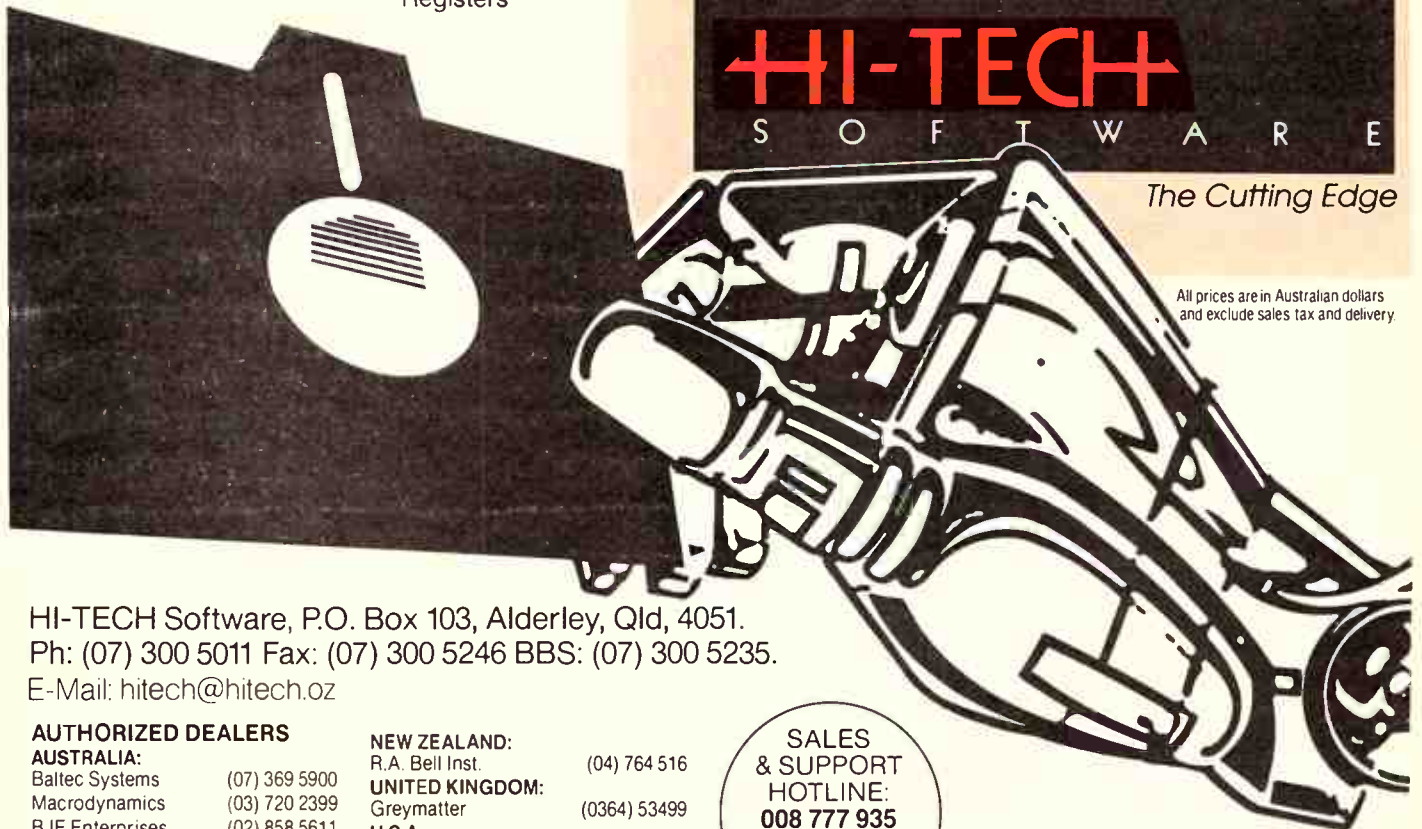
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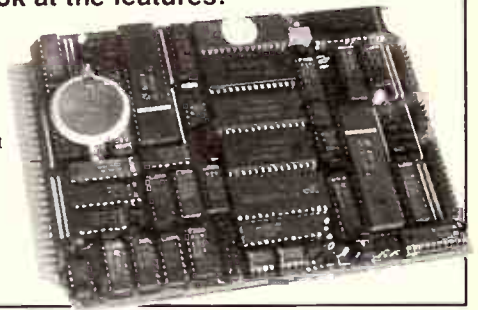
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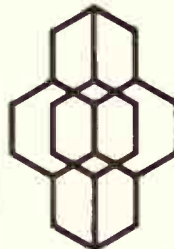
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# FOLLOW THE FLOW

Jack Middlehurst reviews a very useful piece of software that addresses a much neglected topic — flowcharting of any process, program or organisation.

**W**hat is a flowchart? The simplest type of flowchart is the type often adorning the walls of large businesses. They consist of sets of neatly drawn boxes with names of the board, managing director, managers, and so on, showing who is responsible to whom. This could be called a responsibility flowchart.

However, the idea of flowcharting has been extended to all sorts of things these days. The flow of finance, goods and services, production and logic are all routine. PERT (Project Evaluation and Review Technique) and GANTT charts (after Dr Gantt, who developed them) are used to monitor the schedules of massive projects by breaking them down into small manageable pieces, each of which is flowcharted.

## What is Flowcharting II+?

Flowcharting II + comes on a single 5.25" or 3.5" disk. It is a computer-based system produced by Patton & Patton in San Jose, USA for the generation of flowcharts for business and other purposes. It is not intended for use as a PERT or GANTT system, although you could set it up as a PERT system if you really wanted to. Its main claim to fame is speed.

The program requires an IBM PC or compatible, with 256K RAM and equipped with a CGA, EGA, or Hercules video display board. A hard disk is desirable, but not essential.

## Learning to use it

The package includes an excellent tutorial-type handbook with a good index. After working through the manual for about four hours, it was easy to produce charts of considerable complexity. There are many examples given in the tutorial, some with deliberate mistakes so that you learn to correct such things. Good manuals are a rare thing, and this is one of the best.

The menu system is self-explanatory and the keystrokes become intuitive after only a small amount of practice, which indicates good software design. There is a series of help screens if you get lost, but I doubt if you will ever need them.

## Using the system

The first thing to do is to work your way completely through the tutorial. After you become proficient you will know that the system will not allow you to call up a non-

existent file, so if you want to start with a blank screen, simply erase the whole area of one of the example files and save the result.

Putting a box in place consists of moving the cursor to the desired spot, pressing F1 to get to the shape menu, choosing the shape from a library of 26 (shown in miniature at the

bottom of the screen), pressing an arrow key until the size is right, and pressing Enter. There are squares, rectangles, diamonds, parallelograms, trapezia, and so on.

After the blocks are in place, text can be entered anywhere on the chart by pressing F3 to get to the text menu. There are six fonts, as well as subscripts, superscripts and Greek,

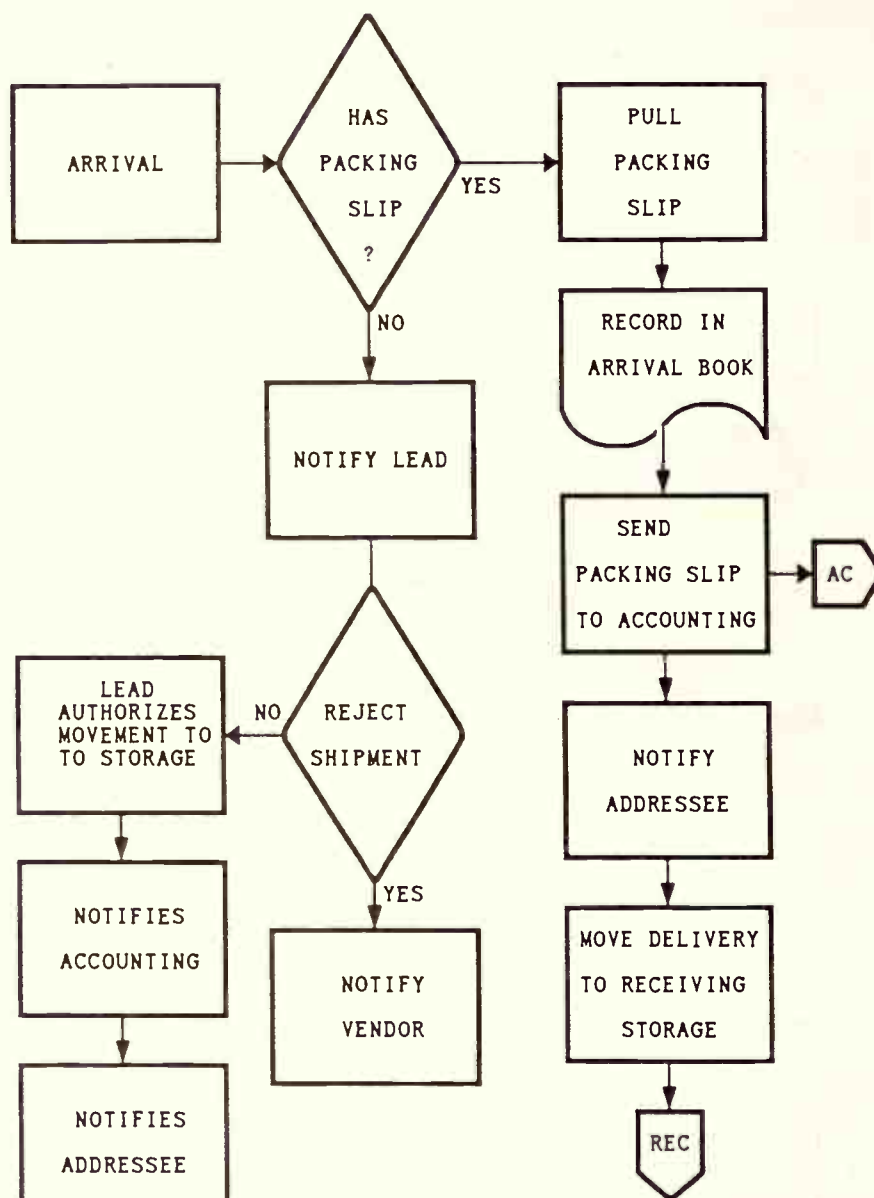


Figure 1. Detailed warehousing flowchart.

for the mathematicians amongst us. Alt-C can be used to centre the text automatically within the boxes.

There is an excellent high-speed system for drawing lines with arrows to show the flow between boxes. This involves placing the cursor where you wish to start a line, pressing F2 to get the line menu, pressing F for fast and then pressing (once) the direction arrow appropriate to the way you wish the line to go. The line will then extend until it hits the next box in that direction, whereupon, if you press A, an arrow pointing in that direction is put where the line contacts the box. The whole process only takes a couple of seconds. You can really zoom around a set of boxes putting in the lines. Backspacing will take them out should you err.

Intersections between lines can be as a simple T, or a blob can be added, rather like the old way of drawing circuits. Crossovers are drawn with a loop across one of the lines, again like old circuits. There are four different line styles for connecting the various blocks. The styles of arrows and intersections change automatically with changes in the line style.

To speed things up further, there is a fast copy system so that parts of the flowchart can be reproduced all over the place. In addition there is a rapid system for creating a hole when you need to add something to an existing chart, rather similar to the system used in spreadsheets in that you move parts away, leaving a gap. To help visualise the overall chart when you are working on a small part, pressing S shrinks the whole chart to fit onto the screen. While in this mode, pressing T will remove the (illegible) text to make it easier to see the boxes and lines.

The whole thing is based on horizontal and vertical connecting lines, but for those who insist on using diagonal lines there is a small library of them to choose from.

A vast array of printers is catered for and there is a special disk available called *LaserCharts* for those who have access to an HP Laserjet +, 500 Plus, or Series II Laser printer. Alas, I could not test this disk, but the system worked first time on my Epson EX800 without changing the printer configuration from its default setting of the IBM Proprinter.

## Uses

This software can easily set up the sort of management chart showing who's who and who is whose boss. However, it can do much more than that. It can be used as the basis for the entire organisation of a business,

showing the flow of goods in and out and who is responsible for each step in the process. It is easy to produce a quite complicated master chart that can be passed around for comment, rapidly altered, and passed around again. In a very short time a final chart can be decided on and multiple copies printed.

This master really defines how the business works. Once the master chart has been produced, secondary charts can be produced showing each of the blocks on the master in more detail. This layering of the charts can go on to many levels in a large organisation, in principle down to a chart for each employee.

This means that a new recruit can not only be given an overall view of the organisation, but also a detailed chart of their particular area of responsibility that very effectively defines their job. This in turn makes it easy for a personnel manager to explain to incoming staff what they are required to do, and to do so in a way that creates the minimum of misunderstanding. Furthermore, if a copy of their part of the chart is given to the newcomer, they can rapidly see the responsibilities of the other staff with whom they need to interact to get their own job done.

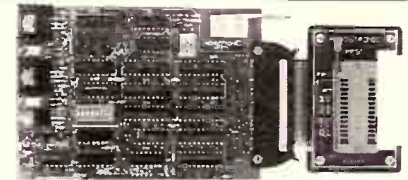
Since all of the charts are stored as files, major changes in the master chart can be implemented quickly. This involves altering only those blocks that have been affected by the reorganisation and then altering the necessary secondary charts. Charts are not connected in the way that spreadsheet charts can be, i.e. altering something on a secondary chart is not automatically reflected on some other, dependent, chart.

Figure 1 is copied with permission from the handbook, and shows a typical second level flowchart that expands a VENDOR DELIVERY block on a master chart. In practice, the names of the employees responsible for each step would be printed next to each block.

In addition to its more obvious business uses, the software can be used very effectively by computer programmers for handling large projects that involve many subroutines, subprograms, functions, structures, procedures or whatever. In its library of 26 shapes there are shapes for punched cards (!), magnetic tape units, communications systems & so on, so it is clearly intended for systems programmers as well.

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## Follow the flow

In addition to the standard shapes, you can make a library of complete blocks, which can include text that you find you use repeatedly. An example of such a block is shown in Figure 2. Programs for electronics could use this block for asking a whole range of questions such as "What is the frequency (kHz)?" and checking to see that the answer is a number and that the number is greater than zero. If not, the warning message becomes "Frequency must be > 0. Press spacebar to continue", whereupon the question is asked again.

There would be no difficulty in using this software for power and telephone wiring diagrams, although it uses the old style of loop crossover. Intersections can be the modern type or the old blob type.

## Testing

The software was tested at 20 MHz and 10 MHz on an 80386 machine equipped with a 28 ms hard disk and an EGA/Hercules card. It was also tested at 6 and 10 MHz on an 80286 machine with a 30 ms disk and Hercules Graphics Card Plus. There was no noticeable difference in the speed of operation of the software on either machine at any of these speeds. It would probably work satisfactorily on a 4.7 MHz machine. Switching from EGA to Hercules made negligible difference to the screen.

## Conclusions

This is an excellent flow-charting program. It is easy to learn, fast, and fun to use, and has a first class manual. Loading, storing, and handling flowcharts are fast if you have a hard disk.

The great advantage of such a program is that it makes it easier to think logically, since a flowchart on any subject must follow a logical progression or, when you try and assemble it, you rapidly find that the flow is either too complicated, or going in the wrong direction! This is one program where it can truly be said that its applications are limited mainly by the imagination of the user.

