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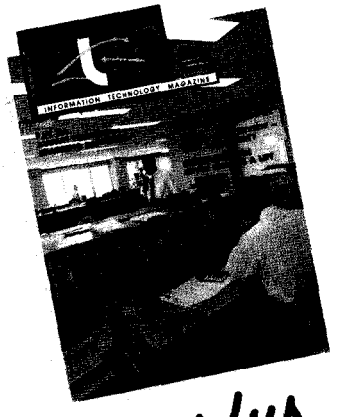

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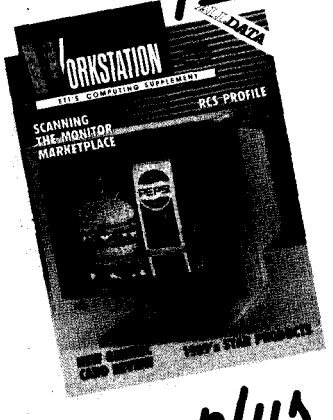

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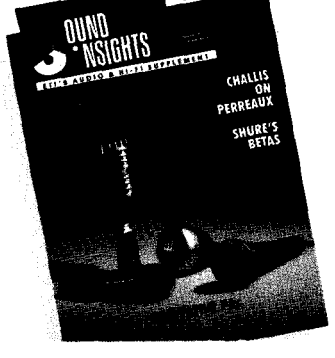

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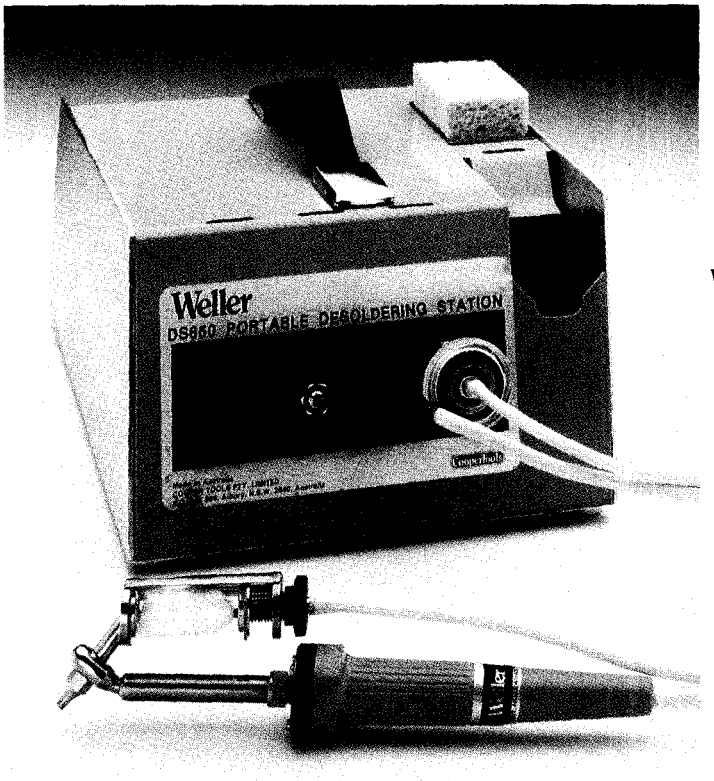

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ELECTRONICS TODAY INTERNATIONAL

JANUARY 1990

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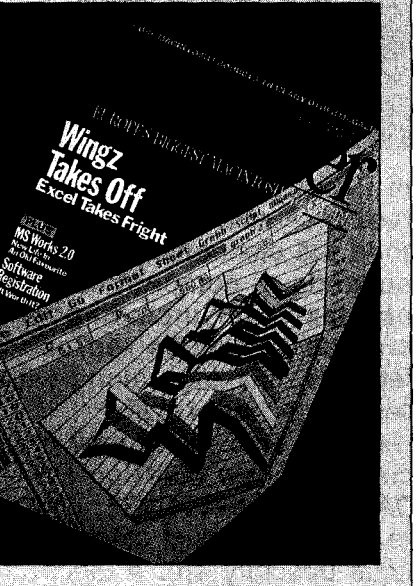

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COVER: Telecom Iterra Satellite Services' stand at IREECON '89. Pic by Jeremy Bannister.

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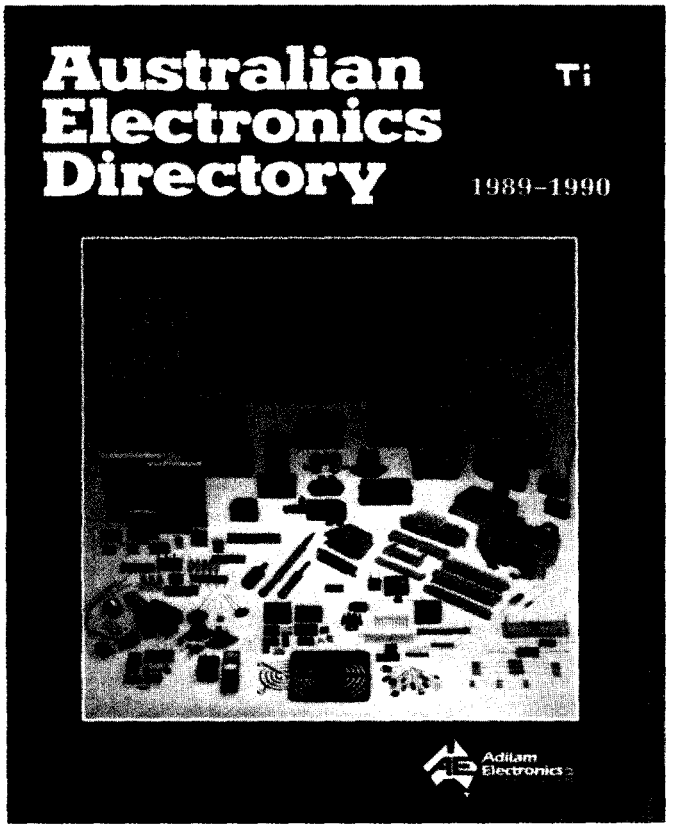

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The Australian Electronics Directory is priced at $89.00 (including delivery within Australia). To obtain your copy, complete and return the coupon below or contact our nearest Sales Office.

The 21st Edition of the Australian Electronics Directory (Australia's only true directory to who's who in the electronics industry) has had many thousands of company information changes since last year including:— agencies and overseas principals represented, address, telephone, fax etc., along with management sales and technical staff.
There are also many new product headings, including a new chart on PRINTED CIRCUIT BOARD MANUFACTURE.
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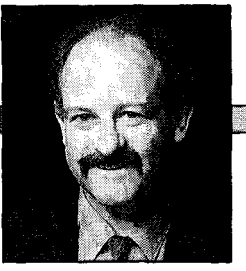

KIM BUCKNOLE

Tempus fugit

Welcome to our latest Yearbook. I hope it contains plenty of interest. Within, we review ETI's year in instrumentation. We expand on the ETI Industry Awards and IREECON. We bring you a word from Barry Jones, the Minister with many portfolios. We continue the tradition of CAD features in the Yearbook.

In Workstation, we also concern ourselves with CAD, reviewing Generic CADD and surveying the monitor market. RCS Design is profiled and Kester Cranswick continues his survey of 1989's stand-outs in computing.

Sound Insight's year is reviewed – a year of high quality and innovation in the products we examined. Louis Challis has filed his customary review and we look at some innovative, compact PA systems.

Remarkably, over the year, we have published over 60 reviews of instruments, devices, software and consumer electronics products. I cannot think of any other journal in Australia which can match this level of service to its readers within our frames of reference. I am grateful to our reviewers for their diligence, independence and expertise.

As promised in my November editorial "Plus ca change, ..." Jon Fairall has filed some stories. One is about a 486-based computer just available in Australia and the other recalls Jon's visit to the Perth Electronics Show.

All in all, 1989 has been a remarkable year for ETI – editors and contributors have come and gone (and returned). We have overseen the birth of Workstation and acquired HUB. I hope the Yearbook reflects some of the excitement felt in our editorial office.

Danger — falling clichés

When editors write at this time of year (cliché) it's usually time to run for cover (cliché). In December or January issues editors want to convey the Season's Greetings (cliché!) to their readers. But they want (or should want) to avoid clichés. They can't. I can't. Merry Christmas and a Prosperous New Year (sigh!). Thanks to our readers and advertisers who, in conjunction, make ETI's publication possible.

P.S. A final thought for 1989. This issue contains three promotions. One, from Philips Scientific and Industrial, is for subscribers. The others, from Marconi and Marantz, are open to all readers. This is your last chance to win any of the remarkable products offered. Find a pen, and enter now – postage is free!

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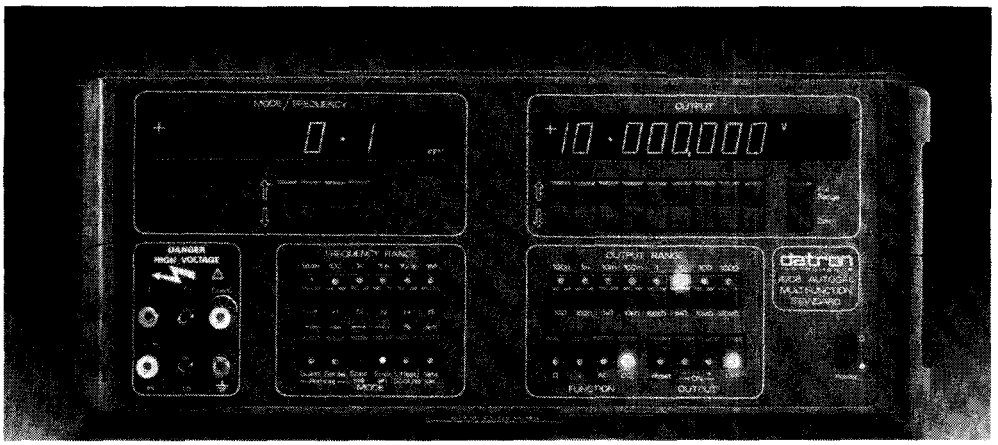
INSTRUMENTATION IN REVIEW



Iwatsu 500 MHz CRO

JF, ETI April 1989, p82

THE new Iwatsu really is quite a machine. It has some remarkably sophisticated functions, with oustanding performance married to extreme operational simplicity.

Without reading the manual it's quite possible to take control of most of the standard functions, which operate in a conventional way.

It's easy to forget, when going over the 6521, just how advanced a device it is but the ability to do such small yet significant time adjustments puts it back into focus.

Dataplex DPX-222 modem

JH, ETI August 1989, p84

THE Dataplex DPX-222 modem sports the usual popular CCITT V21, V22 and V22bis communications standards along with Bell 103 and Bell212A.

Physically similar in design to its predecessor, the DPX-224, the DPX-222 stands 53 mm high, 210 mm deep and 198 mm wide, making it about 60 per cent smaller than the 224. While it would be unfair to say it is modest in size compared to other modems on the market the DPX-222, with its sturdy metal case, would easily survive the school of hard knocks, and would last any proud purchaser (physically, if not technologically) for many years to come.

I used the modem in all modes, Bell included, and it came up tops every time. Setting the modem up was no easier or harder than before, although I did appreciate the fact that an external plug pack was not required.

Len Altman of OBIAT rang me some weeks ago, having read Ros Bromwich's editorial about the state of T & M ("Crisis? What Crisis?" ETI, September 1989).

Len, of course, has vast experience in the T&M field and wanted (in the nicest way) to have his two penny-worth. Len said he had "no doubt" the T&M industry is cyclical. For a good, well-managed company, there is always an increase; some years show five per cent, others 25 per cent, but the cycle is there. The cycle is three to five years.

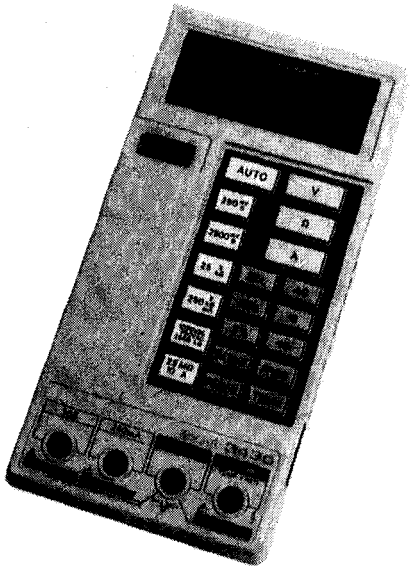
Len has agreed that there are "a lot of cheap, imported 20 Meg 'scopes — too many". Disagreeing somewhat with Ralph Brown of Parameters, he felt that "the average technician does want stand alone instruments and that was why OBIAT was set up, although what Ralph said was true to some extent."

Len's views (borne of experience) are to be respected. Fundamentally he is in line with the people spoken to by Ros. Cyclical or not, the distributors of T&M products have a bullish attitude. I think that is as it should be. There is some remarkably good product out there and a healthy state of competition. This should mean (and I think it does) that the end user benefits from a wide range to choose from, with plenty of features and the early spill-down of R&D derived technology through the product ranges. Isn't that what the end user wants — the best available technology at the best available price? (KB)

Hughes Probeye thermal imaging video system

RH, ETI August 1989, p87

THE Hughes 7300 supplied for review was intended as a portable instrument and consisted of four individual units: an infrared imaging 'camera' which may be handheld or mounted, a portable processing unit, a portable colour video monitor and combined 8 mm VCR, and a video printer. The video monitor/8mm VCR is manufactured by Sony and is one of their standard product lines. A portable Sony 8 mm video camcorder is also supplied as part of the kit, for recording views of the scene being imaged.



Test and measurement in electronics today: Part 1

RH, ETI August 1989, p94

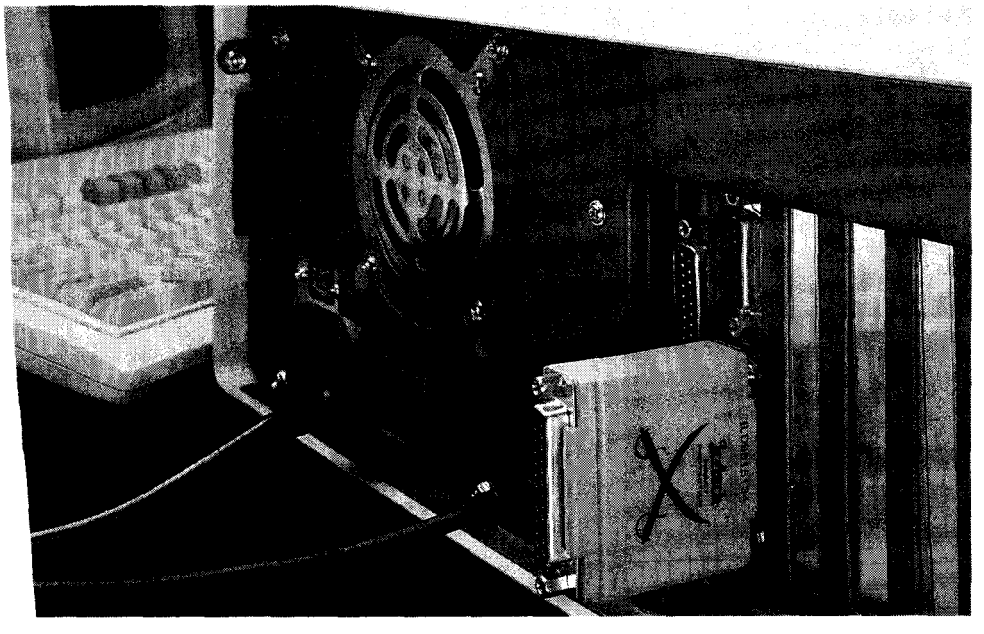
AN overview of the current state of instrumentation for test and measurement in electronic applications.

Cambridge Z88 PC

BH, ETI September 1989, p83

THE Z88 portable computer from Cambridge Computer Ltd is of compact and neat design.

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.



Icelock software protection

ETI September 1989, p74

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.

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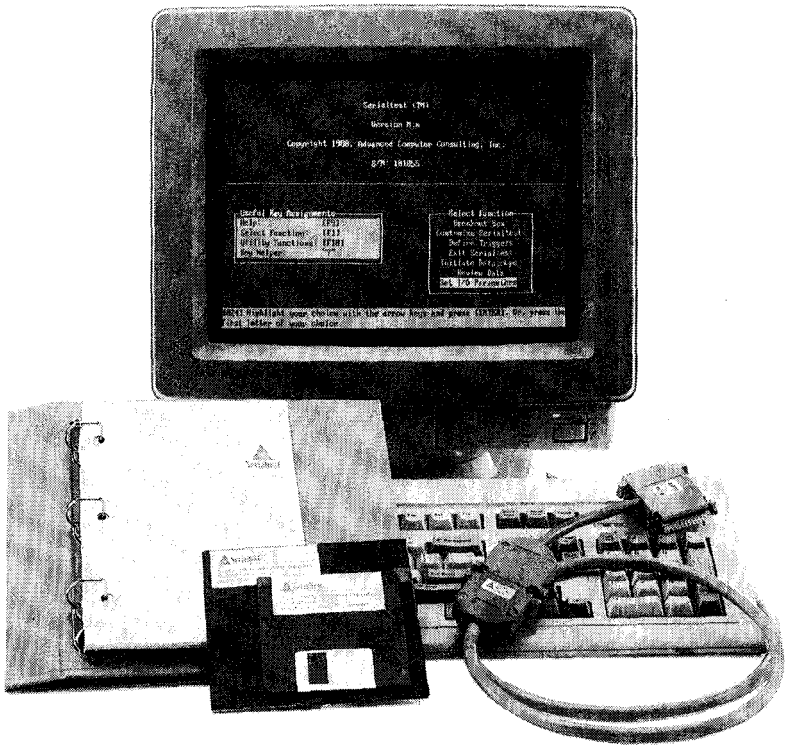
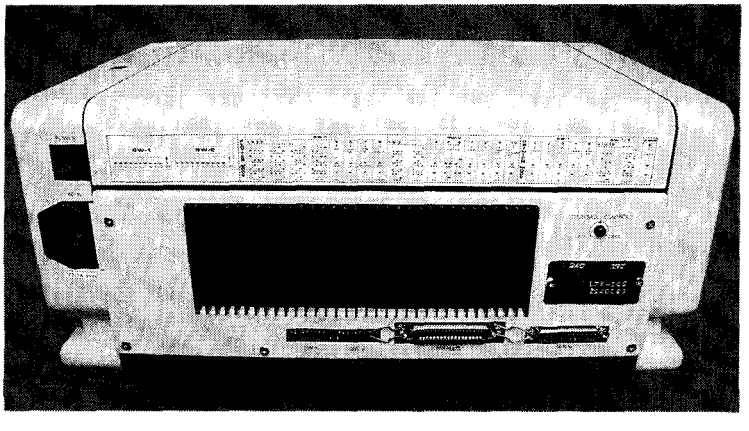


Serialtest: serial data link tester

JH, ETI October 1989, p84

SERIALTEST appears to be a software alternative to dedicated serial data analysers. What usually takes expensive and specialised hardware can now be performed on almost any IBM-PC/XT/AT compatible computer.

Serialtest is a versatile, comprehensive tool and I found it easy to get into and use.



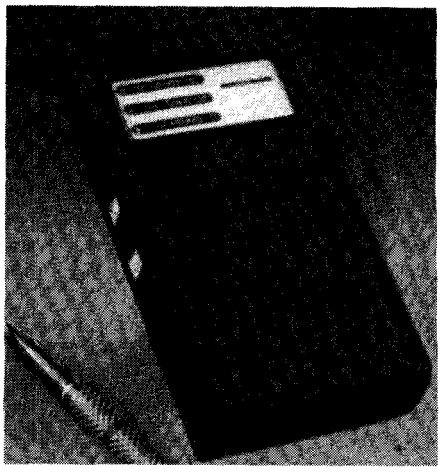
Roland LTX-100 thermal printer/plotter

JH, ETI November 1989, p44

THE appearance of the Roland LTX-100 thermal plotter is quite unusual, so far as plotters go. It's about the size of a medium-sized fax machine, and definitely a squat, rectangular shape; overall its appearance and functionality is quite pleasing.

Measuring just 410 mm wide by 260 mm deep by 180 mm high, the LTX-100 can quite comfortably sit on the end of one's desk.

Would I use the Roland LTX-100? In short, yes I would. However I don't think it would be suitable for final plots to be used as plans, or to be reproduced, say in a manual. The LTX-100 would serve very well producing check plots.



Compact modem

ETI September 1989, p88

FEATURES of the Jacobs Radio Compact Modem Type JMS-4 include that it is portable; operates from a variety of power sources including internal battery; is lightweight; can direct-connect to PSTN (normal telephone network); can communicate at 7 speeds instead of the usual 3-4; has practically no installation requirements; is specified, therefore guaranteed for a wide range of environments, eg, air travel; is manufactured in Australia to AS 1821 quality control standard and comes with a 3-year warranty.

Exec-U-Log data log system

ETI October 1989, p82

MELBOURNE-based Automotive Electronic Specialists has developed a system to log all the data necessary for an effective vehicle fleet management system. It has released Exec-u-log, a computerised data logging system with comprehensive mounting, enabling it to be installed in all types of vehicles.

Continued on page 26

WIN A MARCONI PROBE

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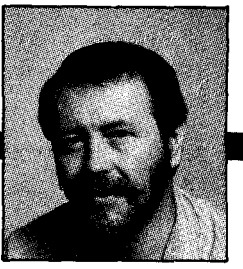
4. The judges' decision is final and no correspondence will be entered into.
5. Description of the competition and instructions on how to enter form a part of the competitions conditions.
6. The competition commences on 26th October, 1989 and closes with the last mail January 31, 1990. The draw will take place in Sydney on 5th February, 1990 and the winner will be notified by telephone and letter. The winner will also be announced in The Australian on 8th February, 1990 and a later issue of this magazine.
7. The prize is: One only Marconi 2388 Active Probe complete with power supply. Valued at $2610.



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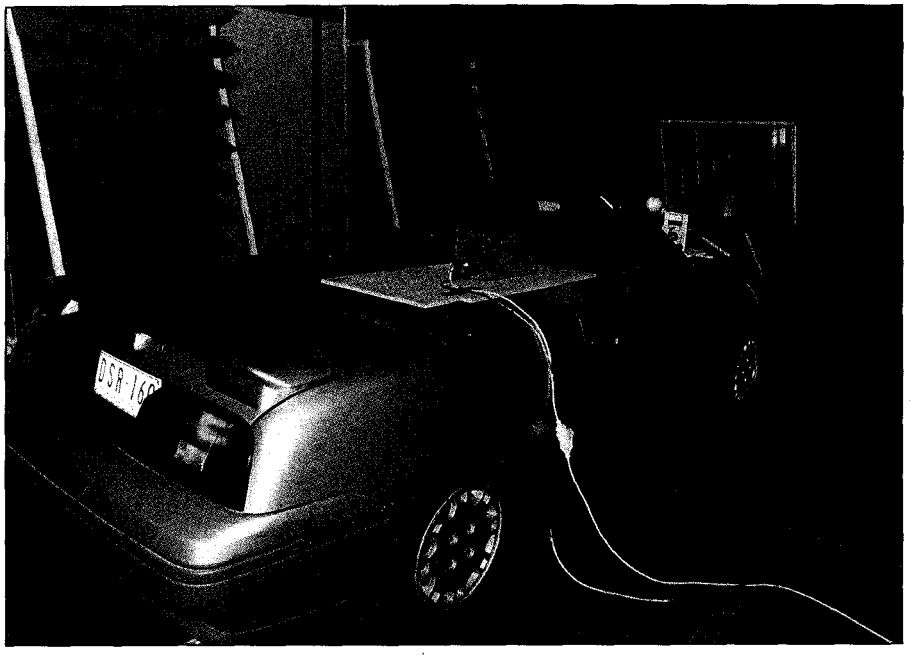

It wasn't all that long ago that a person's only electronic equipment was a valve wireless and record player and its most likely source of RFI (Radio Frequency Interference) was the home's wiring.

It was (and still is) called 50Hz hum and technicians have spent more than half a century trying to reduce it to a minimum.

Now, the microprocessor has brought with it an entire industry devoted to locating and elminating the effects of RFI. Why? Because to a processor, RFI may mean faulty processing, indecision (or wrong decisions) or even fraudulent instructions given to a component controlled by the processor.

The modern car may use many microprocessors. Typically less than 16kbytes in size, these have sophisticated software to monitor and control the car's ignition, fuel injection, adaptive suspension, automatic transmission, anti-lock braking system, instrument panel, radio/cassette and even the cellular phone. A glitch in the entertainment or communications system in a car would be irritating, but a glitch in the car's operating system could be catastrophic.

RFI comes from a wide variety of sources. In a list prepared by Australia's newest and most comprehensively equipped company dealing with the problem, radio and television transmitters top the list. Other sources listed are airport and other radar systems, telephones, communications systems, lightning, power lines and even the car's high tension system.

It was in Germany where radar-induced RFI first reared its ugly head. Bosch had been developing on-board engine management systems for some time to cope with 50 to 100volts/metre. But cars which drove near the NATO radar installations, peering endlessly at the military activities over the border were often brought to a halt, their EPROMs wiped. Signal levels can become alarmingly high down wind of these very large radar snoops.

The problem was so great that the German government had to enclose several sections of autobahnen in a wire Faraday cage. This proved to be the only cost effective method of reducing RFI.

Overseas testing

Since the beginning of the computer age in car engine management, Australia's car industry has had to send development and prototype vehicles overseas for testing. Now, RFI Industries in the Bayswater suburb of Melbourne, has constructed an RFI test tank (correctly called a Shielded Enclosure) large enough to test motor vehicles. They can "blast" cars in the tank with RFI from 10kHz to 2000MHz at a field strength of 100 volt/metre or double the typical field strengths encountered in a worst level situation on the road.

Ford Australia was one of RFI's first major customers in new vehicle development. The Capri is an important car for Ford and a very

Ford Australia used on-shore testing to ensure there would be no RFI problems when the export-oriented Capri was being developed. By Brian Woodward.

DEBUGGING THE CAPRI

important car for Australia. The Lincoln Mercury Division of Ford North America has ordered 30,000 of the cute convertibles in its first year of manufacture. This will earn Australia in excess of $200m.

Development time for the Capri was short in world car industry terms, one reason being that Ford didn't have huge time delays by having the car sent offshore for sophisticated engineering and electrical tests.

But the USA has many high intensity RFI areas and the car's electrical and electronic system had to be comprehensively tested before it went on sale there.

Bullet-proof parts

Two areas on the car require bullet-proof reliability – the air-bag sensing system and the cruise control. The air bag, mandatory for cars registered in the USA, inflates when the car exceeds a pre-determined deceleration under impact. It inflates from the dash and the centre of the steering wheel hub, protecting fast decelerating occupants and preventing them from hitting the car's interior.

The system uses very sensitive sensors which must neither false nor fail under any circumstances. Mercedes Benz has installed over 500,000 air bag systems and reports not a single failure. Ford Australia had to achieve this level for the car to be accepted as a long term project in high value exports.

A car undergoes radiated emissions testing at RFI Industries in Melbourne.

The cruise control operates by monitoring the car's speed and altering the car's throttle position to maintain that speed on the highway. Should RFI give the speed sensor false information, the car could speed up and hit the car in front, or slow down and be hit from behind in heavy, fast moving traffic.

Given many American citizens' willingness to sue anyone and everyone, a failure of either system could mean financial ruin for Ford Australia.

Inside RFI Industries' tank, the instrumentation is constantly monitored and the exhaust and cooling systems vented to the outside world. The tank is constructed of highly absorbent material so that errors due to the large field gradients caused by standing waves will be reduced.

Broadband antennas are driven by high power broadband RF power amplifiers. Field strengths are measured with broadband isotropic electric field probes. Interestingly, the fields generated are so high that information to and from the tank (correctly called a Shielded Enclosure) is carried on fibre optic links. Any attempt at using conventional conductors was long ago discarded because of false information generated in the wires.

Other information is broadcast from an EMI hardened (RFI shielded) video camera which monitors the Capri's instrument panel during tests.

The Ford Capri is now building towards full scale production at Broadmeadows, the (secret) on-sale date in the USA not having been announced as we went to press. The success of the car – and the benefits to Australia – have been given a much better chance by the testing carried out on-shore by RFI Industries. eti

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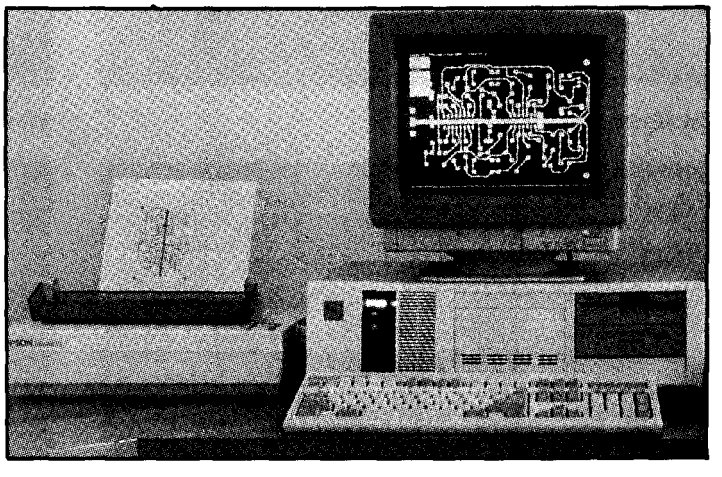

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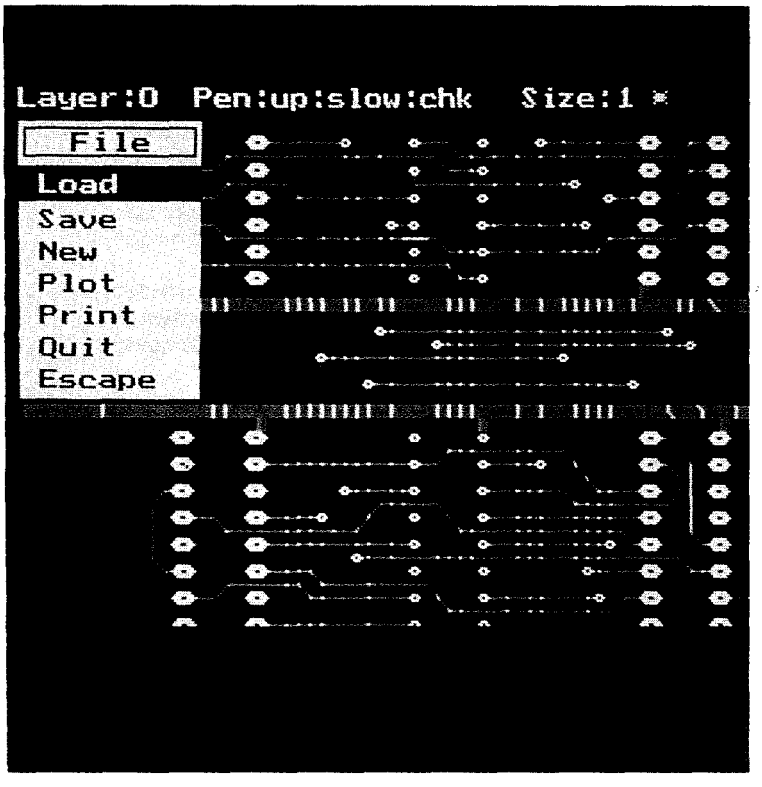
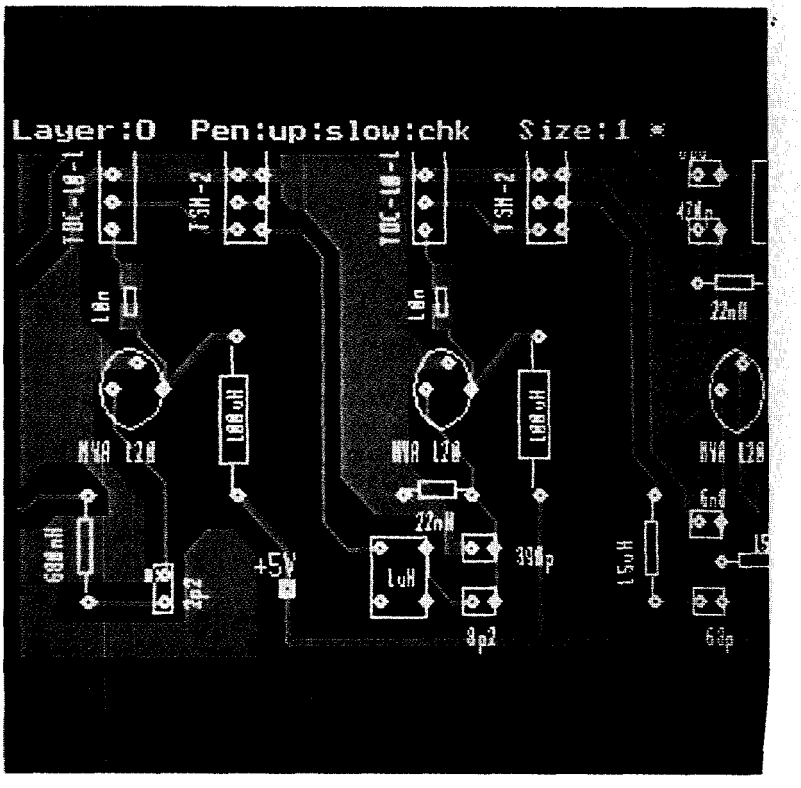
READER INFO No. 5

IT'S A BREEZE

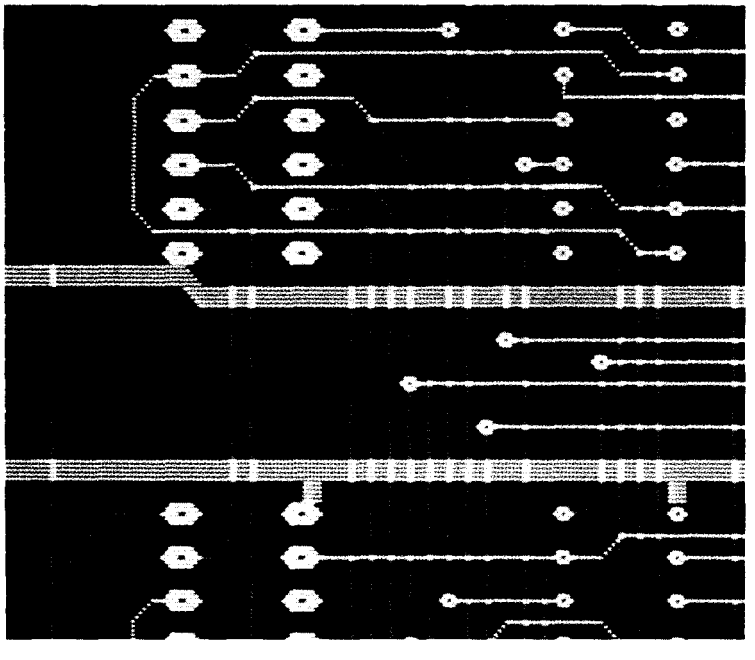
Herman Nacinovich reviews PCBreeze, a handy and affordable CAD package for anyone who designs single or doublesided pc boards.



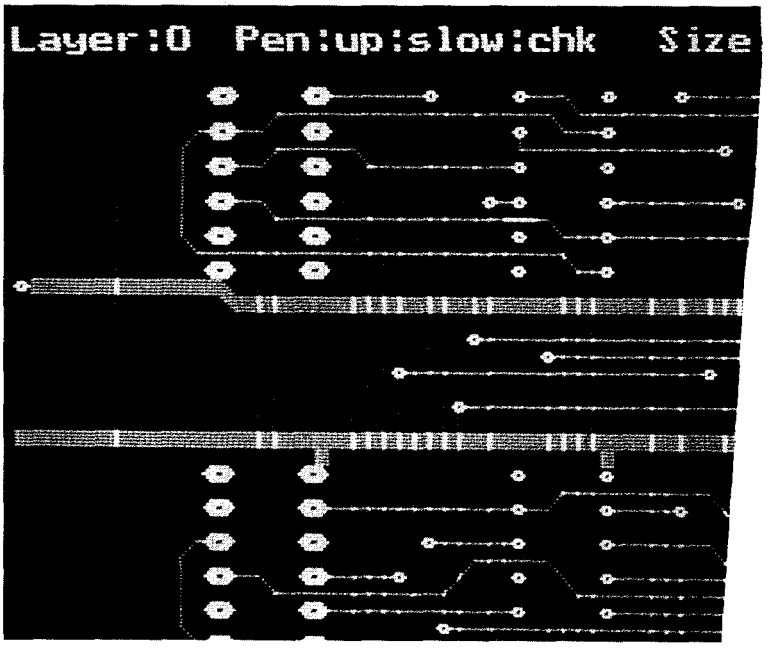
View highlighting menu display.



View showing silkscreen layer symbols.



View showing display in edit mode.



View showing display with blue background.

ELECTRONICS

It all started when brothers Luke and Anton Kepic were working on the design of some computer hardware. Naturally, this involved the design of printed circuit board artwork. Manual methods of artwork design being laborious and inaccurate, it was obvious that CAD (computer aided design) was the way to go. But, available CAD packages at the time were too expensive, let alone difficult to learn and use. Also, it seemed to these brothers that there must be many other people who felt the same way. Luke, a computer programmer by trade, and Anton, a physicist, decided that the thing to do was to write their own CAD program, not just for their use alone but one that others could use also, and at a price that everyone could afford. And so it was that PCBreeze was conceived. The current version, PCBreeze II, is the result of more than two years of evolution and refinement. Luke and Anton plan to produce other, related, software in the future, including a schematic capture program.

Introduction

A very important aspect of the electronics designer's trade is the design of printed circuit board artwork. The traditional methods involving pen and ink or drafting tape laid on plastic sheets are slow and tedious, and have, for the most part, given way to CAD (computer aided design/drafting) techniques.

CAD is to the modern electronics circuit designer what a word processor is to the modern writer. These kinds of software tools are not just useful; they are now essential to the professionals in these highly competitive fields. But it is not only the professional circuit designer who is discovering the advantages of CAD. The wide popularity of personal computers and the availability of sophisticated, yet low cost software packages means that the benefits of CAD are now accessible to a wide range of potential users, from students and hobbyists to technicians and professional engineers.

There are, certainly, some CAD packages which are outside the financial reach of most individuals and smaller design firms. These are highly sophisticated and intended primarily for the top end professional market. At a cost of up to $20,000 or more for some packages they are hardly a viable consideration for, say, the typical student or hobbyist. There are others in what I would call a medium price range, say, from $1,000 to $4,000 and which obviously suit a wider market. Software packages in this price range generally offer quite a lot of features that should meet most requirements for the professional PC board designer as well as features that some designers might rarely need.

A number of software packages in this 'medium' price catagory have been reviewed in the pages of ETI in the past. Software packages in the last mentioned price range may well represent a justifiable investment for a range of professional users. On the other hand, a student or hobbyist, or perhaps a small design firm might want to consider carefully before spending, say, $1,000 plus on their first CAD package. Also the cost of switching to a CAD system can, in some cases, be somewhat higher than the face value of the software. This is because some CAD systems require at least an EGA or VGA monitor, perhaps a hard disk, a mouse and maybe quite a bit of computer RAM. This is fair enough where the features offered by the software and the application requirements of the software user justify the hardware requirements. However there are plenty of personal computer users, I am sure, who would find some sort of CAD software useful but who would not have access to the full complement of hardware called for by certain CAD packages. For these users, the cost of upgrading their hardware to accommodate a particular CAD software would have to be considered as well as the cost of the software itself.

In my work I design printed circuit board artwork quite regularly and it has become apparent to me that a CAD system would be extremely useful to my work. But, I also work on a limited budget and a limited hardware system (who doesn't?). Until recently, the cost of available CAD packages and the hardware requirements has put me off getting one. This position changed for me when I saw an advertisement in ETI for a software CAD package called PCBreeze which was priced at under $300. Now, at this price, here was a CAD package which I felt suited my pocketbook. Equally importantly, it seemed to provide the essential CAD features that I required, and without the need for an expensive hardware upgrade, so I jumped at the chance to try it out.

Installation

The package arrived, comprising a single 5-1/4inch floppy disk and a manual. According to Kepic, which is distributing the package, the software will run on an IBM PC or compatible with a minimum of 384 Kbytes of RAM, at least one disk drive and either a CGA, HGC, EGA or VGA display system. The software also supports an EPSON FX or LQ type dot matrix printer, laser printer, a range of plotters and a mouse where these are available.