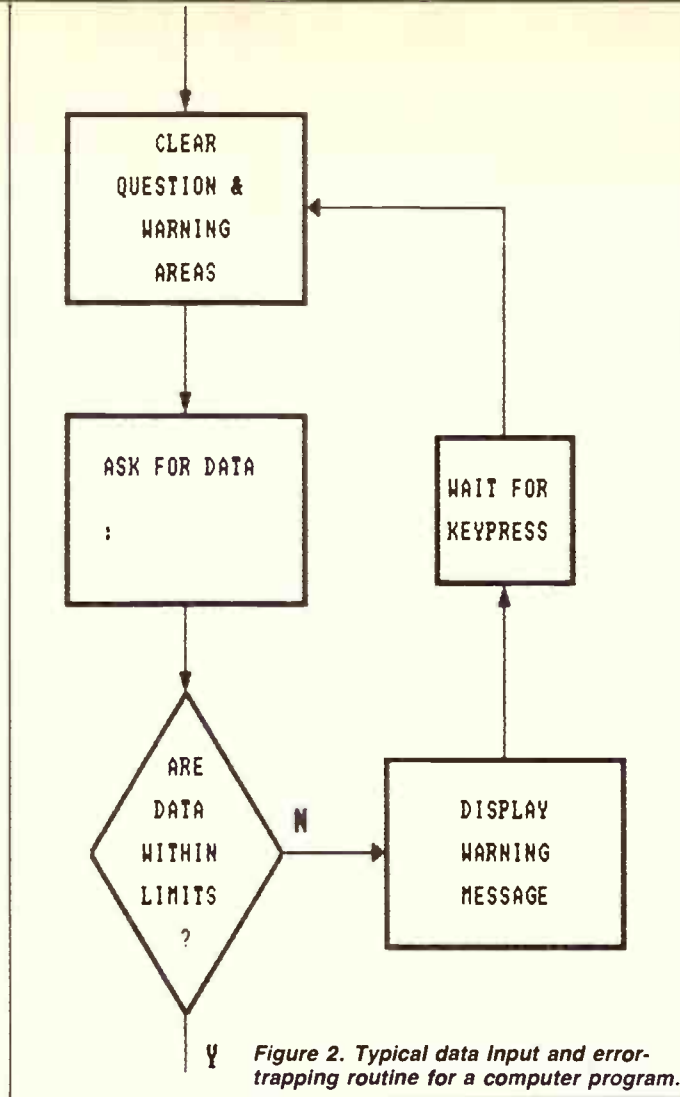


Figure 2. Typical data input and error-trapping routine for a computer program.

For a practical example, see the two flowcharts given with the Project 1621 *Programmable Amp/Delay Equaliser* elsewhere in this issue, which were produced using this program.

At \$479 it is a bit expensive for the casual user unless you are particularly well heeled, but for businesses, professional programmers, engineering and drawing offices it is certainly worth the money.

(At time of going to press, however, we understand that the program was to be

offered at a much reduced price, making it even more attractive and putting it within the financial reach of many more users.) **eti**

*FLOWCHARTING II* + by Patton & Patton Software is available from Software Express; rrp \$479. Check price and availability with your nearest store: Melbourne - 48 A'Beckett St, Melbourne Ph: ☎ (03) 663-6580, Fax: ☎ (03) 663-6117; Sydney - 74 Parramatta Rd, Stanmore Ph: ☎ (02) 519-3249, Fax: ☎ (02) 519-3868.



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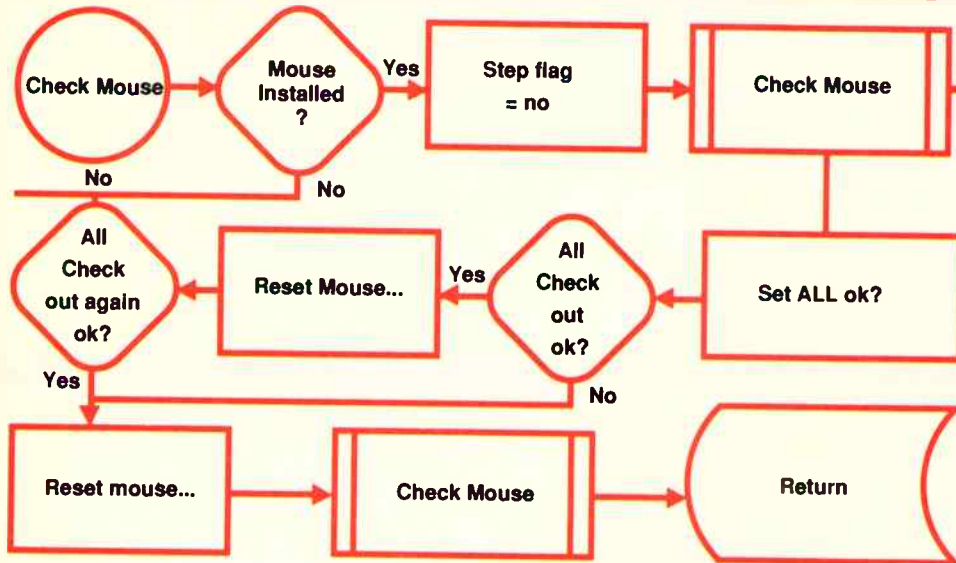
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## PORTABLE COMPUTER



So-called laptop computers are beginning to make an impact in the market. Their go anywhere convenience is especially attractive to people who move around a great deal and need the facility a computer offers. Largely, laptops emulate their desktop counterparts. The Cambridge Z88 might cause some rethinking of just what a laptop's role is and how they're configured. Brian Hammill reports.

**T**he Z88 portable computer from Cambridge Computer Ltd is of compact and neat design. Measuring 294 mm wide by 210 mm high – just a little larger than this magazine – and only 23 mm thick, it comes in sleek black with the familiar QWERTY typewriter keyboard dominating the top of the case. The liquid crystal screen, rather than folding up as with most laptop computers, occupies the area above the keyboard. The screen is eight text lines deep. I'll discuss the screen width later because there are some unusual aspects about it.

Internally, the computer features a Z80 CMOS microprocessor, 32K bytes of RAM and 128K bytes of ROM. It has a miniature loudspeaker on-board, used for warning beeps and alarm applications. A serial (RS232) port is provided, using a DB9 socket. The serial port can be used for outputting to

a printer or for exporting or importing files to or from a PC.

Provision is made for plug-in cartridges via three slots along the front edge of the case, below the keyboard. Using these slots, you can plug-in extra RAM or application programs contained in EPROMs, with a capacity of up to 1M byte per card maximum. Using these slots you can also record, or store, data on an empty EPROM card.

It is powered by four AA-size batteries; alkaline types are specified and Cambridge claims these will give around 20 hours of use. All up, it weighs 900 grams.

There is no disk drive provided, but any files you are working on are maintained in RAM (internal, or a RAM card plugged into a slot) so long as the unit is powered (batteries inserted or plug pack in use). You can also

permanently store data in an EPROM card. EPROM cards can be erased and re-used using a Cambridge EPROM eraser (optional extra).

So, it is apparent there are some primary physical differences to current laptops, but there are some software features of interest, too, that also set it apart.

Two different kinds of inbuilt programs come with the Z88: applications and popdowns. Applications, probably the most used, are for writing and editing text, setting up financial calculations and the like. You also get BBC BASIC, for programming, and a diary. Popdowns are more akin to tools, and can be called up while you are in any application, as the need arises. The popdowns include an index (like a directory), a calculator, a clock and calendar and an alarm, among others. I'll get into the software in detail later in the review.

The Z88 reviewed here is priced at \$995 rrp. A version which can be used in conjunction with an Apple Macintosh costs around \$1400 rrp. A number of optional extras are available: a mains adaptor for \$34.95, a modem for \$595, 32K RAM cards for \$69.95, 128K RAM cards for \$174.95 (EPROM cards of the same capacity cost the same) and an EPROM eraser for around \$135. A carry case will set you back just under \$35.

### Keyboard

The Z88 has a 64-key QWERTY-type keyboard, but there are some differences to what you see on other computers.

Below the TAB key on the left is a diamond key, which provides access to short-cuts for carrying out an operation within an application or popdown. And underneath the SHIFT key, which is below the diamond, are the INDEX, MENU, HELP and square keys, arranged from the keyboard's left to the spacebar.

The square key provides a short-cut to accessing an application or popdown. HELP displays information about the action you are currently carrying out. MENU displays the different functions of the Z88, and you can access any one by using the direction keys to locate the required function and pressing ENTER. INDEX will return you to the index from inside an application.

The keys are embossed mesas or islands on a rubber sheet, saving it from the inevitable spillages encountered by laptops. It reminds one of the old Sinclair Spectrum computer of a few years back.

The keyboard is light to the touch and virtually soundless. If you're used to a PC-style keyboard, there are minor differences to take into account, other than the unique items mentioned above. The backslash (\) key is at upper right, next to the DEL key.

## Z88 Portable computer

### The display

The liquid crystal display is comparatively small, but that's an acceptable compromise under the circumstances and for the convenience the Z88 otherwise provides. Some area of the display is always taken up, in each application, by some menu and indicator functions. However, you generally get a working screen area 72 characters wide by eight lines deep. It seems total screen width is around 100 characters, depending on the application.

The displayed characters are a little smaller than normal VDU screen characters, but are quite clear. The display contrast is very good, even under poor lighting conditions.

### Details

On the right hand side of the Z88, not on the front face, is the place for connecting the serial cable. In the same spot on the opposite side is a socket for a cord to supply mains power from a plug pack adapter. Beside it is a knob for adjusting the contrast of the LCD display.

On the back side of the device are two defined panels, one large and one small. The large one opens to provide a foot which props up the Z88 when you're using it on a desktop, or other flat surface. The smaller one gives access to the batteries. I note that an internal 'super' capacitor maintains the supply to the RAM while you change batteries. You get three minutes with no RAM cards fitted, one minute with one RAM card fitted and only 30 seconds with two RAM cards.

There is no disk drive, which is both an advantage and perhaps a disadvantage. Having no disk drive substantially reduces power consumption, allowing the use of smaller batteries, allowing better battery life and giving less weight. Against it, you can't load standard software packages or access files on disk. Instead of a disk, you use the plug-in RAM cartridges. You can load files using Import/Export, but not proprietary software.

Unless you must use proprietary disk-based software in the field, as it were, then lack of a disk drive is no drawback. What the majority of people are going to need is provided in the Z88: word processing and financial manipulation, a diary and a means of transferring files between the portable and a desktop PC.

The 250-page User Manual is a coil-bound volume so that the pages lay flat when you open it. It is very well laid-out and clearly written, with a comprehensive index; an excellent example of how such manuals *should* be done.

### Software

In the software, you get five applications:

- \* PipeDream
- \* Diary
- \* Terminal
- \* PrinterEd, and
- \* BBC BASIC.

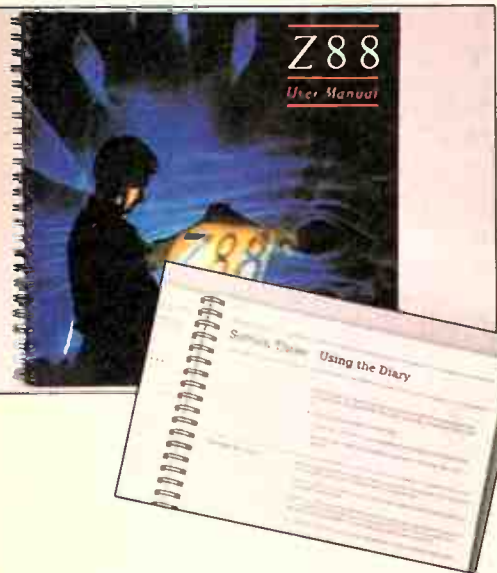
And you get eight popdowns:

- \* Index
- \* Calculator
- \* Clock
- \* Calendar
- \* Alarm
- \* Filer
- \* Panel, and
- \* Import/Export.

PipeDream is a word processing program for creating documents, but it has a few other trick facilities, too. Like other word processing packages, you use it to write documents etc, and you have the usual word processor facilities such as the ability to move blocks of text around in the course of editing files, format text (adjust margins, tabulate text, etc) – just as you're used to with any word processor. But, you can also get it to put lists of items in numerical order, and even perform calculations on tables of values. Normally, such features are only obtained via add-on software.

PipeDream is remarkably easy to use, not the least reason being because there's a help panel immediately below the LCD

Top-down view of the Z88, showing the keyboard and LCD screen.



The Z88 User Manual, cover (inset) and inside.

Instead of a reverse apostrophe (lower case) residing with the tilde (upper case), you get a British pound sign. The ENTER key is at least of generous dimensions. Intriguingly, you power-on and power-off by pressing both the SHIFT keys.

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**Side-on view, showing the foot which folds down from the rear of the case. The connector you can see there is the DB9 RS232 serial interface.**

screen listing the commonly required functions, and how to access them. If you're a WordStar user, it's all very familiar. The diamond key is the control (CTRL) key, so diamond G is used to delete a character, diamond T deletes a word, etc.

The Diary is, well, what it would seem to be! It can be used just like a desktop diary, with a page for each day on which you can write engagements, daily notes and expenses etc, any details you like, in fact. So, if you're not computer familiar, let alone computer literate, this application is very user friendly (though I hate to use that term!) You can recall entries of a certain type by keyword (all your party invitations, for example, simply by searching for party entries!). The Diary will find the pages on which you've made such entries. You can also print out entries of a given type. This would be great for doing summaries of business trips and meetings, for example, or summarising monthly expenses.

If you're into programming, BBC BASIC is provided. I can't see as wide an application for this as the other applications; programming is more an activity for non-mobile surroundings. Perhaps some teachers may find the facility useful.

All of the above applications allow you to output to a printer, but if you want to use a

particular printer's features, such as special fonts etc, then you need a specially configured printer driver. For this, the Z88 has PrinterEd. With it, you can create your own specially configured printer output to take advantage of the facilities offered by your plain or fancy printer - underlining, bold, italic, special characters, subscripts and superscripts, alternative fonts, et al. You can get such applications for your desktop or home computer to go with popular word processors, the locally produced FLASHPRINT for WordStar being a good example. PrintEd doesn't provide the extensive facilities that FLASHPRINT does, but it's horses for courses here and PrintEd is a welcome, and useful, inclusion.

The Terminal application allows you to use the Z88 to communicate with another computer, or another Z88, via the RS232 serial port. It employs the widely used VT52 standard, for those interested in such things. You can spool material received by the Terminal application into a file, to save and work on it later. And you can transmit files, too. Terminal is very simple to use.

Popdowns include an Index for managing resources, a calculator, calendar, clock and an alarm to remind the operator of appointments. It reminds you with a


message, and can be set to go off each day, month or other lapse of time.

The Filer provides access to the Z88 filing system. Here documents and programs written in BBC BASIC can be stored. For more permanent storage, of course, there is the EPROM card.

The Panel is a set of controls for the Z88, allowing you to make the keyboard, filing system and serial interface work to your own preferences. And for transferring files to or from another computer there is the Import/Export facility, for which some extras were provided.

Supplied with the Z88 was a PC DOS 5.25" disk and an EPROM card, both containing PC Link II International Version intercomputer communications software, and a serial cable (DB9 to DB25), all of which enables you to link the Z88 with an IBM PC or compatible. Using these, you can interchange files created on the Z88 as well as Lotus and Wordstar files between the two computers. A very handy facility and indeed, necessary, for laptops are best used as an adjunct to, or in conjunction with, another personal computer. Swapping files is, as they say in the vernacular, a snack.

## Summarising

Clearly, the needs of likely laptop users have been canvassed in advance and the Z88's design has been tackled accordingly. For people who are not really computer literate, the Cambridge Z88 would be a very good, cost-effective entry level laptop. For someone looking for a laptop to service their away from the PC computing needs, the Z88 is worthy of close consideration, particularly for its price. 

*Cambridge Z88 review unit kindly supplied by Jansit Computers, 5/5 Macquarie St, Parramatta NSW 2150. ☎ (02)891-5388. Basic cost, for version that links with IBM PCs and compatibles, \$995. The Z88 is distributed by ZComp Portable Computers in Sydney. ☎ (02)958-2797.*

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READER INFO No. 27



JIM TUCKER

## THE FAX OF LIFE

Can your computer be used as a fax? Is copy protection worth the effort? Is your you-beaut program worth selling? All is revealed by Jim Tucker this month.

**M**y latest toy is a fax board for my PC. Now, my need for fax doesn't justify spending \$2000-\$3000 for the full blown thing. The solution is a \$750 board which slots into one of my XTs.

It has all the features of a normal fax except the whole thing is controlled by software supplied with the board - four floppies! There are 28 .EXE files taking up 798k of disk space as well as about 100k of .COM files. You've gotta have a hard disk!

Two simple menu programs let you install the main program for different addresses and so on. Then all you need do is run the fax program whenever you boot.

Sounds simple, but the manual that came with the board is RS and it took the best part of a day to work it all out, create some dialling files and generally get it running. But that's par for the course.

The fax board will send ASCII files created with your word processor. If your word processor contains strange code (a la Wordstar's high bit) or headers (a la Wordstar 5) you have to print to disk then transmit the printer file. The program will automatically convert the ASCII file into a Group III (as they call it) fax file before transmission. Transmission rate for Group III is 9600 baud, so it romps along.

The program and board will receive a fax in background mode. If the line is connected in parallel to a standard phone you will hear the phone ring a number of times (you can install how many rings) before the fax program takes over. Your

computer will go beep-beep and the keyboard will lock. Go make a cup of coffee. When reception is complete your PC will go beep-beep again and you carry on with what you were doing. The incoming fax will be saved on disk.

In background mode the program uses 35K of memory - not a lot. Received faxes are stored on your hard disk in fax mode. They cannot be ASCII files because they may contain graphics. The file size will depend on the amount of data on each page but about 20K is used for each page of text.

The program keeps two logs - the names of incoming and outgoing faxes. You can look at these at any time and simply select files to output to your Epson compatible printer. But it's slow. A page can take five minutes on your average Epson printer.

### Auto dialling

Once you have received a fax, or created one from an ASCII file, you can send it on to another fax. In fact, you can send it on to hundreds of faxes.

The program lets you create an automatic dialling log with the name of the fax file to be sent, the number to dial, the number of times to retry the number in case it's busy, and the time of day to send it.

Stand by for junk fax! Here we have a fax on disk, a list of 300 phone numbers, all to be called after 10 pm when STD rates are lowest (21 cents for a 55 second transmission - about the time for

an average A4 page).

Congratulations! We have just fired 300 rockets for a cost of \$63. We didn't have to print anything, address envelopes, buy stamps or go to the post office. To do the same thing by mail would cost around \$150, not counting the time it takes to stuff 300 envelopes.

### Graphic fax

Fax board software cannot convert ASCII to graphics. So if you want to include a company letterhead with a logo, you have a couple of options. Buy a scanner or buy a fax. I'd opt for the fax unless you need a scanner for desk top publishing.

You can plug your fax directly into the fax board, in which case the fax will transfer pages to the board and they will be saved as fax files on disk. If you have a fax connected to a separate line you can phone yourself.

If you would like a standard covering letter with graphics before sending an ASCII file give the letter to a friend with a fax and ask him to send it to you. It will be saved on disk and you can send it with each transmission in front of an ASCII file.

### It takes time

On a real fax you can slap on a sheet of paper, press a few buttons and away it goes. On a fax board there are other things to do. I used this column and sent it to ETI's electronics editor as an example. The original is a 13.4K Wordstar file. The times are simple computer processing

times on a 10 meg XT, not allowing for how long it takes you to hit the keys.

Print 13.5K Wordstar file to disk: 1:17 mins

Convert print file to fax file: 3:28 mins

Number of fax pages: 9  
Transmission of all pages: 4:22 mins

Converting of this column to Group III fax created nine files (one file per page), named \$\$\$\$\$\$.001 and so on, used 166K on disk.

### Pros and cons

Fax boards have advantages. They're cheaper than fax machines. They allow large batch transmissions which are program controlled. They allow you to store faxes on disk for later printing or re-transmission.

On the other hand, to receive faxes in background mode your computer must always be switched on. Printing a fax is slow.

### Protecting programs

*I don't believe it!* My old mate, Jamye, phoned me. He wants rights to a program made in the USA to sell in Australia. But the US person wants a program that will count the number of copies he makes. That's not hard. A competent DOS programmer can write that on a wet Sunday morning. Your competent DOS programmer also knows how to make the thing count backwards so that Jamye can claim he made a negative number of copies!

Copy protection is not worth the itty-bitty bits of rust it is written on. For every protection scheme there is a program buster. A program called Copywrite (which can, itself, be copied) does most of the work. For the real stubborn stuff you need a copy board which sits between the floppy disk controller and the

disk drives. It simply copies magnetism. Any number of tracks and all manner of weird sectors. It copies errors (put there by the clever guys on purpose).

However, if you write custom software all is not lost. My Parton Label Program and other programs I write for specific customers, looks at the system ROM. At address F000:E000 you'll find a message. To read it use DEBUG and you will find out who wrote your ROM. Try this:

```
DEBUG
D F000:E000 Here's the
BASIC code I use to check that
my program is running on the
right ROM. The three bytes on my
customised ROM (at
F000:E000) are JRT but use
debug to find your (or your
customer's) ROM signature. Put
the first three bytes you find into
CHECK$.
CHECK$ = JRT
DEF SEG = &HF000
CS = CHR$(PEEK(&HE000))
CS = CS + CHR$(PEEK(&HE001))
CS = CS + CHR$(PEEK(&HE002))
IF CS < > CHECK$ THEN PRINT
"WRONG COMPUTER!" SYSTEM
END IF
```

Actually, my code is a bit more complex than this. I throw in a longer message and a few noises. The main point is to define the segment where the ROM lives (F000) before you begin peeking.

## Selling software

A friend of mine spent months writing a program. And he got the documentation together – wrote the manual, got it typeset, and even spent \$50 advertising it! It promised to pay off the mortgage, but did not have much success I'm afraid. Last year he sold two copies at \$20 each. (And one was to a sympathetic friend.)

Now, Gordon is a much better programmer than me. Been in the business since the year BF – before floppies-when everything was done from the front panel or paper tape.

What went wrong? Just about everything. The program was good, but aimed at a limited market – how many people need a label program for a

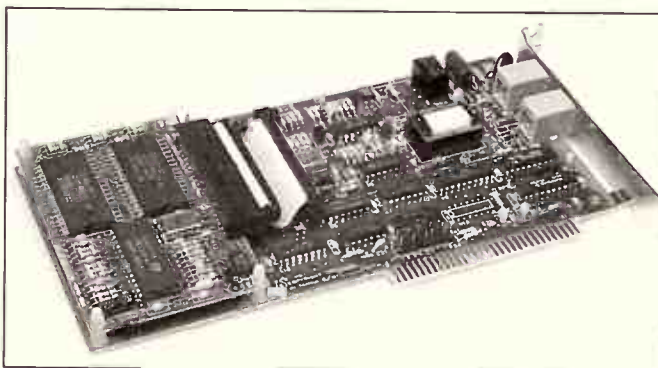
Commodore 64 floppy disk? No money was spent on promotion, and the price was too low.

## Your turn

So you want to write and sell a program? Or maybe a new circuit board with chips that have cunning connections?

First of all, there's not much sense in trying to sell a better mouse trap unless it is superlative! Your program should be unique as well as useful. The road of the fallen is full of better versions of dBase, Lotus, word processors and communications packages.

If you have yet another menu program, DOS handler, word processor or a game, go back to the drawing board. There are dozens of these in the public domain.



*Your typical fax card for a PC compatible. The little sub board at the left hand end contains the fax modem chipset (the smart bit!) of three ICs — this one's by Rockwell. The card came from Clarke Electronics in Adelaide, ☎ (08) 371-0711. Other suppliers around the country are advertising them, too.*

## The manual

But let's assume you have written something you call Super-Duper (you need a catchy name, and one that fits the DOS eight letter limit is even better). If you think writing a program is difficult try writing the manual! Not easy. In fact I suggest you write the manual before you finish the program. Write how the program works, then write the program.

The manual becomes the program's specs. More good programs have been killed by poor manuals than the other way. The best praise you can get is: "The manual is easy to understand and Super-Duper is easy to use."

## Selling it

Hypothetical time! Super-Duper is unique. It solves all kinds of problems and makes the life of a computer user much easier. Now you have to sell it.

One way is through a concept known as shareware or public domain. But one writer described shareware as: "Ten people who copy it and one who buys it. If you sell a program normally then one person buys it and ten copy it." Shareware seems to work in the United States, but not in Australia.

## Advertising

If you want to sell your program you have to advertise it. So far all you have spent is time. Now, my friend, you have to spend real

sales person. Plead poverty. Their general rate cards are just a bargaining position. Ask for 90 days credit, free spot colour, up front position and anything else you can think of. They'll knock you back nine times out of ten but bargaining can be fun. Talking to them after lunch is best and just before deadline when they want to meet a sales quota.

## Retail sales

You'll have to produce a brilliant program, with brilliant reviews, and spend a lot of money on national advertising to break into the retail software market. Most computer shops just don't have the time to learn about new software or demonstrate it unless it comes with a \$1000 price tag and they make a hefty profit.

So, for starters, keep the product under your control. Direct marketing through mail order. Put a proper address in your ads (not just a box number) and a telephone number. See your bank to arrange taking credit card orders by mail and over the phone.

## Support

Software support is essential. Most US software is sold on the basis of "if it doesn't work drop dead." I've sold software on the basis that if you can't get it to work, phone me. I'll try to help. If everything fails return it and I'll refund your money. In five years I have returned two disks – both from fools who couldn't be bothered reading the manual. I refunded their money.

## Pricing

Your precious program needs a price. How much? Well, let's assume you wrote it out of love. No cost there. But you have to supply a floppy disk, a box and a user guide. All up cost, about \$10.

Will it sell for double that – \$20? That's silly. How about \$50? How many copies do you have to sell to pay for promotion? Is Lotus 1-2-3 worth \$600 when a public domain program called ASEASY (which I use for spreadsheets) is free? You tell me.

ETI

# A COMPACT MODEM

Modems have been with us a long time, evolving from clumsy, largish boxes, rarely understood, through smaller boxes which rarely worked, to smaller boxes which work quite reasonably, for a price. There is quite a selection of modems on the market. Why, then, another one? Mike Jacobs writes.

**D**ata modems can be looked at from two viewpoints. One is deep-level functionality. At this level, each modem contains perhaps 50,000 – 10,000 transistors in total (in the form of LSI circuits) and most of us will shudder to even contemplate such unholy intricacy. This level, luckily, is not one that a product designer can do anything about.

The other viewpoint is that of 'black boxes' – components put together to create, miraculously, a higher order of matter, the final product.

It is this level, the component level, that is important in creating a successful product. To create a successful product, all components must be put together in a fashion which will ensure that the product will be:

- functioning perfectly
- reliable
- easy to manufacture
- easy to service
- pleasant and easy to use
- aesthetically appealing to the intended customers
- within the costing limits set in advance.

With the Compact Modem Type JMS-4, Jacobs Radio (Australia) Pty Ltd believes an important gap in the modems market has been filled. Features include:

- portable modem of compact size that does not take up a lot of room on the desk or in the briefcase
- operates from a variety of power sources including internal battery
- lightweight
- is direct-connect to PSTN (normal telephone network)
- can communicate at 7 speeds instead of the usual 3-4
- has all the standard 'AT' set of commands plus many more extended commands
- operates at CCITT and 3 Bell standards
- can automatically dial through all types of exchanges
- can automatically answer incoming calls
- has 4 different self-test modes to enable you to determine exactly where the fault lies
- has a built-in audio monitor to let you hear the progress of the calls, if you wish
- has 3 vari-colored LED indicators that will inform you of 5 different functions
- has an internal storage for all setup



- parameters that will hold them indefinitely, even without power, until you change them
- has practically no installation requirements
  - is specified, therefore guaranteed for a wide range of environments e.g. air travel
  - is manufactured in Australia to AS 1821 quality control standard
  - comes with a 3-year warranty
  - is low-cost

## Transmission capability

CCITT standards V21, V22, V23, V22bis as well as Bell 103, 212A and 224 are supported.

Data communication is possible at speeds 75,150,300,600,1200,2100 bps full duplex and 1200/75 bps asymmetrical duplex (V23).

Internal buffering and rate conversion is provided and is user-transparent. This means that while in V23 standard (e.g. Viatel) and the link speed is 1200 bps incoming and 75 bps outgoing, your computer is sending and receiving at 1200 bps.

## Self-testing

The Compact Modem can be thoroughly tested by several 'AT' commands. It can be configured into a local digital loop – this will test your end of the data path (the computer, cabling and the digital half of the modem).

It can be put into a local analogue loop which tests about 95 per cent of your modem. When you are on-line with another modem, you can initiate a remote digital loopback which will test all of your modem, telephone

connection and a part of the remote modem.

To ensure that the internal battery or the external DC power source have a sufficient voltage to power the modem, there is a special command to test this voltage. It returns either the standard 'OK' response of a 'Low Battery' message if the voltage is low. In this way there is not much left to chance.

## Powering the modem

There is a plugpack supplied for powering the modem from mains at fixed locations. Alternatively, if you have a DC source of 7V-15V, it can be used to power the modem.

The easiest, however, is the internal battery. An ordinary 9V alkaline battery will last you a long time. To ensure that further, there is a software command to turn off all LEDs – a prudent way to extend your battery life (the 'Low Battery' LED cannot be turned off).

There is no power switch. The modem does not consume any power until the DTR line comes on. This normally happens when you enter the communication mode via your software. At this point the modem draws minimum power about 150 milliwatts. It will stay at this level even during all V23 data transmissions. While on-line at other speeds, this power doubles. As soon as the modem is on-hook again, the power consumption drops to the previous level.

## Reset

Although the DTR line acts as an On/Off switch, it can also be used in the traditional way to signal the modem that the terminal is not ready. This is done by dropping the DTR for up to 100 ms.

There is a delay in the power switch circuit that will not turn the modem off prematurely and thus perhaps cancel your various settings.

However, a low DTR for less than 100ms will result in the modem assuming the local command state.

## Indicators

A red LED indicates that DTR is on. During dialling this LED will pulse in accordance with the dialled number.

The green LED indicates that a carrier is present from the remote modem. During answering this LED will flash with the incoming ring cadence. The third LED is the Low Battery Indicator. When lit, the supply voltage is below the acceptable minimum.

## Commands

There is a set of approximately 25 'AT' commands that control the modem. Most of these have trailing parameters that specify



what the command is to do (e.g. M1, M2 or M3 controls the monitor speaker in three different ways.)

There are 11 internal storage registers that can be read or written to (modified) by the user and another 5 registers that are read-only.

S15 contains the current B number (as established by the B command) and S17 contains the current interface speed (O-5) for 75-2400 bps. The rest (S13, S14 and S16) are bit-mapped flag registers.

Special care was taken in the command parsing and decoding area. Many modems accept wrong commands without giving any indication to the user that the command was rejected. The Compact Modem will produce an error message for each wrong command.

### Messages

There are all of the basic responses as in the standard 'AT' set of commands. However, another 25 extended responses are provided that will make the operation of the modem a pleasure for a discerning user.

Not only will the modem tell you at which speed you are being connected; it will tell you the standard and whether you are originating or answering the call.

It will tell you that you are being tested by the remote modem or that your attempt to test has been denied. Shortly, you're in charge at all times!

All of these responses are normally sent as words. They can, however, be sent to the computer in two other ways.

Firstly, as decimal numbers from O-29. Or, if it's easier for your program, as a single displayable hex number 30h-40h (ASCII O to M).

### Specials

There are a few special features not normally found in this price range. The modem can accept, by a special command, an extended signalling speed up to +2.3 percent (as per CCITT standard V22).

You can choose or decline, by a special command, to generate the guard tones as per CCITT standards.

At 2400bps in V22b1s, you can initiate a retrain to improve the quality of the link connection. You can also grant or deny such request to the other station.

The modem has an internal error detector that detects a bad connection with many errors. By a special command you can enable or disable an automatic retrain when the quality of the connection gets bad (only at V22b1s - 2400 bps).

To protect your property each modem has its serial number embedded in the firmware and it is displayed by the I command together with the software version and other information.

eti

More information from Mike Jacobs, FIE (Aust), managing director of Jacobs Radio (Australia) Pty Ltd, PO Box xxx, Croydon, Vic. 3136. ☎ (03) 879 3337.

# DEFINITELY NOT YOUR AVERAGE COMPUTER

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The Applix 1616 microcomputer.