Installation was quite straighforward. I followed the recommended procedure by first making a backup copy on a floppy disk to protect the original. Next, essential files were copied to a 'working disk' as recommended by the distributor. Those with a hard disk would copy these files to a 'working subdirectory' on the hard disk.

Using PCBreeze really is a 'breeze', as the name implies. In less than an hour after installation I found myself comfortably designing artwork on the screen. With PCBreeze you can enter commands using either a menu or by entering the commands directly using keystrokes. Most keystroke commands are simple mnemonics of the required command and are very easy, therefore, to remember. Thus, after a little

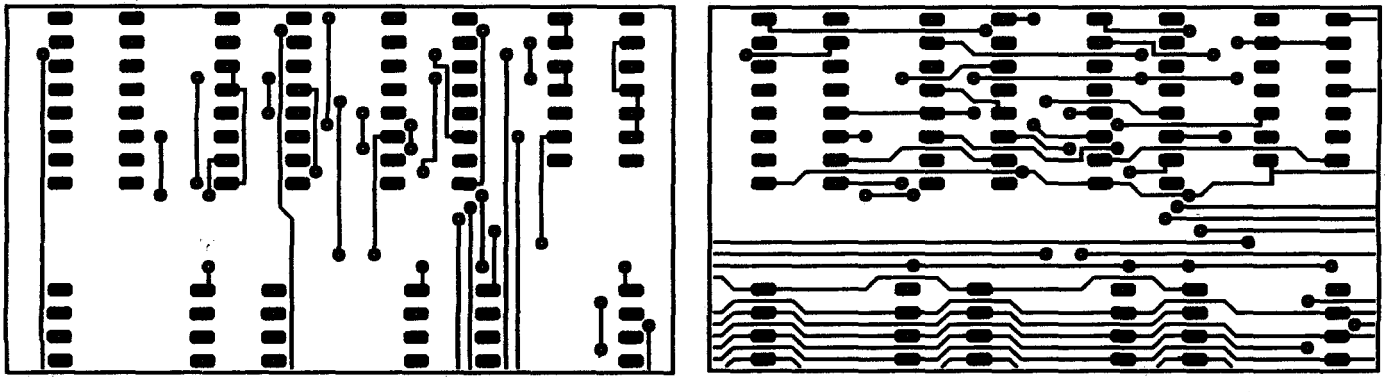


Figure 1. Sample of PCBreeze output on dot matrix printer. Left: component side artwork (2 x scale). Right: copper side artwork (2 x scale).

practice, users will probably use the keystrokes for entering commands rather than the menu for most of the time. If you have a mouse, PCBreeze lets you use the mouse to move the cursor and select menu functions.

Editing artwork

Laying artwork consists basically of laying pads (round, square, small, large, dual-in-line, etc) onto a workspace (as viewed on the monitor screen) and drawing traces between pads using cursor keys on the keyboard or a mouse. The size of the workspace is defined by the user prior to laying the artwork. This size can be the equivalent of anywhere up to 300 square inches (258,064 square mm), depending on the amount of memory (RAM) available. A trace is drawn by moving a cursor along the path desired in what is called a pen down mode . Pressing an appropriate cursor key or mouse button toggles the cursor into a pen up mode in which the cursor can be moved without laying or affecting a trace underneath it. Similarly, pressing another key toggles the cursor into a delete mode which allows you to erase any trace section under the cursor. Another feature is that the cursor can be toggled between a check mode and an insert mode. The former mode checks for previous work and prevents drawing over it. The latter allows a trace to be drawn over previous work.

PCBreeze provides a choice of no less than five trace widths and 14 pad sizes and types (including round, square, medium, large and rectangular). Pads can be either single pads, vias (pads intended for through-the-board connections on double sided, plated-through boards), dual-in-line and single-in-line types. The minimum spacing between lines and pads and the minimum trace length are 0.05 inches (0.127mm).

PCBreeze also provides display zoom capability with four zoom levels, which are useful for moving quickly from one section of the workspace to another and for closeup views when desired. An optional display grid pattern of dots with 0.10 inch (0.254mm) horizontal and vertical spacing assists in measuring relative distances on the screen, while measurement is further assisted by an optional odometer display at the top of the screen. The odometer displays pen coordinates and grid spaces relative to an origin which you can set anywhere on the workspace. Some of the features of PCBreeze which I have found to be particularly useful are the ability to move, copy and erase a trace or a section of the artwork (block) with ease. You can also print a block or save it on disk, and you can retrieve a saved block and place it anywhere on the workspace. Thus, for example, you can duplicate sections of artwork easily or move them around with ease. If you wish, you can create your own library of commonly used circuit patterns.

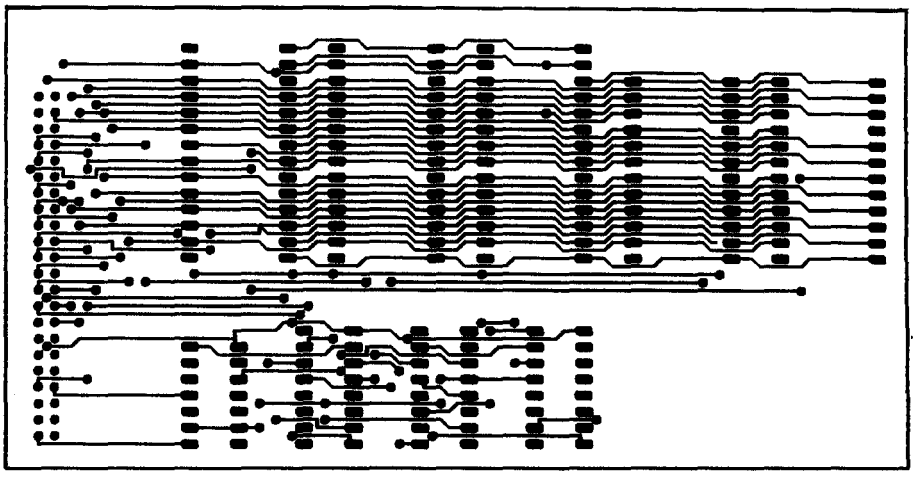


Figure 2. Sample of artwork generated by PCBreeze autorouter — output on dot matrix printer. Left: copper side artwork (1 x scale). Right: component side artwork (1 x scale).

PCBreeze is ideally suited for designing single layer and double layer pc board artwork. It is not intended for designing artwork for boards with more than two layers. With a CGA colour monitor, traces on the two layers and pads are displayed in different colours. With an EGA or VGA monitor a total of 16 colours is available. The default colours can be changed, if desired, by the user. According to Kepic, PCBreeze also supports monochrome displays with a Hercules graphics board, however, I have not tested this.

Autorouting

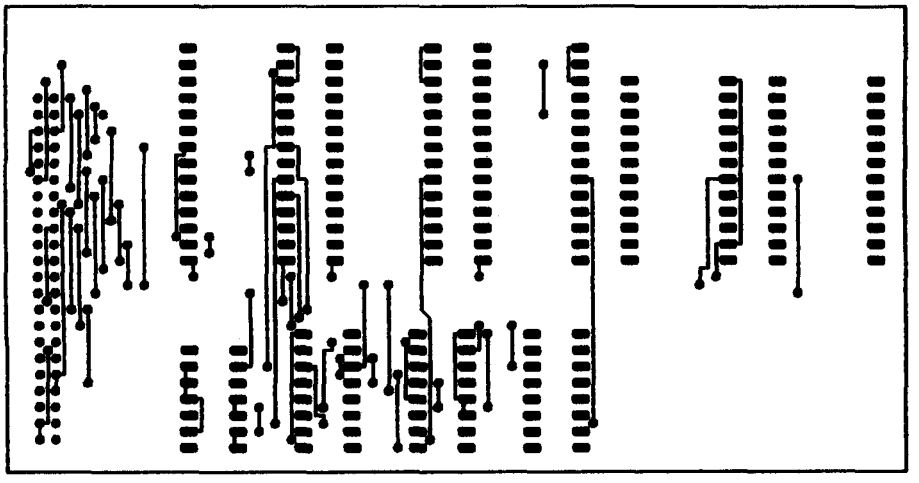
Undoubtedly, the most difficult task of any printed circuit board CAD program is autorouting. This is the process whereby you provide a list of components and their relative locations and a netlist of the interconnections which need to be made between components. The autorouting program generates the interconnections as far as possible from these lists. Depending on how sophisticated and/or efficient the algorithms are, which dictates how the interconnections are to be made, autorouting can take up a lot of computer resources and a lot of computing time. PCBreeze attempts to minimise these with an algorithm which first tries to find the shortest routes in either a horizontal or vertical line. It then proceeds to try and find the remaining routes in the order of how short and how close to a horizontal or vertical line they may be. Once a route has been worked out and a trace laid out on the screen, PCBreeze then proceeds to try and find the next route. If PCBreeze cannot find a route within a reasonable time it leaves it aside until all of the remaining routes have, as far as possible, been found. Unlike programs using rip up and re-route algorithms, it does not try to find alternative routes for those traces which have already been laid. As the autorouter proceeds it generates a list of incompleted routes and this list is automatically saved in a file. Incompleted routes then have to be worked out manually by modifying the placement of components to provide adequate room on the artwork for these routes or by modifying existing routes or by adding links, or by making other modifications as may be necessary. One disadvantage, though not a serious one, of the autorouting algorithm used by PCBreeze is that it tends to use lots of vias. However, on the plus side, it appears to be capable of fast results even when compared with algorithms used by more expensive CAD packages. This would seem to make PCBreeze ideal for pc board design in situations such as prototyping, where it is important to get quickly from the design stage to the final board.

According to the PCBreeze manual, a success rate of 95 percent completed nets for a double-sided board layout is typical. Initially, I tried the autorouter out on some circuits for single-sided boards and found success rates to vary between 80 and 90 percent. With double layered artwork, where vias are allowed, the success rate should be inherently higher. To test this, I designed a circuit containing several ICs, representing a typical memory section of a computer or RAM module. I then manually generated a net list using a word processor and used the editing functions of PCBreeze to manually place the components. I then let the autorouter do its thing. The results are given in Table 1.

TABLE 1

Number of nets entered	**166**
Number of nets completed	**160**
Number of errors	**2**
Success rate	**95.2%**
Completion time	**7.5 minutes**

As can be seen from this table, there were some nets which the autorouter could not complete. However, the success rate is quite high and within the figure suggested as typical by the PCBreeze manual. I should add that, even with very expensive autorouting



systems there is always a possibility that some routes cannot be completed by the autorouter alone and some manual intervention may be required. Apart from the nets which PCBreeze could not complete, there were a couple of errors. In one case a trace was written over a previously laid trace. In another case, one of the traces was not quite completed. However, these were obvious and easily fixed.

The most impressive aspect of these results, I think, is the very short time it took for PCBreeze to complete the majority of nets. This was, by the way, achieved on a relatively slow 'XT' compatible machine and therefore the speed may well be even more impressive on a faster machine. Offset against the speed of the autorouter itself was the time it took to manually generate a netlist. Bearing in mind that the reason for using an autorouter in the first place is to save time, the need to manually enter a netlist suggests that the autorouter is best suited (as Kepic has pointed out) for artwork containing lots of digital logic with random paths from pin to pin. For circuits with only a small number of components, precision analogue circuits, critical signal paths, power busses and very high speed digital circuitry, it is probably better to avoid autorouters altogether. The above described procedure (autorouting using netlists) is referred to as "non-interactive routing". PCBreeze also permits 'interactive routing' in which you mark two end points and PCBreeze finds a route between these points, if possible. This avoids the need for setting up netlists and is likely to be faster when designing small boards. The two routing procedures can be combined or interrupted at any time, making PCBreeze quite flexible in this regard.

Printing artwork

My guess is that most PCBreeze users will be outputting their artwork onto a dot matrix printer. Whilst a standard dot matrix printer may not have the inherent printing resolution of, say, a laser printer or a plotter, I have found that PCBreeze nevertheless is capable of giving excellent results on a good quality dot matrix printer. My only complaint is that if you forget to turn on the printer or if some other printer 'error' condition exists, the program locks for several minutes without any way of returning to normal operation in that time, short of rebooting and starting again. At the end of a 'time out' period, the program jumps into DOS so that you have to restart PCBreeze. In my view, it would be better if the program would generate a "printer not ready" message and give the option of either fixing the error (turn on the printer) or aborting and returning to edit mode. It would also be desirable if one could abort printing at any time by pressing (ESC) or some other suitable key or combination, but at present this is not possible.

The software is optimised for an Epson printer of the FX or LQ series but should work with any compatible printer. However, if your printer is of a different type or brand, it is possible that the dimensions on the printed output, eg, the spacings between IC pads, will be slightly different in the vertical and horizontal directions. This is because of variations in line feed pitches between printers. Whether or not it is of serious consequence will depend on the degree of accuracy required. As a general rule it is desirable to orientate parts with critical dimensions, such as IC pads, in the horizontal direction (direction of print head movement) since dimensional accuracy seems to be best for most dot matrix printers in this direction. PCBreeze will print artwork in either 1x or 2x scales. In most cases, particularly where IC pads are included in the artwork, the 1x output should be reserved for checkprints and the 2x output used for the final printing for photo reduction.

If you have an inexpensive dot matrix printer which is unable to give you the print quality or accuracy that you require with critical artwork, Kepic has suggested that you could have your final artwork printed by one of the several desktop publishing services which are available. This will allow you to obtain professional quality artwork without having to upgrade to an expensive printer or plotter. At the same time, you can use your inexpensive dot matrix printer for all your checkprints before having the final artwork done.

Text and silkscreen layers

In addition to pads and traces, PCBreeze also allows you to enter text and a wide choice of symbols (boxes, circuit symbols, component outlines, etc) into what are called "text" and "silkscreen" layers. Text and symbols can be moved around, changed in size, stretched vertically or horizontally, rotated, mirrored, copied and deleted. These layers can be sent to a plotter to produce artwork for silkscreening or for use as a component overlay. PCbreeze also includes a utility which converts plotter output into printer output, allowing the silkscreen layer to be printed on a dot matrix printer. However, in this case it is necessary to first save plotter output in a file, then exit to DOS to run the utility.

The ability to generate component overlays and silkscreen artwork will be appreciated, I am sure, by PCBreeze users. Editing the text/silkscreen layers is straight forward, once you become familiar with the commands and cursor movements. And you can toggle any time between the silkscreen layer and the pc board layers by pressing appropriate keys. For the most part, I have not experienced any major problems while editing the text/ silkscreen layers but on a couple of occasions I was unable to send plotter output to a file for subsequent printing. This occurred with artwork which used lots of text and symbols in the overlay pattern. At first I suspected a bug in the program. However, the problem turned out to be that I was using part of the computer memory as a RAMDISK and there was (apparently) insufficient memory remaining for use by the program when saving the plotter output to file. Interestingly, none of the other program functions seemed to be affected by the reduced memory and there were no problems when printing the artwork for the copper layers. It took me a long time to work out what the problem was, but once I did, the cure was simple. Perhaps future, updated, versions of PCBreeze could detect problems of this kind when they occur and then display appropriate error messages to alert the user. Apart from this point, I was impressed by the versatility of the text and symbol editing functions and I believe that these are worthwhile inclusions in the program.

Conclusion

PCBreeze is an easy to use, yet powerful PC board CAD package, with a wide choice of pad and line sizes and extensive editing capabilities.

At the time of writing, the price of PCBreeze is under $300, which must make it one of the least expensive CAD packages of its type available. I feel that PCBreeze is good value for money and is worth considering by anyone who regularly designs single-sided or double-sided printed circuit boards. eti

PCBreeze is obtainable from Kepic Pty Ltd at the following address: Kepic Pty Ltd, 4 Steinbeck Pl, Spearwood, WA 6163.

INNOVATION

Adam Searle looks at this electronic lexicon recently released by Expo Ultrasound and available from a chemist or department store near you.

SPELL IT RIGHT

It is fair to describe the Electronics Spellright device from Expo as a single function computer. Designed for business, school and leisure use, the light and compact spelling aid has a base of some 80,000 words (both common and unusual), including proper names and abbreviations.

These are stored on a one megabit ROM chip with the software. The CPU is a 4 MHz Z80. Other circuit features include 128 Kbytes of ROM and 2 Kbytes of RAM. The letter keys are arranged in the familiar QWERTY typewriter style with some extra command keys, including ON, CLEAR, ENTER and direction keys.

It is a compact, lightweight device, measuring 194 mm by 105 mm by 36 mm, and weighs 265 grams without batteries. Above the neatly laid-out and easy to understand keypad is a black panel with the device and manufacturer's name, and the model number on it. This also houses the 16 digit liquid crystal display, bordered in white against the black.

Operation

To check the spelling of a word, you key in the spelling you think most likely, in the same way people use dictionaries. The display will tell you to "WAIT". While in this searching mode, a small clock with a revolving hand is displayed. The Spellright will then either indicate that you have spelled the word correctly – it indicates so with an asterisk – or give you a list of other possibilities.

Sometimes it will tell you "SORRY CAN'T HELP". There are also times when the device will not recognise the word you enter. For example, myxomatosis, which is spelled correctly.

To get back to your original word, you simply press ENTER again.

Also, if you do not know how to spell a word (say, concrete), you can key in what it sounds like (e.g. konkreet) and the machine will give you a list of possibilities to choose from.

How well this facility works depends on what your approximation is. For instance, if you spell cage 'kayj', it will not give you the correct spelling. But if you key in kayg it will. For this to work well you have to possess a reasonable idea of what you are after.

If you would rather not even guess, just key in the first few letters then press the hyphen button and press ENTER. It will give you words which begin with those letters. You may scroll up and down the lists given using the direction keys. When not in spell-checking, these keys can be used to adjust the contrast of the 16-digit LCD display screen.

Even if the machine says a word is correctly spelled, pressing the ? button will enable it to list alternatives for you. It will also list words which rhyme with the word you have keyed in.

To remove the work you have just completed, press CLEAR. All the words which Spellright gives you are genuine English Oxford Dictionary spellings, not Americanised corruptions.

It can operate from either mains power or batteries. For mains power, simply connect the adapter cord which comes with Spellright into a convenient power point. For battery use, you need four AA (UM-3) batteries..

Extra heavy duty batteries are especially recommended as they will last up to four hours during heavy use. If the display gets faint or begins to give partial or erratic characters, the batteries will need replacing.

To turn Electronics Spellright off, just press ON again. If you forget to do this, Spellright will automatically turn itself off if no keys have been pressed for a while. A brief warning, "SHUTTING OFF" will be shown first. There is another on/off switch on the right hand side of the machine to turn it off completely.

Uses

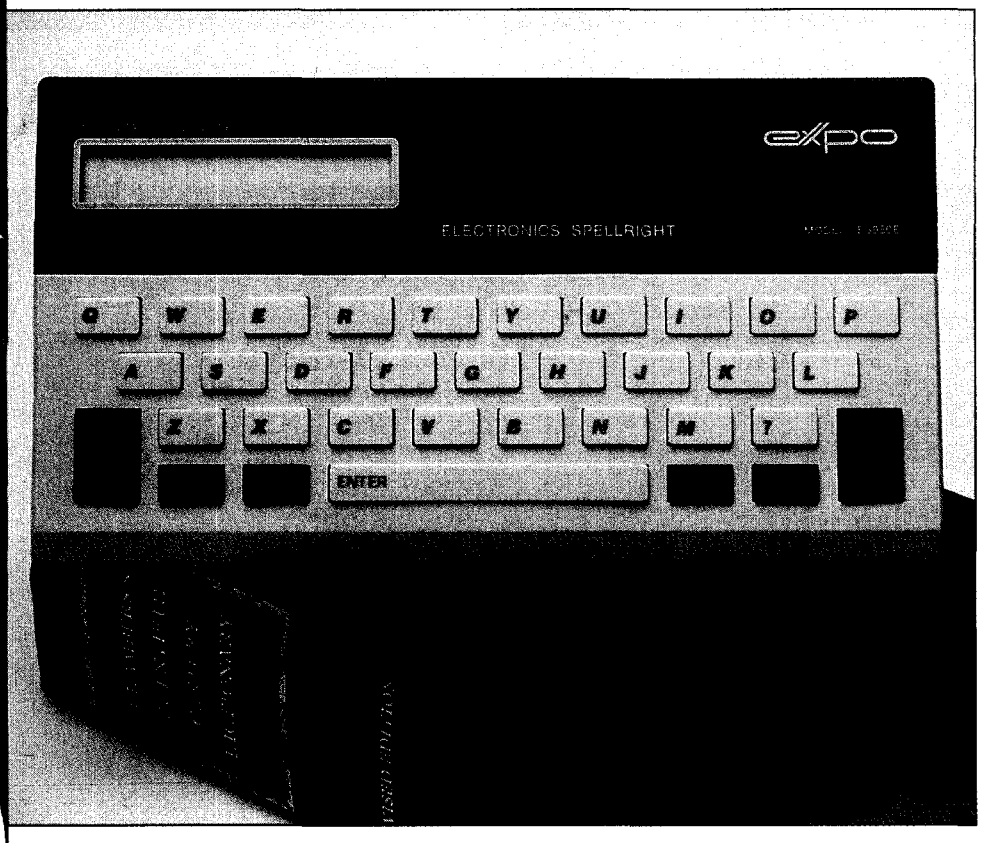
The Electronics Spellright is handy for spell-checking, word lists, and doing crossword puzzles, by removing the bother of having to think up possibilities. For example Four Across may be "to fake", with the letters being F–I–N. Enter F?I?N into Spellright and you get an answer.

Spellright can also list all five letter words with T in the middle by entering ??T??, or all the five letter words with X in the middle. This function is also useful for Scrabble and other word games.

For word learning and similar activities it could be very handy in schools as a teaching aid. It may help make necessary tasks like spelling, which children often find a chore, into a more interesting enterprise.

By encouraging students to work independently of the teacher it would enhance self-reliance and also take some of the load off the teacher. The device would also make a good educational toy for children to use at home, although in this sphere it is hard to go past Speak and Spell from Texas Instruments.

For wider usage among adults, those who would require the facilities offered by the



The Electronics Spellright, from Expo.

Electronics Spellright for work-related purposes are in the main already catered for with the wide choice of spell-check and thesaurus programs available in word processing packages. For those who travel, laptop computers with the same capabilities are becoming increasingly widespread. However, there are still many who do not have access to word processors. For them, the Electronics Spellright would be ideal.

Conclusion

So, for parents and teachers who are responsible for primary school children, and those who do not have access to more sophisticated technology in this area, the Expo Electronics Spellright would make a good companion.

It is more portable and easier to use than a dictionary, and in any practical sense, just as useful. Only on relatively modern words like granny-flat and houseparent does it appear to fall down, and even the most up-to-date word processor spell-checks have been known to stumble.

Electronics Spellright from Expo is available from Soul Chemists, Grace Brothers and some other department stores for around $99. It is distributed by Expo Ultrasound. For further information contact them through PO Box 133, Mortdale NSW 2223. (02) 533-2266. ETI

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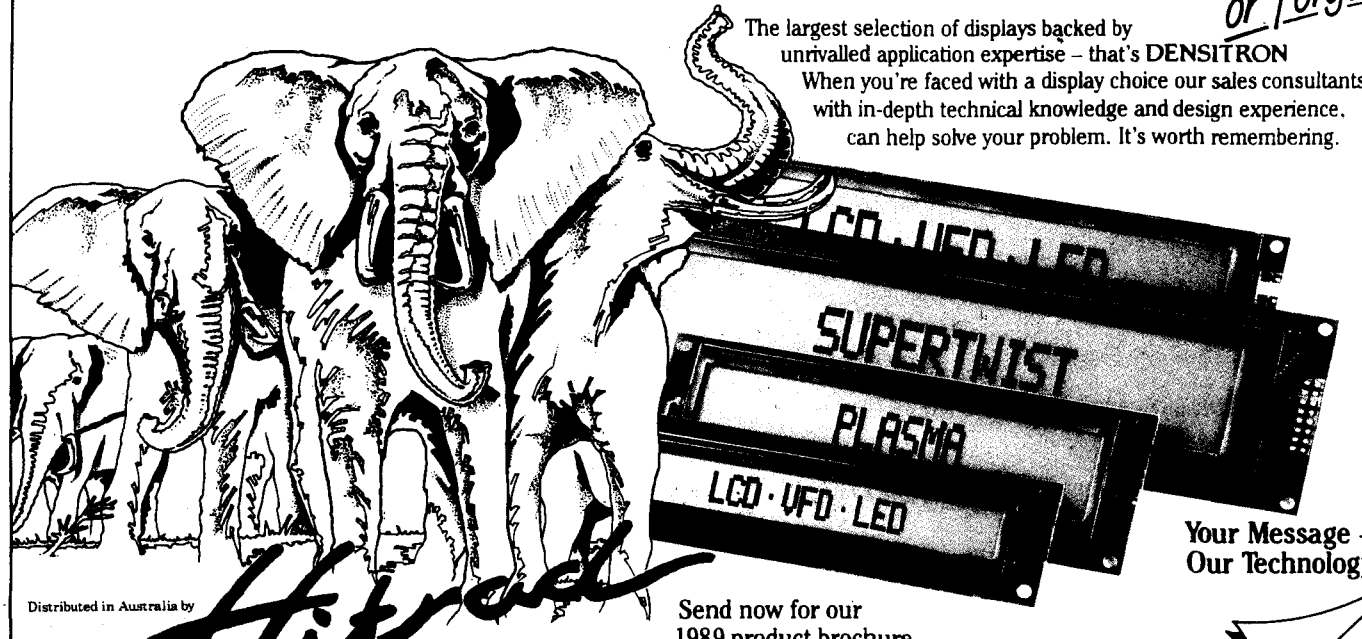

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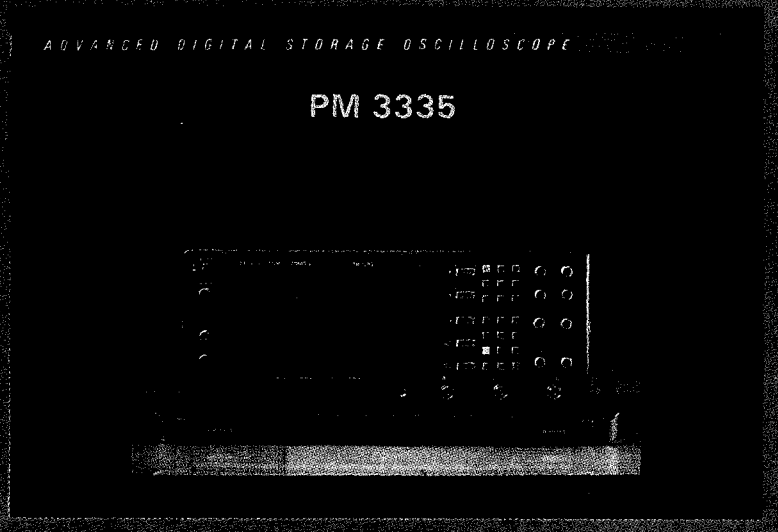

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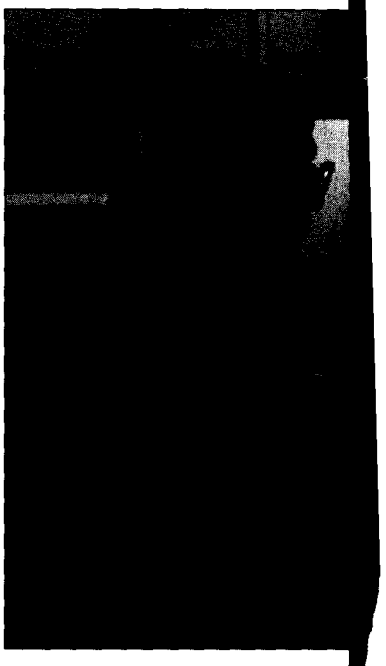
ND WIN THEM BOTH

HP: BUILDING A BETTER MOUSETRAP



They say that five years is a lifetime in television, and a week is a long time in politics. In the computer and electronics industry, some companies have museums of quaint products – the antiquities of the high tech age, many of which are all of five or ten years old.

It is only when you cast your eyes back on these relics, that you realise just how rapid the evolution of electronics has been in our lifetimes. The proverbial "room full of computers" which, in the past decade has shrunk to the desktop, to the hand-held, to a single square of silicon the size of your thumbnail, is about as illustrative of the electronics revolution as saying "the Universe is big."

If ten years is an eternity in the electronics industry, the mind boggles at the recent announcement that a one-car garage in Palo Alto, California, 50 years ago, has now been officially declared the birthplace of Silicon Valley and the world electronics industry.

The garage was a humble beginning for Hewlett-Packard, now a $13b company, with 95,000 employees in nearly 100 countries around the world. Today, HP has over 10,000 different products, from electronic components to test and measurement equpment, computers, medical electronic and analytical equipment.

HP is also one of the world's top two non-Government research companies, spending $1.5b per year on projects ranging from superconductor levitation to high-definition TV.

Although few are aware of it, HP technology touches every phase of most people's lives. The company pioneered ultrasound technology, which provides an image of the foetus before it is born. HP clinical monitoring equipment is used in operating theatres and intensive care wards throughout the world. HP heart defibrillators bring thousands of people back from the brink of death each year.

The air we breathe, the water we drink, and a thousand other elements are tested and analysed using HP analytical equipment including gas chromatographs and mass spectrometers.

HP brought about the demise of the slide-rule with the world's first desktop electronic calculator in 1968 and the first handheld scientific calculator in 1972.

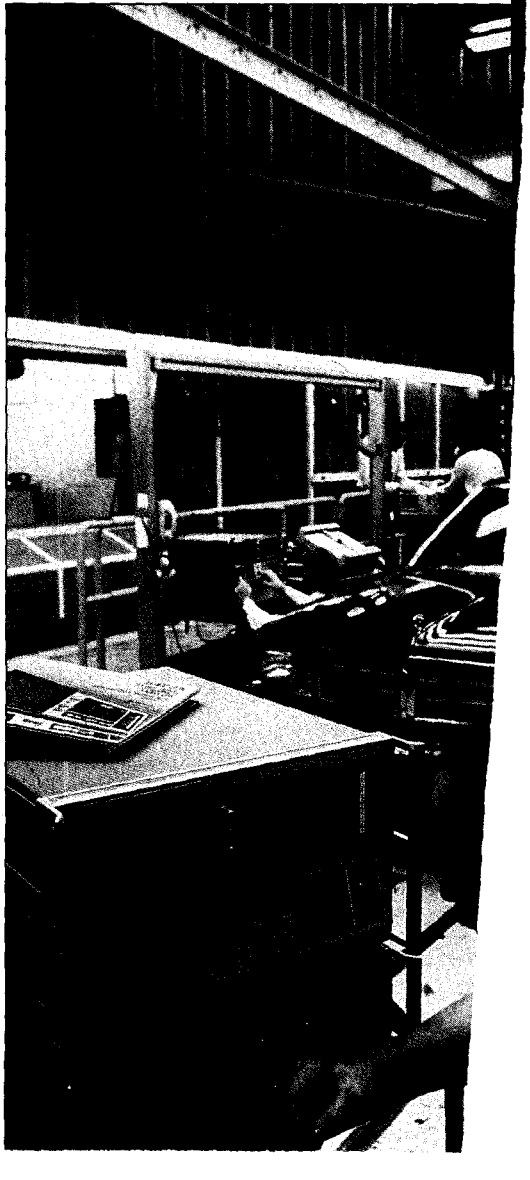
The company was also a pioneer in the computer industry, firstly as intelligent controller for its test and measurement equipment, and later with the HP 3000 family – the world's second most widely used general business computer. HP was also the first to commit to RISC computer architecture, driving the industry towards a new era of higher performance, more reliable super minicomputers.

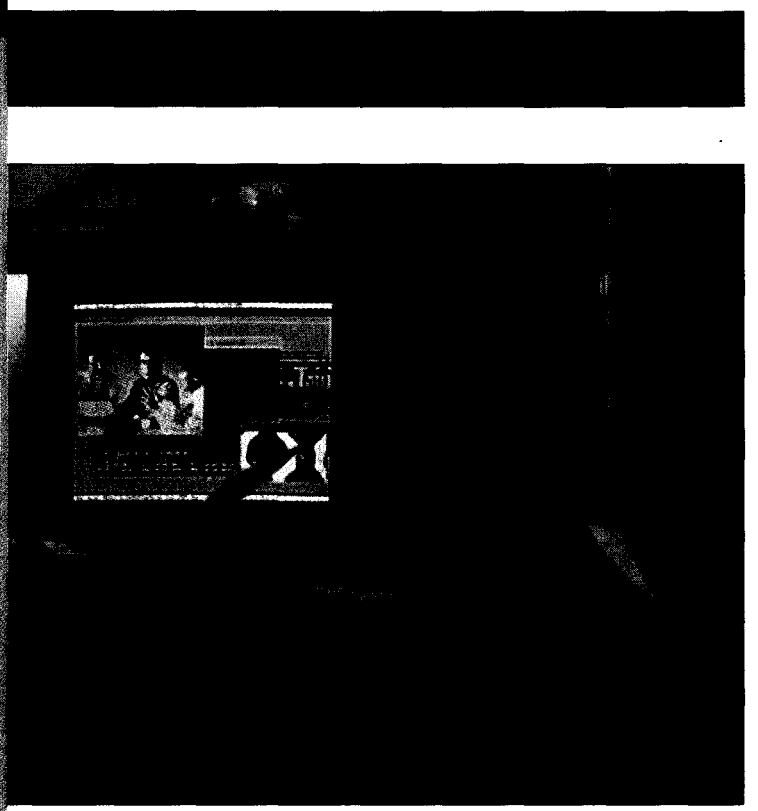
In the personal computer arena, HP released the first intelligent terminal/PC, introduced three-and-a-half inch disks, the first non-keyboard PC interface with the release of HP TouchScreen and the world's first full-function laptop computer, all in the early 1980s.

The reason that HP has largely been forgotten for these achievements, and that it is only just starting to take off elsewhere in the industry, brought home to the company that there is more to marketing than better engineering and new innovations.

If HP has been criticised for anything in the past, it has been that it is guilty of being a great company for developing outstanding technology and then not telling anyone about it. The "build a better mousetrap and the world will beat a path to your door" apprach is an offshoot from the company's early technology-driven days, which has only recently been stripped away.

The first product for Bill Hewlett and Dave Packard was an audio oscillator. Their first major customer was Walt Disney Studios, which purchased eight of the test instruments to develop an innovative sound system for the classic film "Fantasia". According to Disney officials, several of the original oscillators were still in use in the early 1980s.





Today, Hewlett-Packard's test and measurement products range from digital oscilloscopes, network analysers, signal generators, protocol analysers, spectrum analysers, board-test systems, and virtually every test and measurement product to suit the scientific, engineering and telecommunications industries.

Lettuce thinners

In its first years, HP developed products to meet the requests of friends and local businessmen: these products were not exactly highlights in the history of electronics!

First, there was a lettuce thinner, based on an electric eye. Unfortunately, vacuum tubes proved incompatible with the farmland environment, and the machine wiped out rows and rows of perfectly healthy plants.

There was also a foot-fault detector for 10-pin bowling alleys, and an oscillator whose terminals were placed across the temples of an animal with the aim of replacing the use of anaesthesia in the veterinary industry.

These efforts were early attempts to find practical uses for electronics in a world where electronics was a totally unknown quantity.

Test equipment suppliers had to help the industry grow by providing the tools that would make it possible for engineers to develop and apply electronics technology.

Today, with electronics a $500b industry worldwide, Hewlett-Packard is continuing to lead with the broadest range of test and measurement equipment available, at competitive prices, and with a reputation for quality construction and service that has stayed with the company throughout its 50-year history. eti

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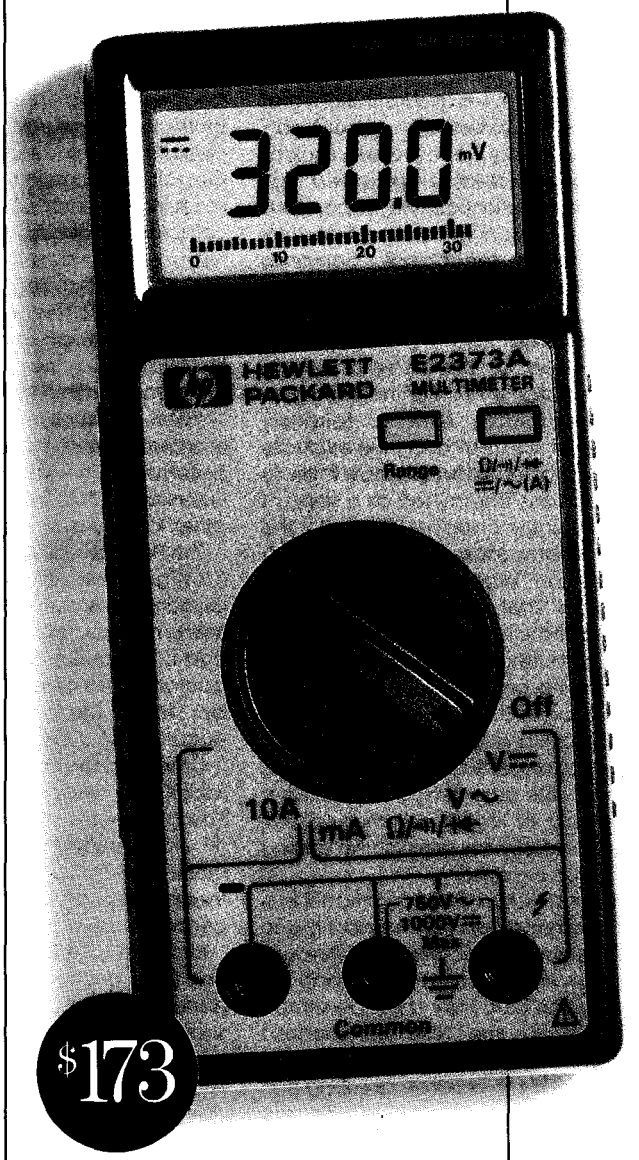

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READER INFO No. 7

A HIGH-FLYING BERD

The Fireberd 6000 Communications Analyser is regarded in the communications industry as the 'Rolls Royce' of digital communications analysers — and deservedly so. Roger Harrison reports.

INSTRUMENTATION

The infrastructures and institutions that underpin business, government and, indeed, pretty well our whole society, are dependent on reliable, high speed, high quality communications carrying voice, video and data. The sophistication of today's communications technology demands equally sophisticated – if not more so – test equipment for its installation, troubleshooting and maintenance.

A great deal of this communications technology is digital. In order that the signal (voice/video/data) sent is faithfully reproduced at the destination, the *error rate* must be maintained within tolerable limits. As digital signals are transmitted as a string of bits, it is the 'bit error rate', or BER, that is the basic performance parameter of importance in digital communications systems. After that, there are many other parameters that characterise the behaviour of data communications equipment, but BER is the basic one, equating to signal-to-noise ratio in analogue RF systems, I guess.

What the digital storage oscilloscope is to general electronics test and measurement, the bit error rate communications analyser is to the field of digital communications. Hence, you can see the origin of the spelling of the Fireberd's name.

The Fireberd 6000 is the top model in a range of communications analysers made by the Telecommunications Techniques Corporation which hails from Gaithersburg, Maryland in the USA. They are represented in Australia by the Melbourne-based communications specialist, Vicom.

Founded in 1974 to provide consulting and product development services to the satellite communications industry, TTC focused its efforts on the development of innovative diagnostic test and simulation equipment.

Talk about getting in on the ground floor of a growing industry...

So, the Fireberd 6000 has a handsome pedigree behind it. Today, TTC is a wholly owned subsidiary of the not insubstantial Dynatech Corporation of Massachusetts, a name which would be familiar to a number of readers, no doubt.

Features and functions

The Fireberd 6000 Communications Analyser is a comprehensive test instrument for analysing, evaluating, and troubleshooting digital communications systems and equipment. Designed to operate from 50 bits/second (b/s) to 15 megabits/second (Mb/s) and to use modular data interfaces, the Fireberd 6000 combines traditional bit error rate analysis with such additional features as performance analysis, signal analysis, and timing analysis. The Fireberd 6000 is suited for a variety of applications, says TTC: installation, acceptance testing, maintenance, and fault isolation of T-Carrier systems, modems, multiplexers, digital radios, microwave and satellite communications systems, etc. In Australia, they can be found in service in OTC, Telecom, major banks and other large digital communications users.

The Fireberd 6000 operates in full-duplex configuration and with synchronous, asynchronous, or recovered timing. Transmit timing may be supplied externally or from the built-in frequency synthesiser, which allows operation at any rate in the range from 50 b/s to 15 Mb/s with the stability and accuracy of a crystal oscillator.