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- On-board high speed cassette interface
- Optional disk/co-processor card
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- General purpose digital to analogue I/O port
- Analogue two-button joystick port
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### THE OPERATING SYSTEM

1616/OS is a programmer's delight

- ROM resident
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- File & Directory management
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The flexibility and power of 1616/OS make it a pleasure to use. Complicated tasks are simple.

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SSDCC Technical Features:

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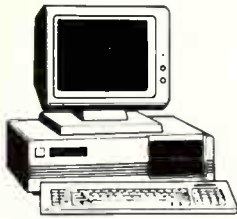
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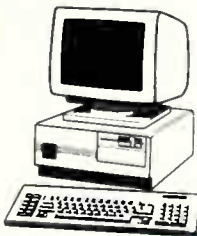
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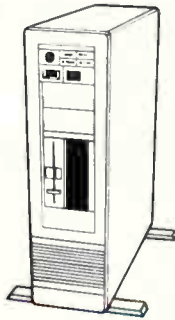


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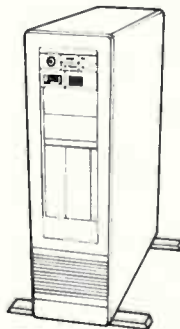
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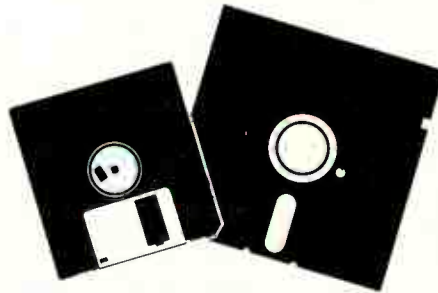
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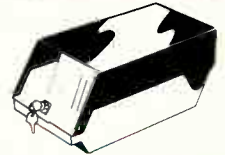


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## Upgrade for Siemens PLC

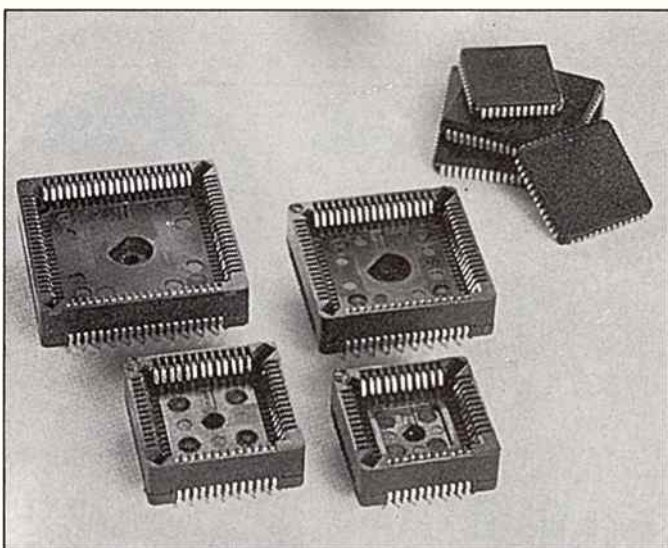
A NUMBER of new software and hardware developments have enhanced the performance capability of Siemens S5-100U mini-programmable controller. The CPU 100 now permits connection of the 385B high-speed counter module.

Integral function blocks for multiplication and division as well as for analogue value processing extend the functions of the CPU 102. Applications of the CP 103 have been extended by interrupt handling and a real-time clock.

Three new I/O modules have been added to the range of the S5-100: an 8-channel relay module; a 32-channel I/O module of compact design and the CP 521 printer interface module for printing out messages.

For further information, contact Siemens Limited, Power Engineering and Automation Department, 544 Church Street, Richmond Vic 3121. ☎ (03)420-7586.

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## Thru-board chip carrier socket

THIS socket from Adilam Electronics Pty Ltd, which conforms to Jedec specification MO-047, is said to offer a protective package in both through board and surface mount configurations to take advantage of conventional and vapour phase soldering techniques.

The exclusive high pressure contact system eliminates the need for gold plating while

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assuring a reliable, cost effective way to mount leaded chip carriers, it is claimed.

It converts a 0.05" pitch chip carrier to a 0.100" by 0.100" grid (through board version). Optional polarisation pegs are available. Pins mount into standard 0.035" holes.

More information from Adilam Electronics Pty Ltd, Suite 7, 145 Parker Street, Templestowe Vic 3106. ☎ (03)846-2511.

## Plug-in relays

A NEW range of general purpose plug-in relays from Sprecher and Schuh, type CH1, are available with two or three change over contacts, 8- or 11-pin plugs, and feature exceptional mechanical life due to their design which only requires six individual components in each relay, according to the makers.

A further version for direct printed circuit board mounting features three changeover contacts.

Further information can be obtained from NHP Electrical Engineering Products Pty Ltd, 51-67 River Street, Richmond Vic 3121. ☎ (03) 429-2999.

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## 500 VA line regulator

THE Powersafe 500, rated at 2.1 Amps/500 VA, has been added by Component Resources to its existing Powersafe 1000 and 2500 range. All incorporate an inbuilt power line filter and include built-in surge protection guarding against lightning spikes and power line noise.

If large magnitude transients interfere with the mains voltage, they are clamped and filtered out with surge reduction circuitry together with the electronic voltage regulator.

Powersafe units monitor the

mains voltage all the time. If it drops out of tolerance, the transformer taps are switched to provide a low distortion output to the equipment being used.

The Powersafe 500 guarantees to maintain output voltage at 220/230/240 V + / - 5 per cent. So does the Powersafe 1000. The 2500 has electronic regulation of output at + / - 4 per cent.

Contact Component Resources Pty Ltd, GPO Box 536F, Hobart Tas 7001. ☎ (002) 73-0066.

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## Video monitoring system ▼

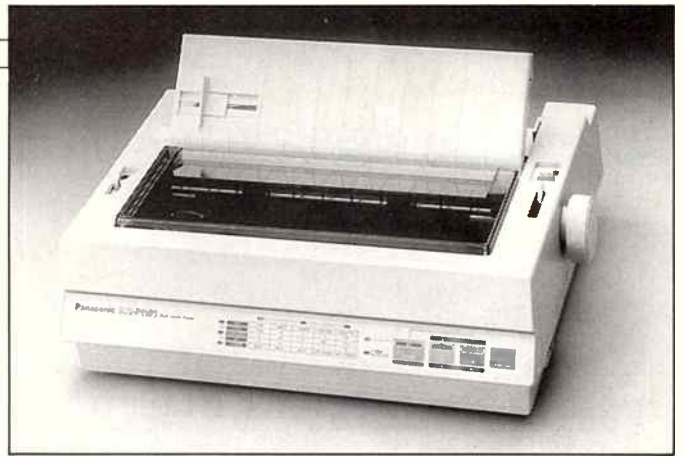
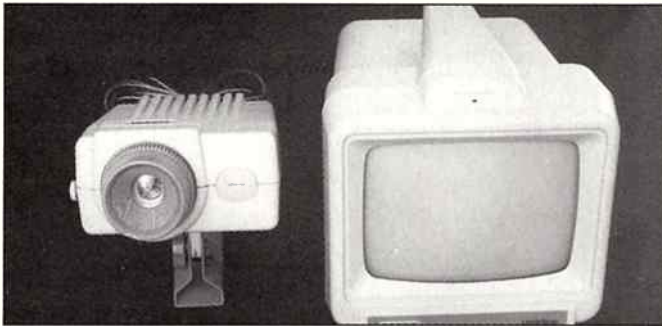
THE OnSight Video Monitoring System comes with camera and monitor and is intended for applications such as store monitoring, security monitoring, door minding, etc. It is small and light, easy to install and operate, according to the distributor, Captain Communications.

The use of a 13.8 V power (via a mains adapter) makes the OnSight suitable for battery backup and use in situations where mains power is not available.

The system is easily expanded to meet future needs, and can be used outdoors with a weather shield.

Other features include a compact six inch diagonal monitor; front mounted power switch; contrast and brightness controls; and 70 feet of wire included for installation flexibility. Further details are available from Captain Communications, 26-28 Parkes Street, Parramatta NSW 2150. ☎ (02)633-4333.

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## Two new Panasonic printers ▲

THE KX-P1191 and KX-P1180 11 inch 9-pin dot matrix printers from Panasonic have been designed to accommodate demand at the lower end of the market, the company says.

Operator panels are positioned at the front of the printers, which makes changing type faces and font sizes an easy task. The versatile paper handling facilities include both paper parking and a choice of rear, bottom and top feeding.

The KX-P1191 has print speeds up to 240 cps draft (pica and elite) fonts and 48 cps near letter quality fonts.

More than 4600 type styles can be created on the KX-P1191 by combining fonts, character sizes and enhancement modes like italic, underline and superscript. Further information is available from Panasonic Australia Pty Ltd, 95-99 Epping Road, North Ryde NSW 2113.

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## PortaDisk

PORTADISK from Electronic Solutions gives you 43 megs of mobile data in a completely removable hard disk and chassis that fits into a standard 5.25" housing on any PC, XT, AT or 386 PC.

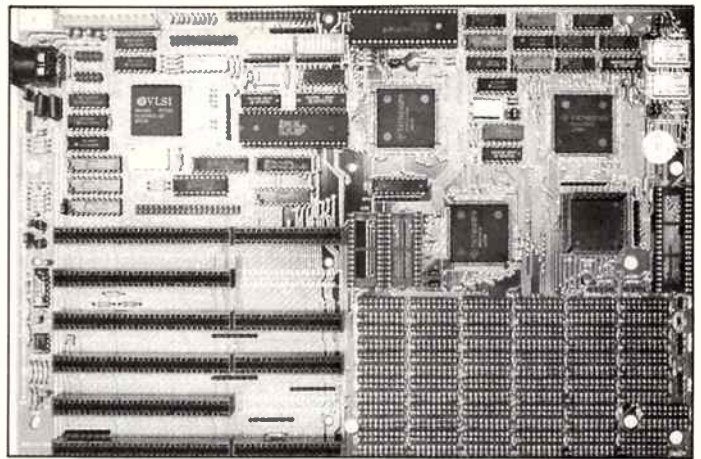
It contains a 42 Mbyte high speed NEC hard disk and all connectors to function with the PC's hard disk controller.

PortaDisk comes with keylock

and cabling and is said to take only minutes to fit. It has a three month warranty and a 14 day money back guarantee.

For PCs with hard disk controllers that cannot support a second drive, Electronic Solutions can supply suitable controllers for XT, AT and 386 machines. Contact Electronic Solutions, PO Box 426, Gladesville NSW 2111.

READER INFO No. 205



## 12 MHz PC/AT under \$500

ELECTRONIC Solutions has produced a 12 MHz zero wait state PC AT Computer (minus a video card) built onto a baby-sized motherboard, only 8.5 inch by 13 inch.

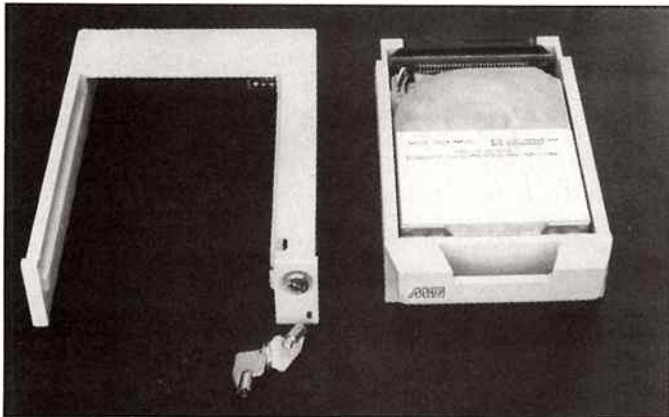
It costs about half the price it would take to buy its constituent parts. Features include dynamic I/O speed control which provides superior compatibility with add-on cards, the company says, plus two serial ports and one parallel port on-board.

An on-board floppy drive disk

controller for both 5.25" and 3.25" drives is included, plus all cables for ports and floppy drives and it boasts the Award BIOS with built-in setup, 7 channel DMA and 16 level interrupts. A real-time clock and off-board battery backup is provided too.

Up to 4 Mbytes of RAM can be fitted onto the motherboard. There is no need for memory expansion cards. The device uses 256K or 1M chips. From Electronic Solutions, ☎ (02) 427-4422.

READER INFO No. 204



## ELECTRONICS TODAY

# eti

ELECTRONICS • TECHNOLOGY  
INNOVATION

## Reader Information Card

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## Step generator

THE TG-511 Step Generator enables the accurate alignment of tape recorders and the real-time alignment of high-speed cassette duplicating equipment.

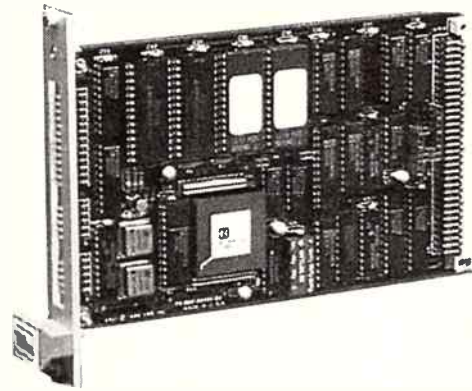
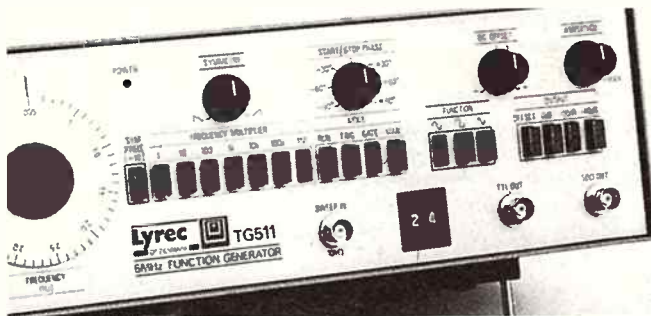
Based on the Lyrec Standard Thandar TG501 function generator, it works by generating a pulse train viewed on an oscilloscope. The pulse train is made up of ten discrete frequencies, each represented by a vertical bar. Bar height indicates the level at each

frequency.

The unit operates in either the standard function generator mode or in the Step mode, where the pulse train can be made to run on different lengths (slow, medium and fast). Any one of the ten discrete frequencies can be selected.

For more information contact David Hudson, Amber Technology, PO Box 942, Brookvale NSW 2100. ☎ (02) 975-1211.

READER INFO No. 200



## 15 MIPS processor board

THE V401-O from VME Inc is a processor board for real-time embedded control applications capable of 15 MIPS execution speeds, with bursts up to 40 MIPS.

The device is based on Harris Semiconductor's RTX-2000 (20 MHz) micro-controller. It is intended for use in robotics, machine and process control, data acquisition and factory automation.

The V401-O is a standard 100 x 160 mm VMEbus card that

occupies one cardcage slot. It has 64 Kbytes of EPROM, 64 Kbytes of CMOS SRAM supporting battery backup, a 16-bit parallel multiplier, 16-bit multi-channel parallel I/O port and two R232C serial ports, VMEbus Master and Interrupt Handler.

Further information is available from Energy Control International, 26 Boron Street, Sumner Park, Brisbane Qld 4074. ☎ (07) 376-3286. READER INFO No. 201



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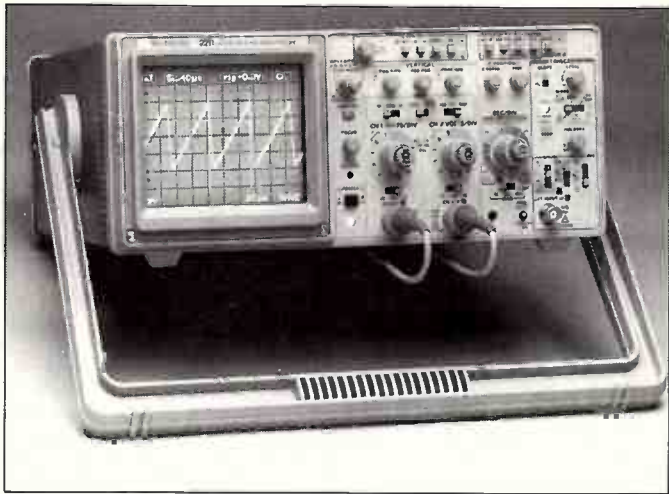
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6	31	56	81	106	131	156	181	206	231	256	281	306	331
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18	43	68	93	118	143	168	193	218	243	268	293	318	343
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25	50	75	100	125	150	175	200	225	250	275	300	325	350

For a prompt reply



ETI SEPT '89





## New portable storage CRO ▲

THE 2211 portable oscilloscope builds on the feature set of the popular 2200 Series oscilloscopes and provides 50 MHz bandwidth and 20 MS/sec sampling rate per channel. The new scope also offers 8-bit vertical resolution and 4K record length per channel.