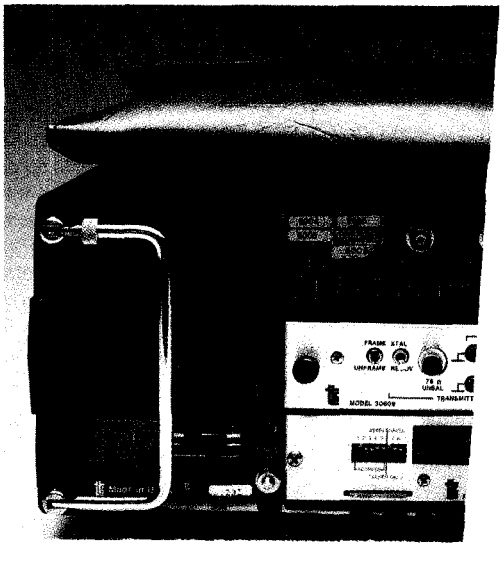
Other timing analysis features include: a 'clock slip' detector that identifies system timing problems; high-resolution transmit and receive frequency counters; an inverted clock detector; a selectable transmit clock inverter; and a clock recovery option that permits received clock fault isolation.

Included in the Fireberd 6000's signal analysis functions are advanced jitter generation and measurement capabilities, such as external or internal jitter modulation as well as automatic frequency sweeps. The receiver features a peak-to-peak measurement and a 'jitter hits' circuit with variable thresholds which operate continuously so that short-duration events will not be missed. Jitter spectral analysis – with multiple jitter masks – is performed using non-overlapping frequency bands to permit jitter "fingerprinting" and rapid identification of jitter sources. In addition, hard-copy graphs of the spectrum can be generated. Other important signal analysis functions include delay measurement and automatic data and clock polarity detection.

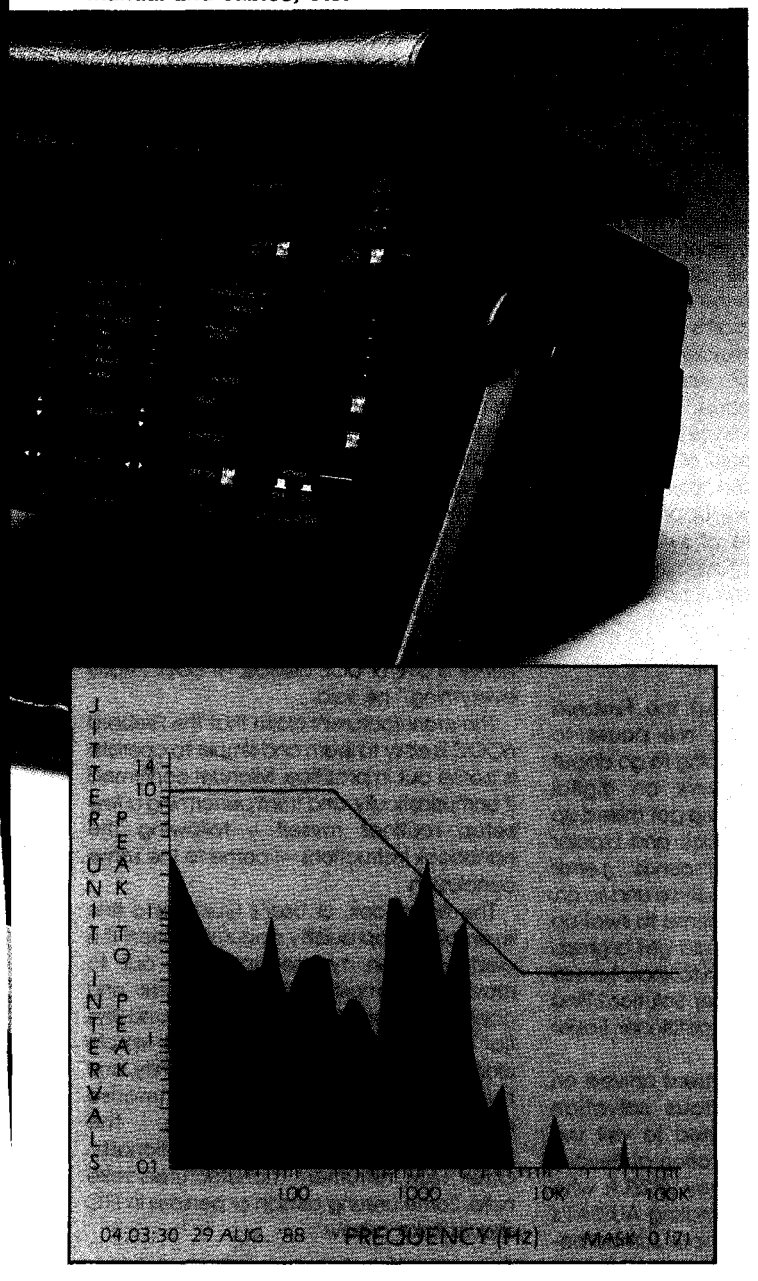
The instrument's front panel features a display which simultaneously presents two sets of results. A combination of electronic slide switches, pushbutton switches and menu formats with extensive HELP guidance further facilitate setup of complex test configurations, according to TTC's literature.

In addition to the Fireberd 6000's extensive current capabilities, its flexible architecture and 16-bit processor are designed to easily accommodate upgrades as standards change or as new features and capabilities are added, says the manufacturer. A separate, easily accessible EPROM module permits the implementation of software upgrades without disassembling the instrument. Very handy.

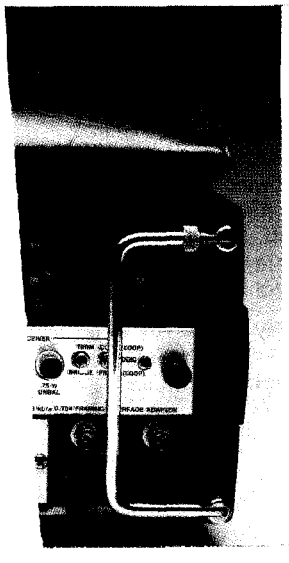
The 6000 provides a basic 'mainframe' to which you add plug-in interface modules to suit the individual application. These are all inserted in the rear panel. This mainframe can



The Fireberd 6000 Communications Analyser; smart, smart looking and incredibly versatile. The pouch, which reminds me of certain native marsupials, carries the instrument manual and cables, etc.

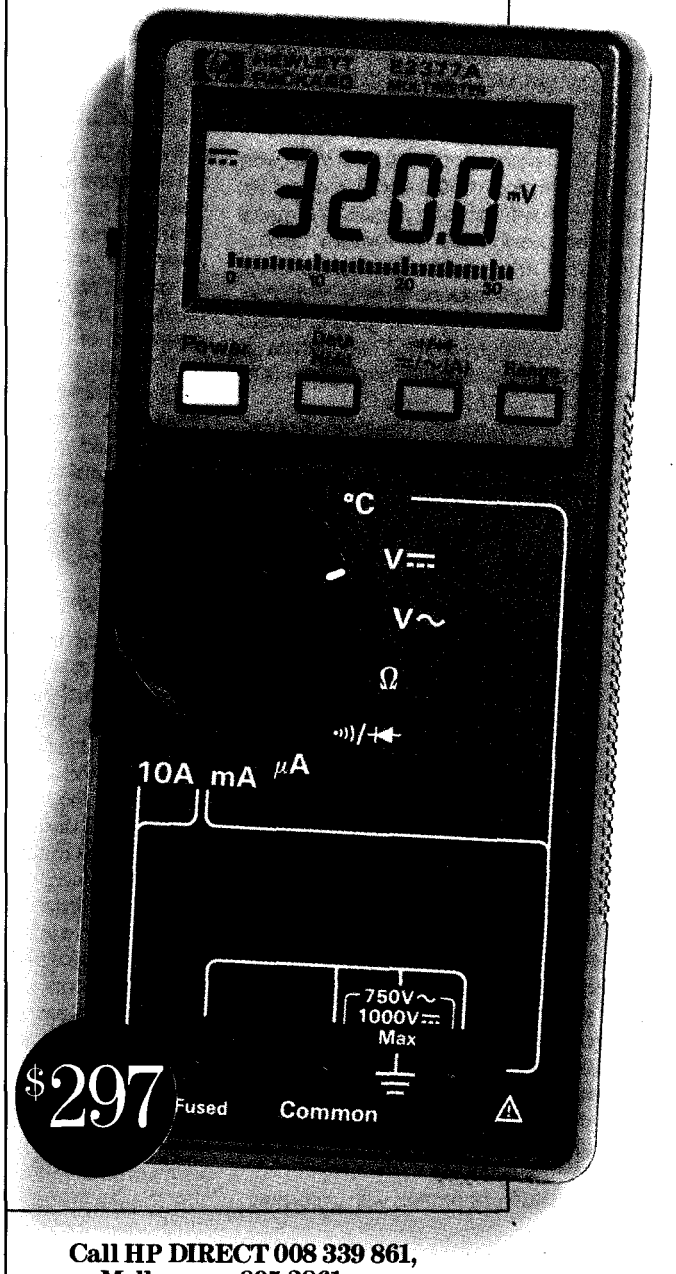


A high resolution graphic printout from the Fireberd 6000 clearly presents a jitter mask and a received jitter spectral analysis.



Rear view of the Fireberd 6000 showing two plug-ins installed. The chromed handles fold out to provide protection for the rear panel.

...in a handheld multimeter...



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READER INFO No. 8

Fireberd 6000

be purchased with or without a variety of some six options – all of which may be factory installed, or five of which may be customer installed. The options include jitter measurement and generation facilities, clock recovery, IEEE-488 remote control and a precision timebase.

A total of 18 plug-in interface modules are available. These include various RS232 plug-ins, for example, plus a G.703 (CCITT) 64 Kb/s co-directional interface, G.703 2.048 Mb/s and 8.448 Mb/s interfaces.

The 6000 is powered from 240 Vac (with a specified range of 190-260 V), 48-66 Hz. It is available with either a plastic or a metal case. One model has full remote control facilities for totally unattended operation. A standard 19" rack mounting kit is available. The unit supplied was the plastic-cased model, which weighs around 7 kg with plug-ins installed. It measures 153 mm high by 305 mm wide by 305 mm deep.

The unit came in a very robust 'road case', lined with foam sponge, sculpted to carry the Fireberd and its coterie of cables, interfaces and accessories. A convenient pouch attached to the instrument's case top provides storage for the handbook and seemingly, whatever else you can stuff in there.

I think a summary of the 6000's abilities and facilities is appropriate at this juncture. It provides over 50 diagnostic measurements:

Error Analysis

- simultaneous bit, block and bipolar violation error test;
- current, average and statistical error measurements;
- selectable response upon sync loss and selectable sync loss thresholds.

Timing Analysis

- frequency counters;
- inverted clock detection;
- clock slip measurement;
- synchronous, asynchronous and recovered clock operation.

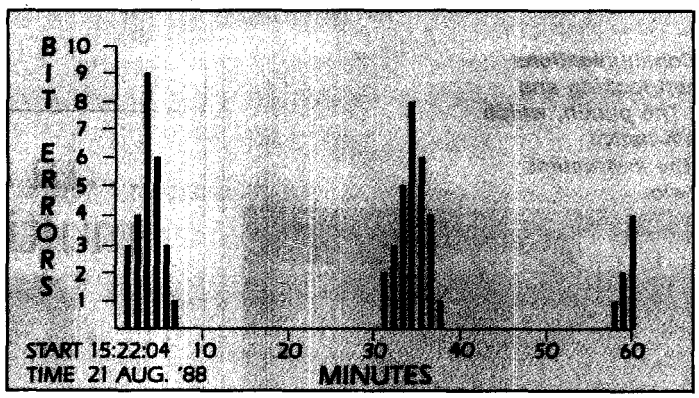
Jitter Generation and Measurement

- multiple standard jitter masks;
- wideband jitter and jitter hits;
- jitter spectral analysis;
- programmable generation with automatic sweeps.

T1 Measurements

- unframed, D4 and ESF framing, AMI and B8ZS line codes;
- bipolar violation, framing and CRC error analysis on live traffic;
- framed and unframed loop code generation;
- bipolar violation insertion at programmable rates;
- built-in transmit line build-out.

You can send standard bit patterns, the standard QUICK BROWN FOX message (in four codes) or a user-programmable message up to 255 characters long. All selectable from front panel controls.



Histograms of test results may be plotted automatically after periods of unattended testing of up to 60 hours.

The 6000 may be hooked up to a printer. All measurement results appropriate to a specific data interface are measured simultaneously and can be printed for a permanent record. Histograms of results may be plotted automatically to allow review and analysis after periods of unattended test operation of up to 60 hours.

TTC claims that extensive use of front panel 'softkeys' make the Fireberd 6000 easy to learn and simple to operate. "Both the novice and the old pro alike will appreciate the carefully crafted mixture of switches and menus", says TTC's literature.

A full set of specifications runs for more than five A4 pages.

Commentary

When I was initially offered the Fireberd 6000 to review, it gave me pause to ponder on just *how* I was going to go about it. I did a little homework on digital communications analysis and got mixed up in such wonders as bit, block and bipolar violation (... not as kinky as it sounds ...) error testing, CRC and framing analysis, and so on. Hmmm. A bit much there for me to swot up in the time available, but I did get a grasp of the fundamentals. Enough to know I could get myself in a little hot water. Solution? Find an expert, or better still, a practitioner. Easier said than done ...

However, before the Fireberd arrived on my doorstop, serendipitous salvation presented itself. I was invited to visit the AUSSAT Major City Earth Station at Belrose in Sydney by Laurence Adney VK2ZLA, who was one of a team coordinating AUSSAT's involvement in this year's Scout Jamboree-On-The-Air. While I was there, marching up and down racks and racks of codecs and other fascinating technology, I spotted ... a Fireberd.

I enlisted Laurence's help and he put me in touch with the Station's Communications Supervisor, Michael Buchanan. Just what I was after, a practitioner. Michael kindly consented to assist and in due course, I despatched the review instrument to him at Belrose. He duly confirmed that the instrument performed properly.

Michael says he uses the Station's Fireberd on pretty much a daily basis. It gets used mostly on 64 Kbit/second and 2 Megabit/second circuits for BER checking. It also gets used for obtaining long-term statistics of communications circuit performance characteristics. He said a particularly useful facility in this regard is the Fireberd's facility to produce histograms. It gets hooked up to the system for a week at a time, for example, specifically on 2 Mb/s channels, to determine a channel's performance. Long-term effects on a channel are important and the Fireberd's ability to deliver the required statistics is very useful, he said.

I asked Michael about the Fireberd's outstanding points. He cited the fact that it's a very versatile instrument aided by a vast array of plug-in interface modules, its ability to do framed and unframed (loop code) tests, the fact that it can be configured as either a DTE or DCE device; "It does nearly everything," he said.

The manufacturer's claim that the Fireberd 6000 is easy to learn and simple to operate is borne out in practice. Michael confirmed it enthusiastically, and from performing a few setup routines myself – following the handbook instructions – I came to the same conclusion.

The handbook, or User's Guide, is a fine example of top quality documentation. It is clearly written, typeset and laid out to provide the utmost clarity for the reader, and copiously indexed. It is spiral bound and lays flat anywhere you open it. The simple diagrams, included at every opportunity, and the many tables which summarise procedures, contribute to the documentation's clarity and functionality. Other T&M instrument manufacturers take note. Some unsung person or persons in TTC should take a bow.

In conclusion

For a 'Rolls Royce' instrument, you'd expect Rolls Royce performance, and a Rolls Royce price. Expectations are met on both counts. Priced from $17 – 35,000, it would have to be a crucial item of equipment to be justified, and be able to deliver the productivity and performance it might be called on to deliver. I see no reason why the Firebird wouldn't deliver on both counts. To appreciate just what it has to offer requires close examination of the real thing. eti

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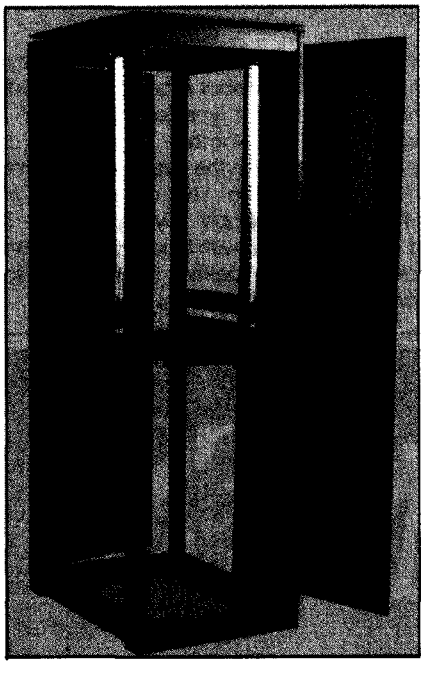

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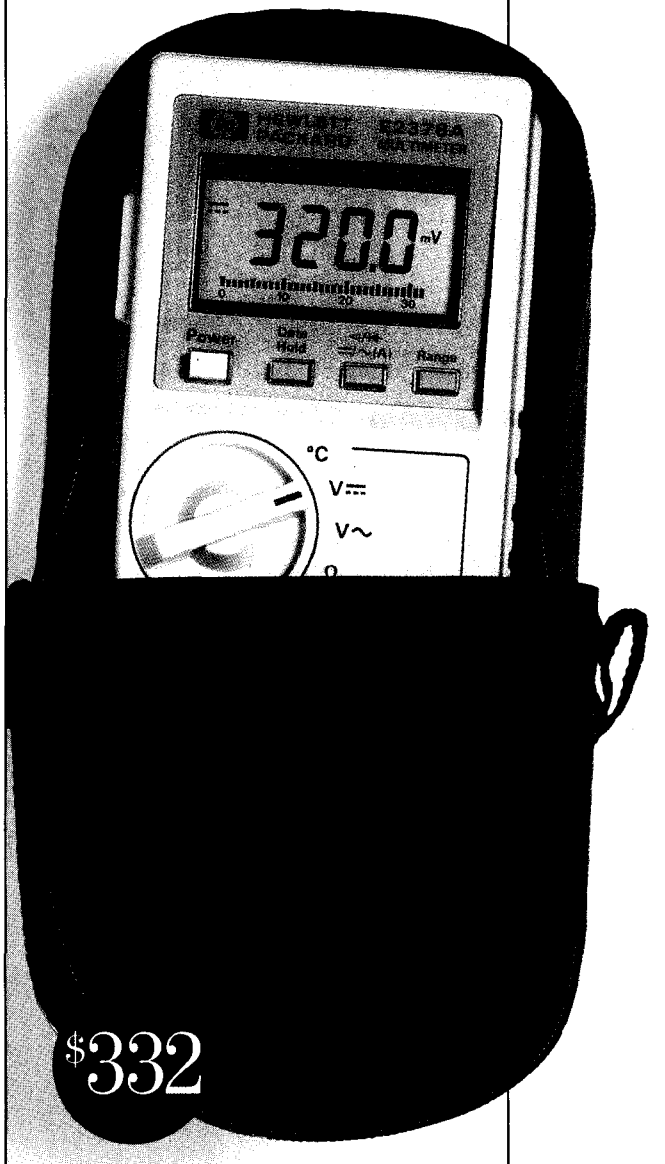

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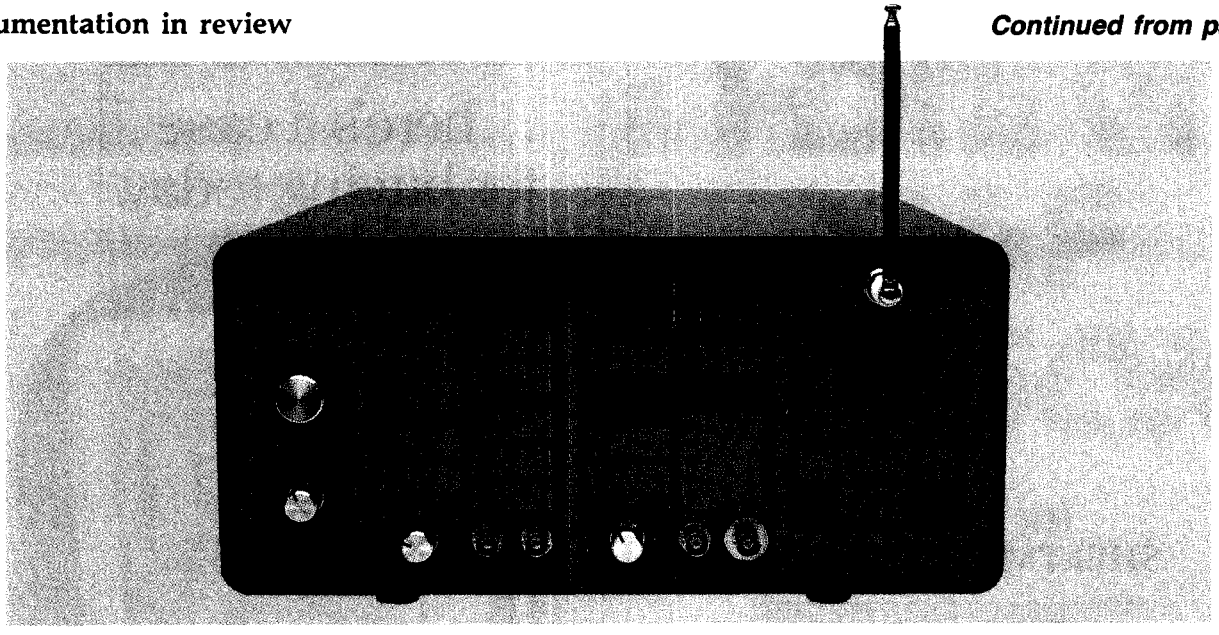
Continued from page 8



Ramsey COM3 service monitor

RH, ETI November 1989, p40

THE Ramsey Electronics COM3 Communications Service Monitor is a combination service instrument that has clearly been designed with speed, simplicity, speed, numbers and more speed in mind. It is a no-frills, simple to operate, comparatively low cost instrument for use in the test and servicing of AM and FM radio communications equipment that operates anywhere in the range from 100 kHz to just less than 1 GHz.

The makers have clearly set its specifications so that it will meet the necessary requirements to test or check the vast majority of radio communications equipment currently deployed in the commercial market. It is not designed for stringent type testing.

The Ramsey COM3 fits comfortably between the over-the-top combo machine and the set of multiple instruments, comfortably shying clear of bottom-end devices with inadequate performance and limited facilities to cope with today's radio communications equipment.

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8015	Black/White	$71.00	$81.00
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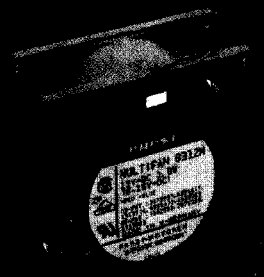

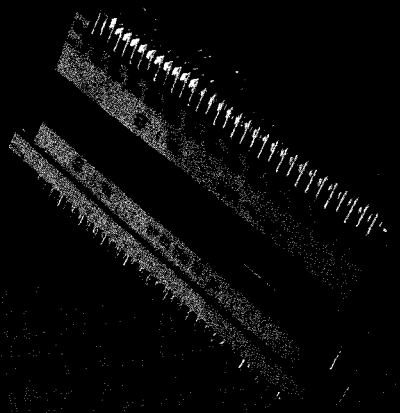

PAPST

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WECO

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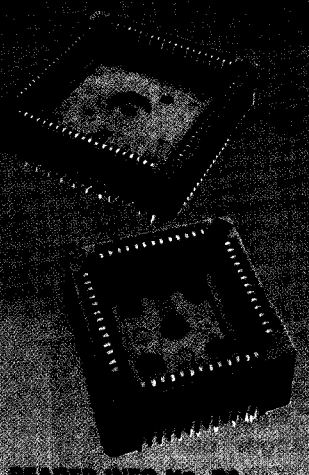

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[illegible] connectors and other special products.

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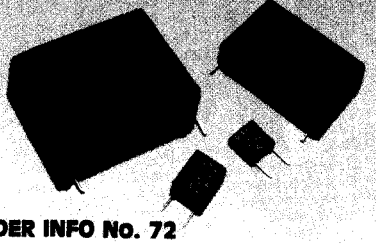

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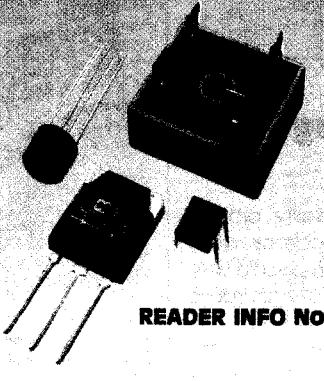

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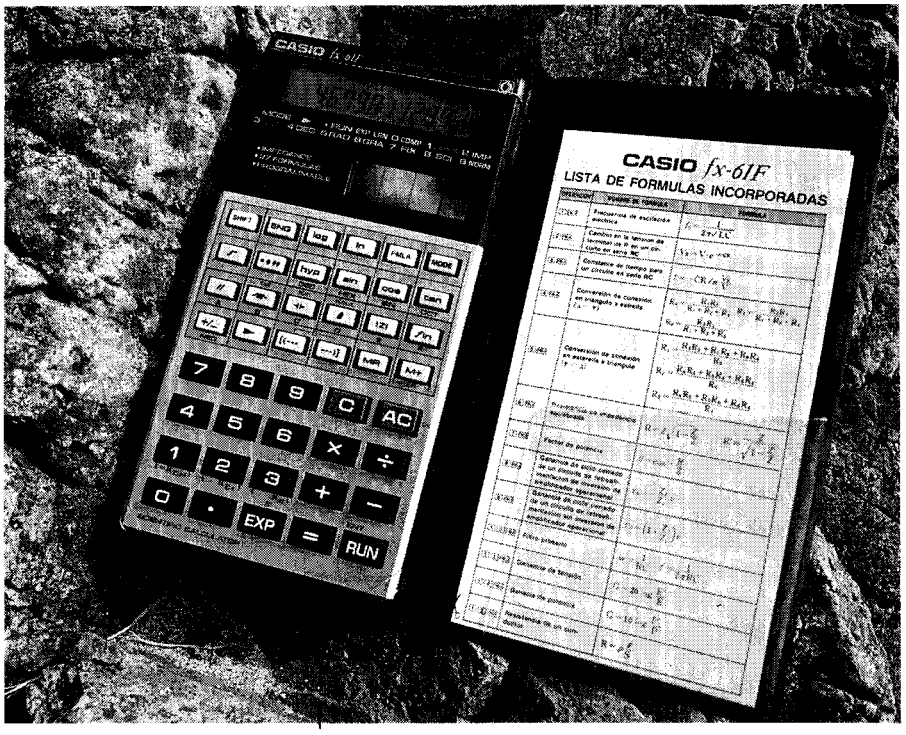


Casio fx-61F

JP, ETI July 1989, p70

THE Casio fx-61F combines all the features of a fully-fledged scientific calculator with a useful range of special functions and formulae in the electronics area including complex numbers, special exponent keys for milli, kilo, mega, etc and 27 common electronic formulae built in. Modes are provided which allow the user to work and calculate in binary, octal, decimal and hex and convert between them easily – a handy facility for those who do work in the digital field.

I found the fx-61F fairly easy to use and, when dealing with electrical circuit calculations, a definite advantage over a normal scientific calculator.

Ladder logic programming

ETI October 1989, p86

A PACKAGE from Wizdom Systems, called 86-Ladder, enables a PC to be used both as a PLC and to gather information that may be placed in packages such as spread sheets, data bases and speciality graphical control and monitoring software.

86-Ladder is a family of standalone software packages that replaces the Allen-Bradley PLC processor and I/O modules.

Additional software packages are available that extend the functionality of the basic 86-Ladder software.

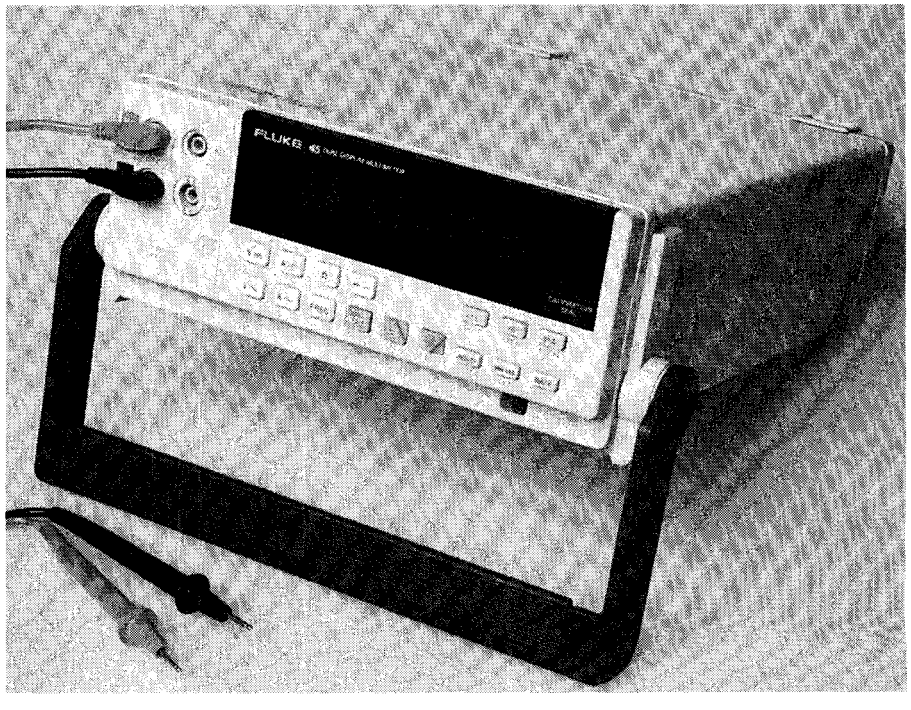
Anti-lightning plug

ETI November 1989, p38

THE rising incidence of mortality among facsimile machines and modems after lightning storms has made those people who have suffered it more aware of hazardous voltage problems across phone lines.

Developed by Melbourne computer retailer Max Elliott (managing director of ABE Computers), the Telephone Safety Device sprung about three years ago from his company's development work in modems.

The TSD is a relatively simple Telecom-type plug which is inserted directly into the wall plug. A phone, modem or facsimile machine plugs directly into it. A gas fuse automatically drains any excess voltage into an attached earth wire.



Fluke 45 dual display multimeter

RH, ETI September 1989, p40

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.

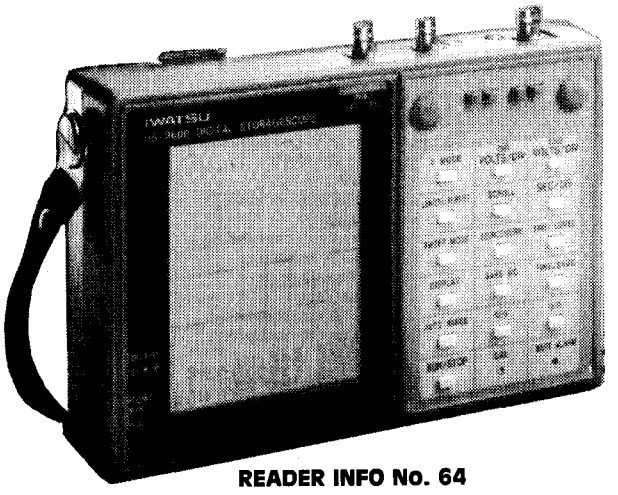
When you consider the features and functions offered, the accuracy and construction – all with regard to the price, you'd be hard pressed to find another instrument in the same league.

Continued on page 137

IWATSU

THE LATEST — SMALLER, LIGHTER

DS-8600 – Digital Storage Oscilloscope



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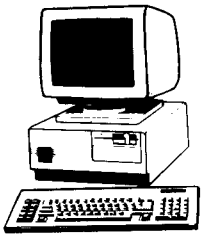
COMPUTER



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- Final assembling and testing in Australia!
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- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
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- Size: 360(W) x 175(H) x 405(D)mm

With 20 M/Byte Hard Disk.$2,195
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- Attaches to the top of your monitor
- Put your copy right where you need it spring clip to hold paper
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C21065.....$14.95

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R-NET/ S INTERFACE NETWORK CARD

- Fully compatible with SMC, Novell Arenet card
- Star-burst topology through RG-62 A/U coaxial cable
- Zero wait at 20MHz or higher 80386 machine
- 2.5 Mbps transmission rate

X18162.....$275

E-NET INTERFACE NETWORK CARD

- Fully compatible withNovell NE-1000 Ethernet card
- Built-in 15 pin D type connector
- 10 Mbps transmission rate
- Meets the IEEE 802.3 standard

X18160.....$425

IBM* CARDS

G7 MONOCHROME COLOUR CARD

- IBM* Colour Graphics Adapter compatible (support 600 x 200 four colour graphics model)
- IBM* Monochrome Display Adaptor compatible
- Hercules Monochrome Graphics Adaptor Compatible
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- Support Composite Monochrome monitors

X18007.....$139

GRAPHICS CARD

TTL and Hercules compatible with printer port

X18003.....$99

ENHANCED GRAPHICS ADAPTOR CARD

Auto switch CGA, EGA and Hercules with 256K Video Ram

X18070.....$295

VGA CARD

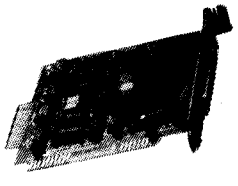
PC*/ XT*/ AT* compatible 256K Ram works with OS/2

X18071.....$595

VGA 512K

PC*/ XT*/ AT* compatible 512K Ram. Hardware zoom, pan, window.

X18072.....$795



FLOPPY DISK DRIVE CONTROLLER CARD

These cards will control up to 2 or 4 double sided 360K IBM* compatible disk drives

For 2 Disk Drives

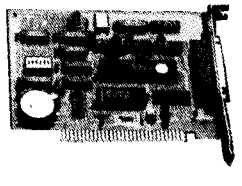
X18005.....$52

RS232 (SERIAL CARD)

WITHOUT CABLE

Supports 2 asynchronous communication ports. 50 baud to 9600 baud.

X18026.....$39



RS232 & CLOCK CARD

WITHOUT CABLE

Supports 1 asynchronous communication port. 50 to 9600 baud with Clock.

X18028.....$59

CLOCK CARD

X18024.....$49

PRINTER CARD

Parallel interface for Centronics printers.

X18017.....$29

3.5 M/BYTE EXTENDED/ EXPANDABLE RAM AT* CARD

X18056.....$275

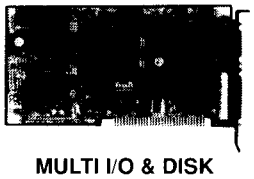
I/O PLUS CARD

Provides a serial port, a parallel port and a joystick port, and even a clock/calendar with battery backup!

X18045.....$115

2 M/BYTE EXTENDED MEMORY RAM CARD

X18052.....$225



MULTI I/O & DISK CONTROLLER CARD

This card will control 2 x double sided, double density drives, and features a serial port, a parallel port, and a joystick port or games port. It also has a clock/calendar genarator with battery backup

X18040.....$99

SERIAL/ PARALLEL/ GAMES CARD

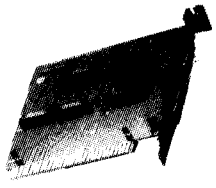
XT*/ AT* compatible 1 parallel port, 2 Serial ports, 2 port games adaptor.

X18151.....$115

4 WAY DISK CONTROLLER

- PC*/ XT*/ AT* compatible
- 1.44 M/B, 1.2 M/B, 720K, 360K Drives

X18006.....$129



GAMES I/O CARD

Features 2 joystick ports.(DB15)

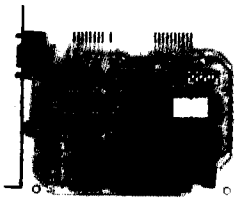
X18019.....$29

HARD DISK CONTROLLER CARDS

X18060 (XT*).....$129
X18140 (AT*).....$195

MULTI-CHIP PROGRAMMER CARD

X18020.....$575



MIDI INTERFACE CARD - DS/401

The MIDI DS-401 Card is the PC standard MIDI interface that runs most popular PC music programs for sequencing, recording, composing, music printing, patch editing, music instruction and many other applications.

- Run all programs designed for the Roland MPU-401 architecture
- Socketed EPROM for easy user replacement
- 1/3 length (short) card will fit in any computer accepting standard expansion card, including laptops
- Including "Y" cable, external connector box to transport is unnecessary

X18164.....$245

386SX 16MHz MOTHERBOARD

- Processor: 80386SX-16MHz (0/1 wait state)
- Co-processor:80387SX-16 (optional)
- CHIPS & TECH NEAT chipsets
- (SMT) Surface Mount Technology for chipsets & CPU
- Supports up to 2MB on board, (Sixteen 44256 and Eight 41256 sockets)
- Three 8 BIT slots
- Five 16 BIT slots
- Memory Expansion Slot
- Optional 2-8MB memory card
- Supports LOTUS-INTEL-MICROSOFT (LIM) Expanded Memory Spec. (EMS) version 4.0
- Supports Page Interleave Mode using 100NS DRAM
- BIOS: AMI or PHOENIX
- Turbo Light and Hardware Reset connector
- Keyboard or Hardware Reset connector
- Power Good Signal on board
- Baby size main board
- Without Ram

X18094.....$900

286 NEAT MOTHERBOARD

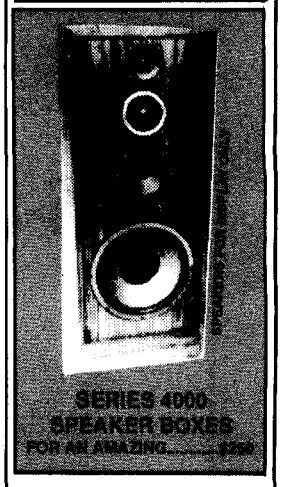
- Processor: 80286-12, -16MHz or -20MHz (0/1 wait state)
- Co-processor: 80287 (optional)
- CHIPS & TECH NEAT chipsets
- 1-4MB dual RAM socket
- 1-4MB module RAM socket on board
- 640KB-384KB memory relocation
- Three 8 BIT expansion slots
- Five 16 BIT expansion slots
- Memory expansion to 8MB
- Supports EMS 4.0
- Page Interleave Technology
- BIOS: AMI or PHOENIX
- Hardware and keyboard switchable Clock Speed
- LED speed display
- Power Good Signal on board
- Baby size main board
- 16MHz

X18090.....$700

- 20MHz

X18092.....$895

AMAZING SAVINGS



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The above postage rates are fo basic postage only. Road Freig bulky and fragile items will be charged at different rates.

Errors and omissions exceptec Prices and specifications subje to change.

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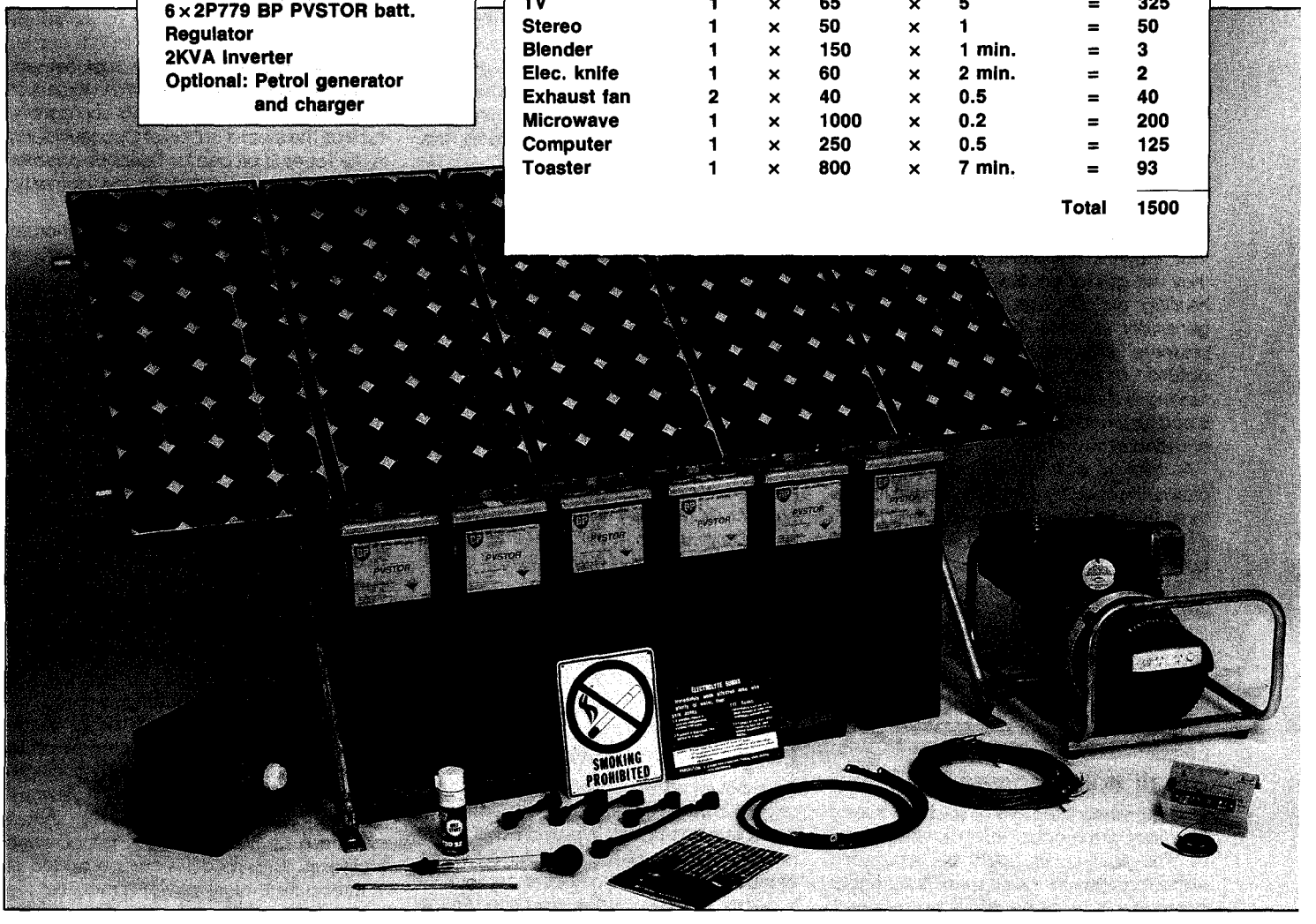
VISA MasterCard

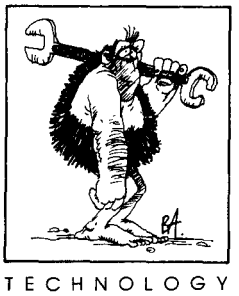
Large Solar Power Kit

Components:
10 × BP158 58W Solar modules
Module mounting frame
6 × 2P779 BP PVSTOR batt.
Regulator
2KVA Inverter
Optional: Petrol generator and charger

TYPICAL AVERAGE DAILY LOAD

Appliance	Qty	×	Watts	×	Hrs/Day	=	WH/Day
Lights	5	×	20	×	4	=	400
Pump	1	×	450	×	0.1	=	45
Vacuum	1	×	750	×	0.1	=	75
Washing mach.	1	×	500	×	2/week	=	142
TV	1	×	65	×	5	=	325
Stereo	1	×	50	×	1	=	50
Blender	1	×	150	×	1 min.	=	3
Elec. knife	1	×	60	×	2 min.	=	2
Exhaust fan	2	×	40	×	0.5	=	40
Microwave	1	×	1000	×	0.2	=	200
Computer	1	×	250	×	0.5	=	125
Toaster	1	×	800	×	7 min.	=	93
						Total	1500





TECHNOLOGY

GOING SOLAR

As a follow up to last month's ETI story on Remote Area Power Supply, BP Solar's David Bartley tells us what's available in solar power systems.

Many homes throughout Australia and other countries do not have mains power connected. The reasons include:

- High cost – typically $10,000/km to bring power lines to a remote property in Australia.
- Environmental considerations – some people prefer to generate their own power.
- Independence – not having to pay electricity bills to the power authority.

Solar power is now a viable alternative for people who live more than a few hundred metres from the power lines.

What is solar power?

Solar electricity is generated when sunlight shines on a solar cell. A solar cell is a semiconductor, similar to a diode. In fact, if you were to break open an ordinary diode and expose it to sunlight, it would generate electricity. Current would flow in the opposite direction to normal and you would have a solar cell, albeit a poor one.

The solar cell is encapsulated into a glass-faced module along with 35 other cells to form a 12 volt string. When placed in the sun,

the solar module will generate DC electricity which can be used to charge batteries. The batteries, in turn, can be used to supply DC appliances directly, or supply an inverter which converts DC to 240VAC for ordinary household appliances.

The beauty of the solar module is that it has no moving parts, is silent, non polluting and requires only sunlight for it to operate.

Solar lighting kit

One of the most basic uses for solar power is to provide night time lighting. Many people living in cities and towns have holiday homes that they visit on weekends. Traditionally, they use gas for cooking, refrigeration and heating but still use a petrol or diesel generator at night for lights, TV etc. This presents drawbacks in terms of noise, pollution, maintenance and fuel costs. Also, running a generator with only a small load is bad for it and can result in increased wear and decreased lifetime.

A small kit can be erected which can provide hours of light and TV at night for less than $A1,000. As it is low voltage (12VDC) it can be installed by a competent handyman.

These kits are economical for the weekender, as they store power throughout the week until it is needed at the weekend. Effectively, you get seven days of solar power condensed for use over two days of the week. High efficiency DC fluorescent lights are used and a 12VDC TV could also be connected.

Small solar power kit

One convenient feature of solar modules is that they are modular and can be added to. The lighting kit could be expanded without having to throw away the original components. A stage might be reached, however, where it would be more economical to choose a larger battery bank.

Again, gas or a wood stove is normally used for the really heavy power uses such as cooking, with perhaps a solar hot water system that can be integrated with gas and a slow combustion heater.

Refrigeration, also a heavy power user, runs on gas as well. This leaves most other electrical loads (which only use a fraction of the total energy consumption) to be run on solar electricity. Lights, washing machines, vacuum cleaner, radio, TV, kitchen appliances, water pump, stereo etc. can all be run off solar power. These types of appliances tend not to use too much power, and have no alternative to electricity as a power source anyway.

Water pressure is most efficiently achieved by pumping from a collection tank to a gravity feed tank. The collection tank collects rainwater from the roof, and a simple float switch system turns a pump on to transfer water back to the gravity feed tank. As long as you have the bottom of the gravity feed tank at least one metre above the highest water outlet in the house (usually the shower), then there is ample pressure.

The most efficient types of lights to use are fluorescent. There are many small, attractive fluorescent lights to choose from nowadays, and some throw out a light that is similar in colour to incandescent globes. When you consider that fluorescents use around one third of the power of incandescents, the choice is clear.

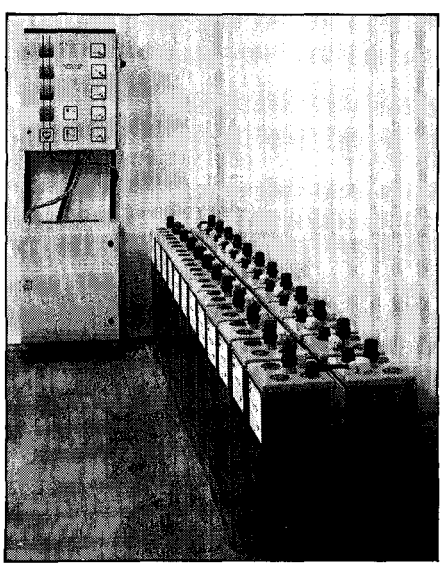
All appliances should be chosen with minimum power consumption in mind. Televisions consuming less than 75W at 240V are common and can be run for longer hours on a given solar power supply than a less efficient TV. The same applies to every appliance – the lower its power rating, the longer you can use it each day.

A system to supply a load of 750WH/day at 240V would typically cost around $6000. The power systems are sized to get you through the worst time of year (winter) while in summer you would find that there was extra power being produced. So, a system sized for 750WH/day would actualy be able to supply up to 1000WH/day during summer. The output of a system will of course vary depending on location.

For around an extra $1500 a petrol generator and charger could be added, providing emergency backup in times of extended bad weather and giving a portable source of 240V power for use around the property.

Large solar power kit

Solar power systems can be used to supply any amount of power required. Generally, the cost of the system is proportional to the power required. This system is twice the size of the previous system and, at under $11000, is a little less than twice the price. As this system is larger, it warrants the use of a large battery.



The heart of the BP Hybrid Power System is the controller, inverter, charger and batteries.

The BP PVSTOR battery is designed for use in solar power systems and has proven itself over the past 10 years to be an extremely reliable and long life component. It comes with a five-year, free of charge, replacement guarantee and an expected life in excess of eight years. Used in professional applications such as the electrification of Coconut Island in the Torres Strait and for Telecom repeater sites, it is also available to the domestic power user.

Again, the petrol generator and charger are optional extras if emergency backup is required.

The system comes complete with solar module mounting frames which have an adjustable tilt angle. Solar modules should be mounted so that they face directly into the sun at solar noon. In the southern hemisphere this means that they should face north and be inclined at a tilt angle anywhere up to 60 degrees to the horizontal. Adjusting the tilt angle is easy and should be done three or four times per year at solar noon so that the solar modules cast the longest shadow possible. They are then perpendicular to the sun's rays, receiving the greatest concentration of sunlight and generating the most power.

A regulator is included with the system to ensure that the battery bank isn't overcharged or over discharged. It also has a temperature sensor which straps to the side of one of the batteries for temperature compensation. This is necessary for accurate charge control because the voltage which the batteries are charged to should decrease as the electrolyte temperature increases. Solar modules can be added at a later date if more power is required.

The 2KVA modified square wave inverter is capable of surging to 6KVA for induction motor starting. It features high efficiency, smooth operation with low power factor loads and automatic load sensing. Load sensing enables the inverter to shutdown automatically when all loads are switched off. This saves power, enabling more of the solar generated electricity to be consumed in the house.

With a system of this size, DC refrigeration could also be used. Typically, a 220L fridge-freezer will use 720WH/day, and could be substituted for some of the appliances above – or, extra solar modules could be added to the system.

Ordinary 240V refrigerators use quite a lot of energy, usually 1000 to 3000WH/day and would require either more solar modules or a generator to maintain the charge level of the batteries.

Hybrid power systems

For those who wish to use a significant amount of power, and can't afford the costs of an all-solar power supply, a Hybrid Power

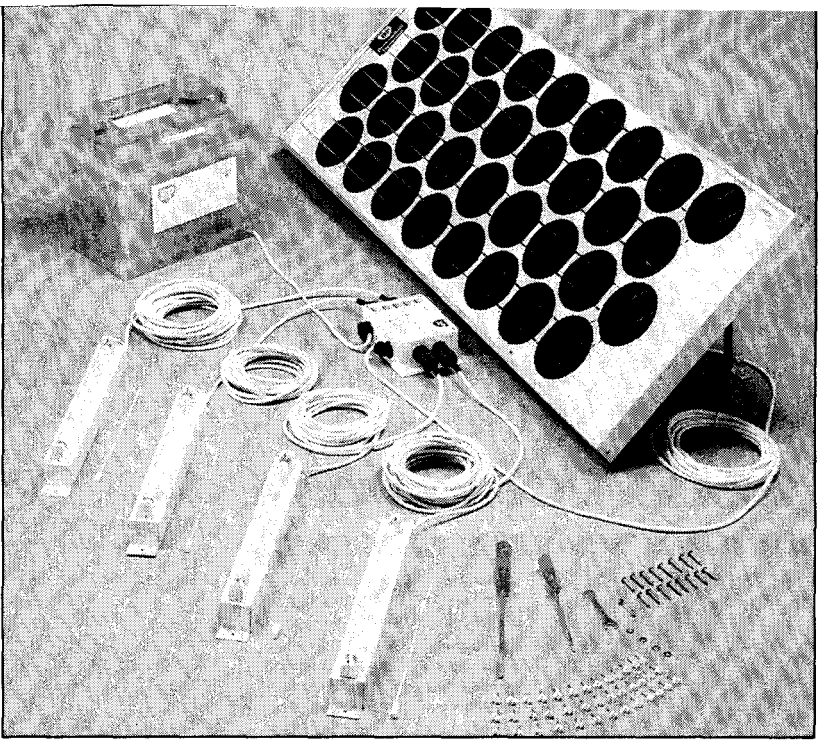
System is an economical alternative.

With these systems, the power source is mainly a diesel generator with additional input from an optional array of solar modules.

Most electrical appliances can be used and, in particular, ordinary 240V fridges and freezers. The fridge and freezer here have been chosen from the NSW Government list of appliances tested under the energy rating scheme. These units were the most efficient in their class, and will help to minimise diesel fuel consumption.

Most appliances can be accommodated, but when buying new appliances it is always useful to choose the most efficient available, especially when generating your own power.

If you already own a diesel generator then you could purchase a system for a load of 6755WH/day for around A$15000. If not, then these too can be purchased from BP Solar. A standard range of systems is offered to accommodate loads up to 10kW peak and 45kWH/day.



The BP Solar Lighting Kit.

Traditionally, this size of load has been powered by diesel generator alone. The problem with this is that the diesel is typically run for around 12 hours or more per day with a fairly low average load. This causes generator maintenance problems and low engine life. Also, you don't get 24 hour power and refrigerators tend to warm up again by the morning.

By installing a hybrid power system the diesel runs less than six hours per day, and is heavily loaded during this time. It runs more efficiently, which means lower fuel consumption, less maintenance and longer diesel lifetime. Also, it means that you get 24 hour power because when the diesel is off, the load is supplied by an inverter.

Many remote properties throughout Australia presently use diesel generators for power generation without any prospect of ever being connected to grid power. Most of these properties could benefit from a hybrid power system.

Fully Australian designed, the systems are completely automatic, controlling generator operation, solar power regulation, battery charging and load shedding. At the same time they allow for manual diesel operation for any special loads that must be run off generator power only.

Government assistance

Some countries provide government assistance for people who generate their own power. Fortunately, Australia is one of them.

The Australian Government allows equipment for domestic power generation to be purchased exempt from sales tax. Additionally, the NSW State Government conducts the Remote Area Power Assistance Scheme (RAPAS) (see ETI,

Solar systems

THE OM1602 is a custom designed hybrid circuit module designed and manufactured in Australia by Philips. It is an example of the microelectronic technology available and is typical of many custom circuits manufactured for the industrial, automotive, telecommunication and defence industries.

The OM1602 is for use in photovoltaic solar installations for controlling the charge input to a lead acid battery system. Charge control is achieved by switching a charging circuit ON or OFF depending on the state of charge of the battery as assessed from the battery terminal voltage.

All the control circuitry has been integrated into one hybrid module. The module is suitable for use in 12V, 24V, 36V and 48V systems. Maximum charge current is determined by the switching element used. The switching element can be a relay or FET, as the OM1602 can drive either device.

Charging current is permitted to flow via normally closed relay contacts until the voltage across the battery exceeds a preset value corresponding to full charge. The battery is then able to discharge until the voltage falls to another preset level at which the relay is closed, so that charging may recommence. Should the voltage fall to the level of the low voltage alarm threshold, then an open collector alarm output is activated. All switching voltages are obtained from resistor networks connected to an internal voltage reference.

The MBX solar panel mounting frame is designed for zones located outside of the 25th parallels but can be easily adapted for use in tropical zones. The design allows easy installation on prepared surfaces such as concrete slabs or roof structures. It can also be anchored to the ground with suitable foundations.

Its rigid construction ensures the solar array will withstand the most severe meteorological conditions and the use of anodised aluminium and stainless steel offers excellent protection against corrosion.

The length of the rear leg as supplied suits an angle of tilt of 45 degrees but can be cut to suit lower angles of tilt as required. Longer rear legs to allow high tilt angles can be supplied on request.

A range of photovoltaic solar modules is also available. The PVM1550 PVM2550, ESS3601 and PVM4550 feature screen printed polycrystalline silicon solar cells; redundant intercell connections increase reliability; ultra low iron toughened glass front surface combines strength with high light transmission; textured front glass improves efficiency; laminated encapsulation gives long life, and more.

Manufactured in Australia by Philips, these modules are designed to meet most power applications.

For further information contact the office of Philips Electronic Components nearest you.

IS YOUR DIESEL WASTING MONEY?

- Is the cost of connection to the power lines too high?
- Would you like to generate your own electricity from the sun?
- Do you need or already use a generator?

- Do you wish to avoid the high cost of diesel fuel?
- Do you wish to avoid the hassles of diesel maintenance?
- Do you want 24-hour electrical power?

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24-hour Power. You can use electric refrigerators and most other normal electric appliances at your convenience.

Fully Automatic. Just imagine the convenience and savings of not having to operate switches, giving you more time to manage your property.

Lower Operating Costs. Offering you savings because of lower diesel running time, less fuel use and a longer diesel life.

Of course the answer to all the above questions is YES.

But this can't be achieved by a diesel generator alone. Diesel generators run inefficiently, using lots of fuel and needing regular maintenance, especially if they are run for long hours with small loads. BP Solar can give you 24-hour power and save your money with a Hybrid Diesel/Solar/Battery/Inverter system.

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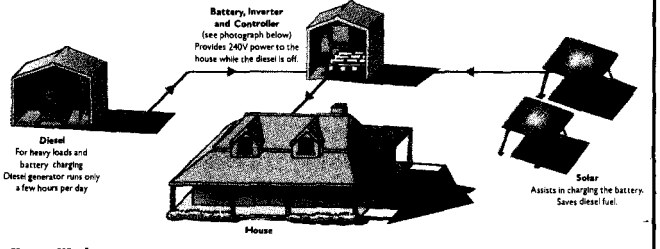
BP SOLAR POWER MANAGEMENT SYSTEM



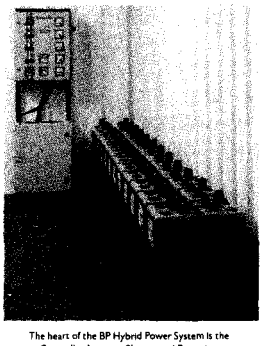
How It Works. The BP Solar Hybrid Power System (HPS) is fully automatic. It switches the diesel generator on and off at the times you nominate. It monitors and maintains correct battery state of charge and automatically equalises the batteries once every 2 weeks on the day of your choice.

The inverter converts the battery voltage to 240V AC for single-phase power supply to the house when the generator is switched off.

The diesel runs generally 6 hours per day or less if solar modules are added to the system.

Cost Savings. Compared to a diesel-only type power system, the HPS can decrease overall power costs by up to 40%. This is achieved by ensuring that the diesel generator is run efficiently and only for a short time each day.

As the price of fuel rises and the cost of solar modules reduces, you can make your BP system even more economical by adding more solar modules. This will directly shorten the diesel running time required each day for recharging the batteries.



The heart of the BP Hybrid Power System is the Controller, Inverter, Charger and Batteries.

BP SOLAR

The product specifications contained in this brochure are generally descriptive of the product in question and were correct at the time of going to press: In accordance with a policy of continued product improvement, we reserve the right to vary the specifications at any time.

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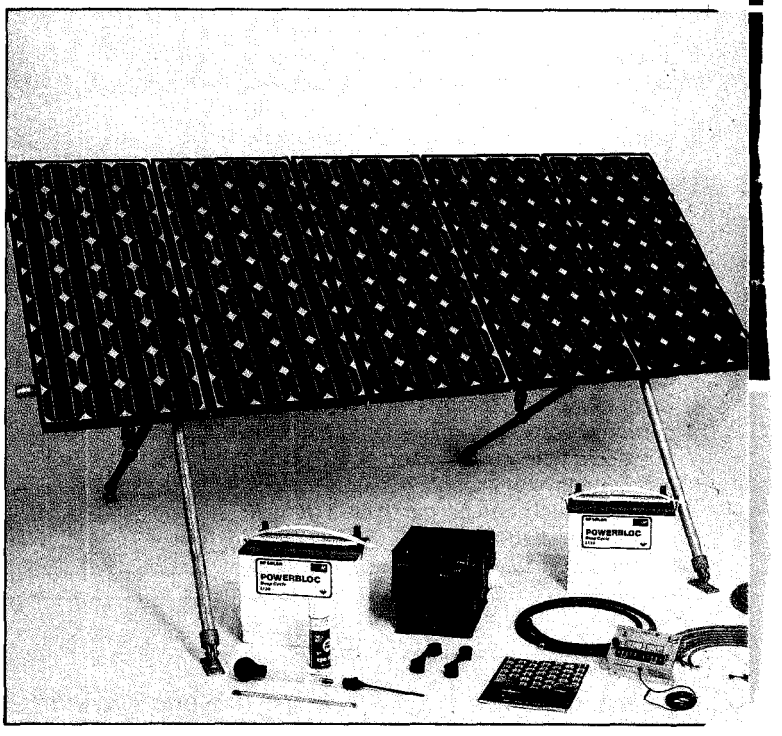
Going solar



Solar Power Kit
Components: **5 x BP158 58W Solar modules** **3 x BP Powerbloc batteries** **Module mounting frame** **Regulator** **2KVA Inverter** **Optional: Petrol generator and charger**
System rated for approx 750WH/day

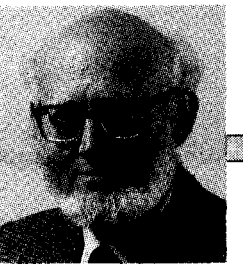
December) for people generating their own power. Under this scheme, residents of NSW can be eligible for a 50 percent grant towards the cost of their power system. Hopefully, other State Governments will introduce similar schemes in the future.

New Zealand also has a scheme where one seventh of the cost of purchasing and running a home power generation system after the first seven years of operation can be refunded.

Summary

Home solar power systems are available in a comprehensive range of sizes.

They can be all solar, or a hybrid mixture including petrol or diesel generators. BP Solar Australia has developed over the years to become one of Australia's leading home power generation suppliers. The operation has extended into the supply of diesel and petrol generators along with the traditional solar modules, batteries and electronics. eti



JOHN COULTER

PATENTING AND GENETIC ENGINEERING

Would the patenting of DNA be akin to going back to the days of slavery? Instead of owning a human being, though, life itself would be enslaved for profit. John Coulter raises this disturbing issue.

For several decades now it has been known that the genetic code which determines the nature of each living creature is written in a very simple language. It consists of words made up of three letters and the letters are of only four kinds. In the language of the genetic code only 4 cubed words, i.e. 64, are possible. Each word codes for one amino acid in a protein chain and as there are only 20 common amino acids, 64 allows a high degree of redundancy. The triplets of DNA are strung along the DNA strands forming a sequence (words in a sentence) which, in turn, codes for a sequence of amino acids in a protein when the DNA has been translated.

Every living cell contains this mechanism and the cells of plants, animals and bacteria are remarkably similar. A gene sequence in one species will be faithfully translated if transferred and succesfully incorporated into the DNA of a second, unrelated species. This is the basis of genetic engineering. Genes, or bits of genes, can be taken from one species, attached to the DNA of a second species and there will manufacture the protein or amino acid sequence which it would have done had it remained in the first cell.

It would be equally possible to introduce damaging genes into otherwise harmless bacteria, to put genes making powerful toxins into bacteria which could invade the human body without much resistance. Or one could make artificial organisms which may have damaging effects on the environment, either deliberately or by accident. For example, many herbicides lack specificity and damage crops as well as weeds. Suppose one could introduce the gene for resistance to a particular herbicide into the crop plant. It would then be possible to kill all the competing plants while leaving the crop unharmed. This could have a devastating effect on the ecology of the natural system which the crop replaces.

What and who should determine the types and purposes of genetic engineering. Should it be left to commerical forces? This is the way Australia is going. The question is not just one of balancing potential harm against benefit; the patenting and commercialisation of DNA raises, in my mind, significant matters for ethical consideration!

These ethical matters have already been canvassed in Australia when the plant variety rights legislation was debated. On that occasion we legislated to allow patenting of genetic material. We now face, in the very near future, the patenting of animal genes and the animals which carry them. Animals may carry human genes. How many human genes would an animal have to carry before it became unpatentable? What and who would determine this point? Would it be that the patenting of something that looked like, or exhibited, certain human characteristics offended our human dignity? What and where is this point? According to Senator Button, in answer to a question from me, whether to patent or not would be left with the patent office to determine.

It has always seemed to me that our developing rapport with particular non-human species has not been very logical. We protest massively over killing of whales and dolphins, one justification often advanced being that these animals have large brains. We might well object to killing these creatures because some are threatened with extinction or because the killing is needless – but big brains? How anthropocentric and arrogant! Kangaroo culling engenders enormous opposition and the suggestion that we might actually domesticate and farm kangaroos wends some right out of their minds.

For me, the problem does not arise as we approach the patenting of a 90 per cent human. The problem arises because we have allowed the patenting of DNA in the first place. DNA is the material which lies at the root of all life; without it, life as we know it would not exist. To allow this 'sacred' material to be owned exclusively for profit is unethical in my view.

Without doubt, gene manipulation is the most powerful technology for environmental change we possess and perhaps will ever possess. With it we can change the course of evolution which has shaped life on the planet through 3.5 billion years. Are short term commerical interests the appropriate determinants of the direction this change should take? Is it not possible that other directions would be more beneficial but will not be followed because there is no foreseeable profit? How do the concerned who want to halt a development compete with large commercial forces that may have already invested millions in developing a new animal? But, even more fundamentally, is not the ownership of the very life process itself rather akin to owning a human being. Are we not returning to the days of slavery – only, now, we are enslaving life itself, not just a particular form of it?

How, then, should we proceed? If we do not allow the commercialisation of this technology shall we not fall behind the rest of the world and have to forego the benefits as well as avoiding the pitfalls? The older technology which this partly replaces is selective breeding. With wheat and other grains, Australia has had a very successful program of developing new strains for very many years. The program has been government funded and has been conducted in government funded laboratories such as CSIRO. We did not fall behind.

The appropriate place for powerful research and manipulation of this sort is in government funded and controlled laboratories with direction and application determined by this democratically elected and representative body. ETI

Senator John Coulter is the spokesman for the Australian Democrats on Science and Technology.

KILOHERTZ COMMENT

ARTHUR CUSHEN

56 YEARS OF JAPANESE OVERSEAS BROADCASTS

Today, Radio Japan broadcasts in 21 languages for a total of 43 program hours a day. Arthur Cushen reflects on the changes the station has seen since its humble beginnings as Radio Tokyo 56 years ago.

In 1935, Radio Tokyo was first heard on the air with listeners in the Pacific and the West Coast of North America tuning into a one hour broadcast in English and Japanese.

Now in its 56th year of operation, Radio Japan has seen major changes, and developed from an initially low powered shortwave broadcaster to a complex of transmitters. Today, the transmitters are not only used by Radio Japan, but other overseas broadcasters.

International broadcasting had its beginnings in 1927, when Philips at Eindhoven pioneered the way with PCJJ. This was closely followed by the BBC Empire Service and Germany in 1929, while Japan started broadcasting overseas in 1935, on the 10th anniversary of domestic broadcasting in Japan.

The station was operated by NHK, the Broadcasting Corporation of Japan, still the operators of Radio Japan. Power was only 20kW.

During the war in the Pacific (1941-45), there was considerable expansion, the main aim being to boost the morale of the American and Allied servicemen in the Asian and Pacific areas. There were several female announcers who became known as "Tokyo Rose". There was a distinct lack of accuracy as far as reports from the battle fronts were concerned, until the Midway Island encounter, when Japan suffered its first major reversal.

With the fall of Japan, the shortwave service was silenced by the Allied forces, and for seven years the transmitters remained inactive.

In February, 1952, overseas broadcasts were resumed. The first broadcasts were of one hour duration in Japanese and English, five times a day and under the name of Radio Japan instead of

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All without the delays, inaccuracies and cost of outside services.

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SDT **$ 995**

To help the electrical/electronic engineer create schematics using a personal computer. Develop schematics, produce check prints, check standard design rules, produce parts lists, wire lists, netlists in many formats and finally produce professional schematic documentation.

Much of the tedium associated with other packages has been eliminated with a simple to use macro command structure and a comprehensive library of parts (over 6,000 unique parts.)

PCB **$ 2,995**

Autorouting printed circuit board (PCB) package. Takes input of the design from SDT via a netlist and allows the designer to place components and tracks on the board. The auto-routing facility gives the designer control over the layout so that priority can be given to the tracks, modules or zones which really matter. Annotation changes which become necessary during the layout phase can be exported back to the schematic. Modifications can be imported from the schematic without the need to completely redesign the PCB. Complex designs up to 16 copper layers can be accommodated, surface mount components can be used and an optimizer routine is provided to reduce the number of pinthroughs and track length in the layout.

PLD **$ 995**

Allows the designer to enter and compile code for programmable logic devices (PLD's). The PLD documentation can be exported back to the schematic keeping all your documentation together. The designer can use several methods for logic input, compile the code, generate functional test vectors and output JEDEC code that can be used by PLD programming systems.

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Converts JEDEC fuse map input files into timing based computer models of PLD's. These are used by OrCAD VST to simulate an entire design - including the PLD's.

VST **$1,985**

A digital simulator which allows the designer to simulate an entire design developed with SDT and PLD.

The package has an oscilloscope-like output on the screen and results can be printed to assist with documentation. Designs can be simulated not only for logic functionality but also for timing constraints - eliminating much of the need for repeated breadboarding of the circuit.

Prometheus Software Developments Pty Ltd

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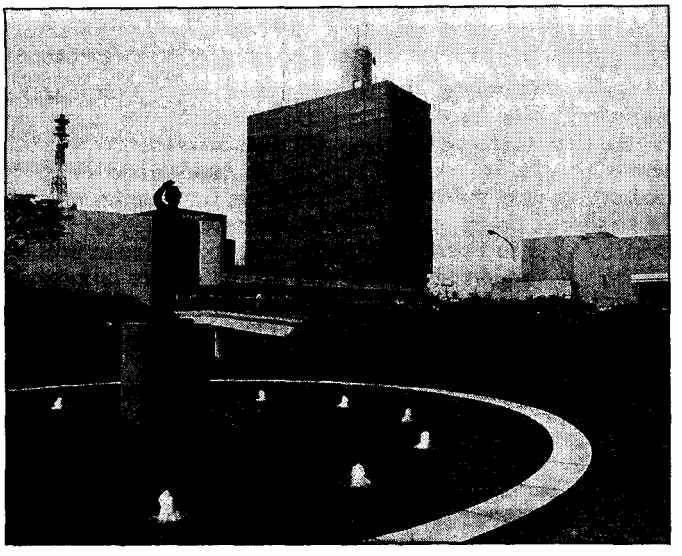

Broadcasting House, Tokyo.

Radio Tokyo. The first year brought in 554 letters, compared to over 80,000 received in the mail last year. In September, 1960 Radio Japan re-organised its overseas broadcasts into regional services and the general service.

There was further expansion in 1964, the year of the Tokyo Olympics, when broadcasting was stepped up to 36 hours each day in 18 directions, with 12 transmitters in operation, eight being 100kW.

The first overseas re-broadcasts were commenced through Trans Europe in Sines, Portugal and, in April, 1984 relays through a 500kW transmitter of Africa No. 1 in Gabon were commenced. Later, an exchange with Radio Canada International enabled Radio Japan signals to be better heard in North America when relayed through the Sackville transmitters. At the same time, there were major improvements at NHK's transmitting station at Yamata. In 1988, four 300kW and four 100kW transmitters and new antennas were put into operation. During that year, an agreement was signed with Radio France International to relay Radio Japan broadcasts from their relay base in French Guyana.

Today, Radio Japan broadcasts in 21 languages for a total of 43 program hours a day in both the general and regional service, including relays through Moyabi, Gabon for 12 hours, from Sackville, Canada for 4 hours and Montsinnery, French Guyana for 6 hours daily. The reciprocal agreement between broadcasters is an effective and economical way of covering a worldwide audience.

Radio Japan broadcasts to Australia and New Zealand daily, 0900-1000UTC on 15270 and 17890kHz, while the general service is heard 0500-0600, 0700-0800, 1900-1930, 2100-2130 on 15270kHz. In addition, the broadcast 1900-1930 and 2100-2130 is carried on 11850, 17890kHz.

The address for reception reports is Radio Japan, NHK, Tokyo, Japan.

1990 Conventions

TWO major functions are being held in New Zealand this year. Over Easter, April 13 – 16, the Auckland branch of the New Zealand Radio DX League is hosting a national convention at Shakespeare Park on the Whangaparaoa Peninsula, north of Auckland. The convention is being held at a YMCA Hostel which offers an area for good

ELECTRONICS · TECHNOLOGY INNOVATION

SOUND INSIGHTS

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radio reception, and members of the clubs affiliated to the South Pacific Association of Radio Clubs are attending. Information is available from 1990 Convention, PO Box 3011, Auckland, New Zealand.

The 1990 Conference of the New Zealand Association of Radio Transmitters is to be held in Hamilton over the Queen's Birthday weekend June 1 – 4. As 1990 is the 150th anniversary of the founding of New Zealand, there are many special events being held and this NZART Conference is being hosted by the Waikato area branches for men and women radio amateurs. The writer has been asked to be keynote speaker on the Friday evening and Sunday morning of the conference, discussing radio listening and the mutual interest of radio amateurs and shortwave listeners. Information on this conference is available from the Secretary, HH Garnett-Frizelle, Conference Committee, PO Box 606, Hamilton.

Another relay base

COOPERATION between broadcasting organisations in building a relay base as a joint project is fairly widespread, with the BBC and Voice of Germany combining in Antigua to set up a joint facility. The latest move is talks between the BBC and Radio Nederland to set up a base in the Asian area.

Radio Nederland carried out an extensive survey in South East Asia to investigate the possibilities of establishing a relay base and, since then, talks have been conducted with the BBC.

Both parties know roughly what they want and the station would consist of four or five transmitters with 15 to 20 antennas. Radio Nederland has not yet raised the necessary capital to start building but with a change of Government it is expected that a firm decision will be made shortly.

In the meantime, Radio Nederland has installed an additional transmitter at Bonaire with a new 250kW unit now in operation. One of the old Philips transmitters is being used on a standby basis so there are no additional frequencies being used, Bonaire still operates on a two transmitter system.

AROUND THE WORLD

GUAM: The Voice of Hope, operated by High Adventure Ministry, recently used the transmitters of KSDA for its initial test; this month its 100kW transmitter should be in operation broadcasting to Asia. During recent tests, the frequency of 15225kHz was used 0400-0700 and reports were requested to PO Box 22228, Guam. The call sign KHBN has been assigned to the station.

HOLLAND: Radio Nederland is using 15560kHz for its transmission 0730-0825UTC to Australia in English as well as 9630kHz. The second transmission, 1030-1125UTC, has been on 9505kHz as well as 6020kHz, but, due to interference on both channels, a frequency change seems inevitable.

SWEDEN: Radio Sweden, through our summer months, broadcasts in English 0230-0300 9695, 11705; 1230-1300 on 15190, 17740, 21570; 1400-1430 on 11905, 17740 and 2100-2130 on 9655 and 11705kHz.

SWITZERLAND: International Red Cross Geneva is using Swiss Radio International transmitters and is scheduled to the Pacific: 0740-0757 on 9560, 13685, 17670, 21695 Mondays 29 January, 26 February and 1 March, 1990. eti

This item was contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand. He would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time.

eti ELECTRONICS TODAY INTERNATIONAL

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SOUND INSIGHTS

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4	29	54	79	104	129	154	179	204	229	254	279	304	329
5	30	55	80	105	130	155	180	205	230	255	280	305	330
6	31	56	81	106	131	156	181	206	231	256	281	306	331
7	32	57	82	107	132	157	182	207	232	257	282	307	332
8	33	58	83	108	133	158	183	208	233	258	283	308	333
9	34	59	84	109	134	159	184	209	234	259	284	309	334
10	35	60	85	110	135	160	185	210	235	260	285	310	335
11	36	61	86	111	136	161	186	211	236	261	286	311	336
12	37	62	87	112	137	162	187	212	237	262	287	312	337
13	38	63	88	113	138	163	188	213	238	263	288	313	338
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18	43	68	93	118	143	168	193	218	243	268	293	318	343
19	44	69	94	119	144	169	194	219	244	269	294	319	344
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21	46	71	96	121	146	171	196	221	246	271	296	321	346
22	47	72	97	122	147	172	197	222	247	272	297	322	347
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25	50	75	100	125	150	175	200	225	250	275	300	325	350

JAN 90

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eti PROJECTS

The projects presented in ETI are chosen to appeal to a wide variety of reader interests. They range from simple, fun but practical, low-cost entry level devices, through interesting, useful and often challenging projects for more experienced enthusiasts, to technology demonstration projects that introduce emerging, new and exciting technological developments for constructors at all levels. Often, ETI projects will present engineering solutions to real problems or market needs. Over a year, we aim to publish a balanced selection, to cater to readers' wide interests and levels of experience.

This month we include:

- ***ETI - 1626 Digital to Analogue Converter***
- ***ETI - 749 SWR Meter***
- ***ETI - 1201 Simple Intercom***

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Artwork for all our projects: $5 for boards up to 10 cm, $10 for larger boards.

Back issues, if available: $4.

Photocopies of articles: $4, or $8 if more than one part.

Send orders to **Reader Services, ETI Magazine, 180 Bourke Rd., Alexandria, NSW 2015 Australia.** Please note that phone orders cannot be accepted.

Unfortunately we are also unable to handle technical enquiries on projects and articles on the telephone. We are happy, however, to handle such enquiries by mail. Please address such enquiries to: **Technical Enquiries, ETI Magazine, 180 Bourke Rd., Alexandria, NSW 2015 Australia.** We will endeavour to deal with them as promptly as possible.

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Circuit boards and some front panels are available from the following:
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ETI Project Update 1989

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January 1989

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ETI - 815		Raffle Monitor
ETI - 616		Midi Interfaces
ETI - 1539		Metal Detector

February

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ETI -1411		Headphone Distribution Box
ETI - 1620	Part I	Printer Buffer
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ETI - 1621		Programmable Amp/Delay EQ
ETI -1615	Part II	16-bit VGA Card

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ETI - 1550		Telescope Drive Controller
ETI -1545		Galvanic Skin Response Meter

November

ETI - 781		Novice Loop Antenna
ETI -748		R F Monitor with LED Bargraph
ETI - 1546		Reaction Timer
ETI - 1625	Part I	2400 BPS PC In-Modem

December

ETI - 1625	Part II	2400 BPS PC In-Modem
ETI -782		Quad Antenna
ETI - 1547		150 ms/s Flash Converter — Front end

Did you miss any of these? If so, back copies (where available) or photostats (where not) may be ordered. Details on preceding page.

ERRATA
ETI-284 VCR Alarm (Nov '86) has been reallocated as ETI-1203.
ETI-285 Oscillators and Amplifiers (Mar '87) becomes ETI-284.
ETI-285 is Simple Test Set (Apr '87).

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Part 6

BUILDING BLOCKS OF ELECTRONICS

Pentodes, transistors and ICs

Now we get into more detail on active blocks, covering further valve circuitry, then transistors, and introducing that 'universal' IC — the op-amp. By Jack Middlehurst.

Triode audio amplifier stages are quite simple affairs, as you saw in Part 5, and so are single transistor stages, as we shall soon see. But first, let us look at that other widely-used valve – the five-element pentode.

Pentodes

The circuit for a pentode voltage amplifier is shown in Figure 6.1. The passive input and output blocks are the same as those for the triode. Typical pentodes would include the 1L4, 1K7 (which has two diodes included) 6J7, 6BW7 and the low noise EF86, although there are literally hundreds of suitable valves.

The anode current is measured using the voltage drop in Rf as for a triode but, since the screen grid of the pentode draws current, the total current in the cathode resistor is the sum of the anode and screen currents, so Vc will be about 15 per cent higher than Rc times the anode current. If Vc is very much lower than calculated, the cathode capacitor is acting as a resistor, so replace it.

If Rl is high, (0.1M to 0.5M is common for 6J7 valves) you will need a dc voltmeter with an input resistance of at least 10M to get accurate results when measuring Va. A '1000 Ohms per Volt meter', as some of the older /cheaper ones are known, will have a resistance of only 1M on the 1000 V scale. This will read 9 per cent low when measuring circuits with Rl = 0.1M, and 32 per cent low if Rl is 0.5M (or 0.47M).