New features include on-screen cursors, CRT readout and a hardcopy serial interface. Targeted applications include field and in-house service, electromechanical analysis, production test and process control and it's well-suited for low-frequency and single-shot

measurements found in biophysical applications.

Cursors providing both delta voltage, delta time, and inverse delta time measurement with on-screen readout of both front-panel scale factors and cursor measurement results.

It has pre and post trigger capability, so users can view events occurring before and after a trigger event, and dual digitisers so each channel can be acquired simultaneously. Further details from Tektronix Australia Pty Ltd, 80 Waterloo Road, North Ryde NSW 2113. ☎ (02)888-7066.

READER INFO No. 202

## Conductivity, temp.

### measurement ▼



THE new LC84 is designed for conductivity, salinity and temperature measurements, and covers a range of conductivities.

Most readings are taken with the  $k=1$  electrode which is supplied in the standard kit. For low and high measurements,  $k=0.1$  and  $k=10$  electrodes can also be used.

The unit features automatic temperature compensation, a large liquid crystal display and is claimed to provide excellent portability.

The manufacturers claim it meets the needs of a number of industries, including water and effluent treatment, aquaculture and a number of other areas of scientific research. For more details contact TPS Pty Ltd, 4 Jamberoo Street, Springwood Qld 4127. ☎ (07) 290-0400.

READER INFO No. 203

# Total Protection



**TOTAL LIGHTNING,  
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Technology**



## Process

The SA line barrier can be supplied with a variety of clamping voltages as required to suit particular applications. Use the SA to protect Computers, Data, RS232, CMOS, TTL, FSK, Baseband, Telemetry, Thermocouples and Current Loops. Choose the clamping voltages to suit the application.



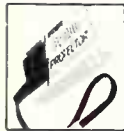
## Telecom

The DP200 is the first hybrid barrier to plug directly into a BT631 type line socket and provide protection from lightning, NEMP, Static, Noise and RFI. Use the DP200 to protect Fax, Modems, Telex, Telemetry and other PSTN Telecom systems. The units are extremely easy to install and give full 4 wire protection.



## Network

The NP series of protectors are suitable for protecting computer networks, particularly those with high data rates up to 10 Mbits per sec, ie. RS422 and RS485, IBM Twin-Ax and Ethernet LAN's. The NP should also be selected to protect video links including security cameras.



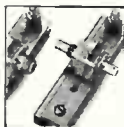
## Aerial

The CA series of Aerial Protectors are high energy coax arrestors with a very wide bandwidth and low VSWR. The units are available with BNC or type N connectors, are easily mounted and are precision engineered from nickel plated aluminium to resist corrosion even in severe conditions. The CA series will protect receivers or transmitters from Lightning, Nemp, RFI and other Surges picked up by aerial installations.



## Mains

The MA series will protect equipment, powered by the mains supply, from the possibly disastrous effects of Surges, Noise and Spikes. The MA06 has twin sockets and incorporates a separate filter for each socket, spike protection and an earth line choke. It is supplied in a strong, but stylish metal case to suit the office or workshop.



**Westinghouse Systems:**  
80-86 Douglas Parade,  
Williamstown, Vic. 3016  
Postal Address: P.O. Box 267,  
Williamstown, Vic. 3016  
Ph: (03) 397 1033 Fax: (03) 397 1861





BUFFOONERY

## PEEKING, POKING AND PATIENCE

**B**arry, a colleague, works as a specialist consultant in the medical electronics field, designing, commissioning and servicing some very sophisticated patient monitoring systems and medical laboratory instrumentation. Lovely gear, it is, just bristling with knobs, dials and flashing LEDs! It features such wonders as probes and sensors for placement in, on, over or around various bodily parts, orifices or appendages, as appropriate.

He says he gets a warm inner glow whenever his machines spring to life with a spectacular display of urgently winking lights, rolling display digits and beeps as a patient drifts out of a deep coma to semi-consciousness. Thank goodness the poor patient is too groggy to be aware of the machine's neurotic freneticism, else he would want to slip back and leave the worries of the world behind!

Barry launched on his career at age 10 when he explored behind the family radiogram. A wonderful thing of design and craftsmanship it was. The sort of thing you see in inner city vintage wireless specialists these days. It had a wood-veneered cabinet (with an open back), stood as tall as he did, proudly boasted a 12-inch Rola ("the finest loud-speaker in the world") and featured a large, square, glass-fronted dial with a long, wire pointer that moved behind the stations painted on the rear of the glass.

In the rear he pushed, prodded and poked until he gained a response – a loud hum as he

touched the grid cap of the low level audio stage. Lifting the chassis, he prodded underneath. *Much* more response – a healthy bite from the hundred and fifty volts or so of high tension! ("Ooh Mummy – look at all the pretty coloured stars!") Involuntarily, Barry was propelled backwards, knocking over some item of furniture.

Alerted by the commotion, his mother appeared on the scene and, deducing what had happened, scolded him, saying "Barry! Don't you know not to push or poke things when you don't know what they do?"

Undaunted, Barry went on to a career in electronics engineering. When the solid-state revolution swept through, he saw an opportunity in medical electronics, having spent some student vacations servicing X-ray machines. He found the field lucrative.

A year or two ago, he acquired a long lusted-after possession. A bright red Ferrari. Cherishing his acquisition, he designed, constructed and installed a 'smart' burglar alarm. Barry does not speak about its principle of operation; his patent attorney

has the details. Rumour has it this alarm can 'smell' the owner and alarms itself when unfamiliar passengers get into the vehicle. I can just imagine the thought processes circulating in its non-volatile RAM – "...sniff, sniff; gas analysis; familiar smell; Sonia – no, Cynthia! ... that's Arpege."

A short time after acquiring the Ferrari, Barry acquired a new girlfriend, perhaps inaptly named Patience. One evening, Barry and Patience went out for a late dinner. However, when picking her up, he warned her that he would have to make a few short calls before getting to the restaurant.

Call number one was to his service centre and took 15 minutes. Patience cooled her heels in the car. Call number two, at a large public hospital, took about 20 minutes. Patience, cooled her heels in the car, yet again.

Call number three was to a small, quiet private hospital in a leafy peninsular suburb on the harbourside. Barry parked in the visitors' car space out front. All was quiet, only a discreet light at the entrance glowed gently in the darkness.

Searching for something to read, to while away the increasingly lengthening calls, Patience opened the Ferrari's glove box. "Maybe I can read the street directory," she muttered between clenched teeth. Inside,

there was no road map, but she spied a pushbutton. She pushed it ... no response. She pushed it again ... no response.

Presently, a light on the dash began to flash on and off about twice a second. Quickly, she opened the glove box, and frantically pushed the button again. Too late! *Honk-Honk-Honk!* went the horn as all the car's lights flashed in unison.

Charging outside, Barry found friend cringing in her seat in front of an open glove box. It all flashed back in his mind's eye – that day he explored behind the radiogram – as he tersely echoed his mother's words, "Don't you know not to push or poke things when you don't know what they do?"

## Laptop robotics

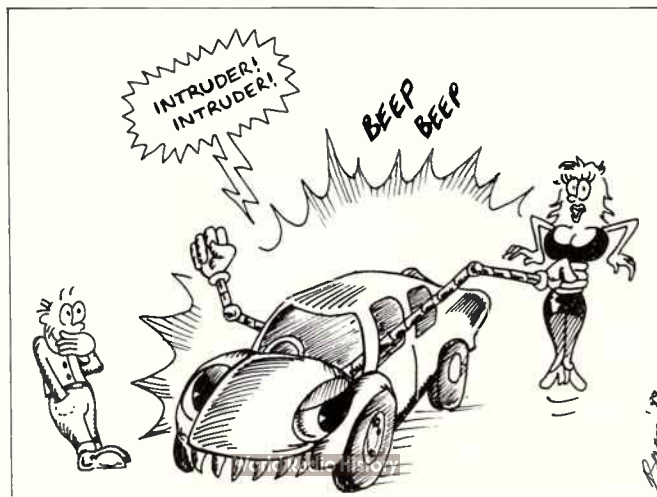
THIS should be an Irish story, but it's not. In Edinburgh a little time back, we heard tell of a curious court case, involving the high-tech ambitions of a certain restaurant proprietor and how they came to grief...

Said proprietor, perhaps dissatisfied by unreliable waiters who made personal adjustments to the stock, outlaid a not inconsiderable sum on a second-hand (or perhaps the word should be pre-loved) wine-serving robot.

Unfortunately, as an Edinburgh court was later told, the robot misbehaved. First, it spilled a glass of wine. Then after a few minutes, it became uncontrollable and began to knock over furniture, allegedly frightening the clientele.

As if this behaviour seemed too similar to the human waiter which the robot replaced, it reinforced its uniqueness by finally depositing its head into a customer's lap.

eti





# SOUND INSIGHTS



**WE REVIEW:**

● **PIONEER  
Z770 SYSTEM**

● **AKAI  
GX-95 STEREO  
CASSETTE DECK**



# IT JUST GOES TO SHOW . . .

By the time you read this, the 1989 Perth Electronics Show will be just past — we'll have a report on that in an upcoming issue — but, this issue, let's look at what's happening in the world of sight and sound overseas. Specifically, the Chicago summer Consumer Electronics Show in the USA. By Roger Harrison.

The summer Consumer Electronics Show held in Chicago each June is an American institution. It has been that, too, for a good many Australians in the hi-fi and video industry who make the pilgrimage almost every year. In comparison with Australian shows (and Perth is really the nearest thing to it in nature), the Chicago bash is positively massive, with some 100,000 delegates attending from the USA and other countries around the world.

The 1988 show was reportedly flat, with attendances of delegates and exhibitors being significantly down on previous years, and not a lot of innovation showing up in the various product categories that have characterised the show in earlier years. Again this year, crowds were thinner than expected and exhibitors were not up to

previous years' strengths.

This may be affected by what is reported to be listlessness in sales in the USA at present. However, the US Electronic Industries Association released a projection for 1989 showing a rise of some US\$1.5 billion in factory sales in 1990 over 1989.

Some industry identities commented on the lack of innovation in many products launched this year, saying that what they saw were just slight enhancements on existing products.

That may be so, but there was some excitement, particularly in video equipment. GoVideo released a dual-deck video cassette recorder which is reported on in a little more detail in Sight and Sound News this issue.

It seems a number of manufacturers are following Sony's lead with their Video

Walkman "combo" LCD TV and VCR (8 mm) unit released late last year. A number of similar units appeared, along with a lot of LCD handheld and portable TV receivers.

But the truly hot product line this year is, surprisingly, video games! It seems 16-bit game systems are all the go this year. As the generic title suggests, these games use a 16-bit processor, whereas most games systems to date have been in the 8-bit class.

There's been a boom in video games in Japan since 1987 apparently, and it's just starting to sweep the States. NEC released a 16-bit game dubbed TurboGrafx-16, while Sega (remember them?) launched a feature-packed one dubbed Genesis.

Apparently, NEC's TurboGrafx-16 uses an 8-bit microprocessor but a 16-bit graphics processor, which provides smoother, faster action, larger characters and more colour. It boasts high quality sound, too.

Sega's Genesis features arcade-like graphics and colour, plus stereo sound. It uses an 8-bit processor (Z80) and a 16-bit (68000) processor, and is able to run older 8-bit games cartridges as well as the new, 16-bit games. An optional modem is available so you can play head-to-head with someone else across town, or across the country, via the telephone!

Japanese electronic games giant, Nintendo (whose motto is "the future of fun"), released a portable game unit boasting a 150 x 100 mm (6" x 4") LCD screen and capable of playing gamepack cartridges of 256K, 1M and 2M capacity! With a videolink hookup, two players

can square-off against each other. Nintendo will enter the 16-bit games market in Japan this year, followed by the USA next year.

Meanwhile, Atari — better known for their home computers — unveiled what is said to be the first portable, handheld video game with a colour LCD screen.

You might think these games sell only to kids. Not so! Well, not entirely. While 61 per cent of users are aged 6-14 years, a whopping 27 per cent fall between 25 and 44 years of age. Industry sources say the percentage of adult and female users is rising. Who knows when, or if, this games boom will reach Australia.

High definition television (HDTV) was hotly debated at the Chicago show. Cable TV companies want it introduced to give them an edge in picture quality compared to broadcast reception, while broadcasters want it introduced for the quality improvement it offers viewers and advertisers. TV product distributors want it introduced to boost sales in an otherwise slow market. But, they're all blaming the politicians for delaying it.

When is a camera not a camera? When it's a Canon Xap Shot. This is a still video camera that looks and operates like a tiny, conventional film camera. But, it's a still video camera that records pictures on a tiny 50 mm floppy disc that can be instantly replayed on a TV set. The disk stores up to 50 pictures. Canon gave it a heavy push at the CES.

## New force in hi-fi retail

PACIFIC Hi-Fi Ltd, a newcomer to the Sydney hi-fi retail scene,



A corner of the Chicago Consumer Electronics Show.



From left to right, those behind Pacific Hi-Fi: Joe Daidone, Paul Touzell, John Johnson and Frank Di Bartolo.

positions itself as a "diversified retailing company whose business is to serve the consumer through the retailing of fashionable quality hi-fi merchandise."

Pacific Hi-Fi says it will take on the competitive retail market with new merchandising and marketing strategies, innovative entertainment display concepts and full service facilities.

Managing director, Frank Di Bartolo, says Pacific Hi-Fi will not be competing in the discount market.

The first Pacific Hi-Fi store is located at Roselands, to be followed by another at Liverpool in the near future.

Di Bartolo and his three key management staff broke away from competitor, Miranda Hi-Fi earlier this year and operated two stores under the name Hi-Fi Clearance Centre in preparation for the Pacific Hi-Fi launch.

A private, family-owned company, Pacific Hi-Fi says it will provide good, old-fashioned service, a commitment to quality and a desire to educate the consumer as to what hi-fi is all about, providing a refreshing change in an industry which currently concentrates on price wars and discounting.

Key people include marketing manager John Johnson, special projects manager Paul Touzell and stores merchandising controller Joe Daidone.

Under the direction of Johnson and Daidone, the company will take on a fresh approach to merchandising. According to Johnson, "Pacific will break away from the cluttered warehouse feel of many retail outlets. Through creative display techniques and the co-ordinated packaging of hi-fi components,


we will eliminate the confusion felt by some consumers when they enter many hi-fi stores and are bombarded by hi-tech.

"The use of televisions, videos and speakers will allow our sales team to demonstrate a complete entertainment package to the consumer - one which is tailored specifically to their needs," he says.

In line with the company philosophy of offering good, old-fashioned service, Pacific Hi-Fi says it will offer consumers full in-store service facilities to minimise inconvenience to customers when one of their units is not working. Although initially the service centre will be based at Liverpool, by the end of this year a service department will be established in each store, the company says. Special warranty systems will also be offered.

Pacific Hi-Fi will also cater for the specialist needs of private and government bodies. Headed by special projects manager Paul Touzell, the company aims to advise on and supply sound and vision equipment to offices, clubs, motels, hotels and other institutions.


The company also aims to provide a full insurance replacement service for insurance companies and brokers. Under the registered trading name of Insurance Replacements, this business will also be headed up by Paul Touzell as general manager.

And the future? According to Di Bartolo, "The Roselands store is only the first of many. By the end of this year we will have a minimum of three fully operational stores in the Sydney metropolitan area plus a hi-fi clearance centre." 

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## New Tannoy monitor ▲

THE NFM-8, a new Near Field Monitor from UK loudspeaker specialist Tannoy Limited, has a 200 mm (8") dual concentric drive unit which incorporates an improved roll surround design said to ensure linearity and robustness while still allowing maximum radiation with minimum acoustic interference from the roll surround.

The separate sections of the dual concentric drive unit are designed to provide a point source. Both high and low

frequency sound sources are aligned by a crossover network to a single point on the same axis.

The unit is intended for use with amplifier powers from 10 to 200 W, boasts a  $\pm 3$  dB frequency response from 48 Hz to 25 kHz and distortion less than 0.5 per cent, according to the specifications.

Further information is available from the distributors, Hi-Phon, Unit 13, Block C, Allambie Grove Business Park, Warringah Road, Frenchs Forest NSW 2086.

READER INFO No. 236

## Sound FX on CD

THE Series 1000, 2000 and the newly released Series 3000 digitally recorded sound effects libraries from Sound Ideas are available from Australian distributor Syntec International.

More than 5000 sound effects are stored on the 72 CDs which comprise the three series. They are fully catalogued in cross-referenced alphabetical order, with track, index, duration and recording process

READER INFO No. 235

information.

In addition to this comes a sampler library on six CDs, with over 3000 digitally recorded sounds from 135 instruments. Accompanying these recordings are ensembles, percussion sounds, vocal sounds and other selected effects.

For further information contact Syntec International Pty Ltd, PO Box 165, North Sydney NSW 2059. (02) 406-4700.

## Classy Class A

AUDIO Investments of Sydney has been appointed as distributor and retailer for Audio Innovations of Brighton, UK, which makes a range of Class A valve audio equipment.

The Audio Innovations Series 500 is designed using Class A circuit topology with low negative and local feedback (14 dB). The designers have used the EL34 pentode in matched pairs, delivering 25 watts per channel.

The range offers inputs to accommodate CD, auxiliary, tuner, tape in/tape out and monitor. All inputs are 100k impedance and have a sensitivity of 400 mV with a maximum overload better than 3 V. The gold plated phono input

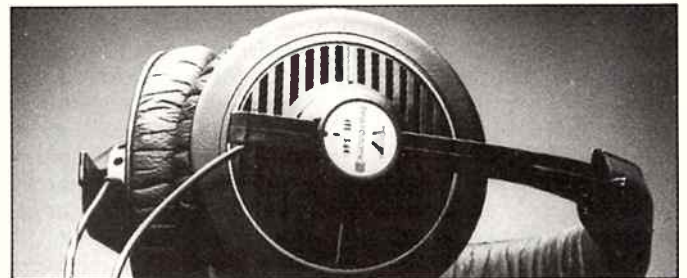
is designed with enough sensitivity for most moving coil cartridges. The input impedance is 47k, so an impedance-matching transformer is recommended.

The output transformers are said to be chosen for their high frequency performance while maintaining flat low frequency response to below 20 Hz.

Speaker connections are made via heavy duty binding posts on the rear offering 4, 8 and 16 ohm impedance, and will accept either bare wire or banana plugs.

For further information, contact John Murt of High Profile Communications, 5 Towri Close, St Ives NSW 2075. (02)488-8184.

READER INFO No. 234



## TV headphones ▲

THE DT340 TV headphones from Beyerdynamic, designed for TV watching, are claimed to use an advanced transducer to provide "...clear, natural sound reproduction and fast transient response."

A 7 m-long flat cable enables maximum accessibility and twin, clearly-marked rotary controls allow fully independent left and right channel volume adjustment without you having to move from your chair.

Another model, the DT 303 TVs, has a wideband frequency

response of 20 - 20,000 Hz and is said to provide sound as good as the DT 340 TVs. It has a 7.5 m cable. Full control is afforded by a special mono/stereo switch and independent volume controls for both left and right channels.

Both headphone models can be used with 3.5 mm or 6 mm connectors. Further information is available from Hi-Phon Distributors Pty Ltd, Unit 13, Block C, Allambie Grove Business Park, Warringah Road, Frenchs Forest NSW 2086.

READER INFO No. 232

## New VCR encourages pirates?

THE latest VCR from controversial US manufacturer Go-Video incorporates a new microprocessor from Intel which apparently enables the machine to record two programs at once, record one program while playing another tape as well as edit and duplicate tapes.

For this reason many in the industry say the VCR will cause an outbreak of rental movie

cassette pirating. However, undeterred by this, Go-Video is proceeding with the production and marketing of the new product. The Go-Video machine is not available in Australia.

Go-Video came to prominence in the USA last year with a dual-cassette VCR system which occasioned considerable industry disapproval.

READER INFO No. 231



## New Sanyo sound systems ▲

A NEW generation of sound systems has been introduced by Sanyo. They include a range of portable sound systems incorporating trapezoid - specially-shaped speaker boxes, the DJ-1 and the furniture look range of products.

In the trapezoid line up is the MW242F. It features a 5-band graphic equaliser, FM stereo MW radio condenser microphone, surround sound, high speed and synchronised dubbing and one touch recording.

Also in this range, the MW232F incorporates a three-band graphic equaliser and two-way speaker sound system with built-in condenser microphone in addition to other features found on the 242F. The M9731F, a three-piece stereo radio cassette recorder, completes the range.

The DJ-1 has the new round look in hi-fi and digital sound systems. It is fully automatic with CD program edit and twin seven-

band spectrum analyser with a graphic equaliser. Also, it has a 48-key remote control providing access to all operations.

Designed to blend into a livingroom, the furniture look range includes a cordless remote 15 watt sound system. GXT 848S has a 5-band graphic equaliser and 18 pre-set channel tuner as well as a dual cassette deck synchronised for high speed dubbing.

It has two-way full range speakers and auto-touch tuning with LCD readout and a semi auto belt drive turntable. The other system, the GXT 828S, is a 10 watt/channel RMS system with a 3-band graphic equaliser. It also has touch tuning with LCD read-out.

For further information contact Mark Tyler, Product Manager, Sanyo Australia Pty Ltd, 7 Figtree Drive, Homebush NSW 2140. (02) 763-3822.

READER INFO No. 230

## Continuous play

THE TRK-CW3W from Hitachi is a lightweight, cylindrically designed twin cassette recorder and player. The twin cassette feature provides for continuous playback facility. When the cassette in Deck 1 is finished it switches automatically to the cassette in Deck 2, so the music is not interrupted.

Among the other features are the free-angle speakers. The speakers are mounted on the end of the main unit so they can rotate, enabling you to point the speakers directly at yourself or to

direct the sound more widely.

There is high-speed dubbing, an auto stop mechanism, mechanical pause, LED FM stereo indicator, a built-in headphone jack, a built-in condenser microphone, a battery two-way power operation, music power and a soft eject mechanism.

The device comes with a carrying strap, has a four track, two-channel stereo and magnet erase capability. See your nearest Hitachi dealer.

READER INFO No. 229



## Hi-Phon move ▲

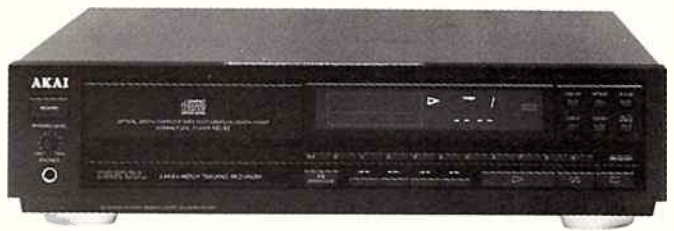
HI-PHON Distributors has moved its head office and central warehouse to the recently completed Allambie Grove Business Park, at Frenchs Forest just north of Sydney. The move took place in July for greater distribution convenience, and to provide a nicer working environment for the staff,

according to the company.

The new address is Unit 13, Block C, Allambie Grove Business Park, Warringah Road, Frenchs Forest NSW 2086.

For a similar reason, the company recently relocated its Melbourne office to 47 Nott Street, Port Melbourne Vic 3207.

READER INFO No. 212



## Tape copy-edit for CD player ▲

COINCIDING with the Federal Government's passage of legislation on the blank tape levy, Akai has introduced its first 18-bit, 8-times oversampling compact disc player, the CD-62 which features an automatic edit facility which edits the tracks on your CD into programs that will fit

within the recording length of each side of the cassette tape you are using.

It will show the combination of tracks that will fit on one side of the tape and also display the total playback time of tape tracks.

READER INFO No. 228

## KEF's Uni-Q speaker concept

BRITISH loudspeaker manufacturer, KEF, has developed a speaker which unifies the woofer and tweeter into a single module. Nothing new in itself, Tannoy's been at it for years - putting the drivers not only on the same axis but in the same plane, so that the sound sources are not only coaxial but time aligned, too.

Claimed as a significant first in the sound industry, the development of the Uni-Q Driver

(as it's called) was only made possible by the recent development of a new magnetic alloy, neodymium-iron-boron, which KEF used to manufacture the driver which calls for a unique magnet assembly.

The innovative new driver has been used in KEF's C-series of loudspeakers; the C95, C75, C55 and C35, recently released through Falk Electrosound, which is based in Sydney.

READER INFO No. 199

## 8083 Mixer

COMPLEMENTING the TX8000 series, the 8083 mixer from Audio Telex is a full-featured mic/line mixer. It has seven mic/line inputs and one stereo or mono auxiliary input accessed through a pushbutton program selector.

It also possesses individual gain, foldback, bass, treble, effects and

fader controls for each channel to enable full set up and equalisation of each. Outputs are transformer balanced and include stereo for the auxiliary inputs.

For further information contact Audio Telex in your capital city.

READER INFO No. 196

## Something New in Specialist Audio retailing.



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READER INFO No. 45

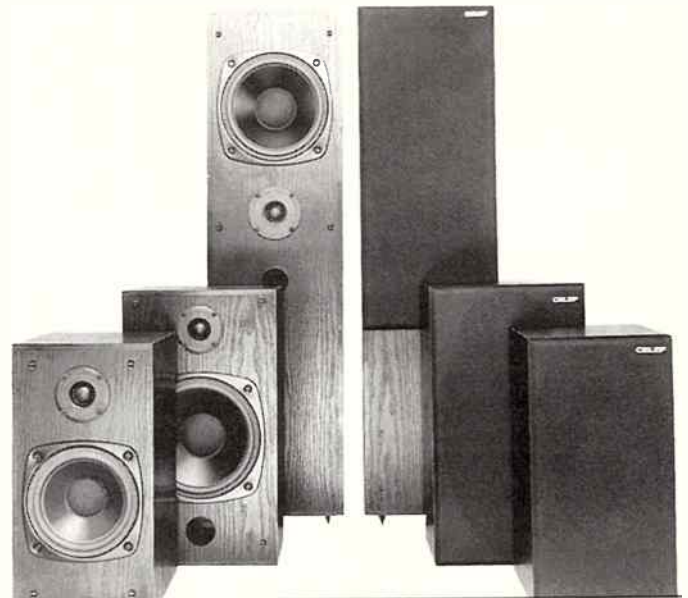
## Shuffle-play CDs

BOTH the CD883 and CD583 from Marantz have twin 16-bit digital-to-analogue converters with four times oversampling and feature shuffle play, repeat functions, direct access to 99 tracks, and a 20-track memory as standard. The CD883 also features Automatic Music Search (AMS) which plays the first few seconds of each track.

Also common to each model is Marantz's fully floating laser transport with its swinging-arm pickup that can track the CD's small information track with more precision, it is said, than the linear-tracking arms used on most CDs.

For further information, call John Wiseman, Marantz Australia, ☎ (02) 742 88322.

READER INFO No. 198



## Speakers in the clouds ▲

SALD to incorporate some of the design criteria used in developing the ProAc range, the new range of Celef speakers are the Cirrus, the Nimbus and the Stratus.

Aimed at the domestic market, they apparently have good imagine, excellent detail and low colouration, according to the distributor.

With a claimed frequency response of 40kHz-20kHz, the Cirrus boasts a quoted sensitivity of 90 dB for 2.83 V input. The bass/midrange driver is a 150 mm diameter polypropylene cone type, while the HF driver is a 25 mm dome tweeter. Recommended amplifiers should be rated at between 15 and 80 W, the makers say.

The Nimbus has the same frequency response and sensitivity but uses a 250 mm diameter polypropylene cone bass/midrange driver. The HF

driver is also a 25 mm dome tweeter, but with ferrofluid. It is recommended for amplifiers rated from 20 to 100 W.

The Stratus has the highest power rating, being recommended for use with amplifiers rated up to 150 W. Frequency response is quoted as 35 Hz-20 kHz. It has a bass/midrange driver the same as the Nimbus, and the same sensitivity as both the other models. Its HF driver is the same as that on the Cirrus.

All models have a nominal impedance of 8 Ohms and the cabinets use 18 mm HD chipboard with a removable, acoustically transparent grille. The finish common to each is a black ash effect.

Full details from Arena Distributors, Victoria Park WA ☎ (09) 361 5422.

READER INFO No. 197





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READER INFO No. 33

World Radio History

# PIONEER'S PROGRESS

## The Z770 system

Pioneer's Z770 package should satisfy both kinds of buyers, says Pat Hayes.

**P**hilosophers tell us that there are only two types of people: those who keep their heads in a crisis and those who understand the full gravity of the situation. I'm no philosopher but I can assure you that there are only two types of people who buy sound systems.

The first wants the simplest possible combination, one that is as close as possible to the classic 'straight wire with gain'. The heart of such a system, the amplifier, should be no more than the classic black box with two controls: an on-off switch and a volume control. The rest of the system is along the same lines, including the turntable which must have an arm that has to be lowered gingerly on to the vinyl at the start of play.

This person is able to use a wide range of technical terms, not necessarily accurately, and calls himself (or herself) an audiophile.

The other type of buyer wants to see value for money. For this person, it is not enough for Jennifer Warnes to raise hairs on the back of the listener's neck. No indeed, this listener wants to see as well as hear the value promised by the sales assistant and, after parting with a price that would have picked up a secondhand VW only a year or two

ago, expects a bit of luxurious high-tech extravaganza as well.

I call these people the hedonists and, although I come from the audiophile camp myself, I can understand their fascination with flashing lights, graphic equalisers and remote controls.

The manufacturers understand them even better and in fact make a much wider range of what we audiophiles call 'commercial' sound systems for hedonists than they make of our dull black boxes.

You can easily prove that an audiophile sound system sounds better than a commercial one but it is much more difficult to prove that it is as attractively styled or anywhere near as versatile. The audiophiles might get better music but the hedonists have a lot more fun.

One company that seems to have an excellent understanding of both the audiophile and the hedonist is Pioneer. It has always produced solid, soundly designed hi-fi gear that would not sound out of place in any company and it has also offered a wide range of innovative commercial systems.

Consider, for instance, Pioneer's Z770 system. It is a midi unit comprising a



combined amplifier-twin cassette deck-graphic equaliser, a belt-driven turntable, a twin compact disc player and a pair of three way bass reflex speakers. It has been designed to look like a stack of individual components and has a stylish appearance with a suitable amount of illumination.

It is essential that this sort of equipment, which is likely to be used by every member of a family, should be as user-friendly as possible. The Z770, despite its myriad functions, is as amiable as a labrador pup. If it were any friendlier, in fact, it would be crawling into bed with you at night.

When the power is turned on the illuminated readout on the tuner's front panel greets everyone with a cheery 'Hello'. When the power is turned off the system pauses long enough to say 'Goodbye' before the lights go out. At other times the readout keeps the operator informed about which component is switched in to the amplifier.

The first departure from the norm is the provision of remote control. The audiophiles will tell you that remotes are a BAD THING. They make sudden, unwarranted demands on power supplies that can interfere with sound signals being processed at the same



time. They require tuning and volume controls to be built into electronic chips that degrade the sound signals as they pass through (it is possible to have motor-driven conventional tuners and volume controls but this route adds to costs and unreliability, two areas that mass manufacturers are particularly sensitive about).

The hedonists say that the loss in sound quality is more than made up for by the joy of being able to lounge back in an armchair and boost the volume instantly when Jennifer Warnes starts getting emotional or, even better, being able to cut the sound instantly when Kylie Minogue starts getting emotional.