The screen voltage of the pentode is usually 100-150 V for mains equipment, and

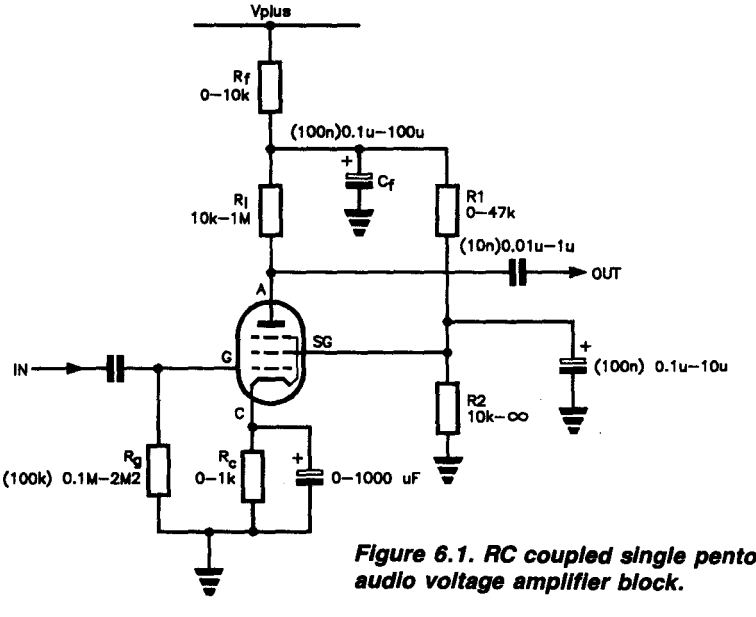
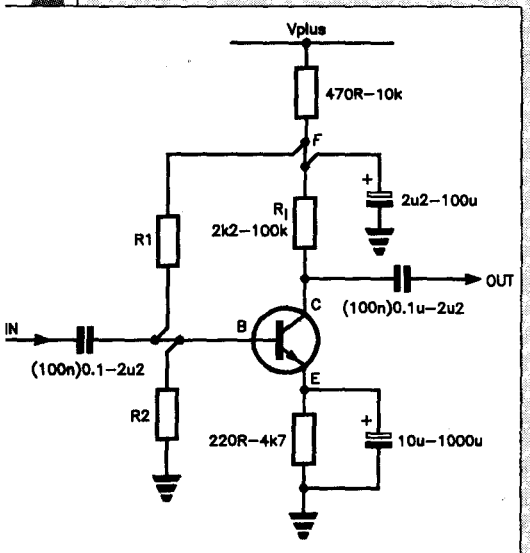


Figure 6.1. RC coupled single pentode audio voltage amplifier block.

Vplus = 250 V

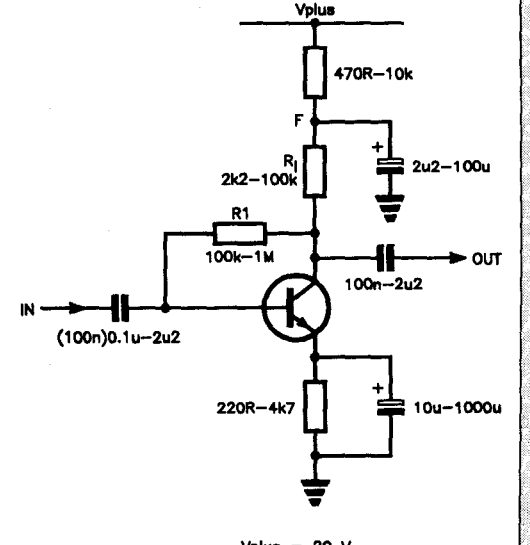
V_A	150 V
V_{SG}	100 V
V_C	1–6 V
V_g	0 V
Zin	R_g
Zout	R_l
GAIN	50–250
Eout	100 V_{p-p}
DIST.	5%
BW	20 Hz–20 kHz



Vplus = 20 V

V_F	18 V
V_C	10 V
V_E	1 V
V_B	1.6 V
Zin	1k–10k
Zout	R_l
GAIN	10–1500
Eout	$(V_F–2)_{p–p}$
DIST.	2%
BW	20 Hz–100 kHz

Figure 6.2. RC coupled NPN transistor audio amplifier block.



Vplus = 20 V

V_F	18 V
V_C	10 V
V_E	1 V
V_B	1.6 V
Zin	5–100k
Zout	R_l
GAIN	10–1500
Eout	$(V_F–2)_{p–p}$
DIST.	2%
BW	20 Hz–100 kHz

Figure 6.3. NPN amplifier with feedback bias.

often R2 will be left out of the circuit, the voltage being controlled by the voltage drop in R1. Such circuits are particularly prone to screen voltage problems when R1 drifts high, effectively starving the screen of current. If Vplus is designed to be about 150 V, the screen will often be connected directly to Vf. For battery equipment the screen voltage is usually in the range 45-90 V. Some designers return the screen bypass capacitor to the cathode, others return it to earth.

For pentodes such as the 6J7, 6BR7, 6BW7, and EF86, gains of 100 or more can be attained. With values of Rl over 100k (0.1M), the 680k input resistance of the ETI-195 Tracer will load the output, so the measured gain will be lower than expected. Only if the gain is less than half what you would expect is it likely that the valve emission has fallen off sufficiently far to be affecting the gain.

NPN transistors

Figure 6.2 shows a circuit for a single stage NPN audio amplifier. Since transistors are current-controlled devices, the biasing arrangements are different from those used with valves, the base voltage being always about 0.6-0.7 V more positive than that of the emitter. Early designs used the resistive divider R1, R2 of Figure 6.2.

To improve the stability of the biasing, and increase the input impedance, resistor R1 is usually returned to the collector and R2 is omitted as in Figure 6.3. If Vc tends to rise, more current is fed to the base via R1, so the collector current increases, lowering Vc. The use of R1 in this way also introduces some ac negative feedback, and some designers remove this by splitting Rf into two and bypassing the ac signal as indicated in Figure 6.4. The emitter resistor can be omitted altogether, or split into two and partly bypassed as in Figure 6.5.

Unless there is a good reason for doing otherwise, the dc design makes Vc, the voltage at the collector, half of Vplus. Since Rc is rarely higher than 10k, a dc voltmeter with a resistance of 1M does not introduce much error in this measurement. If the voltage is zero, the transistor is short circuited or Rc is open circuited; if it is almost equal to Vplus, the transistor or Re is open circuited or the bias has been removed, either by Ra going high, or Rb going low.

If Vc is correct, the circuit should work. Injecting a few mV of signal into the base should produce some output at the collector. The voltage gain of transistor circuits such as this can range from 10 to well over 1000, depending on the design. With high gains it is easy to saturate the transistor when testing it. This can reduce the gain to 1, so always start with an input of 1 mV and increase it until a measurement can be made at the output.

PNP transistors

The circuits for PNP transistors are similar to

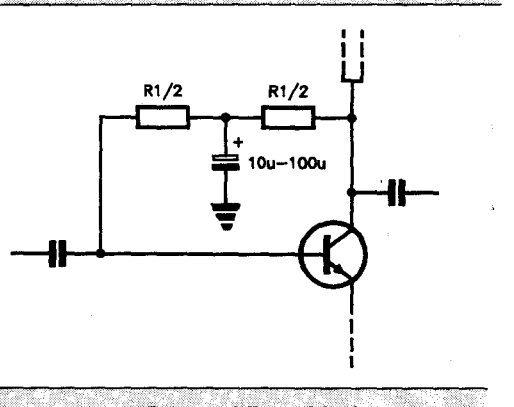
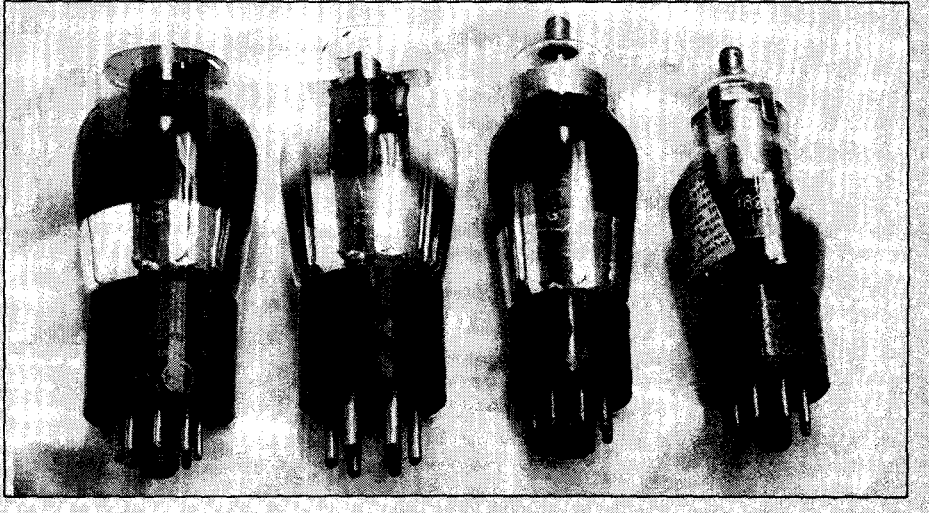


Figure 6.4. NPN amplifier with dc feedback but no ac feedback.



A parcel of popular pentodes of yesteryear. From the left: 6V6G audio power pentode, 2A5 audio power pentode, 1K7G signal pentode for battery receivers (grid cap on top), 6J7G — a widely encountered signal pentode, with grid cap.

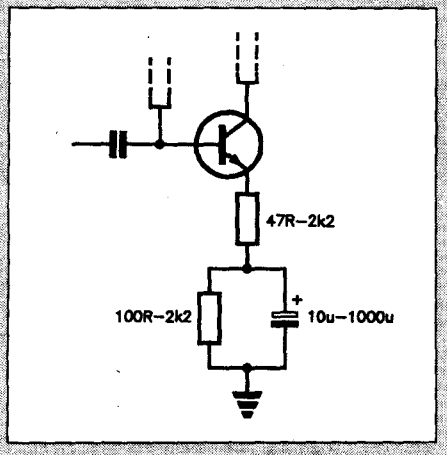


Figure 6.5. NPN amplifier with some emitter feedback.

those for NPN, except that the power supply and polarised capacitors are reversed. Figure 6.6 shows the PNP circuit equivalent to Figure 6.3. Since many modern designs use equal positive and negative supplies, these circuits are often drawn upside down, with the collector at the bottom. Small PNP transistors have lower noise levels than their NPN counterparts, so PNPs are often used in the input stages of audio amplifiers.

The dc levels of these circuits are the same (with the sign reversed) as those for NPN transistors. The ac properties such as input impedance and gain are also the same. Likewise the ac measuring technique is the same and should produce the same results.

FETs

Because the biasing arrangements of enhancement FETs are similar to those of valves, the audio frequency voltage amplifier of Figure 6.7 is similar to Figure 6.1. In fact, the characteristics of FETs have the same general shape as those of pentodes, so the high output impedance must be allowed for when taking measurements. In circuits such as this the dc voltage on the drain is about half Vplus for ac coupling, although it is fairly common to use dc coupling in high fidelity equipment. For high impedance circuits, junction FETs can have a lower noise level than transistors. If Vs is in the correct range, the circuit should work. If not, look for ac short circuits on the output.

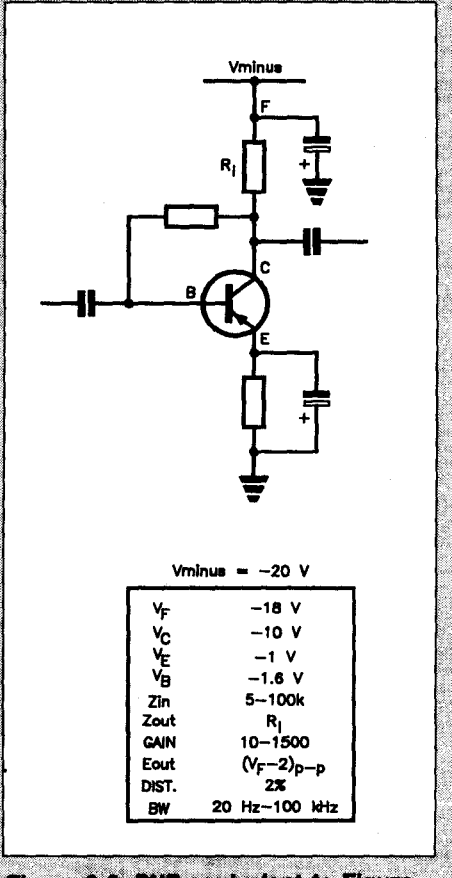
MOSFETs are sometimes used for audio work, particularly where a low capacitance is needed between input and output, and where the circuit impedance is high. The circuit of Figure 6.8 shows a dual-gate MOSFET as an AF amplifier. G2 acts in much the way that the screen grid acts in a pentode, reducing the gate one-to-drain (G1-to-D) capacitance. The dc voltage on G2 is usually about 25 per cent of Vplus, and it is heavily bypassed. To maintain linearity, a source current of about 5 mA is used. This limits the value of Rl to the range 1200-3300 Ohms (1k2 to 3k3) which restricts the gain to the range 5 to 15.

IC audio voltage amplifiers

The symbol for an IC amplifier, shown in Part 5, Figure 5.4 (o), covers a multitude of sins. The input circuit may contain NPN or PNP transistors, or FETs, the amplifier may require frequency compensation, and the frequency response may be down by 120 dB anywhere from 100 kHz to 10 MHz. Since all such ICs are dc coupled, and they are intended to be used with feedback, the dc gain tends to be high, 80 to 120 dB being common. The frequency response is 3 dB down at about 3 kHz in early models such as the uA741, but in later models the 3 dB cutoff frequency ranges from 300 Hz (LM10C) to 200 kHz (LH0032), depending on the intended use of the IC.

Figure 6.9 shows the circuit of the inverting AF amplifier. Rfbk and Rin control the gain, and, for gains less than about 5, many amplifiers need frequency compensating capacitors C1 and/or C2, each being in the range 2 pF to 220 pF. To limit the output current in the case of an accidental short circuit on the output, it is common to find Rs included in the feedback loop.

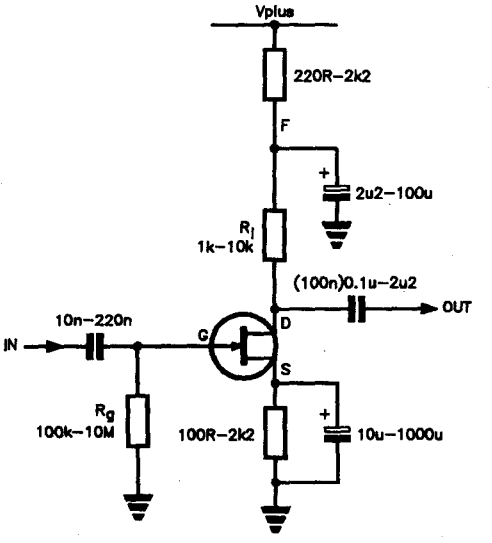
The non-inverting amplifier is shown in Figure 6.10. The main virtue of this connection



Vminus = −20 V

V_F	−18 V
V_C	−10 V
V_E	−1 V
V_B	−1.6 V
Zin	5–100k
Zout	R_l
GAIN	10–1500
Eout	$(V_F-2)_{p-p}$
DIST.	2%
BW	20 Hz–100 kHz

Figure 6.6. PNP equivalent to Figure 6.3.



Vplus = 20 V

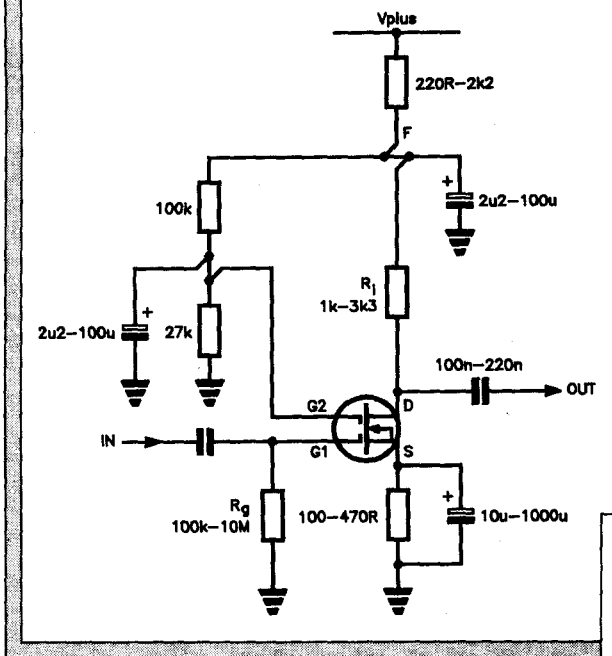
V_F	18 V
V_D	12 V
V_S	1 V
V_G	0 V
Zin	R_g
Zout	R_l
GAIN	2–20
Eout	10 V_{p-p}
DIST.	2%
BW	20 Hz–10 MHz

Figure 6.7. RC coupled FET audio amplifier block.

is that the input impedance is high, >100M for FET input amplifiers and >100k for non-FET. Both the non-inverting (+) and the inverting (−) input terminals must have a return to earth to allow for the bias current of the input stage, even if it is a FET.

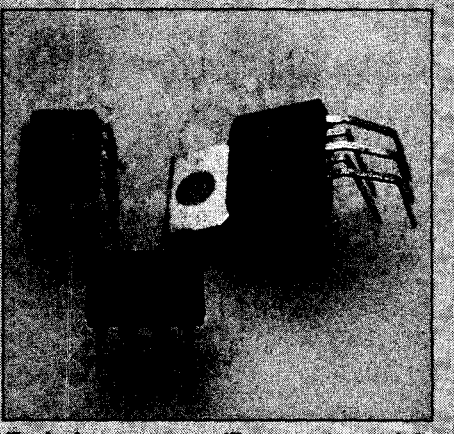
Checking the dc voltages of both of these amplifiers is simply a matter of ensuring that the voltages are correct on the power supply pins (usually pins 4 and 7 for an 8-pin IC) and that the dc voltage on the output pin (often pin 6) is close to zero volts. If this latter voltage is the same as one of the power supply voltages, there is a fault in the IC. The ac performance can be checked by applying, say, 10 mV from the injector to the input terminal of the amplifier and measuring the output with the tracer. The measured gain should be close to the calculated gain, otherwise check the values of the feedback resistors. If the gain is still low, there may be too much load on the output, so re-check the gain with the load removed.

Figure 6.11 shows the circuit of an IC amplifier used as a summing amplifier. If R1 = R2 = R3 and so on, the output voltage is proportional to the sum of the voltages on all of the inputs. Otherwise, the output voltage is

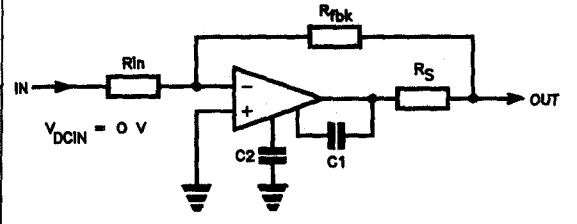


Vplus = 15 V	
V_F	12 V
V_D	9 V
V_S	1 V
V_{G1}	0 V
Zin	R_g
Zout	R_l
GAIN	5–15
Eout	5 V_{p-p}
DIST.	4%
BW	20 Hz–10 MHz

Figure 6.8. RC coupled MOSFET audio amplifier block.



Typical op-amps you'll encounter: at left rear is a 741, in front is a high performance LM833; the other device is a power op-amp TDA 2002/LM383.



± 15 V SUPPLY	
V_{DC} OUT	0 V
Zin	Rin
Zout	20R–2k
GAIN	$-\frac{Rfbk}{Rin}$
Eout	24 V_{p-p}
DIST.	<0.1%
BW	dc – >20 kHz

Figure 6.9. IC inverting voltage amplifier.

R fx E1/R1 + R fx E2/R2 + R fx E3/R3 +...

This circuit is much used in audio mixers.

The dc testing of this circuit is similar to the previous circuits. If the dc conditions are correct, applying the injector to any input should produce an output. If most inputs are working but an odd one is not, check that input's input resistor.

Figure 6.12 shows the use of an IC amplifier in balanced mode. This is sometimes called a difference amplifier since the output is proportional to E1-E2. This system is much used in professional equipment, but superior high fidelity designs also use it. The main advantage of the balanced mode is that there is an inherent rejection of any signals, such as hum, that are common to the two input connections. This is called common mode rejection and is particularly useful in removing the effects of earth loops when different pieces of equipment have to be connected together.

Such a circuit, using the low-noise 5534A is very popular as the input stage of microphone or pickup amplifiers. Notice that, provided there is an external dc connection between the input leads, there is no need for an earth connection on the input. This dc connection often takes the form of the secondary of a microphone or audio transformer, or the coil of a pickup.

The dc testing of this circuit is the same as

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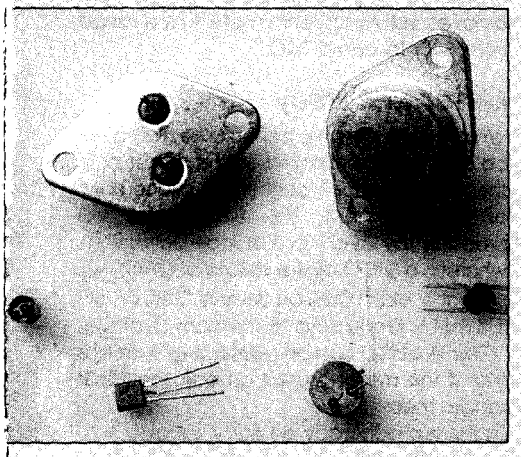


A tally of transistors, plus a few FETs. The two large devices at the rear are a bipolar power transistor (left) and a power MOSFET (right). Then, going clockwise, a dual-gate FET, a medium-power bipolar transistor, a common plastic package bipolar transistor and last, a metal package bipolar transistor.

that for the previous IC circuits. Testing the gain is a little more difficult, only in that the two sinewave output probes from the ETI-195 Signal Injector must be connected to the two amplifier input terminals, not from one connector to earth.

The common mode rejection of the circuit is tested using the circuit of Figure 6.13. The output should be zero, even for 500 mV input from the injector. Since the rejection depends on R1a/R2a being equal to R1b/R2b, a little judicious trimming of the highest of the four resistors can be used to improve matters. For example, if all four resistors are supposed to be 10k and are within 1 per cent, improving the resistor matching to within 0.1 per cent can improve the hum rejection by 20 dB. This is one case where even a resistance meter accurate to 0.1 per cent is not really good enough; trimming one resistor is essential for best results.

The technique is simple. Temporarily clip a 10M resistor across each resistor in turn, noting the output in each case. If the output increases in each case, you are as close as you can get to balance. If you find one resistor where the output decreases, use progressively lower-valued resistors across that resistor until the output starts to increase, then shunt the resistor with the value that gave the lowest reading. You can repeat this process if you wish, but stop when shunting each of the four resistors increases the output. eti

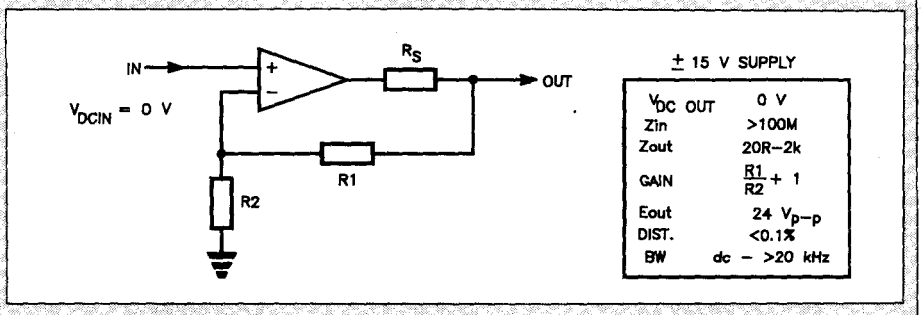


Figure 6.10. IC non-inverting voltage amplifier.

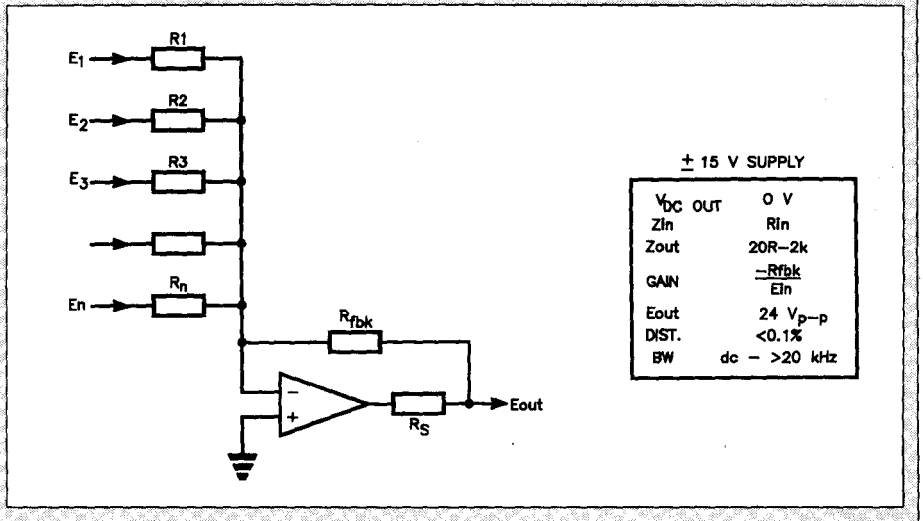


Figure 6.11. IC summing amplifier.

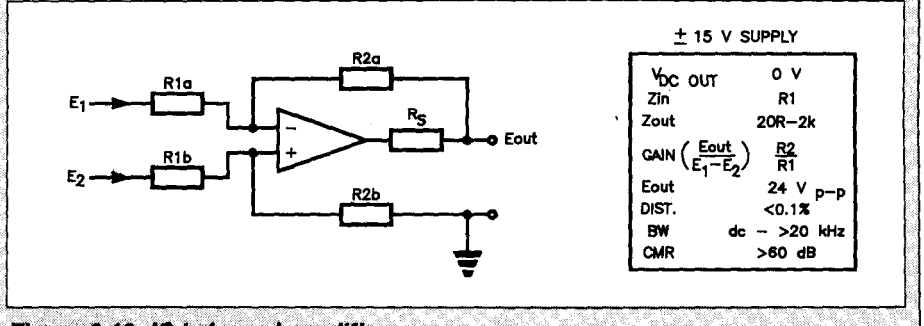


Figure 6.12. IC balanced amplifier, also known as a difference amplifier.

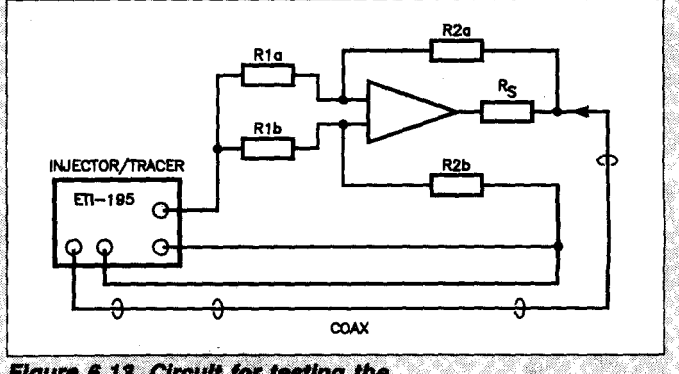
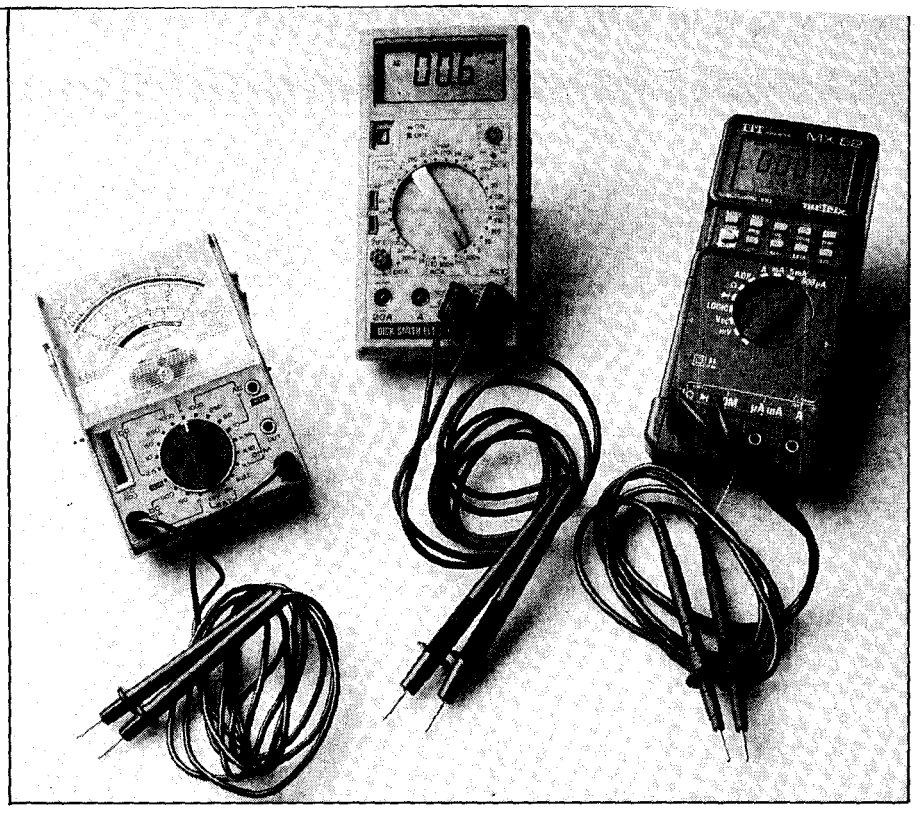


Figure 6.13. Circuit for testing the common mode rejection of a balanced amplifier.



Typical multimeters in the $40 to $400 price range. At left is the Dick Smith analogue Q1022 meter ($39.95), centre is the mid-priced Dick Smith 3.5-digit handheld DMM Q-1526 ($179), and on the right is the high performance 5000-count Metrix MX52 from Elmeasco.

There is a law of quantum mechanics that translates loosely into "you can't measure anything without disturbing something". In electronics, this translates into the much more powerful Murphy's law: "No matter how carefully you measure something, you will get the wrong answer!" By Jack Middlehurst.

TIPS ON MEASUREMENT TECHNIQUES

This article is intended to help enthusiasts who want to develop their measuring skills to the stage where they instinctively have a feeling for how big their errors of measurement might be. We will only consider the simple measurements of voltage, current and resistance. You can get into quite enough trouble with these without wandering further afield into such things as frequency, impedance, phase angle, distortion, etc.

Voltmeters

There is available on the market an extensive range of instruments for voltage measurement, from the cheap ($40) but nevertheless useful 'one thousand Ohms per Volt' meter to the whizz-bang digital voltmeter ($18,000) with memory, computer control, one part in a million dc accuracy, and better than 1 part in 10,000 ac accuracy.

Since the people reading this magazine are probably not millionaires, nor are they starting up their own National Measurement Laboratory, we will assume that we only have a dc/ac volt/amp/ohm meter in the range from $40 to about $400.

Meter accuracy

Whichever meter we have, some claims will be made, either printed on the meter or in the instruction book, concerning its accuracy of measurement. The $40 meter will probably say 2% of FSD (Full Scale Deflection), whereas a $400 digital voltmeter (DVM) will probably claim 0.1% on dc and 0.5% on ac. If a meter simply says 1%, it means 1% of FSD.

This 1% of FSD can be misleading. It means that if the meter is used on, say, the 50 V range, then:

claimed accuracy on 50 V range
= +/-1% of 50
= +/- 0.5 V

If the meter is reading, say, 10 V on the 50 V range:

uncertainty in the 10 V range
= +/ – 0.5 V
= 5% of 10 V,

so the meter uncertainty in our reading of 10 V is 5%, not 1% as we might have been led to believe by the claims on the meter.

This means that, to get the best accuracy possible from any meter, we always try and use a range on which the measurement that we are taking gives a reading as close to full scale as possible.

Measurement accuracy

So much for the meter. Now to measurement technique. There will be many occasions on which the input resistance of the voltmeter will affect the answer that we get. One way in which this comes about is shown in Figure 1a.

Two resistors R1 and R2 are connected in series across Vplus. By using Ohm's Law, we can show that the true voltage (Vtrue) at the junction of the resistors is given by:

Vtrue = Vplus x R2/(R1 + R2) volts

When we try and measure Vtrue, we put the resistance of the meter (Rmeter) across R2 as in Figure 1b. As shown in Figure 1c, the

ELECTRONICS

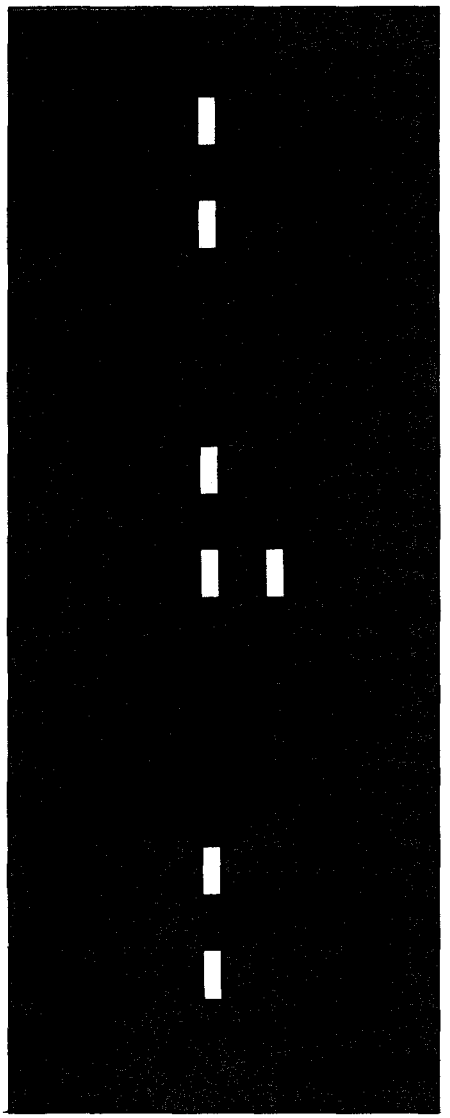


Figure 1. The input resistance of your multimeter can affect the voltage reading on many occasions, the true voltage being always somewhat less than the measured voltage. (a) shows the circuit you might start with; (b) shows what happens when you apply your multimeter, and (c) shows the equivalent circuit to (b), R3 replacing R2 and Rmeter.

two resistors, R2 and Rmeter, in parallel form a resistor R3, where: R3 = R2 × Rmeter/(R2 + Rmeter) Ohms.

Again, using Ohm's Law:

Vmeas = Vplus × R3/(R1 + R3) volts.

Since R3 is always less than R2, Vmeas will always be less than Vtrue.

Suppose that we are measuring the dc voltage on the anode of a pentode valve, as shown in Figure 2a. The equivalent circuit of what we are doing is shown in Figure 2b, the same circuit as Figure 1b.

In the circuit, R2 now represents the internal dc resistance of the pentode, so R2 will be many megohms. If we have a 1000 Ohms/Volt VOM-meter and use the 250 Vdc range, Rmeter is 250k and the claimed accuracy is

+/− 2% of 250 V = +/− 5 V

on this range. We can measure R1, but R2 is inside a valve (or transistor, or whatever) and therefore is not measurable. Fortunately we don't need to know the value of R2, since, by knowing Vplus, Vmeas, R1, and Rmeter, we can calculate Vtrue from:

Vtrue = Vmeas/(1 − R1 × Vmeas/Rmeter/Vplus ..(1)

For example, if Vplus is 250 V and R1 is 270 k, then if Vmeas is 81.2 V, the true voltage, calculated from equation 1, would have been:

Vtrue = 81.2/(1 − 270,000 × 81.2/250,000/250) = 125 V.

So our measurement error would have been:

% error = 100 × (125 = 81.2)/125 = 35%

if we didn't use the equation to calculate the correct value for Vtrue.

Let us now use our $400 DVM to take the same reading, using its 199 Vdc range. The claimed accuracy would be

+/− 0.1 % of 199 = +/− 0.2 V

on this range. The input resistance of these meters is usually 10M on all voltage ranges.

Using this meter we find Vmeas = 123.3 V, and equation 1 again gives 125 V as the corrected answer. This time our measuring error would have been 1.4%, which completely swamps any inaccuracies in the meter itself, but at least is considerably less than that of the cheaper meter. A similar situation occurs using an ac voltmeter to measure the output signal from a moderate to high resistance circuit. Figure 3a shows the circuit of a FET audio amplifier and Figure 3b is the equivalent circuit diagram of what happens when we attempt to measure the signal output.

This time, the FET behaves as a constant current ac source feeding R1, R2, and Rload all in parallel. The input resistance (Rmeter) of the meter is in parallel with this combination. R2 now represents the internal ac resistance of the FET. In this case we can't measure either the ac source current or R2, so things become a bit more complicated.

If R2 is so much greater than R1 that the effect of R2 can be ignored, we can calculate Etrue from the resistors and the measured voltage Emeas:

Etrue = Emeas × (1 + Rload × R1/Rmeter/(R1 + R1load))...(2)

For example, for a FET, R2 is about 1M, so if R1 is 12k we can use equation 2. If Rload is also 12 k, and the 1 Vac range is used on the $40 meter (Rmeter = 1k), then if Emeas is 0.60 Vac, the true output before the meter was connected must have been:

Etrue = 0.60 × (1 + 12,000 × 12,000/1000/(12,000 + 1000) = 4.20 Vac.

the loading effect of the meter producing a massive error of over 85% of the reading. This time the expensive DVM gives an answer of 4.20 V.

If R2 is not considerably greater than R1, we have a bit more work to do. We measure the output on two different ranges of the meter and call the readings E1 and E2. If the input resistance of the meter is Rm1 while reading E1, and Rm2 while reading E2, we calculate:

Etrue = E1 × E2 × (Rm2 − Rm1)/(Rm2 × E1 − Rm1 × E2)... (3)

If a transistor was used instead of a FET in the above example, R2 would only be about 20k, so the double measurement technique and equation 3 have to be used.

Suppose the 1 V range gave a reading (E1) of 0.60 Vac as before. Switching to the 10 V scale increases Rmeter to 10k and we find that E2 is 2.31 Vac. We calculate:

Etrue = 0.6 × 22.31 × (10,000 − 1000)/10,000 × 0.6 - 1000 × 2.31) = 3.68 Vac

The DVM would give 3.68 Vac on each range since its input resistance is constant, which means that this double measurement technique cannot be used with DVMs.

Fortunately, as we can see from the accuracy of the DVM reading, it is not really necessary when using a DVM in this case since its high input resistance does not load the circuit significantly. How do we know if R2 is high enough to ignore? If we take

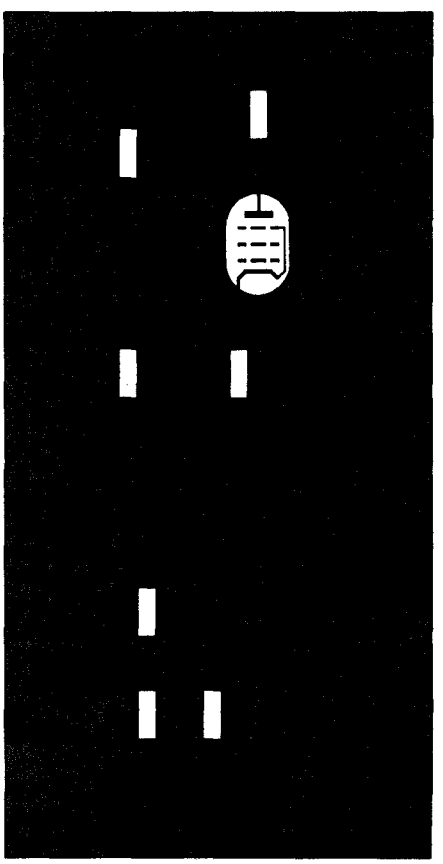


Figure 2. Measuring the dc anode voltage in a valve circuit (a pentode here) is a case in point; the equivalent circuit of the measurement situation is shown in (b), which you can see is similar to Figure 1(b).

measurements on two ranges, and equation 2 gives the same answer on each range, R2 can be ignored and there is no need to go to equation 3. In developing all three of these equations it has been assumed that the actual value of R2 is not affected by our measurements. Fortunately, this is usually sufficiently true for the equations to work.

For ac measurements it has also been assumed that the input resistance of the meter is the same as for the corresponding dc range. For many of the cheaper meters that use simple rectifiers to convert the ac to dc, this is not the case.

For these meters the input resistance at low voltages depends on the voltage being measured. Such meters usually have special scales for ac voltage ranges below about 10 V FSD and even using the equations will not give the correct value for Etrue on these ranges. On the high ac ranges, the equations work correctly.

Current

Nothing could be simpler than measuring current. All you have to do is insert a current meter into the part of the circuit where you want to measure the current and bingo!, there is the answer for all to see.

Well.....almost. Unfortunately, putting the current meter into the circuit can have all sorts of effects on the circuit performance, depending on just where you put the meter.

Suppose that you have the simple circuit of Figure 4a. Ohms law says that the current will be Vdc/Rload. i.e.

current = 1.5/1500 = 1.0 mA.

Let us now put our $40 current meter into the circuit as shown in Figure 4b. On the 1 mA range the current meter has a resistance of 100 Ohms. So the circuit now looks like Figure 4c, and Ohms law now gives the current as:

current = 1.5/1600 = 0.9375 mA,

in other words, putting the current meter in the circuit changed the current by over 6%, even in such a simple case as this.

Things get much more serious if we attempt to measure the emitter current in transistor circuits for example. If you look at the audio amplifier circuit of Figure 5, you see that the voltage at the base of the transistor is 1.0 V, so the voltage on the emitter has to be about 0.36 V. This means that the current through the emitter resistor (18 Ohms) is

0.36/18 = 0.02 A = 20 mA.

What happens if we insert our ammeter between the 18 Ohm resistor and ground? We switch the meter to the 20 mA range where its resistance is 5 Ohms. Since the base voltage is fixed at 1.0 V, the emitter voltage is also fixed at about 0.36 V. This means that, since the total resistance in the emitter circuit is now 18 + 5 = 23 Ohms, the current must be

0.36/23 = 0.0156 A = 15.6 mA.

Simply putting the meter into the circuit has changed the current from 20 to 15.6 mA!

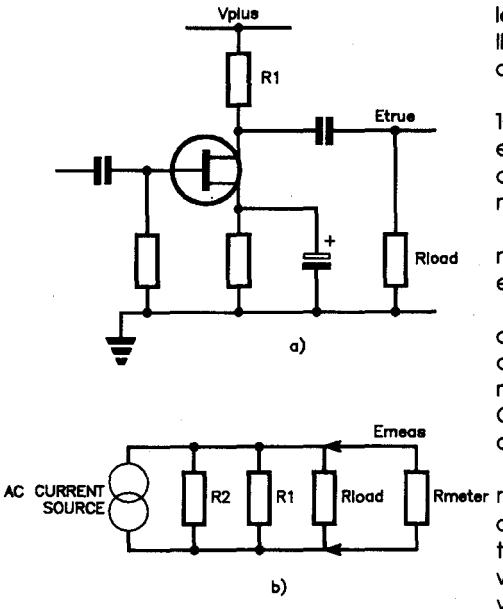


Figure 3. An ac voltmeter also affects the circuit you are trying to take a measurement on, the equivalent circuit of the situation being shown in Figure 3(b).

The reason why such a considerable change was produced is that we are trying to measure a dc current in a dc feedback circuit. Introducing an extra resistance into a feedback circuit always produces interesting results, since the feedback will do its very best to try and cancel out the change that you have made.

In this case, the feedback is designed to maintain the emitter voltage at a constant 0.36 V, and to do this it changes the current to cancel out the effect of adding the extra 5 Ohms. Very clever of the circuit, but very frustrating if you don't realise what the circuit is doing to your current reading. Since many electronic circuits involve feedback, trying to measure currents is fraught with difficulty.

In general, the resistance of DVMs on current ranges are higher than those of cheap meters since the minimum DVM voltage range is commonly 0.199 V, whereas that of a 1 mA/V meter is 0.1 V. So using a DVM will usually make matters worse in current measurements.

Attempting to measure dc currents in radio frequency (RF) circuits can also be a lot of fun. Suppose we decide that we need to know the current in an intermediate frequency (IF) amplifier in a broadcast band radio. The circuit can be something like Figure 6a.

We disconnect the lead from the intermediate frequency transformer (IFT) to the dc supply line and connect our current meter leads, one to the IFT, the other to the dc supply, and then we turn the radio on. What happens next with many radios is that we get a series of whistles and we find that the radio doesn't tune properly. The extra leads connected to the IFT feed some of the IF voltage back to other parts of the circuit and the whole thing oscillates.

This can sometimes be cured by putting a 10 nF (0.01u) capacitor from the IFT lead to earth, or to the dc supply, but despite this, adding such long leads to RF or IF circuits is not really a clever idea.

So what do we do ? The simple answer is not to measure currents unless it is absolutely essential, but to calculate them instead.

In the case of the circuit of Figure 5, it is a comparatively easy matter to measure the actual value of the 18 Ohm resistor and to measure the voltage at the emitter. Then Ohms law can be used to calculate the current quite accurately.

In the case of the IF amplifier, a 10 Ohm resistor bypassed with a 100 nF (0.1u) capacitor can be put neatly from the IFT to the dc supply as shown in Figure 6b. Then a voltmeter can be used to measure the voltage across the 10 Ohm resistor using screened cable on the lead to the IFT, the screen being connected to the dc supply as shown in the Figure. This effectively builds a sensitive current meter with a resistance of your own choosing. A voltmeter with a sensitivity of 0.2 V FSD will behave as a 20 mA FSD current meter when used in this way.

If you use this trick on any high voltage circuit, make sure that the screened cable has an insulating cover. You don't want to get yourself connected to the high voltage by accidentally touching the screened cable.

Resistance

The $40 meter measures resistance by setting up a 'constant voltage' supply (a battery) and measuring the current through

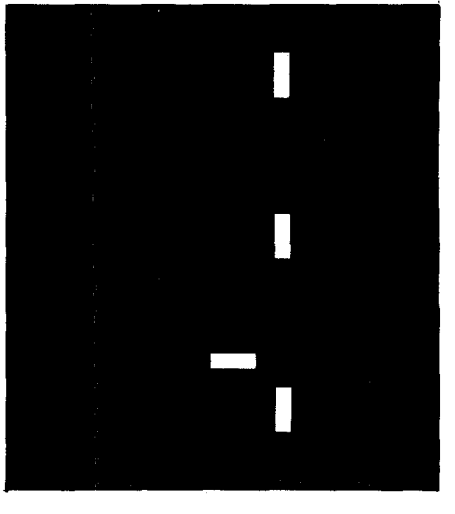


Figure 4. Measuring current has hidden traps, too! Take the simple circuit in (a), add your current meter in series, as in (b), and you have changed the circuit, as shown in (c).

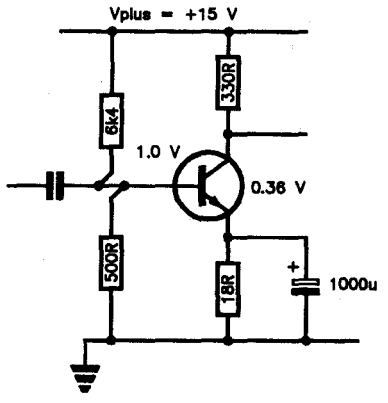


Figure 5. Would you believe putting a meter in series with the emitter resistor in this circuit would markedly change the current? It does! You're better off measuring the voltage across the 18 Ohm emitter resistor and calculating the transistor's emitter current.

the resistor under test. For this reason, low resistances occur at the full scale end of the scale and high resistances towards the zero end. In other words, the resistance scale is non-linear and 'backwards'.

A DVM, on the other hand, uses a 'constant current' source feeding the resistor under test, and measures the voltage across the resistor. This method has the distinct advantage that the resistance scale is linear and in the forward direction.

For the cheaper meters, the problem of getting a truly constant voltage is insurmountable, so the accuracy of measurement is rarely better than 2%, and is more often closer to 5%. Consequently, these meters are of use mainly to establish that the resistance in question is within range of where it should be and is not, for example, 10 times too big or too small (an easy mistake to make!). The way to improve the accuracy of the meter is to have a supply of 1% resistors against which to calibrate it. These resistors are quite cheap, so a range of them can be kept to one side for calibration purposes. For example, if you need to measure a resistor that is nominally 100 Ohms, measure a 100 Ohm 1% resistor first and use the full scale setting control to set the meter to read exactly 100 Ohms. Then any small deviation from 100 Ohms in the resistor under test will become obvious.

In this way you can get an overall accuracy of about 2% from your meter, but you have to remember to calibrate it with the appropriate resistor each time you want to take a serious measurement. What you are really doing is using the meter as a comparator rather than as an absolute resistance meter.

The DVM has a much easier job in making a constant current supply but even then the accuracy is rarely better than 1%, and is more often 2%. This is quite adequate for most electronic circuits, but once again you can use the meter as a comparator with the help of 1% resistors.

The main thing to remember when measuring resistors is to make sure that there is nothing in series or in parallel with the resistor being measured. That sounds easy, but the meter leads are always in series with the resistor, which can be important when measuring low value resistors, and quite often your fingers get to be in parallel with the resistor, which is important when measuring high value resistors.

To allow for the resistance of the meter leads, cheap meters have an adjustment that you use to set the reading to full scale with the meter leads shorted together. This is quite effective provided that the battery is new, the contacts on the range selector switch are clean, and the meter test prods or clips are clean. If not, the setting of full scale will vary all over the place, and the meter can only be used to measure fairly high values of resistance.

Only quite expensive DVMs tend to have an adjustment for the resistance of the meter leads. For most DVMs, you take a reading with the test prods short-circuited and subtract this value from your readings of resistance from there on.

Making sure there is nothing in parallel with the resistor under test is fairly easy if the resistor is not attached to anything, provided you keep your fingers away from it. However, in many cases the resistor will be mounted on a circuit board. In this event it is essential to unsolder one end of the resistor and lift that end clear of the board before trying to measure the resistance.

Even if you are quite sure that there is nothing in the circuit in parallel with the resistor, lift one end. After all, you wouldn't be measuring the thing if there was nothing wrong with the circuit, so you can bet that if you try and measure the resistance without lifting one end, the thing that is wrong with the circuit will have put something in parallel with that darn resistor.

Conclusion

With a few precautions and a little practice, it can become second nature to take measurements of voltage, current, and resistance, and to make a reasoned guess at the level of accuracy that you are attaining in these measurements. Voltage and current measurements always disturb the circuit. Knowing this and knowing the size of the effect can improve your measurement accuracy to the stage where the major limitation is the precision of the meter that you are using.

GENERAL RULES FOR MEASURING VOLTAGE

1. Always choose a range so that the meter reading is near full scale.

2. Use a voltmeter with the highest possible input resistance.

3. Use the techniques described above together with the three equations to check the accuracy of your measurement.

GENERAL RULES FOR MEASURING CURRENT

1. Don't, unless you are really stuck. Always calculate currents if possible.

2. Use a current meter with the lowest possible internal resistance so as to disturb the circuit as little as possible.

3. In RF or IF circuits, bypass and shield all leads to the meter.

RULES FOR MEASURING RESISTANCE

1. Make sure there is nothing in series or parallel with the resistor being measured.

2. Make sure the batteries are fresh, and all test prods are making good contact.

3. Check and allow for the resistance of the test leads.

4. Check the calibration of the meter using 1% resistors. eti

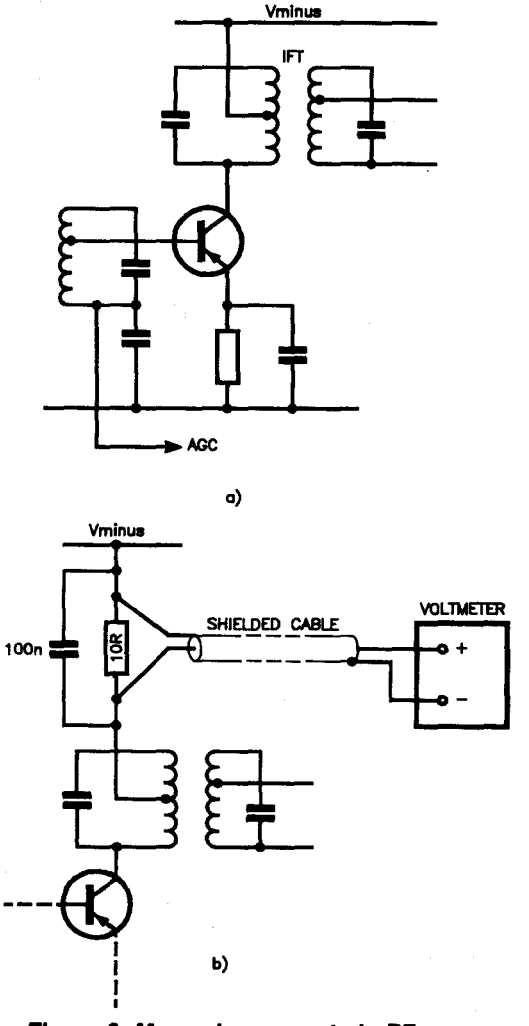
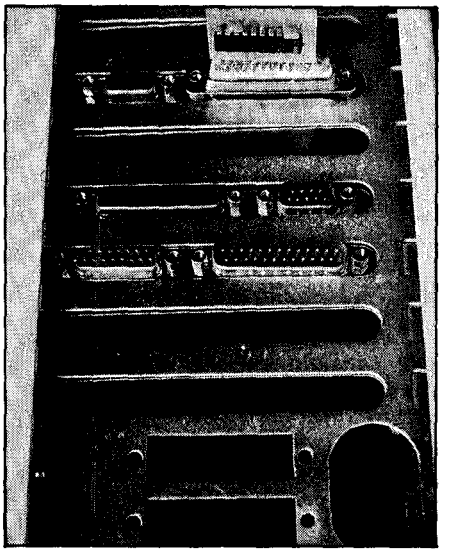


Figure 6. Measuring currents in RF circuits creates special difficulties. An approach for avoiding problems is shown in (b).

SIMPLE DIGITAL-TO-ANALOGUE CONVERTER

Add-on for your computer



This project can be driven by any computer that has a programmable parallel output port. Using it, you can generate all sorts of interesting waveforms, signals and sounds. And you can program it using BASIC. By Graham Dicker.

Over the years, many digital-to-analogue converter (DAC) circuits have been designed for a variety of computers without any degree of uniformity. With the advent of modern personal computers, so many manufacturers have adopted their own bus standards those wishing to control or provide a link between the computer and the outside world face no end of problems.

The DAC project described here is designed to be a universal device in that it is independent of the computer it may be attached to, as it simply plugs into the parallel printer port. Most computers have parallel printer ports, or a parallel user port, which are provided by means of some programmable input/output (I/O) chip, Thus, this project is readily interfaced to any computer with such a port.

The project is built on a printed circuit board measuring about 25 x 35 mm and may be mounted on the rear of a standard 25-pin male D-connector (DB25M or DB25P) as many computers use a 25-pin female D-connector (DB25F or DB25S) for their parallel printer port. If your computer employs some other connector, the project is readily adapted as it simply requires wiring-up to the appropriate pins. I have included a sample test program so that you can check that the converter is operating and to illustrate simple programming techniques.

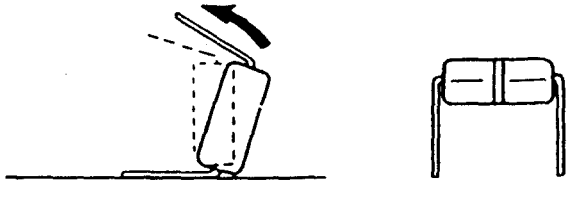


Figure 1. You may need to straighten the IC's pins. To do so, work on a metal surface, such as a small sheet of aluminium. Pick up the IC using your thumb and forefinger to grasp the ends; avoid touching the pins. Touch your other hand on the metal surface to equalise any static charge between you and the work surface, then lay the chip down on its side as shown here. Very carefully roll it towards the pins to bend the lower pins into line. Then turn it over and bend the other row of pins in the same manner.

Design details

The project has been designed around a standard National Semiconductor DAC, the DAC0830, which is a single chip, 8-bit D-A converter of the R-2R type design. The chip was chosen mainly because of the availability of the device and its low cost. It is one of a compatible series, which includes the DAC0831 and DAC0832. They differ from one another only in their linearity specifications. In this project, any one from this series may be substituted, as indicated in the Parts List.

I originally designed a circuit using discrete resistors, but I found that for an 8-bit converter with 256 step resolution, 0.04% tolerance resistors would be required, and even by very carefully

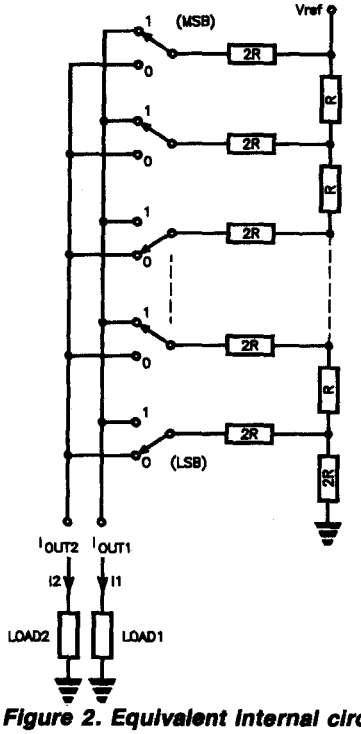
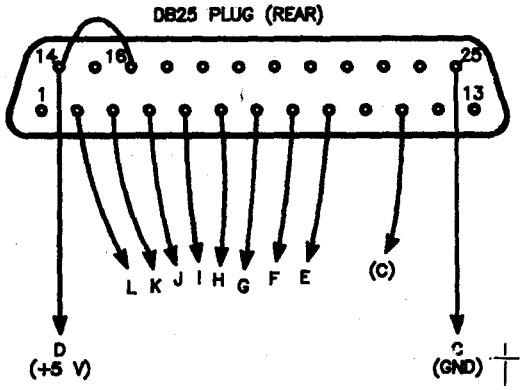
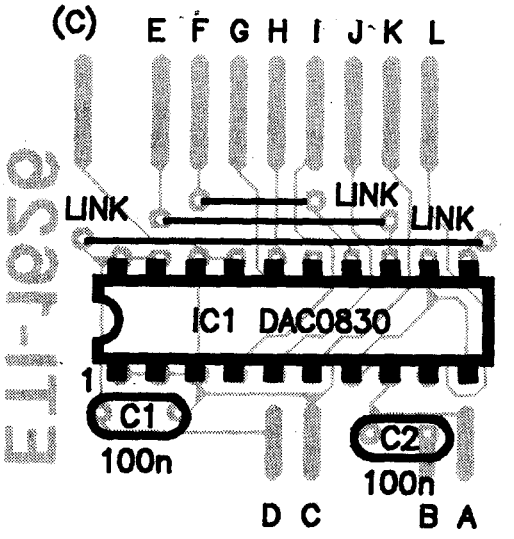


Figure 2. Equivalent internal circuit of the R-2R D-A converter in the DAC0830. This is how it is used in the current switching mode.

ELECTRONICS
ETI-1626





PARTS LIST ETI-1626

SEMICONDUCTORS

IC1.....DAC0830, DAC0831, DAC0832

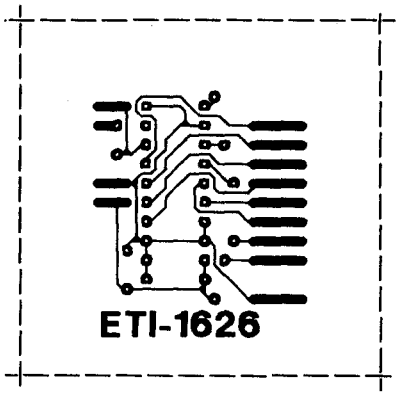
Capacitors

C1, C2.....100n monolithic ceramic

MISCELLANEOUS

ETI-1626 pc board; DB25P connector (or other connector, as required); short length of tinned copper wire or single core plastic insulated hookup wire; cable and connector for output.

Approximate cost: $14-$20.



How it works

The DAC0830 is a CMOS 8-bit multiplying DAC designed to easily interface with a wide variety of microprocessors. The device consists of two internal buffer/latches and an R-2R ladder network (see the accompanying Abbreviated Data Sheet). The R-2R network divides a reference voltage into 256 steps and provides a resolution of eight bits with excellent tracking and temperature stability. The circuit uses low power CMOS switches to provide low power consumption (20 mW) and low output leakage. The linearity error is better than 1/2 the least significant digit (LSD) value, which is assured through the precision R-2R network.

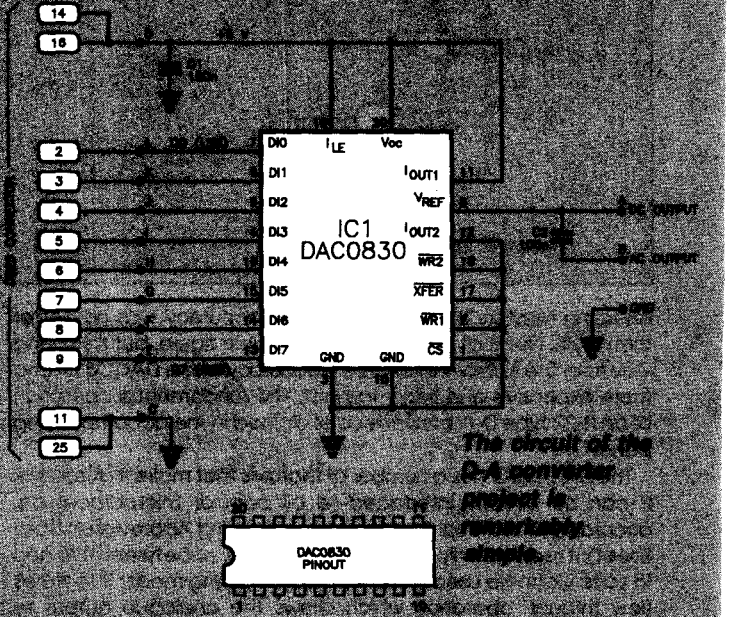
As most DACs suffer the disadvantage of digital signal feedthrough where minute switching signals cause a fluctuation in the analogue output, the use of an existing printer port has the effect of reducing these levels.

The DAC0830 is used in flow through mode here by grounding CS, WR1, WR2, XFER and taking ILE high. This allows the analogue output to continuously reflect the change in the state of the digital inputs in real time.

The fundamental purpose of a DAC is to provide an accurate analogue output quantity which is representative of the applied digital value. The equivalent circuit of the DAC0830's D-A converter section is shown here in Figure 2. The IOUT1 pin provides a current proportional to the product of the applied reference voltage and the digital word. There is an additional output, IOUT2, which is the inverse of IOUT1. The internal source impedance of the DAC0830 is on the order of 15k, which is the nominal value of R in the ladder network. The ladder is switched by eight SPDT CMOS switches to either IOUT1 or IOUT2 as determined by the input logic level. The design for this project uses the DAC in a unipolar configuration (positive output voltage only) but the DAC can support bipolar if appropriately configured. I have connected the DAC0830 here in a voltage switching configuration by using the R-2R ladder in an inverted manner from the standard current switching configuration. So now, it looks like Figure 3. The reference voltage is now connected between the current output terminals (IOUT1 to +5 V, IOUT2 to ground) and the output voltage is taken from the Vref input. The DAC dc output is now in the range of 0 V to approximately 2.5 V as a function of the applied digital code. By using the DAC in this mode you effectively save the extra cost of an op-amp to buffer the output current.

For the sake of circuit simplicity the reference voltage applied to IOUT1 (pin 11) is derived from the supply rail (nominally +5 V). This compromises the IC's linearity and gain error performance, but that's of no consequence in non-critical applications. For this reason, any of the DAC0830 series may be used in this project, as indicated in the Parts List, according to what particular chip is available or is cheapest at the time of purchase. Generally, the DAC0832 is the cheapest. Rod Irving Electronics lists it in their catalogue at $6.95.

If you wish to use this project in an application where the chip's accuracy is called for, the circuit should be modified as shown in Figure 4. An LM336-2.5 (National Semiconductor) precision zener provides the reference voltage, and the IC's supply is raised to 12 V to maintain a difference of more than 5 V between Vref and the supply, at the same time putting Vref below +5 V, as recommended by National Semiconductor.



The circuit of the D-A converter project is remarkably simple.

Simple D-A converter

ABBREVIATED DATA SHEET

DAC0830/DAC0831/DAC0832 8-Bit Microprocessor Compatible, Double-Buffered D-to-A Converters

General Description

The DAC0830 is an advanced CMOS/Si-Cr 8-bit multiplying DAC designed to interface directly with the 8080/8048, 8085/Z80 and other popular microprocessors. A deposited silicon-chromium R-2R resistor ladder network divides the reference current and provides the circuit with excellent temperature tracking characteristics (0.05% of Full Scale Range maximum linearity error over temperature). The circuit uses CMOS current switches and control logic to achieve low power consumption and low output leakage current errors. Special circuitry provides TTL logic input voltage level compatibility.

Double buffering allows these DACs to output a voltage corresponding to one digital word while holding the next digital word. This permits the simultaneous updating of any number of DACs.

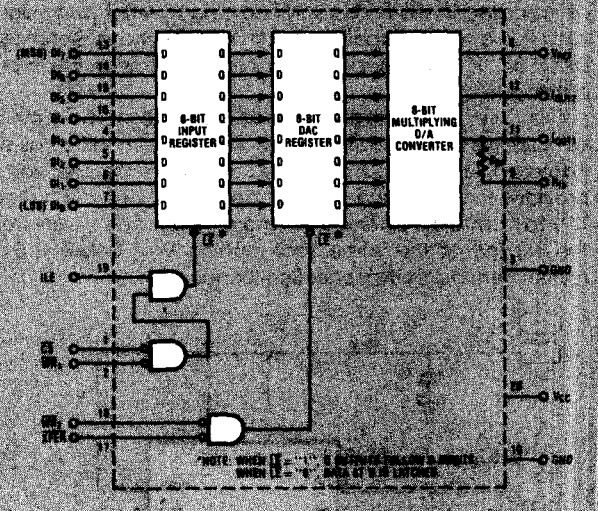
The DAC0830, '31 and '32 differ only in their linearity figures. The '30 is the best at 0.05%, the '31 has 0.1%, the '32 0.2%.

Features

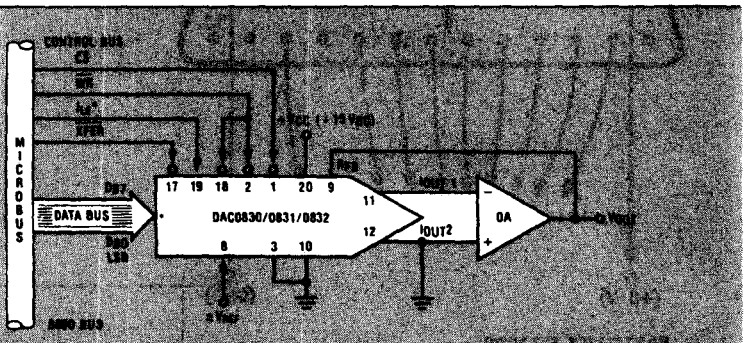
- Double-buffered, single-buffered or flow-through digital data inputs.
- Easy interchange and pin-compatible with 12-bit DAC 1230 series.
- Direct interface to all popular microprocessors.
- Linearity specified with zero and full scale adjust only – NOT BEST STRAIGHT LINE FIT.
- Works with ±10V reference-full 4-quadrant multiplication.
- Can be used in the voltage switching mode.
- Logic inputs which meet TTL voltage level specs (1.4V logic threshold)
- Operates "STAND ALONE" (without uP) if desired.

Key Specifications

• Current setting time	1μs
• Resolution	8 bits
• Linearity (guaranteed over temp.)	8, 9, or 10 bits
• Gain Tempco	0.0002% FS/°C
• Low power dissipation	20 mW
• Single power supply	5 to 15 V_{DC}



DAC0830 Functional Diagram.



Typical Application

The digital input code is referred to as D and represents the decimal equivalent value of the 8-bit binary input, for example:

Binary Input Pin 13 MSB						Pin 7 LSB		D Decimal Equivalent
0	0	0	0	0	0	0	0	255
1	0	0	0	0	0	0	0	128
0	0	0	1	0	0	0	0	16
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	0	0	0

Definition of Package Pinouts

Control Signals (All control signals level activated)

$\overline{CS}$: Chip Select (active low). The $\overline{CS}$ input signal in combination with ILE will enable $\overline{WR_1}$.

ILE: Input Latch Enable (active high). The ILE in combination with $\overline{CS}$ enables $\overline{WR_1}$.

$\overline{WR_1}$: Write 1. The active low $\overline{WR_1}$ is used to load the digital input data bits (DI) into the input latch. The data in the input latch is latched when $\overline{WR_1}$ is high. To update the input latch – $\overline{CS}$ and $\overline{WR_1}$ must be low while ILE is high.

$\overline{WR_2}$: Write 2 (active low). The signal in combination with $\overline{XFER}$, causes the data which is available in the input latch to transfer to the DAC register.

$\overline{XFER}$: Transfer control signal (active low). The $\overline{XFER}$ will enable $\overline{WR_2}$.

Other Pin Functions

DI_0–DI_7: Digital inputs. DI_7 is the most significant bit (MSB) and DI_0 is the least significant bit (LSB).

I_{OUT1}: DAC Current Output 1. I_{OUT1} is a maximum for a digital code of all 1's in the DAC register and is zero for all 0's in DAC register.

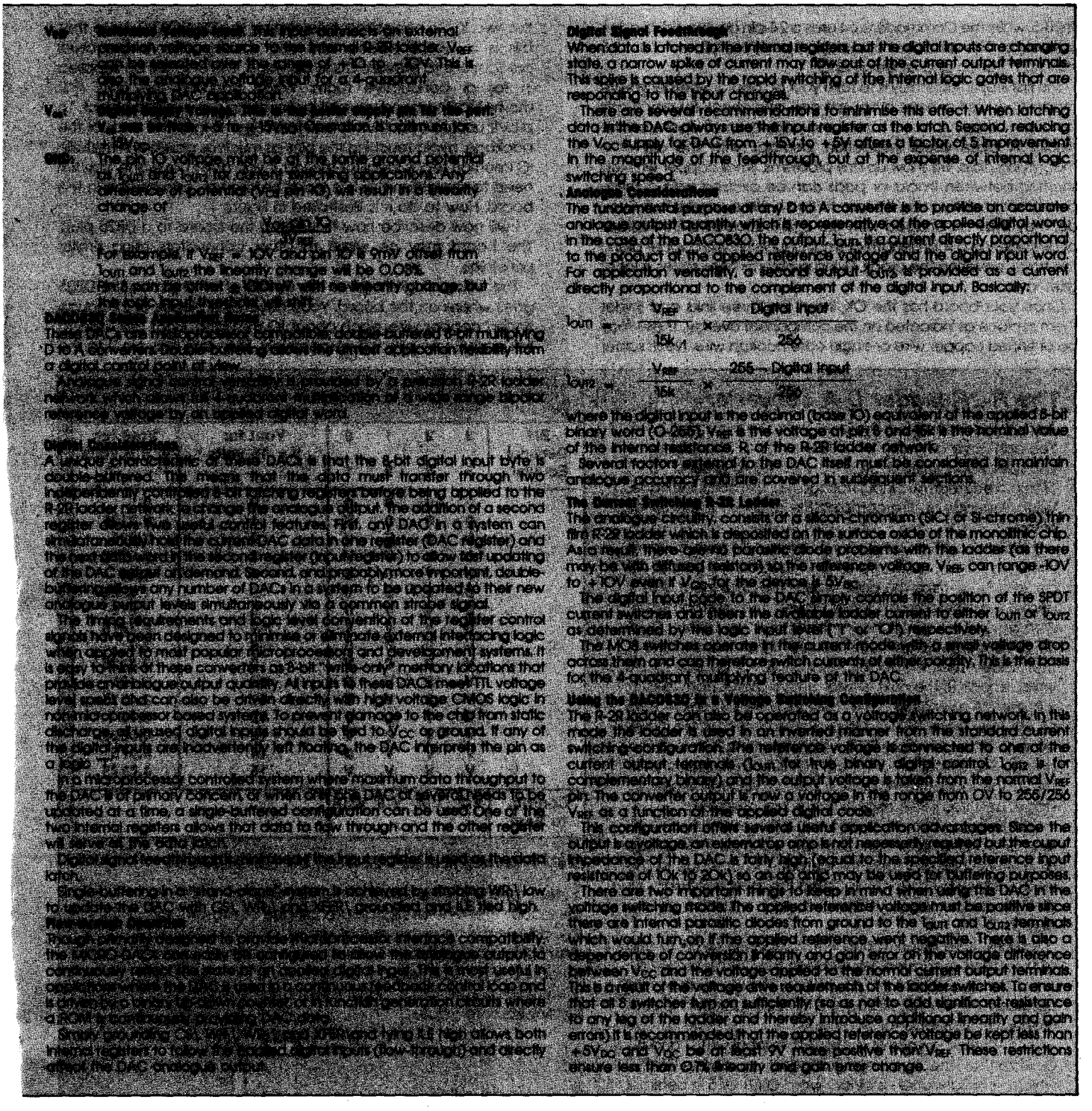
I_{OUT2}: DAC Current Output 2. I_{OUT2} is a constant minus I_{OUT1} + I_{OUT2} = constant (1 full scale for a fixed reference voltage).

R_{fb}: Feedback Resistor. The feedback resistor is provided on the IC chip for use as the drum feedback resistor for the external op amp which is used to provide an output voltage for the DAC. The on-chip resistor should always be used (not an external resistor) since it matches the resistors which are used in the on-chip R-2R ladder and tracks these resistors over temperature.

selecting resistors the best obtainable accuracy was no better than 0.2%. Not that that isn't a respectable figure, but it's a long way from the fundamental 0.05% accuracy of the DAC0830 and more expensive and fiddly to boot. The fundamental operation of an R-2R type D-A converter is explained in the accompanying panel.

The DAC0830 has a number of features that make it attractive. It can be directly interfaced to all popular microprocessors, according to National (see the accompanying Abbreviated Data Sheet); it requires only a single power supply of between five and 15 volts; it can be used in the voltage switching mode; it features flow through operation which allows the analogue output to continuously reflect the digital input in real time, and it's inexpensive – around $10-$11 at the time of writing. (The DAC0832 costs even less!)

To ensure compatibility with most computers it was elected to make the unit plug into a standard Centronics printer port. As a standard Centronics port has eight data lines, plus other control and handshake lines, it was found eminently suitable for the purpose. To provide the +5 V to power the project, two printer port output lines – Auto-Feed (pin 14) and Initialise Printer (pin 16) – were paralleled to provide the 1.2 ma required. These parallel port pins are generally asserted high by being hard-wired to the +5 V supply.



V_{REF}

Reference Voltage Input. This input connects to an external precision voltage source to the internal R-2R ladder. V_{REF} can be specified over the range of +10 to −10V. This is also the analogue voltage input for a 4-quadrant multiplying DAC application.

V_{CC}

Digital Supply Voltage. This is the power supply pin for the part. V_{CC} will operate in the +5V to +15V range. Operation is continuous for V_{CC} as low as +10V.

DGND

The pin 10 voltage must be at the same ground potential as I_{OUT} and I_{OUT2} for correct switching specifications. Any difference of potential (VDG pin 10) will result in a linearity change of

$$\frac{V_{DG} \times 0.1\%}{V_{REF}}$$

For example, if V_{REF} = 10V and pin 10 is 9mV offset from I_{OUT} and I_{OUT2} the linearity change will be 0.09%.

Pin 8 can be tied to DGND with no linearity change, but the logic input thresholds will shift.

Description

These DACs are microprocessor compatible double-buffered 8-bit multiplying D to A converters. Double buffering eases the interface application flexibility from a digital control point of view.

A unique analog multiplying capability is provided by an inverted R-2R ladder network which allows full 4-quadrant multiplication of a wide range bipolar reference voltage by an 8-bit digital word.

Digital Considerations

A unique characteristic of these DACs is that the 8-bit digital input byte is double-buffered. This means that the data must transfer through two independently controlled 8-bit latching registers before being applied to the R-2R ladder network to change the analogue output. The addition of a second register allows five useful control features. First, any DAC in a system can simultaneously hold the current DAC data in one register (DAC register) and the next data word in the second register (input register) to allow fast updating of the DAC output on demand. Second, and probably more important, double-buffering allows any number of DACs in a system to be updated to their new analogue output levels simultaneously via a common strobe signal.

The timing requirements and logic level convention of the register control signals have been designed to minimise or eliminate external interfacing logic when applied to most popular microprocessor and development systems. It is easy to think of these converters as 8-bit "write-only" memory locations that provide analogue output quantity. All inputs to these DACs meet TTL voltage level specs and can also be driven directly with high voltage CMOS logic in non-microprocessor based systems. To prevent damage to the chip from static discharge, all unused digital inputs should be tied to V_{CC} or ground. If any of the digital inputs are inadvertently left floating, the DAC interprets the pin as a logic "1".

In a microprocessor controlled system where maximum data throughput is the DAC's primary concern or when one of the DAC's several inputs is to be updated at a time, a single-buffered configuration can be used. One of the two internal registers allows that data to flow through and the other register will serve as the latch.

Digital signal level thresholds are set at the input register inputs and as the latch.

Single-buffering in an analog system is not forced by shorting WR1 low to update the DAC with CS, WR2, and XFER grounded and LE tied high.

Microprocessor Interfacing

Though primarily designed to provide microprocessor interface compatibility, the DAC0830 family can easily be configured to allow the analogue output to continuously follow the data on an applied digital input. This is most useful in applications where the DAC is used to control a servo-feedback control loop and is driven by a servo to digital converter or in function generation circuits where a ROM is continuously addressed to drive a DAC output.

Simply ground the CS, WR1, WR2, and XFER lines and tying ILE high allows both internal registers to follow the applied digital inputs (flow-through) and directly affect the DAC analogue output.

Digital Signal Feedthrough

When data is latched in the internal registers but the digital inputs are changing state, a narrow spike of current may flow out of the current output terminals. This spike is caused by the rapid switching of the internal logic gates that are responding to the input changes.

There are several recommendations to minimise this effect. When latching data in the DAC, always use the input register as the latch. Second, reducing the V_{CC} supply for DAC from +15V to +5V offers a factor of 5 improvement in the magnitude of the feedthrough, but at the expense of internal logic switching speed.

Analogue Considerations

The fundamental purpose of any D to A converter is to provide an accurate analogue output quantity which is representative of the applied digital word. In the case of the DAC0830, the output, I_{OUT}, is a current directly proportional to the product of the applied reference voltage and the digital input word. For application versatility, a second output, I_{OUT2}, is provided as a current directly proportional to the complement of the digital input. Basically:

$$I_{OUT} = \frac{V_{REF}}{15k} \times \frac{\text{Digital Input}}{256}$$

$$I_{OUT2} = \frac{V_{REF}}{15k} \times \frac{255 - \text{Digital Input}}{256}$$

where the digital input is the decimal (base 10) equivalent of the applied 8-bit binary word (0-255), V_{REF} is the voltage at pin 9 and 15k is the nominal value of the internal resistance, R, of the R-2R ladder network.

Several factors external to the DAC itself must be considered to maintain analogue accuracy and are covered in subsequent sections.

The Basic Switching R-2R Ladder

The analogue circuitry, consists of a silicon-chromium (SiCr or Si-chrome) thin film R-2R ladder which is deposited on the surface oxide of the monolithic chip. As a result there are no parasitic diode problems with the ladder (as there may be with diffused resistors) as the reference voltage, V_{REF}, can range -10V to +10V even if V_{CC} is at the device's +5V.

The digital input code to the DAC simply controls the position of the SPDT current switches and steers the available ladder current to either I_{OUT} or I_{OUT2} as determined by the logic input state ("1" or "0") respectively.

The MOS switches operate in the current mode with a small voltage drop across them and can therefore switch currents of either polarity. This is the basis for the 4-quadrant multiplying feature of the DAC.

Using the DAC0830 as a Voltage Switching Configuration

The R-2R ladder can also be operated as a voltage switching network. In this mode, the ladder is used in an inverted manner from the standard current switching configuration. The reference voltage is connected to one of the current output terminals (I_{OUT} for true binary digital control, I_{OUT2} for complementary binary) and the output voltage is taken from the normal V_{REF} pin. The converter output is now a voltage in the range from 0V to 256/256 V_{REF} as a function of the applied digital code.

This configuration offers several useful application advantages. Since the output is a voltage, an external op amp is not necessarily required but the output impedance of the DAC is fairly high (equal to the specified reference input resistance of 10k to 20k) so an op amp may be used for buffering purposes.

There are two important things to keep in mind when using this DAC in the voltage switching mode. The applied reference voltage must be positive since there are internal parasitic diodes from ground to the I_{OUT} and I_{OUT2} terminals which would turn on if the applied reference went negative. There is also a dependence of conversion linearity and gain error on the voltage difference between V_{CC} and the voltage applied to the normal current output terminals. This is a result of the voltage drive requirements of the ladder switches. To ensure that all 8 switches turn on sufficiently (so as not to add significant resistance to any leg of the ladder and thereby introduce additional linearity and gain errors) it is recommended that the applied reference voltage be kept less than +5V_{DC} and V_{CC} be at least 9V more positive than V_{REF}. These restrictions ensure less than 0.7% linearity and gain error change.