In some ways the system has more in common with a performing seal than a conventional sound player.

Take the twin cassette deck, for instance. It can, of course, copy one cassette tape on to another one. With this unit, however, the autoreverse can be used to dub both sides of a tape at the touch of one button.

There is a tape fader function that can be used to fade out the music on any part of the tape so that a portion of a piece of music does not stop abruptly if you do not want (or haven't the room) to copy the whole piece.

When copying compact discs on to tape the system has even cuter tricks. A touch on the Auto Synchro Editing Switch will start the compact disc player playing and the cassette deck recording. There is no need to cue each device. When one side of the tape is completed the CD player pauses while the tape system reverses itself and then sets off again, recording on the other side of the tape.

It is even more cunning if a track on a compact disc has not been completed. When the first side of the cassette tape runs out, the sound at the end of the tape is automatically faded out gracefully. When the tape turns itself around the CD player goes back to the start of the uncompleted track and records it all over again on the second side of the cassette.

If the compact disc runs for longer than the second side of the cassette, the music fades out again at the end.

There is, of course, a built-in timer. The Z770 can be programmed to wake you up each morning with a CD or cassette or AM or FM radio. It can also turn itself off.

And it doesn't shock sleeping bodies into the sudden horror of the day. At wake-up

time the music starts off at very low volume, building up gently to a predetermined level while the sleeper gets used to the idea of rejoining the real world. Just try to find a valve amplifier-Linn Sondek combination that will do that.

The seven-band graphic equaliser has two factory settings and can also be set to suit the listener's personal taste. This is a great idea because the two factory settings, Car and Phones, create ideal equalisation curves for recording tapes that will be played back mainly in the car or listened to on a Walkman headphone system. A personal equalisation curve can also be stored in the memory and recalled at the touch of a button.

While the graphic equaliser curve is being set, an illuminated display shows the curve. When the system is in operation the display acts as a spectrum analyser.

There is a microphone socket for recording on tape and a mixing control that allows the microphone input to be combined with the sound from another source. This makes it possible to sing along with the radio, CD or cassette, varying the level of either the singer or the accompaniment. The result is broadcast through the speakers and can be recorded on the cassette deck (using the second deck if the mix involves a tape playing on the first deck).

The twin compact disc player has two drawers which can switch from one to the other during play. This enables two discs to be mixed and matched for a couple of hours of random play. The circuitry has nice things like separate digital-to-analogue converts.

The amplifier has an RMS output of 35W per channel into eight ohms with 0.3% total harmonic distortion. But, since this is a system intended for the hedonists, the power is also described more grandly as 65W per channel Music Power Output into eight ohms with 1% THD. For those who derive satisfaction from boasting about these things, a whopping 350W Peak Music Output is claimed for the amplifier.

There's more, of course, but that's enough to give you the flavour of the hedonist music machine, and it doesn't sound bad either. I used it to fill a restaurant with sound for a lively office party and accepted accolades on the sound quality all night. Perhaps we audiophiles are just too fussy.

The Z770 (including the CD player, which is optional) costs a recommended \$1798. For more details contact Pioneer Australia, 178 Boundary Road, Braeside, Victoria, (03) 3580 9911.

**eti**



Louis Challis reviews the AKAI GX-95 Stereo Cassette Deck and concludes that it's a delightful piece of equipment offering consumers the best of both worlds.

# AKAI GX-95 STEREO CASSETTE DECK

**W**hen I look back over the last 25 years of tape recorder development, only a few firms stand out for their pioneering work. One of those firms is AKAI, which, in the 60s, dragged

magnetic tape recorders from what I would describe as 'little more than toys' straight into the realm of high fidelity.

In the ensuing period AKAI has been joined by a small select band of other innovative

ETI SEPTEMBER '89

108

**DIMENSIONS**

Width	460mm
Height	154mm
Depth	350mm
Weight	10.2kg
R.R.P.	\$1299

firms, which like AKAI with its pioneering development, polished that performance and basic recorder technology to the point where only a totally new concept in magnetic tape recorders (such as DAT) has any real potential to achieve state of the art improvements.

You might well ask, "At this point, if DAT recorders perform better, then why should they bother to market compact cassette recorders?"

Well, as sensitive as that question might appear to be, it is clear that the ubiquitous compact cassette will still continue to dominate the consumer recorder market for at least another 10 years. The reasons for making that forecast are easy to define. Firstly, premium quality blank compact cassettes and cassette recorders or players are much less than half the price of DAT cassettes or DAT recorders, and I believe they are likely to retain that cost advantage for quite some time. Secondly, the stationary heads of conventional cassette recorders are more rugged, reliable and undoubtedly far more durable than the rotary heads of the new DAT recorders.

When the performance of the latest generation of cassette recorders is compared against that of the new opposition DATs the only significant areas where that performance is bettered is in the realm of high and low frequency response, in the realm of dynamic range and most particularly in terms of low level noise and specifically "hiss".

The AKAI GX-95 is something of a dark horse, with a sombre appearance from its black fascia, with white silk-screened lettering and rosewood-veneer timber ends to give it a more expensive feel.

The GX-95 constitutes a significant departure from AKAI's previous design philosophy in that it has adopted the best features of previous generations of AKAI recorders and yet has sensibly taken some of the best features of AKAI's competitors' latest designs to produce a thoroughly well conceived piece of equipment.

The best AKAI features, such as the reliable, long life and durable GX heads with oxygen-free copper windings, the Micro computer-controlled direct lead-in control system with the original "Quick and Quiet Mechanism" have been sensibly retained. Akai has also retained its invaluable Auto-tape slack take-up system which reduces the likelihood of chewing up tapes, as well as the innovative spot erase system which is a very practical feature.

Highly desirable concepts adopted from other manufacturers include the user controlled simple adjustment of level/bias settings for optimally flat high frequency recording response. This feature is a winner for those purchasers who want studio quality cassette recordings from each and every recording irrespective of tape type. AKAI has gone further though, by also incorporating the Dolby HX PRO headroom extension system and a 2-point repeat play back system that is basically similar to the systems incorporated in many advanced CD players.

Last, but by no means least, they have provided a separate pair of dedicated input sockets to facilitate direct recording from a CD player with pre-matched level sensitivity settings that not only make the recording childishly simple, but more significantly ensure that a perfect recording results every time.

The front panel of the recorder has 4 separate groups of functional controls. These are the POWER ON/OFF switch on the left, with the external timer start switch and the cassette well and lid. In the upper middle of the panel is the large multi-function FL (fluorescent display) which offers a number of conventional monitoring features including left and right channel recording level guide indicators each with 50 dB dynamic ranges. In addition there are supplementary level indicators and separate bias indicators which may be individually set for recording frequency response optimisation to suit the tape being used. In addition, the FL display shows which type of tape is being played, and the four digit tape counter also reads in minutes and seconds as well as the program number when there is a 4 second blank spot between tracks. It also shows

when A-B replay cycle has been selected and which of the Dolby noise reduction, ie; B, C and /or HZ-PRO has been selected.

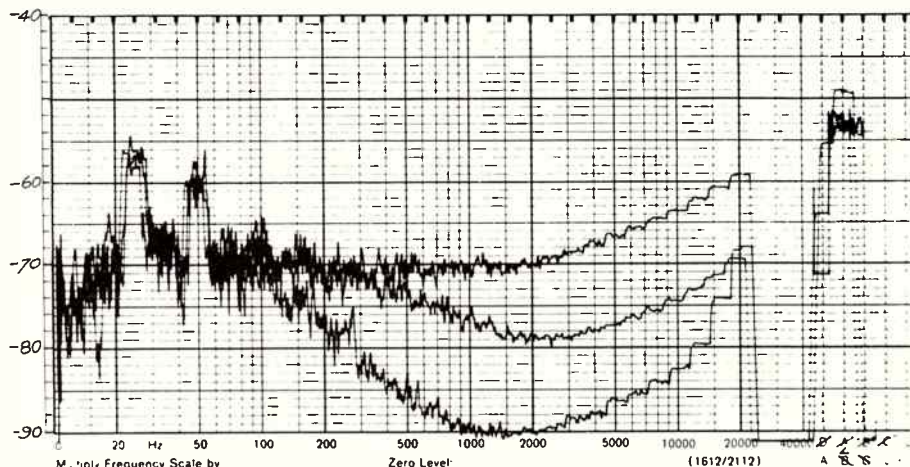
Other small displays are illuminated when the high frequency filter and calibration functions are selected. You are also shown whether TAPE or source signals are being fed to the line output sockets. Last but not least, the display also shows whether the recorder is in the play, fast forward or the fast rewind modes just in case you forget what you are doing, and whether the IPSS, (Instant program searching system) has been activated.

At the upper right hand side of the front panel there are 6 elongated clearly labelled rectangular conventional functional control switches for PLAY, FAST FORWARD, FAST REWIND, PAUSE, STOP/EJECT and RECORD.

Above these are 3 small and less frequently used buttons for IPSS (Instant Program Searching System), the memory A-B button (to memorise the points on the tape between which the 2 point repeat/playback, or alternatively the spot erase function, can take place) and lastly the RECORD CANCEL button. By pressing this switch the user can erase the pre-recorded program when recording, or can cancel the memorised A-B locations during the spot erase procedure.

At the middle of the control panel, immediately below and to the right of the FL display, four additional switches are provided for TAPE/SOURCE monitoring, counter RESET, counter MEMORY as well as Fluorescent display ON/OFF.

At the bottom of the panel on the left hand side is a standard 6.5 mm tip-ring and sleeve head phone socket. Near the middle of the panel are four small rotary knobs. The first controls the headphones' signal level. The second is for level calibration (which is used to adjust the recording sensitivity during the recording calibration to optimise the level to suit the requirements of the tape selected). The third is the BIAS CALIBRATION which is used to adjust or preferably optimise the bias level during the bias calibration procedure. The last of the four knobs is the large dual concentric RECORDING LEVEL ADJUSTMENT



One-third octave analysis of background noise erasure by Akai GX-95. Top: Dolby out; centre: Dolby in B; lower: Dolby in C.

## AKAI GX-95

which is normally set as one, but which can be separately adjusted for left and right channels if required.

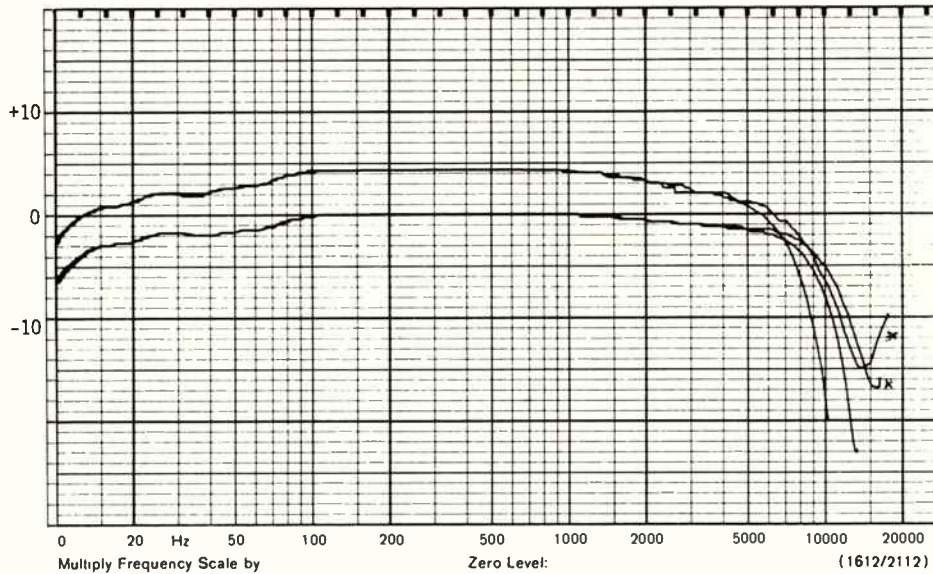
At the lower right hand corner of the panel are 6 less frequently used switches which are: firstly, the CALIBRATION SWITCH to activate the recording calibration system for setting the recording level and bias sensitivities; secondly the DOLBY Noise Reduction ON/OFF and thirdly the DOLBY B or DOLBY C select switch.

The fourth switch selects DOLBY HX-PRO for use during the recording sequence. The fifth switch is the Multiplex filter switch to attenuate the stereo multiplex carrier signal from FM broadcasts. Last but not least is the CD/DAT DIRECT switch. This facilitates direct recording without level adjustment from either a CD player or DAT player whose upper level and range of signal levels (unlike most other sources) are precisely defined and accurately set by the signatories to the RED BOOK. As I subsequently discovered, this switch must be de-activated before normal recording can be initiated. On the back panel are 3 pairs of gold plated RCA coaxial sockets which are for LINE INPUT, LINE OUTPUT and a pair of separate DIRECT INPUT sockets for signals to be recorded from CD player or a DAT recorder. The advantage of using these sockets, in conjunction with the associated front panel switch, is that the recorded signal is less likely to be degraded and the normal level controls on the front panels require no further adjustment.

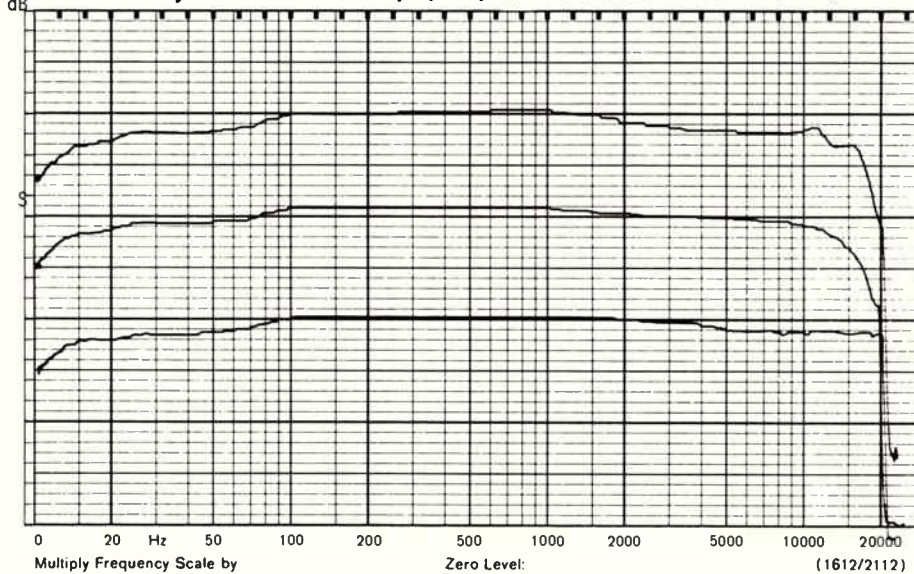
The case is solidly constructed from strong steel panels and is relatively heavy. The inside of the recorder is neatly fabricated with 3 separate fully shielded compartments with the digital control and fluorescent display mother boards at the top, the recorder circuits in the middle and the secondary boards for power supply and motor control at the extreme left hand side. Most of the wiring is neatly executed in ribbon cables with plugs and sockets and I noticed that the digital control board has space for a future crystal controlled Quartz servo-circuit.

The objective performance of the GX-95 can be described under a number of different headings, the most topical relating to the replay characteristics with our two laboratory reference tapes. Not so surprisingly the low frequency response of this recorder is exemplary, with the lower frequency limit being below 10 Hz (and consequently as good as most CD players), whilst the high frequency performance drops off fairly rapidly above the -3dB point - which is limited to 13 kHz in each case because of the differences in the azimuth alignment between the reference recorder and the alignment tape used for setting this particular machine.