In this unit I am using the DACO830 in flow through mode, which I should explain a little more. In this mode of operation, any binary word that appears on the inputs results immediately in a corresponding voltage level on the output. It is, in essence, the simplest mode of operation. The DAC requires only the eight data input lines, a +5 V supply and ground to operate, thus allowing easy programming. You can program a waveform by simply having the output repetitively step through a series of predetermined binary values, for example. If you cycle the output word from decimal zero (O) to decimal 255, then start again at zero, the output will be a sawtooth waveform.

The design provides two outputs: one, a direct-coupled output for driving servo-type circuits, and a second ac-coupled output for applications requiring an audio signal output.

Building it

The project is assembled on a simple, small single-sided printed circuit board which has 13 connections consisting of eight data lines, printer ready, +5 V, ground, and the two outputs. I did not design the pc board to solder directly on the rear of a DB25 plug. Firstly, the CAD software package I used to design the board does not have available the correct spacing for a DB25 connector and, in any case, a number of popular computers do not use DB25 connectors for their parallel port. The Microbee, for example, uses

a DB15, while the Commodore 64 uses a 24-pin double-sided edge connector. The off-board connection pads are laid out on a 2.5 mm (0.1") pitch grid at each end.

The first step in assembly is to take your pc board, whether you've made it yourself or have a bought one, and check for any shorts between closely-spaced tracks and pads or small opens on the tracks. A close visual inspection, perhaps with the aid of a magnifying glass, will show up any problems. Small copper whiskers shorting between tracks or pads can be excised with a sharp penknife or hobby knife. It's rare to find hairline cracks, but if you do, they may be bridged with the application of a little solder, or by soldering a short length of small gauge tinned copper along the track, covering the crack. Fixing problems here saves a lot of grief later.

Once your board has the OK, insert the three links and solder them in place as indicated on the component overlay. These may be of tinned copper wire or single core hookup wire. Next, solder the two 100n capacitors followed by the DAC0830. Note that this is a CMOS device and you should observe the usual precautions to prevent static damage. The chip will be supplied in foil or conductive foam. When handling the chip, first momentarily ground yourself by touching a grounded object. To pick it up, use your thumb and forefinger to grip the ends of the package; avoid touching the pins as much as possible. A metallic IC insertion tool is ideal for the job. If you don't have one, you will need to straighten the IC's leads before you can insert it in the board. How to do it is illustrated in Figure 1.

I will now describe how to wire-up the board to a DB25 plug. The board may be wired to other connectors using similar principles.

The wiring diagram gives the details of what pin on the DB25 goes where on the board. You'll need nine pieces of 22 gauge tinned copper wire, each about 10 mm long. Eight are used to link pads E-L to pins 9-2, respectively. The ninth links pin 11 to the

The R-2R ladder D-A converter

An R-2R ladder network basically looks like the circuit here. You can have as many or as few rungs on the ladder as you wish, each input or bit is connected to ground (0 V) or to a predetermined input voltage (V). The output voltage, Vout, depends on the combination applied of this series of inputs.

Let's look at a four-bit ladder converter, to take a simple case, say all the inputs are at 0 V. Clearly, the output will be zero. Now, take the case where the bit 3 input is at V and all the others are at 0 V, or ground. The resistance from A to ground will be 2R. Now a third 2R resistor from bit 0 will be in parallel with the resistor of the bottom of the ladder. Their combined resistance will be half of 2R, which equals R. The next resistor above the bottom resistor is R, and it's in series with the resistance we just calculated, so we now have 2R. BIT 1 is grounded, so now we have, again, a 2R resistor (from BIT 2) in parallel with a 2R resistance, giving us a resistance of R from point B to ground and so on up the ladder to A. Draw it out for yourself, stage by stage, and you'll see exactly what I've described.

With V applied to BIT 3, we have a 2R resistor from BIT 3 to A and a 2R resistor from A to ground. Thus, the voltage at A will be half of V, and the output – Vout – due to the BIT 3 input will be V/2. BIT 3 is called the most significant bit (MSB) because, alone, it has the most influence on the output.

Similarly, if you work it out, with V applied to BIT 0 and all the others grounded, Vout due to the BIT 0 input will be found to be equal to V/16, and is known as the least significant bit (LSB). Likewise, for BIT 1, its contribution to Vout is equal to V/8, and for BIT 2, V/4.

So, if V were 16 volts and applied to inputs BIT 2 and BIT 0, while the other two were grounded, we'd have 0V0V, which is recognisable as binary word 0101, or 5 in decimal notation. The output, Vout would be 16/4 plus 16/16, or 4 plus 1, equals 5 – that is, 5 volts. If BIT 2 and BIT 1 had V applied, and the other two were grounded, we'd have 0VV0 (binary word 0110) and Vout would be 16/4 plus 16/8, or 4 + 2 = 6 volts.

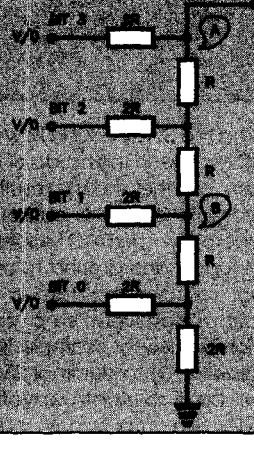
So, now you see that the R-2R ladder provides an output that is proportional to the digital value of the input. Table 1 illustrates how it works for V = 16 volts and V = 5 volts.

In practice, the ladder inputs are driven from digital switches or gates. The R-2R network may be arranged to provide a current output, point A in the circuit here being connected to a precision reference voltage and output

BIT Decimal Equival.	3 8	2 4	1 2	0 1	Vout for V = 16 volts	Vout for V = 5 volts
	0	0	0	0	0	0
	0	0	0	V	1	0.3125
	0	0	V	0	2	0.625
	0	0	V	V	3	0.9375
	0	V	0	0	4	1.25
	0	V	0	V	5	1.5625
	0	V	V	0	6	1.875
	0	V	V	V	7	2.1875
	V	0	0	0	8	2.5
	V	0	0	V	9	2.8125
	V	0	V	0	10	3.125
	V	0	V	V	11	3.4375
	V	V	0	0	12	3.75
	V	V	0	V	13	4.0625
	V	V	V	0	14	4.375
	V	V	V	V	15	4.6875
Contrib. to Vout	V/2	V/4	V/8	V/16		

TABLE 1. Showing how the R-2R ladder D-A converter works.

current taken from the lower end of the bottom resistor in the ladder. This type of digital-to-analogue converter has the advantage that the actual values of the individual resistors are unimportant, only their ratios matter. It is easier to fabricate an R-2R network on silicon in an IC chip and maintain accurate ratios than it is to fabricate resistors of highly accurate values.



A basic, 4-bit R-2R ladder circuit.

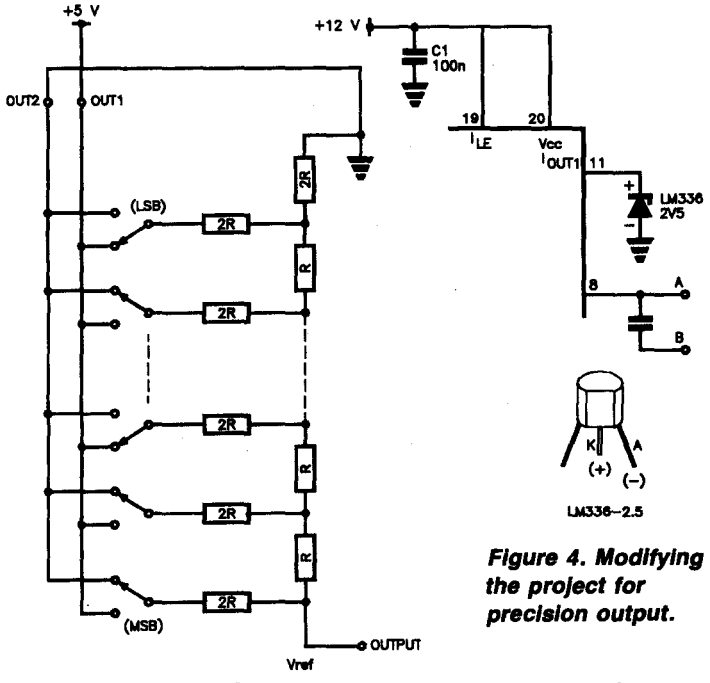


Figure 3. The DAC0830's D-A converter can be used in the voltage switching mode, as shown in this equivalent internal circuit.

Figure 4. Modifying the project for precision output.

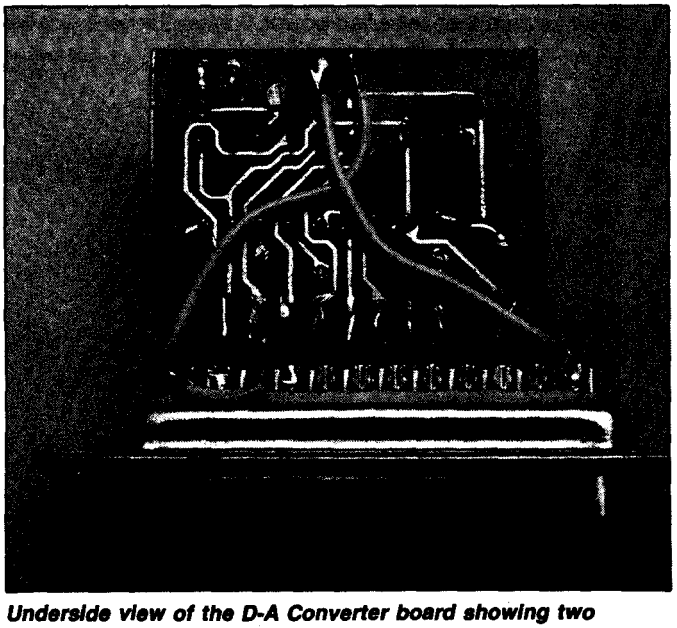
pad marked (C). Solder the links to the DB25 pins first, then solder the free ends to the appropriate pads on the board.

Pins 14 and 16 on the DB25 are linked with a short length of single core hookup wire. Then pin 14 is linked to D and pin 25 linked to C on the board, using 30 mm lengths of single core hookup wire.

Check out

Give the completed assembly a thorough visual inspection. Particularly look for small solder bridges between the IC pin pads. Check that D (+5 V) and C (gnd) are correctly wired to pins 14/16 and pin 25 of the DB25, respectively.

Now you can plug in your project, load up the diagnostic software and, by choosing the Sequential option (1), a slow ramp-up will be observed on the DAC output with a multimeter or CRO hooked to the DAC's dc output. After that, try the other options and see what you get.



Underside view of the D-A Converter board showing two connections to +5 V and ground.

```
5 CLS
10 PRINT "UNIVERSAL DAC TEST PROGRAM " :PRINT:PRINT
20 KEY (1) ON :ON KEY (1) GOSUB 240:PRINT"press F1 to end
function "
30 PRINT:PRINT
40 INPUT "Sequential (1), Toggle all (2), toggle 1 bit (3)
debug (4) range test (5)",T
50 IF T=2 THEN 130
60 IF T=3 THEN 180
65 IF T=4 THEN 300
66 IF T=5 THEN 1000
70 INPUT "speed ",Z
80 FOR A=1 TO 255
90 FOR B=1 TO Z:NEXT B
100 OUT &H378,A
110 NEXT A
120 GOTO 80
130 INPUT"speed",B
140 FOR A= 1 TO B:NEXT A
150 OUT &H378,255
160 FOR A=1 TO B:NEXT A
170 OUT &H378,0:GOTO 140
180 INPUT "speed ",S
190 INPUT "byte to toggle ",B
200 FOR A=1 TO S:NEXT A
210 OUT &H378,B
220 FOR A=1 TO S:NEXT A
230 OUT &H378,0:GOTO 200
240 GOTO 5
300 INPUT "byte to output ",B
310 OUT &H378,B
320 GOTO 300
1000 INPUT "Data output range low,high",L,H
1010 FOR A =L TO H
1020 LPRINT CHR$(A);
1030 NEXT A
1040 LPRINT
1050 GOTO 1010
```

Software listing

This program listing is a test routine for the ETI-1626 written in BASIC for an IBM-compatible computer. It can be readily adapted to other computers, providing you at least know how to address your computer's parallel output port (or user port).

This program features a number of facilities, asking for input and then providing the appropriate output according to what you select. For example, it provides a sequential binary count to the DAC, giving a sawtooth output; it can toggle all bits which switches the DAC output voltages from the maximum to the minimum; you can elect to toggle one bit at a time to check for missing bits caused through dry joints etc. It also features a debug mode where an O byte is alternately toggled with the selected byte.

The port is addressed through the PC's parallel printer port address of $378 (HEX) using the OUT instruction (see lines 100, 150, etc).

A machine code interface can likewise be used for high speed applications, or the use of LPRINT from within BASIC, or by copying data to LPT1: from DOS. Pin 11 of the interface ties Printer Ready to be permanently asserted.

Epilogue

With a little ingenious experimentation in programming, you will be able to produce all sorts of interesting outputs from the DAC board. You can write routines for programs to produce a certain waveform or output from the DAC from a given input; e.g: to produce a triangle wave after TRIANGLE is selected from a menu. Constructors who develop programs might like to submit them to ETI for publication, to share with other constructors.

Shortly before this article went to press, we learned that a US company, Covox, is marketing a low cost speech synthesiser software/hardware package that uses a simple hardware dongle to provide the audio output. This dongle is apparently a simple DAC. We're investigating the possibility of using this project with the speech synthesiser software, which is in fact the product of another US company.

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Centronics I/F

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READER INFO No. 65

Radio amateurs, CBers — build this ECONOMICAL SWR METER

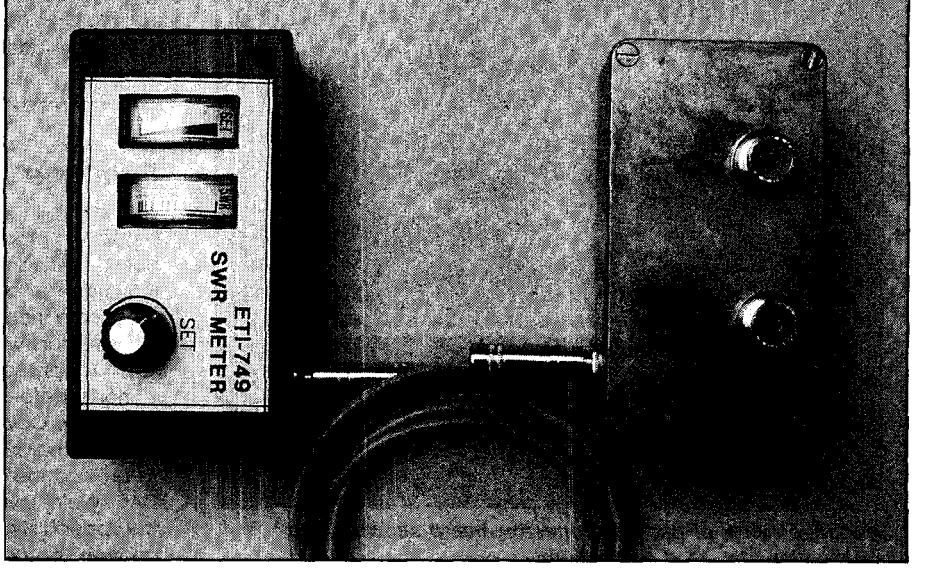
Boasting twin meter readout for ease of operation, this SWR meter project covers a wide frequency range, suits low to high power applications, is easy to build and easy on the pocket, says Roger Harrison VK2ZTB.

ELECTRONICS
E T I - 7 4 9

An SWR meter is the next basic test instrument any radio shack should have after a multimeter. For testing and setting up antennas and transmission lines, adjusting matching schemes or tuning-up an in-line tunable antenna matcher, the SWR meter is a virtually indispensable tool. Few other devices can match it for simplicity and functionality as it delivers direct readout of an important performance parameter in any transmitting system. And it can be used to show actual system performance under the applicable operating conditions.

Now, ETI has only ever published one SWR meter project, and that was a long time ago (and I was involved in *that* one, too). And, having recently described an RF Power Monitor (ETI-748, November 1989), I set myself the challenge of building a useful SWR meter for tolerably low cost while still maintaining useful performance, at least across the popular HF bands below 30 MHz. I wanted a versatile, reasonably rugged unit that could possibly be adapted to a variety of housing configurations. I figured other constructors would want to adapt it to suit their own preferences or applications. So much for the needs of the design. Now for the wants.

An SWR meter with one meter, which is switched alternately to read forward then reflected power, I always thought was like a



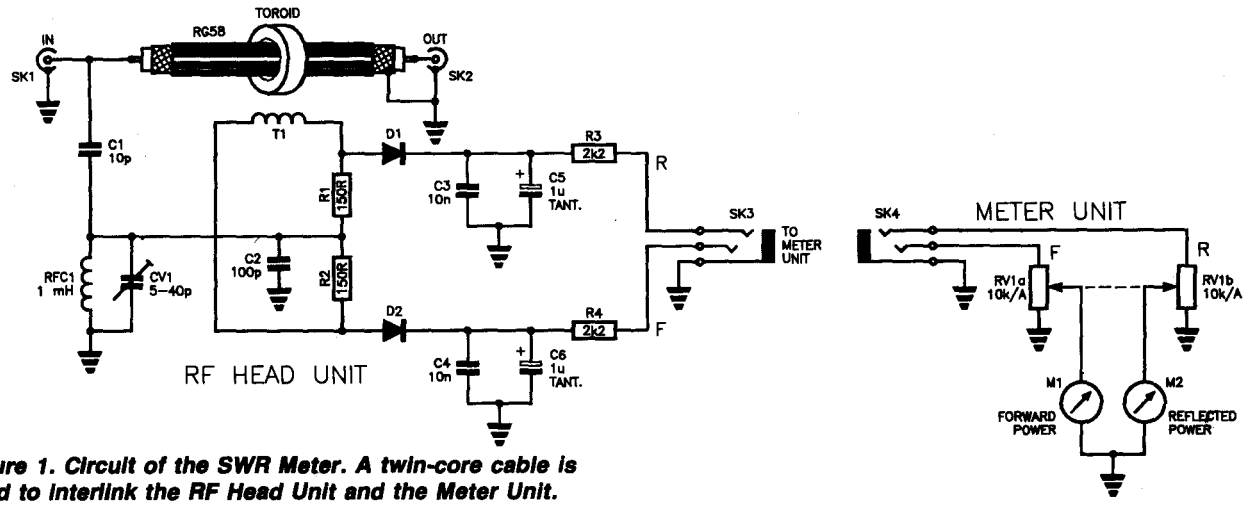


Figure 1. Circuit of the SWR Meter. A twin-core cable is used to interlink the RF Head Unit and the Meter Unit.

car with a 'left headlight/right headlight' switch. When making adjustments to an antenna or transmission line system, either by varying the antenna matching adjustment or tuning a matching unit, the forward power reading changes with each adjustment – as does the reflected power – and one is forced to switch backwards and forwards to ensure that a downward movement in the reflected reading is actually a reduction in the VSWR. This is because the forward reading is always adjusted to read full-scale by means of a 'calibrate' or 'set forward' control before taking a reflected power reading.

The solution to this dilemma is to have two meters to simultaneously show both forward and reflected power readings. Some commercial SWR instruments do just this, boasting two meters or a 'twin' meter movement with two pointers in the one housing. I have used such instruments and, indeed, I made one for myself many years ago as a recently-licensed amateur, pressing into service a twin-needle meter movement bought as a war surplus item.

Such twin-meter SWR instruments are not to be confused with so-called cross needle reflectometers. These have two meter movements positioned side by side in the same housing with the scales facing each other and the needles crossing in the area between. One meter displays forward power, the other reverse power. Where the needles cross is a vertical scale marked in SWR.

For clear reasons, twin-meter SWR instruments are generally more expensive than single-meter ones. Finding ways to overcome this, or at least minimise it, in a home constructed project, was the challenge I set myself. This project is the result.

Behind the design

Conventional, commonly available panel meters aren't exactly inexpensive items. You can build a 10-LED bargraph display for

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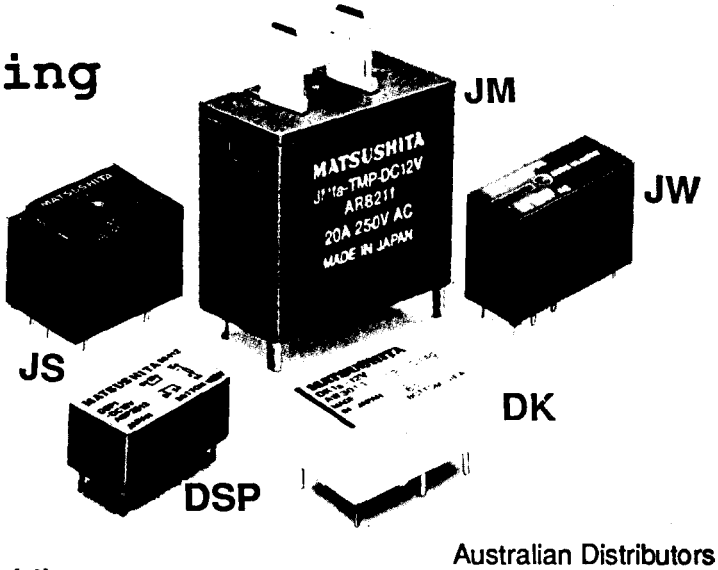

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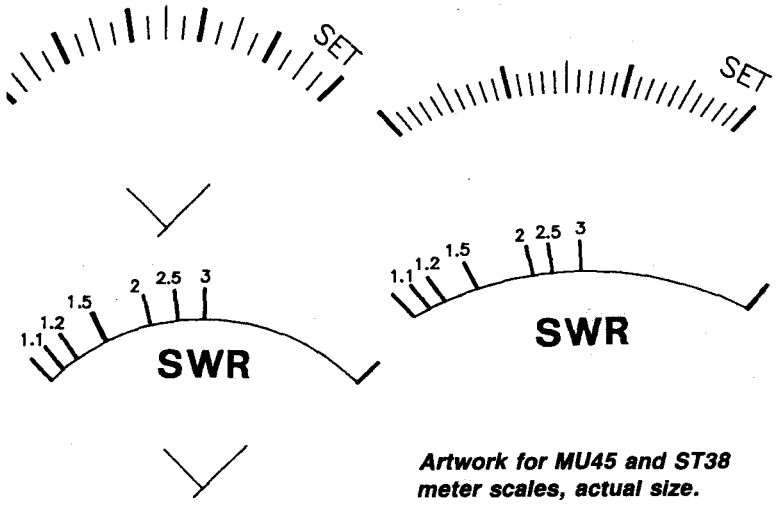
about the same cost as the common 45-52 mm scale moving coil panel meters like the MU45 or ST38. We need an analogue meter in order to track comparatively small analogue variations, so a bargraph display was out, for starters. But, not a great deal of accuracy is required so the accuracy of Class 2.5 (2.5% of FSD) meters (which the MU45, etc are) is not called for.

In regard to SWR accuracy, readings under 1.5:1 are largely academic anyway in most systems, unless you're looking to maintain close tolerance on impedances for a low noise amplifier – which is applicable to VHF/UHF systems; in any case that's out of our scope here. SWR readings of 3:1 or more show you have a bit of a problem, at least in coaxial cable transmission line systems. In general, you want to keep things below that. So, it turns out you need to read SWR at intervals of, say 0.5, from about 3:1 down to 1.5:1. Best reading accuracy, then, is represented by the difference between 2.5:1 and 3.0:1, or about 17%. Few meter movements are *that* bad, except down towards the zero end of the scale where the accuracy of all analogue is the worst.

Where to find a suitable panel meter? Well, a flick through a few retailers' catalogues turned up a couple of suitable candidates in the shape of small edge meters. These have a linear scale some 32 mm long by 10 mm wide that curves in an arc behind the needle which is bent at right angles over the scale. They mount in a rectangular cutout. I noted they presented the additional advantage of being able to mount as two side by side in much the same panel space as an MU45 or similar meter would take up. And, I could mount them vertically, which gives a more natural rise-and-fall type of readout. But the best part of all – two actually cost less than a single MU45 or similar panel meter!

The reflectometer circuitry – the bit that picks off the forward and reflected power on the transmission line – employs a technique, used in the earlier ETI project, first described in the 'popular' technical literature by P.G. Martin back in 1972 (see the Bibliography at the end of this article). It's quite a cunning method, simple and easy to reproduce. It works over a very wide frequency range and can be used equally well at very low powers, like below one watt, as it can at quite high powers, like a few hundred watts.

Figure 1 shows the complete circuit of the project. In use, the instrument is inserted in the line, SK1 being connected to the transmitter end, SK2 to the antenna end so that the transmitted signal passes from left to right in the circuit. A current transformer is constructed by passing a short length of coax transmission line between SK1 and SK2, through the centre of a toroid on which is wound a coil. This piece of transmission line has the outer shield connected *only at one end* so that it acts as an electrostatic shield for the short length of inner conductor passing through the toroid's centre so that only the magnetic field from the signal current in the line couples to the toroid.



Artwork for MU45 and ST38 meter scales, actual size.

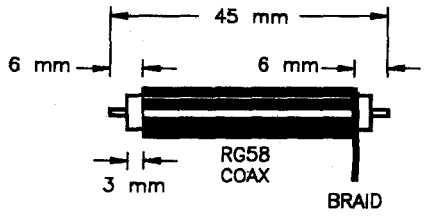


Figure 2. How to cut and strip back the short length of RG58 used for the current transformer part of the circuit.

The winding on the toroid (T1), acts as the transformer secondary, then develops a voltage across its ends proportional to the signal in the line. This winding drives a centre-tapped load – resistors R1 and R2 – developing voltages that are 180 degrees out of phase. The centre-tap of R1-R2 is connected to an RF voltage divider sampling network comprising C1 and C2-CV1 connected across the RF input (SK1). The sum and difference of the forward and reflected RF currents induced in the current transformer will thus appear across R1 and R2 and so we can derive the forward and reflected signals to be displayed on the meters.

Diodes D1 and D2 rectify the signals appearing across R1 and R2, charging C3-C5 and C4-C6, respectively. The 10n capacitors provide RF bypassing at the higher frequencies, the two tantalums provide RF bypassing at the lower end of the spectrum and smooth out modulation (audio) on the rectified signals. The RF choke, RFC1, provides a dc return path for the two rectifiers. It presents a low dc resistance but a high RF impedance so as not to 'short out' the capacitive RF voltage divider.

In a single-meter SWR instrument, the meter is connected via a pot, switched between the outputs of the two rectifiers. Here, I've used a ganged (stereo) pot.

I decided to mount the reflectometer section in a separate case to the metering circuitry. I did this for the sake of convenience for I've found, from experience, that the reflectometer cannot always be conveniently located near where you need to see the meters. Separating the reflectometer, by building it into an RF Head Unit, from the meters – which are housed in a Meter Unit – makes for a flexible, convenient arrangement. Only dc is passed from the RF Head Unit to the Meter Unit and I linked the two using 6 mm stereo jacks and a length of twin shielded cable. The shield provides dc return via circuit common and obviates RF pickup on the interlinking lines.

The toroid is an Amidon type, obtained from Stewart Electronic Components in Melbourne. Either of two types may be used – the T50-2 or T50-6. These are iron powder cores, measuring 12.7 mm outside diameter, 7.7 mm inside diameter and 4.83 mm thick. Being conductive, they are coated in a lacquer. The 50 in the part number is a size code, the 2 and 6 are 'mix' codes. The '2' mix is suited for the 1-30 MHz range, while the '6' mix is suited to the 2-50 MHz range. The choice is up to you. The T50-2 is colour-coded with red paint, while the T50-6 is colour-coded with yellow paint. The inside diameter of 7.7 mm ensures the core will slip over a piece of RG58, which is used for the RF current transformer 'primary'. For more details and data on toroids, see the article by John Day VK3ZJF, listed in the Bibliography.

Finally, a little word on the choice of diodes for D1-D2. The Parts List puts the OA47 first. Particularly for low power applications, this is the preferred type because it has a forward voltage of 0.45 volts, compared to 1-1.9 volts for the OA90-series. HP 5082-2800 hot carrier diodes actually have slightly lower forward voltage than the OA47, but they also cost many times more. Their cost is hardly warranted and their legendary bandwidth would be wasted.

Metering

The two meters have new scales affixed. The forward power meter is marked 'SET' as the SET control is adjusted so that this meter always reads full-scale in use. The reflected power meter is marked 'SWR' and the scale is calibrated at 1.1, 1.2, 1.5, 2.0, 2.5 and 3.0. Table 1 here lists meter reading versus SWR.

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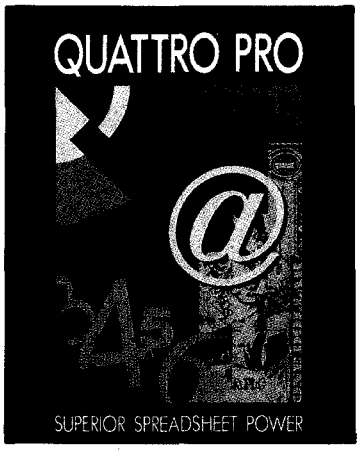
1989's STAR PRODUCTS

THAT WAS THE YEAR THAT WAS

Kester Cranswick continues his survey on what made the headlines last year. This month he takes a look at the big news in software and hardware developments.



Quattro Pro from Borland — a quick response to the 1-2-3.

Of the 1980s will be remembered for one thing, it will be the advent of the personal computer. And, as we party into the next decade, we will look back on the last year as being that in which the PC shook off any lingering toy computer image.

When **IBM** launched the PC back in 1983, it started a revolution that has shaken the industry to the core. It has given the computer a place on every desk and threatened the profits of every mainframe and minicomputer vendor. It has also seen the rise of new players, such as **Compaq, NEC, Zenith** and **Amstrad**.

1989 has been dominated by dramatic increases in the power of PCs, by rampant price discounting and by hotly debated arguments about the PC architecture of the future.

During the year, just about every PC vendor dropped its prices, by 20 per cent or more. **IBM, Compaq, NEC, Olivetti, Hewlett-Packard** and **Toshiba** all slashed the prices of their PCs. At the same time, the market realised that the AT-compatible was really the bottom line of PC power and turned that class of PC into the standard.

That was against a background of heavy discounting by many retailers, trying to cash in on the continuing buoyancy of the PC market.

For a while, it looked like vendor price cuts would replace the heavy discounts, resulting in lower street prices in non-discounting outlets, but little change in discount shops. But discount dealers used vendor cuts to reduce their prices even more.

The cuts were the sign of a rapidly maturing market where vendors came to believe price was a major factor.

However, it became apparent that few vendors or dealers were making money in the cut and thrust of the PC market. There were a number that didn't make it through the year. **President** and **Silicon City** were the two notable losers. The customer, of course, only benefitted from the price wars.

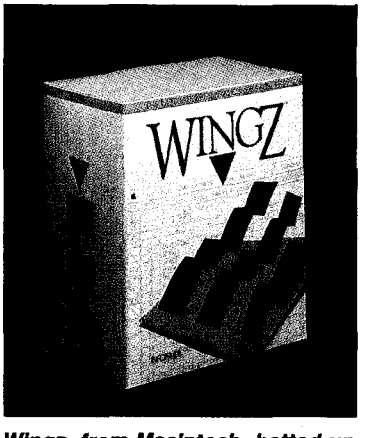
1989 was also the year of power platforms. It started with a race to introduce the first PC powered by a 33Mz 386 processor. **Zenith** won the race, with its **Z-386/33** computer, a desktop PC with a claimed 25 per cent performance edge over the 25MHz version. It used a 16-layer cache memory system which could be upgraded from 16Kbyte to 256Kbyte. Each layer of the cache could hold as much data as a single cache in rival PCs.

Standard RAM came at 2Mbyte of 15ns memory, upgradable to 32Mbyte on board and 64Mbyte with an expansion card. Data storage options were based around a 10Mbyte/sec ESDI controller with 1:1 disk interleave. There were four drive compartments, one occupied by a 1.44Mbyte 3.5in drive.

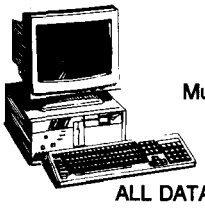
Two hard disk options were launched – 150Mbyte and 320Mbyte, with the 150Mbyte-equipped machine costing under $20,000.

Zenith was followed by just about every other PC maker bringing out a 33MHz 386 PC. There were new processor upgrades, new boards, new architectures – suddenly 1988's best seemed slow.

But the 33MHz PC was overshadowed mid-year by a dramatic new development, the **Intel 486** chip. It embodied a 33MHz processor, a maths coprocessor, a cache and more on a single chip. Despite a few



Wingz, from Macintosh, hotted up the spreadsheet war.



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teething troubles, the chip made it to market barely months later and turned the PC into a fully fledged minicomputer. **Apricot** was the first company to announce a PC using the new powerhouse. Apricot's **VX FTserver** range of Intel-architectured microcomputers marked probably the biggest challenge yet to the established players in the minicomputer marketplace.

Two levels

There were two levels to the VX range. The 400 models were designed as PC network servers and came with 4Mbyte RAM as standard. They were designed to run Novell or LAN Manager networks.

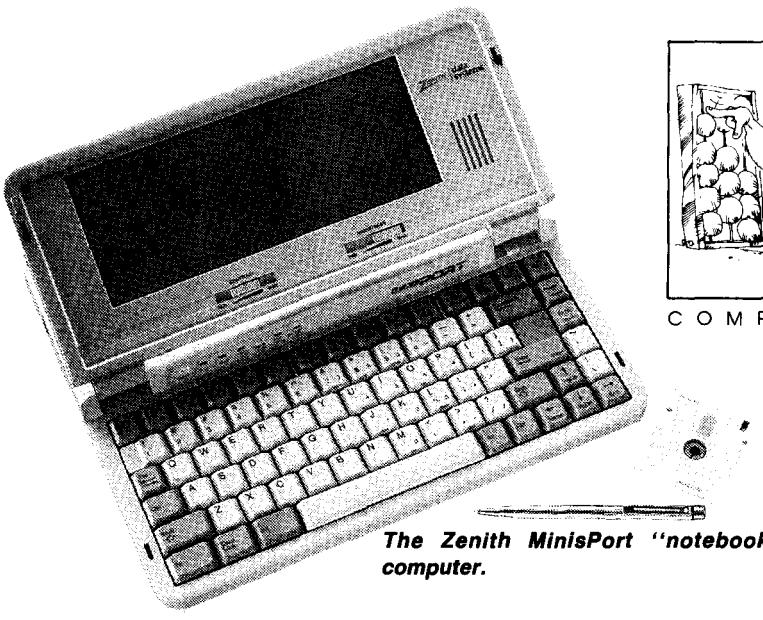
The 800 range was aimed at the **Unix** market and had 8Mbyte or 18Mbyte RAM as standard. The Unix machines also came with serial channels for the connection of terminals and could run SCO Unix V/386. Within each range there were four models, the /10, /30, /60 and /90. The /10 model was the least powerful, running at 6 mips, 25MHz 386 CPU. The other three models had the 15 mips 486 processor, running at 25MHz.

The /30, /60 and /90 machines were distinguished by their drive capacity. The /30 had a 347Mbyte drive, the /60 had a 647Mbyte hard disk, while the top of the line /90 had a 1047Mbyte hard disk.

IBM was a surprisingly early player in the 486 game, with an MCA motherboard upgrade using the 486 chip. Called the **PS/2 486/25 Power Platform**, the 25MHz 486 board simply replaced the Model 70's 25MHz 386 board. With a $6200 recommended price, it had 8Kbyte of internal memory caching and a built in floating point maths coprocessor. It could run all MS-DOS and OS/2 applications.

IBM claimed a machine fitted with the Power Platform would deliver twice the performance of a 33MHz 386 micro with maths coprocessor. Compared to the existing Model 70 processor, IBM claimed three times the performance in numerically-intensive tasks and 80 per cent more grunt for normal business applications.

AST Research just beat IBM to the market with its i486-based accelerator board, which boasted more features than Big Blue. For users of AST's 33MHz 386 machine, there was the **Fastboard 486/33**, using the 33MHz version of the Intel chip. AST was quick to claim that IBM's announcement did not feature a 33MHz chip.



COMPUTING

The Zenith MinisPort "notebook" portable computer.

The **Fastboard 486/25** was a 25MHz accelerator board, designed to replace the CPU board in AST's current 25MHz 386 PC. All AST 386 PCs are designed with the CPU fitted on a separate board that fits into an AST proprietary 32-bit slot. This new found PC power demanded new architectures. The day of the 16-bit PC is coming to an end, particularly at the top end of the market.

IBM's Microchannel Architecture is already well established. During the year other vendors joined the MCA bandwagon, offering more bang for less bucks. The list includes **Olivetti, Mitac, ALR, Tandy, Apricot** and **Wang**.

The rival EISA architecture was talked about during the year, but no product was shipped. It seems that the merits of EISA will have to wait until 1990 to be judged. As for the user, the debate is merely of academic interest.

IBM did boost the MCA line, with the **Model 55** attracting mid-range sales and the **Model P70** acting as IBM's re-entry into the portable computer market. But the biggest news in portability was the launch of the long awaited **Macintosh** laptop in September.

Twice the power

In keeping with the **Apple** version, the **Macintosh Portable** was a battery powered laptop with twice the power of a Macintosh SE. Cursor control was through a built-in trackball, or an external mouse. The display was a 640 x 400 pixel LCD affair, bigger than a standard Macintosh display. The processor was a 16MHz **Motorola CMOS 68000**, drawing on 1Mbyte RAM. Seven ports provided interfaces for hard disks, printer displays and network connections. Inside, there was room for a modem and one expansion card. For storage there was a 1.44Mbyte SuperDrive, able to read 3.5 inch MS-DOS diskettes. A 40Mbyte hard disk was an optional extra.

Apple claimed the built-in lead acid batteries would run the Portable for 12 hours, thanks to a dedicated processor that can slow the CPU to 1MHz or cut power to most components, such as the stereo sound system. The new laptop had a hefty price though. A floppy disked Portable cost $9950. With hard disk, the price leapt to $11,450.

For **Macintosh** users after power rather than portability, **Apple** also had some good news, in the shape of the **IICX**. Launched earlier in the year, it took the features of the **Macintosh IIx** and packed them into a smaller box. It proved an immediate hit.

Apple also launched the **IICI**, with a faster, 25MHz 68030 processor and 68882 cop processor that delivered up to 45 per cent more power. Pricing for the IICI starts at $9950. A model with 4Mbyte RAM and 80Mbyte hard disk costs $13,950.

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That was the year that was

There were exciting developments at the portable end of the market, with the trend inevitably towards more power in a smaller box. **Zenith** really broke the mould with its **MinisPort,** which it claimed as the first notebook computer in the Australian market.

The **MinisPort** was an 8MHz XT compatible with a subset of MS-DOS 3.3 on ROM and a number of novel features. The most innovative was the disk drive – a removable two inch, 720Kbyte disk. Users worried about compatibility problems could use a cable and file transfer utility called **FastLynx LX** supplied as standard, or a port for an external 3.5 inch or 5.25 inch drive.

Another innovation was the display – a backlit, 80 column, 25 line, LCD unit trademarked DayBright. It had a mirrored surface within it that reflected ambient light for better visibility. The clamshell-styled MinisPort measured 315 x 250 x 330mm and weighed a modest 2.7kg. A removable battery pack powered it for three hours away from the mains and a 1Mbyte model version cost just on $3000. That was hardware for 1989 – smaller, faster, cheaper and, as ever, not short of headlines.

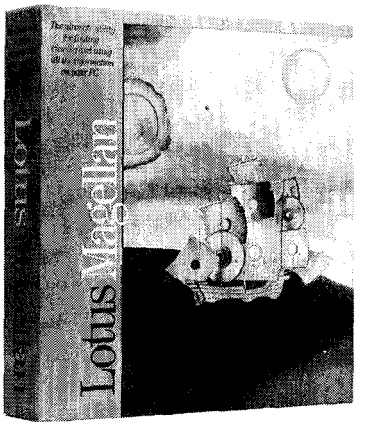
Constant chorus

While hardware raced out the door faster than Vo Rogue out of the starting gate, there was a constant chorus in the background demanding to know where the software was.

The advent of 32-bit computers, in theory, has opened the way for a new generation of software, able to take advantage of the multi-processing, multi-tasking capabilities of the new chips. Unfortunately, the software for this is only trickling out.