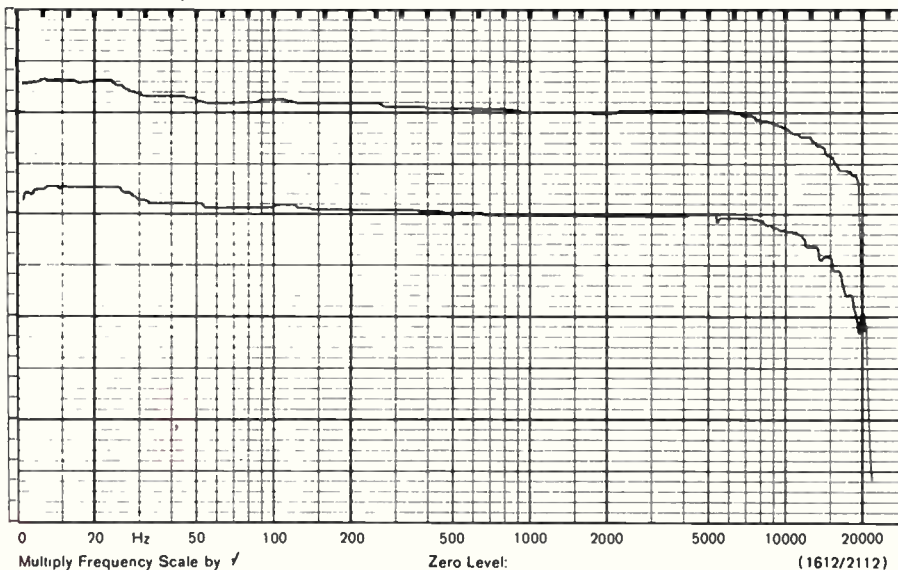
This perennial problem affects most manufacturers, and until such time as they all use the same reference tape recorded



**Effect of Dolby HX Pro-record to replay response at +5VU. (\* = HX Pro 'In')**



**Record to replay frequency response with optimised settings — recorded level -20VU. TOP: TDK AD90 Dolby in; centre: Sony UCX-S60 Dolby out; lower: BASF 60 metal IV Dolby out.**



**Replay frequency response — recorded level -20VU. Top: Maxell UDXL1 C60; lower: TDK SH-C60.**

from the same reference tape recorder, we are going to continue to face that problem.

The record to replay assessment was carried out in two different ways, firstly with the line level and bias controls set to their central position (which is the way the vast majority of purchasers would be likely to use this recorder). The results of this analysis provide varying results with the TDK AD IEC Type I tape for example; the frequency response lies in the range +1/2, -3dB from 15 Hz to 18 kHz. This result is exemplary and considerably better than that provided by most tape recorders on the market. By contrast, the frequency response with the Sony UCX-S60 and the BASF 60 Metal Tape IV is equally good at the low frequency end, but exhibits a -3dB performance of 10kHz because the bias level has not been optimised for these particular tapes. When the bias level is optimised for the tapes the -3dB points vary in a slightly anomalous way. Firstly the Type II and Type IV tapes exhibit substantial improvements in their high frequency response, with the Type IV tape being only 1 dB down at 20 kHz and the Type II tape being -3dB down at 15 kHz. The TDK-AD Type I tape varies its high frequency response with a minor droop in its response so that the optimisation process proves to be less desirable than we would have expected.

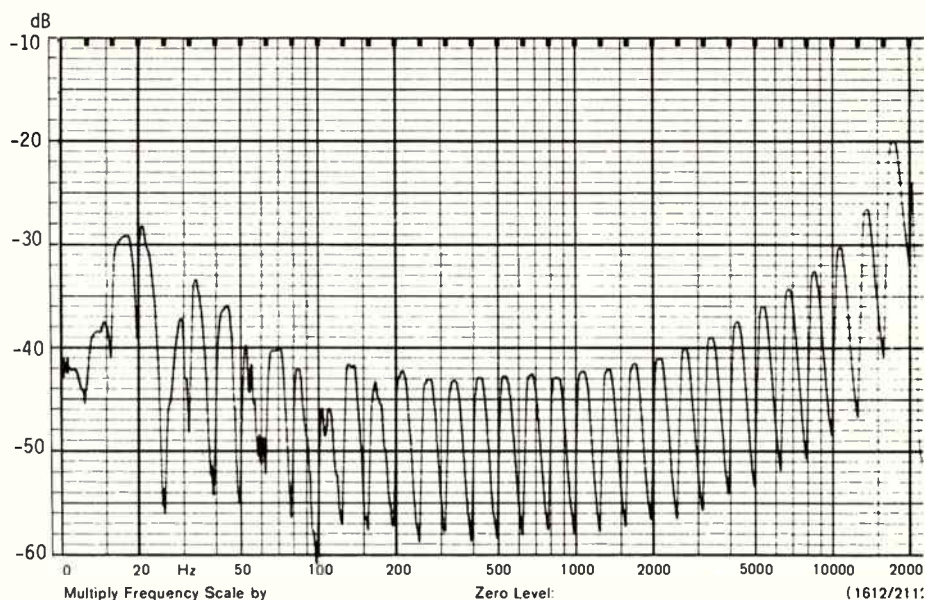
The evaluation of the signal-to-noise performance with Dolby 'B' and Dolby 'C' activated provide graphic illustrations of how effective these noise reduction systems are in removing those nasty hiss problems and A-weighted dynamic ranges noise figures climb from -55dB(A) without Dolby to -64 dB (A) with Dolby 'B' and -71 dB(A) with Dolby 'C' relative to the OVU level. By activating the Dolby HX Pro the dynamic range and frequency response in the frequency region 8 kHz to 12 kHz with high signal levels is measurably improved, although the frequency bandwidth is only increased by approximately 1 kHz, and by approximately 2 kHz for signals at OVU.

This improvement may seem inconsequential, but its benefits should not be denigrated.

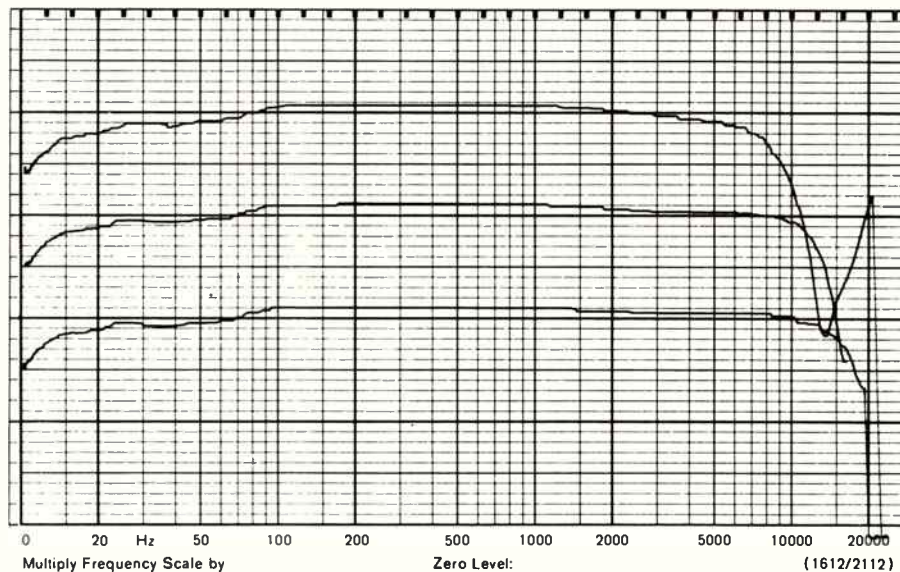
The channel separation is reasonably good at -43 dB mid-band, and better than 30 dB separation at 20Hz and 10 kHz.

The GX-95 exhibits a reasonably low peak wow of 0.05% peak to peak, and flutter of 0.07 rms. The weighted wow and flutter is less than 0.035%, which is marginally higher than the manufacturer claim in their literature. The harmonic distortion at OVU is low at low frequencies, but modestly high at 6.3 kHz. At -6VU the distortion levels are much lower, although still moderately high at 6.3 kHz. The selection of Dolby HX-PRO does not substantially reduce the high frequency distortion figures.

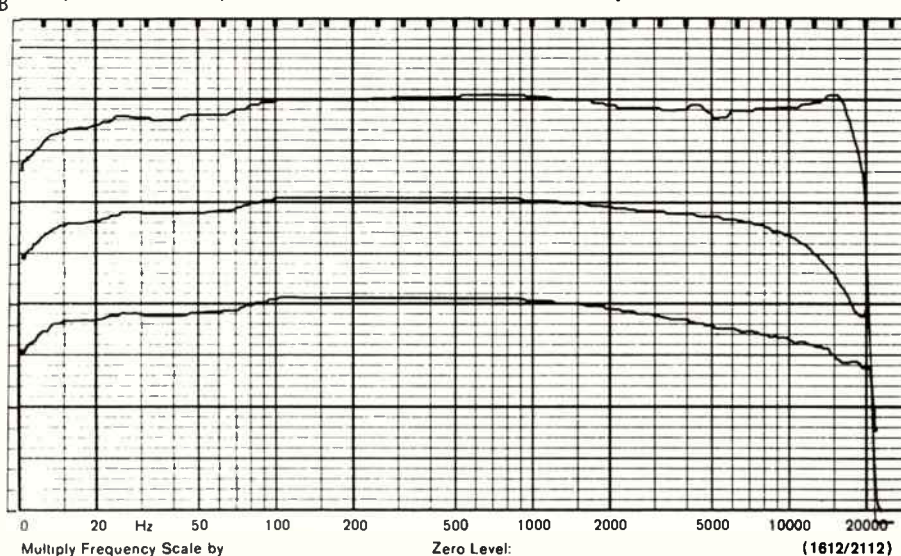
The maximum input level for 3% third



**One-third octave analysis of channel separation using Sony UCX-S60 tape. Sine wave input to other channel at -10VU. 0.5V**



**Record to replay frequency response; Dolby out using Sony UCX-S60 tape. Top: OVU; centre: -10VU; lower: -20VU level and bias set for optimum.**



**Record to replay frequency response recorded level -20VU. Top: TDK AD90 Dolby in; centre: Sony UCX-S60 Dolby out; lower: BASF 60 Metal IV Dolby out.**

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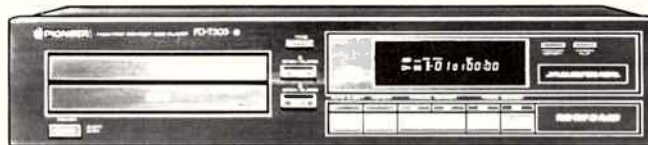


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## AKAI GX-95

harmonic distortion with IEC Type I tapes is +5VU, with Type II tapes +7VU and with Type IV tapes +9VU.

The erasure ratio with both Type I and Type IV tapes is excellent so that residual signals will never be a problem on your tapes.


The subjective assessment of the AKAI GX-95 proved to be an unexpectedly delightful experience. Firstly because, by chance, I was given two of the latest CBS Master Works classical compact cassettes which are recorded on chromium dioxide tape. This approach, which has been adopted by most of the better pre-recorded tape manufacturers, really does achieve worthwhile enhancements in terms of both recorded frequency bandwidth, as well as perceptible improvements in the recorded dynamic range. Until I received these tapes, I did not realise how much pre-recorded cassettes have improved. The first of the cassettes that I listened to was Prokofiev's Piano Concertos Nos 1 & 3 with Gary Graffman at the piano and George Szell with the Cleveland Orchestra, CBS Maestro Series MYT44876. This cassette proved to be aurally exciting with two brilliantly recorded concertos, neither of which were familiar from either orchestral concerts, nor from FM broadcasts.

This cassette displayed all the attributes of a well recorded, well engineered and well manufactured cassette, even though it was generated by high speed duplication.

The second pre-recorded compact cassette was also from CBS Master Series featuring Brahms Symphony No. 2 with Bruno Walter and the Columbia Symphony Orchestra, CBS Maestro Series MYT44870. This delightful cassette recording provided an appropriate medium for assessing the replay characteristics of the cassette recorder and, when monitored with a real time analyser, displayed real frequency content out to beyond 14 kHz. Admittedly the hiss was also just detectible, not very intrusive except during the quietest periods in the recording, which were few and far between. The music was, however, wonderful, and both Bruno Walter's direction and the Columbia Symphony Orchestra make this one of the finest recordings that I have yet heard of the Brahms's Symphony No. 2.

Having satisfied myself that the replay characteristics of this recorder were first class, I proceeded to re-record one topical example of two current CD discs which are widely divergent in their content. The first was "Manon of the Spring" which is the second disc of "Jean de Florette" TVT 3005CD which was an American disc featuring the original sound track of the film. This disc contains some delightful vocal and orchestral music. By utilising the CD DIRECT input, supplemented by the manual level and bias pre-adjustments facilities, firstly with

Dolby 'B' and subsequently with Dolby 'C', I was able to produce a recording which I was particularly hard pressed to detect which was the original CD material and which was the cassette copy during AB testing. If I relied on the hiss level for clues between the two sources of music the task was easy. In the Dolby 'B' mode however, the quality and frequency linearity of the recorded signal was unquestionably better (albeit at the expense of a just detectible hiss), whilst with the Dolby 'C' the quality was marginally inferior with the somewhat questionable gain of lower hiss.

The subjective evaluation for the AKAI GX-95 Stereo Cassette Deck has confirmed that it is a well designed, delightful piece of consumer electronics which offers the best of both worlds. It provides simple recording without complication for those people who want a fine recorder and player, but are too lazy to always use all its attributes. At the same time this is a potent consumer electronic recorder which offers a multiplicity of user friendly functions and capabilities which have been neatly organised to produce superior cassette recordings without any real complications. 

### Measured performance of AKAI GX-95 Stereo Cassette Deck

Serial No: 30985 — 01269

#### Record to replay frequency response at — 20 VU

Tape	Dolby	Lower — 3dB point	Max. Point and Frequency	Upper — 3dB Point
TDK AD 90	In	17 Hz	-	16 kHz
SONY WCX-S60	Out	15 Hz	-	14.5 kHz
BASF 60 Metal IV	Out	13 Hz	-	Above 20 kHz

Speed accuracy — 0.125%

#### Wow and flutter

Wow	Average Unweighted	0.05% P-P
Flutter	Weighted	0.07% RMS
		0.035% RMS

#### Harmonic distortion

Tape Sony UCX-S60

		100Hz	1kHz	6.3kHz
OVU	2nd	-54.3	-57.9	-50.3
	3rd	-40.8	-46.9	-34.5
	4th	-	-	-56.3
	5th	-63.7	-67.8	-
THD -6VU		1%	0.5%	1.9%
	2nd	-58.9	-58.7	-
	3rd	-49.0	-54.5	-41.5
	4th	-	-	-
	5th	-65.7	-	-
THD		0.3%	0.23%	1.1%

#### Maximum input level

(for 3% third harmonic distortion at 333 Hz)

Tape Sony UCX -S60 +5.0VU

#### Dynamic range

Dolby Out	-49.0 dB (Lin)	-55.5 dB (A)
Dolby In (b)	-54.0 dB (Lin)	-64.0 dB (A)
Dolby In (c)	-54.0 dB (Lin)	-71.0 dB (A)
Dolby In (HX Pro)		

#### Erasure ratio

(for 333 Hz signal recorded at 0 VU)

Tape	Sony UCX -S60	-79.2 dB
Tape	BASF 60 Metal IV	-86.6 dB
Date	19-2-89	

Victim fell here. †



Sasachi TAM 082/A

READER INFO No. 36

Shot fired from here with an AVX-100.

at 2.30 a.m. Wednesday morning. It was a city apartment, the kind where someone else pays the rent. The T.V. was still on. I was impressed by the lifelike sound, the rich, moody music of the late night re-run. I spoke to the neighbours. Nobody saw anything, of course. But they'd all heard it. They'd been hearing it for the past three nights. The realistic dolby surround sound and atmosphere effects from her new Yamaha AVX-100 – so when the actual shot was fired, nobody noticed the difference. Isn't that the way these days – can't tell real life from the movies.

The D.A. approached me. "Where'd she buy it?" "In the chest", I replied.

Toying with the remote I changed the sound from concert hall. to smoky night club, to surround cinema. to natural surround and finally to the delayed acoustics of a church. I could have chosen another three or four sound treatments, but somehow that one seemed appropriate.

Next day I checked out the dealers. Just had to ring 008 331 635 for the nearest one. Heard the whole story, right down to the five year guarantee, then I got a tip that the D.A. had bought one.

100



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READER INFO No. 37