The key to success lies in the acceptance of OS/2 as the dominant operating system. By year end, OS/2 was the second best selling operating system, behind MS-DOS, and while there was a book of applications running under the new operating system, finding them in the shops made looking for a needle in a haystack seem easy.

There was plenty of noise from the **Unix** camp, but so far Unix has not moved into the territory currently occupied by MS-DOS. **OS/2! Version 1.2,** in both standard and extended editions, was announced early



Lotus' Magellan made a big splash.

in the year, with the standard edition delivered by year end. Enhancements to Version 1.2 were mainly in the **Presentation Manager** area, with improved mouse support and greater use of icons. It had a new system editor, with a Presentation Manager interface similar to the **Microsoft Windows Notepad**, a PostScript device driver and the ability to boot to DOS or OS/2.

Other improvements were a larger address space for the DOS compatibility box and ability to start DOS applications directly from the shell. Meanwhile, the latest version of MS-DOS kept most users happy, providing they could install it successfully. MS-DOS 4.01 offered a more user friendly interface, complete with application lists and pull-down menus. Version 4.01 was the response to reported bugs in version 4.0.

Halfway house

The halfway house between MS-DOS and OS/2, **Windows,** saw the most activity during the year, as vendors realised that OS/2 would not happen overnight and that Windows offered genuine advantages users were prepared to pay for. The number of Windows applications therefore increased steadily as the year wore on. There was also a corresponding growth in utilities that provided a better way of dealing with the ever increasing number of files on hard disks.

Lotus made the biggest splash when it launched a new $295 utility called **Magellan.** It had the ability to search megabyte after megabyte of hard disk for a given word or phrase of a file. The claimed overhead to store indexing data was five per cent of disk space.

Magellan also offered a file view facility, so that files from any DOS applications could be displayed in their native format, with switching between files of different formats at the press of a key. And, once a file was found, Magellan could launch into the relevant application, returning to Magellan when the application was terminated. File formats supported includes Lotus, WordPerfect, DisplayWrite, dBase, MS Word, Wordstar, Multimate and ASCII.

Lotus scored easily the biggest news of the year with its long delayed launch of the next version of the famous **1-2-3** spreadsheet. The company gave up trying to fit all the functions users wanted into a program small enough for a PC/XT compatible and ended up launching two versions of the product – **Release 3** and the smaller **Release 2.2.**

Release 3 incorporated a three-dimensional spreadsheet feature, presentation graphics, a relational database and a new file format, .WK3. Running under both MS-DOS and OS/2, Release 3 needed a minimum machine specification of 80286 CPU with 1Mbyte RAM and a hard disk. The list of improvements was impressive. Release 3 could store multiple files in memory, with up to 256 worksheets per file. Formulae could automatically update linked files, even if they were not resident in memory. There was an undo function, a search and replace facility, 26 new macro names and several new functions.

On the display side, three worksheets or files could be displayed as stacked windows and there was a zoom facility to enlarge the display. There were better graphics facilities too. Graphs could be updated automatically as data changed, charted from multiple spreadsheets and there were six new graph types. Eight fonts, nine text sizes and different colours or patterns could be used on each chart. PostScript was supported and text and graphics could be mixed on the same page.

Lotus 1-2-3 Release 3 could also be linked to external databases through a Lotus invention called a Blueprint driver. A driver to link to dBase III was included with the new release.

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Release 2.2 embodied some of the Release 3 features, such as undo, minimal recalculation mode, file linking, search and replace, date and time display, new macro commands, plus all the functionality of the add-in Allways. It could run in as little as 384Kbyte RAM, so was suitable for PC and XT micros.

A quick response to the new 1-2-3 came from **Borland**, when it launched **Quattro Professional 2.0**. Unlike 1-2-3, **Quattro Pro** could run in just 512Kbyte of memory. Using something called Virtual, Real Time, Object Oriented Memory Management, or VROOM, it loaded code in and out of memory as needed.

The new spreadsheet also featured network and mouse support, 10 types of graphs, draw, WYSIWYG and slide show facilities, annotation and supported Bitstream fonts. It supported up to 32 windowed spreadsheets in memory and hot links to another 32 spreadsheets on disk. There was a Lotus command interface for 1-2-3 users to start with, compatibility with 1-2-3 files and macros and links to databases such as Paradox and dBase.

The **Macintosh** spreadsheet war hotted up with the arrival of **Wingz** on the scene. With a $699 price tag, it was billed as the first graphics spreadsheet for the Macintosh, with features such as 3-D graphics, basic word processing, colour and a programming language called HyperScript. Wingz hoped to attract buyers on the strength of having the largest spreadsheet area (32,768 x 32,768 cells), the most colours and fonts on screen at one time (256), the most chart types (21), the most built-in functions (over 180) and the most database sort levels (256).

Database news was dominated by the emergence of **SQL** in the PC arena. SQL is a database query standard for anything from a micro to a mainframe. Networks of PCs will use SQL servers to access data resident on almost any connected database. It is an exciting development and 1989 saw the release of the first SQL servers, with a combined effort from **Microsoft** and **Ashton-Tate** leading the way.

Ashton-Tate was still having problems with **dBase IV** and announced that it would follow Lotus' example next year by releasing two versions of dBase IV, one for power PC users, the other for the rest of us.

On the word processing front, things were comparatively quiet. **Microsoft** delivered **Word 5.0** to Australian OS/2 and MS-DOS users in mid-March at a price of $695.

Improvements over the previous version were in the areas of spell checking, where suggested spellings were displayed on screen with fonts displayed in colour, actual size, and screen updating. Macro commands were enhanced, mouse support was built-in and extended memory was supported.

Links to graphics programs were improved too. Users could import images from spreadsheets, graphics programs or screen capture utilities, size them, scale them and add text in any of six locations. Over 200 printer drivers were supplied and PostScript support was enhanced to cope with two to 126 point sizes.

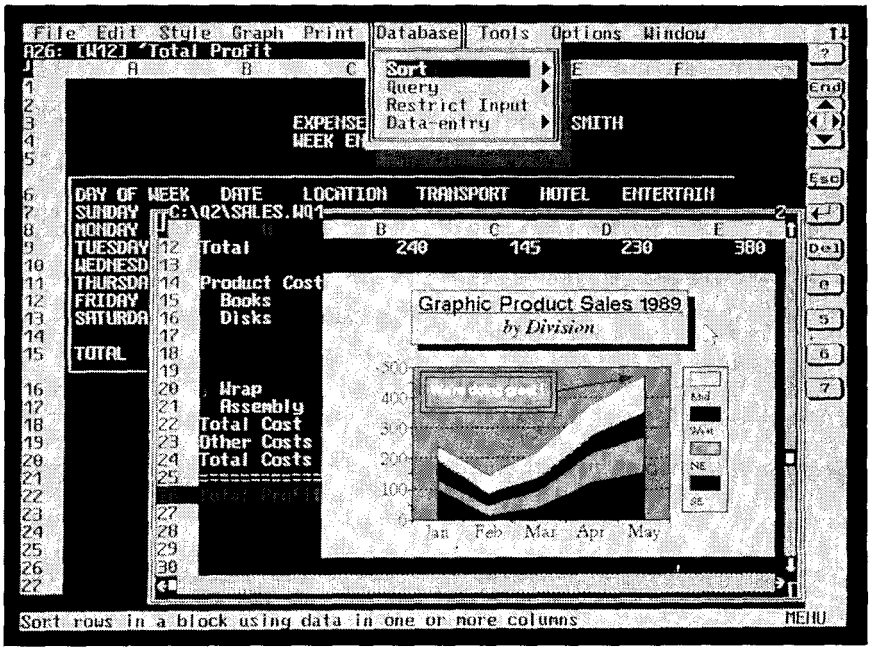
Microsoft also launched version **4.0** of **Word** for the Macintosh. There was also more progress in the field of document processing, with expensive packages such as **ViewStar** lauched. They were able to manage entire documents, including graphics, on a network. In contrast, desktop publishing had a relatively quiet year, highlighted mainly by word processors able to do as much in that field as most users wanted.

Perhaps the boldest software statement of the year came from **IBM** when it released details of a grand plan called **OfficeVision**, built for the SAA, (System Application Architecture) environment. Users will need to be patient though. IBM's promise will not be fully deliverable until the end of next year; much of the talk was visionary hype.

OfficeVision is a set of OA tools that span OS/2, AS/400, VM and MVS environments. They will have a consistent graphical interface and allow easy interchanging of data between different SAA platforms. OfficeVision will eventually incorporate functions such as composite document processing, filing, electronic mail, scheduling and decision support. Users will be able to perform several different tasks at once by simply pointing at screen icons such as filing cabinets and documents.

Developers such as **Lotus, Microsoft, Integral Systems** and **McCormack & Dodge** all pledged applications that would operate links to OfficeVision.

Other companies tried hard in the office automation area. **WordPerfect** announced **OfficePerfect**, a networked package that knitted together word processing, scheduling and other tasks. **Hewlett-Packard** also made a noise about **New Wave**, its software environment that links tasks to application in a user friendly fashion. Certainly if the promises of OfficeVision, SQL servers and New Wave are fulfilled, business software will take a giant stride forward in the next decade. **eti**



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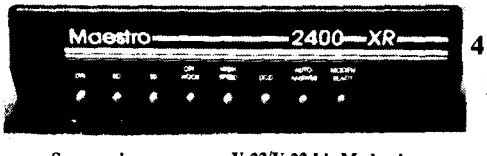

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CAD FOR THE MASSES?

COMPUTING

Jamye Harrison reviews a recent release aimed at the lower-cost end of the market.

CADD is yet another product released in the United States under the Generic label. It was recently released here and is distributed in Australia by AutoDESK Australia, well known for the AutoCAD range of software. The product is obviously targeted at, and unashamedly marketed for, the low-end CAD market.

While there is a plethora of good, highly sophisticated CAD packages around, with highly sophisticated prices, the low-end market has been pretty much neglected until six months ago. It seems Generic CADD in Australia, while it didn't get in at the ground floor (perhaps the first or second), is set to take the market by storm.

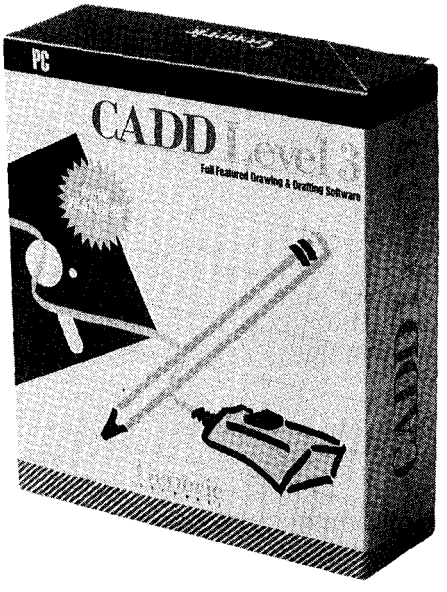
One of the first features which impressed me is the package's presentation. Contained in one brightly coloured box was one manual in a ringbinder, five disks and one 'symbols sample disk'. A far cry from the likes of, say, AutoCAD – 10 disks, about four manuals and a hefty box.

The manual is typically American, although extremely well organised. A particularly striking aspect is the inevitable "About this Manual" section. While others drone on with a lengthy preamble extolling the virtues of their not-so-brilliant manual, Generic CADD gets straight to the point. One paragraph explaining the contents and point behind each chapter, with one paragraph devoted to chapters six through 25, is all that is given – and needed.

"What is CAD, anyway" makes for interesting, if not necessary, reading for most beginners. It describes the main features of most CAD systems and their benefits in the real world.

"About Generic CADD" explains exactly that. The Generic CADD family is actually made up of three separate modules , Level 1, Level 2 and Level 3; much like AutoCAD's ADE-1, ADE-2 and ADE-3 extensions. The package we were given to review was Generic CADD Level 3.

The minimum hardware configuration is: IBM PC/XT/AT, 512K RAM, two floppy disk drives, and a video display adaptor capable of operating in a resolution of at least 640 x 200. Of course, your experience will be considerably enhanced by the addition of a serial port or two, a



mouse or digitiser, a plotter and maybe even a maths co-processor. Just like any application in the world of computing, cars, houses, boats etc, more money buys you more power and luxury. Expanded memory, using the Lotus/Intel/Microsoft standard is also supported.

Installation and configuration

Installation of Generic CADD is an automated process, and a fairly painless operation for even the most novice user. What's more, the manual, especially in potentially confusing areas – like working with DOS – assumes no user knowledge and is quite explicit.

The configuration of the program is a little more tricky, although not by much. This is where you inform the program as to the setup of your computer system. To configure the program just type 1 then <ENTER> and select a graphics adaptor; 2 then <ENTER> allows you to select a pointing device; 3 then <ENTER> is for selecting the plotting device. The ports these devices are connected to are selected at this stage too.

For those who have trouble interfacing their equipment to the computer for use with Generic CADD Level 3, the manual has a listing of the various peripherals and the necessary setup arrangement for them – supplying, where possible, any DIP switch settings and cabling details.

This basic set of configuration options can get the user up and going with Generic CADD. However, there are a number of other parameters which can be defined although they're too numerous to go into here. Basically they are settings to alter the measurement units of the program, colours, etc.

The program itself

Any program of this genre is too complex to completely explain in the scope of a review like this. Apart from giving my opinion as to the general working of the program and its ease of use, I will highlight a few of the more distinctive commands.

On-screen, the program presents the user with a divided working area, the largest area, of course, being the drawing area, where you see the results of your actions. Down at the bottom of the screen can be found a small area containing a prompt. This is where your commands appear and you are prompted for information from time to time. On the right hand side of the screen is the menu area. The user can select items from this area using the keyboard or the pointing device.

While Generic CADD is provided with a standard menu system, the capacity is there for the user to design his own menu system, perhaps more sympathetic to the use the program is put to. However, the menus as they stand are certainly helpful for the beginner, and, depending on your keyboard skills, faster to get around with.

If you choose not to use the menus, commands are entered in the prompt area using two-letter mnemonic codes. Even considering the simplicity of the program, the use of mnemonic codes I found to be annoying. For most people, except those with a penchant for programming in machine language, they are not as natural as we would like and I found myself using the menu system more than anything.

I know that when I am using AutoCAD I most often type in the full word command rather than use the menu system I set up. This is because after a period of using the

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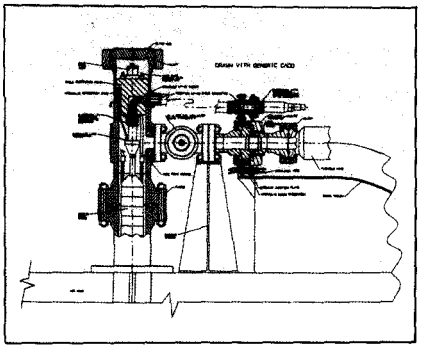

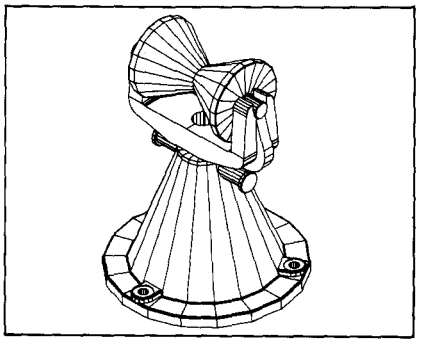

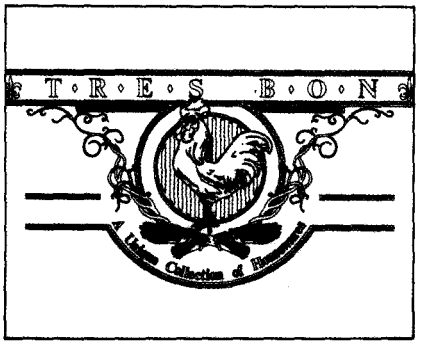

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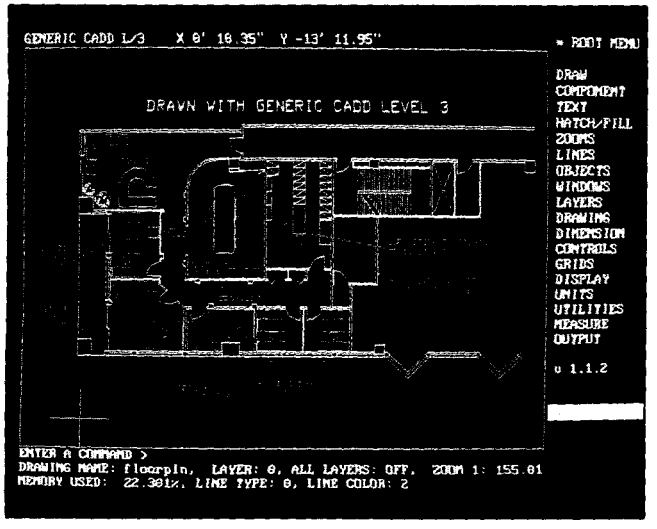
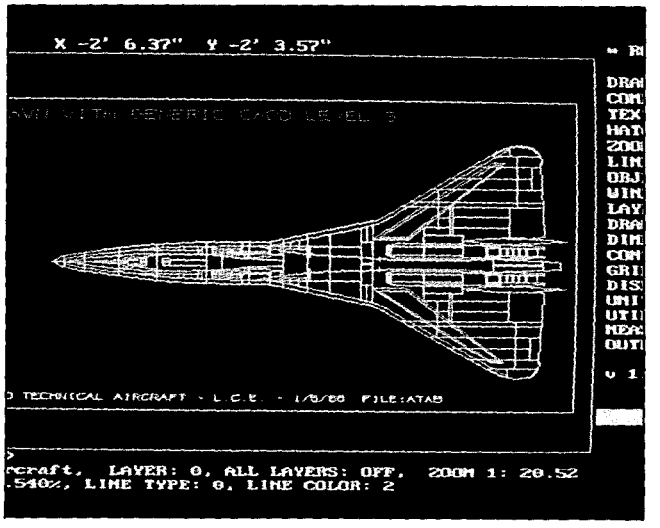




program, each command, like the word ZOOM, becomes a set pattern, rather than a string of letters stuck together. Thus, I found it's usually faster for me to use the keyboard than point at menu items with the mouse. Also, by using the keyboard commands, my hand-eye co-ordination is not divided between the tasks of constructing the drawing and selecting items from the menu; this helps to keep your mind focused on the drawing at hand, rather than swapping between the menu area and the screen area.

At the top of the screen is a set of X,Y co-ordinates (these can be disabled from the configuration menu). These give the location of the crosshairs on the drawing.

Like most popular CAD packages, Generic CADD is object oriented. That is, each item, or construction, in your drawing is thought of as an object. For instance, the program treats each line you draw as separate to each other, each circle, arc, and curve. This is as opposed to programs like PC Paint where the drawing is organised as a series of pixels arranged in the shapes of the objects you've drawn.

One command which strikes me as particularly useful is the DOUBLE LINE command. This can be selected from a menu or entered as its two-character code, L2.

Basically its operation is the same as the line command, where, after invoking the command you simply point to the beginning and end point of one, or a series, of lines. The difference when using the DOUBLE LINE command is that two parallel lines are drawn. This is much simpler than in more sophisticated packages where one line needs to be drawn first, then another command is used to offset another line from the first.

A question which immediately jumped to mind was, how can I alter the distance the two lines are apart from each other? I found out how after a bit of reading – this technique was not described in the description of the double line command, but in another, more complex command: SNAP PARALLEL. This command, it seems, allows the user to alter the distance the line is offset from the original, but also allows you to dynamically draw parallel arcs and concentric circles.

Another feature of the package, collectively known as COMPONENTS, gives the user the power to define a commonly used section of a drawing, or one of many objects, as a COMPONENT or block. Essentially this is not unlike defining macros of text in a wordprocessor. For instance, if you were using Generic CADD to produce schematic diagrams of circuits, a library of COMPONENTS could be created for transistors, diodes, resistors and capacitors, making a simple task of inserting each component (in the electronic sense of the word) into the drawing and making the various connections.

COMPONENTS may be defined for use only in the drawing you are working in, or stored on disk so that they may be recalled for use in any drawing.

With most CAD systems, every so often the screen needs to be refreshed or redrawn. This often happens when zooming into or away from a particular part of the drawing. Depending on the program you're using and the speed of the machine, this may or may not happen too fast for you to track what is going on. Suffice to say that most systems re-draw the screen starting with the first elements you have drawn and finishing with the last.

Often (if it's possible), it is useful to carefully watch this process to help update your mind as to what is going on. This is especially true in a complex drawing you've been working on for a long time. Generic CADD allows you to specify in what order you would prefer the screen to be redrawn – first last or last first. There have been a number of times I have wished this could be done on other systems. It can be quite useful – top marks for thought.

Another innovative feature is known as a Bezier Curve. Just as circles, arcs, ellipses and other more complex curves can be drawn with their respective commands Bezier Curves are constructed by selecting the command from the menu or by type BV at the prompt.

A Bezier Curve is constructed by 'showing' the program the 'direction' the curve is to take by specifying a series of tangent lines. After invoking the command, the system waits for a series of points to be specified from either the keyboard or the pointing device. After the first two points are placed, each subsequent point results in the previous section of the curve to be drawn. Where you place each point, relative to its neighbours, controls the direction and curvature of the Bezier Curve. This feature may not be so useful in drawing circuit boards or schematics, but there have been many times when this type of command would have been useful with more illustrative drawings.

Conclusion

Describing this sector of the market as the low-end can perhaps be criticised as being too generalistic. For example, also in the low-end of the CAD software market is a product from AutoDESK: AutoSKETCH. This retails in the $200 – $300 bracket. Generic CADD Level 3, however, retails for $595. So, direct comparisons among low-end packages would be unfair to say the least, while comparisons amongst their more expensive counterparts are warranted.

All in all, I found Generic CADD a fairly easy program to use. Definitely its ease-of-use, compared to the number of features and commands is commendable. eti

Generic CADD 3 kindly supplied by AutoDESK, Cost $595.

PREFECTS, LIZARDS AND GUNBOATS

COMPUTING

Kim Bucknole scans the marketplace (bypassing schools, the bush and naval dockyards) looking for monitors.

When I was at school in the late fifties and through the sixties, a monitor was i) a pupil who assisted with school functions (e.g. in the days of free milk for school children – pre-Thatcher, milk snatcher – in the UK; there were milk monitors, blackboard monitors, library monitors and possibly others I've long forgotten); ii) a lizard found in Asia, Africa and Australia; iii) a gunboat, low in the water, with rotating gun turrets (named for the first of its kind in the USA in 1862 and almost always said in the same breath as "The Merrimac" – its rival). As a verb, I was vaguely aware that a monitor monitored, some government employees monitored foreign broadcasts and that 'phone calls could be monitored.

In the 1980s, I'm not sure if schools still have monitors; the lizards are still with us; monitor as a generic word for gunboats is archaic; monitors (where they exist) still monitor; foreign broadcasters are still monitored, but phone calls are now 'tapped'. If I ask a school age child what a monitor is, I will be told about the screen on the computer at school or at home. The man in the street might speak of a monitor, or a monitor-style TV, in his home entertainment system. If we pick up a product range brochure from a European or Asian consumer electronics manufacturer, or a DSE catalogue, we cannot escape the 'm' word. I wonder if it is possible to pin-point when the word in its present sense, passed into everyday usage.

In any event, in this feature, we will concern ourselves with the monitor as it is associated with computing.

What monitors are

Monitors in the computing context are a means by which we can display information (in this instance, on a screen). Before video monitors, computers used teletype terminals. These were slow (running circa 110 baud), noisy and, in the pre-greenie days, providing hard copies of everything, were a greater danger to forests than Agent Orange. Then we had "glass teletype" operating circa 9600 baud on ordinary TV video monitors.

Today, there are several monitor standards with differing capabilities.

You can find:–

1) The text only, Monochrome Display Adapter, supplied with the original IBM PC;
2) The Hercules Monochrome Graphics Adapter card introduced shortly after the PC, capable of mono graphics at 720 x 348 resolution with several text fonts and graphics mode;
3) The IBM Colour Graphics Adapter offering some colour capability (320 x 200 in four colours), otherwise 640 x 200 mono;
4) The IBM Enhanced Graphics Adapter offering 640x 350 in sixteen colours and supporting all CGA modes;
5) The Video Graphics Array supporting CGA and EGA plus 640 x 480 in sixteen colours and 320 x 200 in 256 colours which was released with the PS/2 range;
6) The Super VGA system supporting most modes and standards available elsewhere and 640 x 480 in 256 colours; many Super VGA adapters offer 1024 x 768, demanding large screens to best utilise the capabilities.

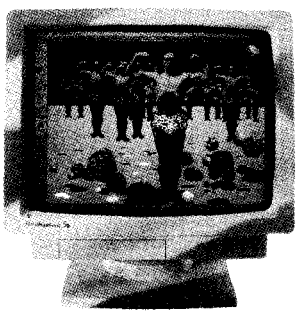
You are unlikely to find: –

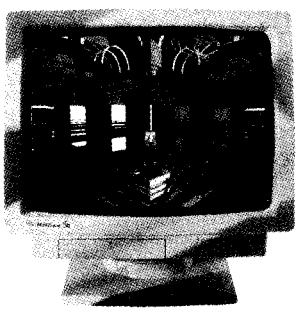
7) The Professional Graphics Controller which came and went, missing its intended market (CAD/CAM) which was "quite happy, thank you" without IBM offering an alternative standard.

Why?

Because we all want it bigger, better, faster, clearer, more colourful, easier to use. Desktop publishing, CAD/CAM, the desire for WYSIWYG in glowing Technicolour, Cinerama with Dolby, for all I know. In other words, we, the end users, are never satisfied. As our dissatisfaction and demands have grown, so has the variety of standards to supply our wants.

Look at how we moved from MDA to MGA, to CGA, to EGA. Look at NEC's industry-first Multisync multiscanning monitor which supported CGA, EGA and others and offered the convenience of mode switching. Look at Sony's Multiscan 1302. Consider the move from TTL (Transistor to Transistor Logic) to the more flexible analogue display technology





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Maximum Recommended Resolution	800 x 600	1024 x 768	1024 x 768	1280 x 1024
Supported Graphics Modes	VGA SuperVGA	8514/A, SuperVGA YGA, PGC, EGA, CGA, MDA, Hercules MCGA & Macintosh II	VGA, SuperVGA, 8514/A, Macintosh II	VGA, SuperVGA, 8514/A, Macintosh II
Horizontal Frequency KHz	31.5 to 35	15 to 38	31.5 to 57	31.5 to 66
Vertical frequency kHz	56, 60, 70	50 to 80	50 to 90	50 to 90
Dot Pitch	.31 mm	.28 mm	.28 mm	.31 mm
Non-Glare	YES	YES	YES	YES
Digital Control System	NO	YES	YES	YES
Tilt-Swivel Base	YES	YES	YES	YES

employed in the VGA system. Here we have seen technology employed, developed, parallelled and surpassed by alternative approaches, and all driven by end user requirements.

Meanwhile Mac hoed its own row. The original Mac only had a mono 9" screen, 512 x 342, but was nearly WYSIWYG for text and graphics. Things have moved on with Mac too, as you will infer from our market survey.

What do we need?

For most of us, standard multiscan monitors suffice for text and graphics display requirements. And if we only need EGA then TTL monitors will do the job. But if you're thinking of full colour graphic representations of the Taj Mahal or designing the ultimate PCB or the next generation of chip, then you'll need to dig deeper in the pocket for the high resolution, high contrast, multi standard, multi dollar, 'you beaut', state-of-the-art monitor that most of us are realistically-unable to justify.

Many users (like car owners) want to buy it, get it home, (or to the workplace) – and, in the case of a monitor, unpack it, plug it in, connect it, switch it on and see it working... reliably...perpetually. But, as ETI/WORKSTATION readers, you will probably want to know...

What goes on under the bonnet?

Earlier, I referred briefly to teletype and 'glass teletype'. Mark Cheeseman from our sister magazine *Your Computer* takes up the story.

"It soon became evident that even greater performance could be obtained if the computer directly controlled the screen itself, rather than sending all the information to an external terminal over a serial link. Bit-mapped graphics became possible, and as display technology improved, and memory prices dropped, the demand grew for displays of ever-increasing resolution. Any computer display system consists of two major components: The monitor itself, and the display controller. The latter may be part of the main board of the computer, as is the case with the IBM PS/2 range and the small footprint Macs, or it can be on a separate card, as in the XT and AT machines and the Mac II. Obviously the second option allows more flexibility than the former in selecting an appropriate display for the intended application.

The operation of monochrome and colour monitors is quite similar in all respects except that with colour there are three colours to be displayed simultaneously instead of one, so for simplicity's sake, we'll look at monochrome first.

Monochrome

The most visible component of a monitor is obviously the picture tube (or cathode ray tube) itself. The screen is coated on the inside with a phosphorescent substance, which emits light when stuck by high-speed electrons. These electrons are emitted from an electron gun at the rear end of the tube and are modulated to vary the brightness as perceived from the front of the screen.

On a monochrome screen displaying basic text or graphics, the electron beam is either on or off, resulting in an image with no grey levels. To obtain grey levels, the beam is accelerated at varying rates, resulting in intermediate levels of brightness from the phosphor on screen. A colour monitor has three such electron guns, one for each primary colour – red, green and blue. When the electrons hit the phosphor coating on the screen, the kinetic energy possessed by the electrons is converted to light energy. The actual colour of the light emitted depends on the composition of the phosphor, and is usually white for a monochrome screen, or red, green and blue for a colour monitor.

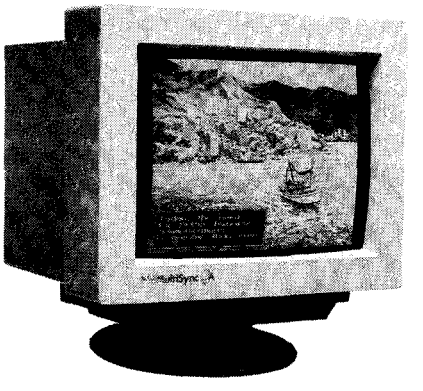
So far, this only results in a single dot in the middle of the screen, which may be either bright or dark or somewhere in between. Of course, a complete screen image is made up of an array of such dots, and in order for the electron beam to 'illuminate' all of these dots, it is swept past them in sequence, while being turned on or off, according to whether that particular pixel is required to be on or off (or in-between). To move the electron beam around the screen, a magnetic field is applied to the stream of electrons, which causes them to be deflected in one direction or the other due to their inherent electric charge. This magnetic field is generated by two pairs of coils placed around the neck of the tube – one pair sweeps the beam in a horizontal direction, while the other pair causes vertical deflection.

By applying appropriate signals to these coils, the electron beam is swept across the screen in a series of horizontal lines, each starting from the left-hand edge of the display area, and ending at the right-hand side. While the beam is traversing one of these lines, the circuitry in the video controller turns the beam on and off, according to whether a dot (or pixel) is to be displayed at that point of the screen or not. The maximum rate at which the electron gun can be turned off is known as the bandwidth, the more discrete dots can be displayed in the space of one horizontal line.

When one complete line has been sent to the monitor, the electron beam is turned off, and a horizontal synchronisation (sync) pulse from the display controller causes the electron beam in the monitor to 'retrace', or move back to the beginning of the next line on the screen. This process is repeated for each line on the screen until the bottom edge of the screen is reached, whereupon the beam is turned off again, and a vertical sync pulse sends the beam back to the top left-hand corner of the screen, ready for the next screenful (or frame) of information.

The number of horizontal sync pulses per second (which is approximately the same as the number of lines displayed in one second), is called the horizontal sync rate, or line rate, and is of the order of tens of thousands of lines per second. The number of frames per second is called (naturally enough) the frame rate or vertical sync rate, and is usually between 50 and 70 frames per second.

There is one exception to this generalisation, and that applies to interlaced displays, which allow an increase in the resolution of a monitor without a corresponding increase in the bandwidth. This is achieved by displaying each frame of the image as two separate fields, each



containing half of the information on the image. One field consists of the odd-numbered lines of the image, and the other the even-numbered lines. These two frames are displayed alternatively to build-up the complete image in two separate operations.

If the rate at which these fields are displayed is (say) 50 fields per second, then only 25 complete images are displayed per second. So, compared with a non-interlaced monitor of the same resolution, the same amount of information is being displayed at half the rate, so that the interlaced monitor only needs to have half the bandwidth of its non-interlaced counterpart. The downside is that, unless the phosphor on the screen is reasonably persistent (that is, it glows for some time after the electron beam has passed it), the screen will have a noticeable flicker. Ordinary television images are interlaced, as is highest resolution mode on the Amiga (for

compatibility with TV images). The IBM high-resolution 8514 display system also uses an interlaced display.

The rate at which the electron beam is swept across the screen, both vertically and horizontally, is determined entirely within the monitor itself; the display controller has not control over these sweep rates, it merely tells the monitor when to begin a new line or frame. Therefore, it is important to ensure that the monitor's beam sweeps across the screen at the correct rate, so that the beam has reached the right-hand side of the screen when the last pixel on that line is sent down the cable to the monitor. Similarly, the electron beam should be at the bottom of the screen when the last line of pixels is being displayed.

Because the vertical and horizontal resolution of the large range of displays are all different (otherwise, why have so many systems in the first place?), a monitor designed for use with one system cannot, as a rule, be used with a different one. However, a number of monitors are available which sense the line and frame rate and automatically adjust to fit the image on the screen. The NEC Multisync was the first of these.

So far, we have only really looked at a monochrome system. The red, green and blue colours used in colour monitors (and colour television sets) allow quite a wide range of colours to be displayed by mixing them in different proportions on the screen.

Colour

The phosphor dots on the screen are usually arranged in a triangular array, called a triad, each consisting of one red, one green and one blue dot. Each pixel on a colour screen is in fact one of these triads of coloured dots. A special mesh behind the screen, called a shadow mask, ensures that each of the three different coloured phosphors is only 'illuminated' by the appropriate electron gun, and is shielded from the other two.

In order to accurately reproduce colour images on the screen, the three beams must always be pointing to the same point at the same time. If this is not the case, the display is said to be mis-converged, with the different colour components of the image displaced vertically, horizontally, or both. Two other forms of distortion which can occur on both colour and monochrome systems are pin-cushion or barrel distortion. Pin-cushion distortion arises because the corners of the display are further away from the electron gun than the centres of the edge of the image. Thus, the electron beam(s) do not need to be deflected through as great an angle.

A pin-cushion correction circuit is built into the monitor to compensate for this effect. However, if this circuit is ineffective (or not correctly adjusted), the sides of the image will appear to bend inwards, giving rise to so-called pin-cushion distortion. If the circuit over-compensates, then the sides will bend outwards, giving the appearance of a barrel.

Analogue and digital

Another way in which display systems can be grouped is their use of analogue or digital signals between the display controller and monitor. Digital signals have the advantage of being less prone to crosstalk (mutual interference between the various signals in the cable) and other forms of interference than analogue ones. However, digital signals can only be either on or off, and not anywhere in between, so that a single signal wire can only turn an electron gun on or off. Two wires per gun would give four levels of intensity, and 18 signal wires (six per gun) would be required to display the 256K colours that the VGA is capable of.

Analogue signals, on the other hand, can assume any voltage level between a pre-determined minimum and maximum, allowing an unlimited range of intensities to be displayed by each gun (this does not mean that any arbitrary colour can be displayed, although the actual range available is more than adequate for most applications). These signals are of course still derived from a digital source (the video RAM in the controller), but are converted to analogue from on-board rather than in the monitor, which is inherently an analogue device regardless of the capabilities of the graphics adaptor.

The vertical and horizontal resolution specifications have been mentioned already, in relation to scan rates and bandwidth. Clearly, the greater the resolution of the monitor and associated controller, the more detail can be shown on the screen. However, the ratio of horizontal to vertical resolution is also important if images displayed on the screen are to appear undistorted. A typical monitor screen is three-quarters as high as it is wide. This ratio of frontal dimensions is the aspect ratio of the screen, which in this case is 4:3. Each individual pixel also has an aspect ratio, and is usually desirable in graphics-based applications for this ratio to be 1:1, as this is the ratio of dots on most printers and step increments on plotters.

It follows from this that there should be one third again as many dots across the screen as there are down. The Macintosh has always had so-called 'square' dots, owing to the heavy graphics emphasis from the outset with this machine. However, of the various IBM adaptors available for its old PC range, none had this aspect ratio. It is only with the VGA adaptor, with its minimum resolution of 640 by 480 that PC users have had a screen which would not make circles appear as ellipses. The so-called 'Super VGA' mode (800 x 600) and even higher resolutions such as 1024 by 768 also meet this requirement. It is for this reason, more than any other, that the VGA is rapidly gaining acceptance as the 'entry-level' graphics subsystem for serious CAD and desktop publishing applications".

(The foregoing is extracted from Mark Cheeseman's article Monitor Mechanics which featured in the August 1989 issue of *Your Computer*. It appears by kind permission of the editor of *Your Computer*, Jake Kennedy).

Now we've covered the standards and the available technologies and so should move on to consider the makes, models, performance, price and...

Will it fit in the garage?

For convenience we have provided screen dumps of various monitors' vital statistics and categorised them according to their capabilities. The first category is the Henry ("any colour as long as its black") Ford division which includes some very upmarket non-Model T examples: these are:–

MONOCHROME

AOC MM-211D

VGA, EGA, CGA; flat display 230 by 180mm; reverse video. Maximum resolution 720 by 350; dot pitch 0.31 mm; vertical scan of 47 to 63 Hz; horizontal 15 to 18kHz. Twelve-month warranty. Micro Focus (02) 476 5944. Computer Developments (07) 352 6022.

Radius Two Page Display

Macintosh II and SE; 48cm diagonal screen. Supports grey scale. Maximum resolution of 1152 by 882; horizontal scan (not specified). 12-month warranty. InfoMagic (02) 975 1044.

AOC MM-213

VGA; flat display 230 by 180mm. Maximum resolution 800 by 600; dot pitch 0.28mm; vertical scan of 50 to 70Hz; horizontal 31.4kHz. Twelve-month warranty. Micro Focus (02) 476 5944. Computer Developments (07) 352 6022.

14-inch (paper white)

Hercules; 35.5cm diag.; non-glare screen. Maximum resolution of 920 by 350; dot pitch (not specified); vertical scan of 50/60Hz; horizontal scan 18.432kHz. 24-month warranty. Philips (02) 742 8222.

14-inch VGA (paper white)

VGA: 35.5cm diag.; non-glare screen. Maximum resolution of 920 by 480; dot pitch (not specified); vertical scan of 50/60Hz; horizontal scan 31.5kHz. 24-month warranty. Philips (02) 742 8222.

MP5771 One-Page (paper white)

Flat face display 264 by 197mm. Maximum

resolution 1006 by 1048; dot pitch (not specified); vertical scan of 59.88Hz; horizontal 62.75kHz. Twelve-month warranty. Samsung Electronics (02) 638 5200.

MU9511 Dual-Page (paper white)

Flat face display 360 by 270m,m. Maximum resolution 1288 by 1024, dot pitch (not specified); vertical scan of 63Hz; horizontal 66kHz. Twelve-month warranty. Samsung Electronics (02) 638 5200.

AOC MM-411D

CGA; flat display 230 by 180mm; reverse video. Maximum resolution 720 by 350; dot pitch 0.31mm; vertical scan of 60Hz; horizontal 15 to 18kHz. Twelve-month warranty. Micro Focus (02) 476 5944.

OMT 1201

CGA, Mac, 8-shade grey scale; flat display 210 by 155mm; reverse video. Maximum resolution 1000 lines; dot pitch 0.39mm; vertical scan of 47 to 63Hz; horizontal 15.7/18.4kHz. Twelve-month warranty. Eastern Micro Electronics (03) 699 3088.

DSE X2400

4-shade grey scale; curved display 240 by 185mm. Maximum resolution 1000 lines; vertical scan of 47 to 63Hz; horizontal 18 to 18.8kHz. Twelve-month warranty. Dick Smith Electronics (02) 888 3200.

OMT 1401

CGA, Mac, 8-shade grey scale; flat display 235 by 175mm; reverse video. Maximum resolution 1000 lines; dot pitch 0.39mm; vertical scan of 47 to 63Hz; horizontal 15.7/18.4kHz. Twelve-month warranty. Eastern Micro Electronics (03) 699 3088.

VM 1400

Grey scale, flat display 240 by 180mm; reverse video support. Maximum resolution 1000 lines; vertical scan of 47 to 63Hz; horizontal 18.432kHz. 90-day warranty. SKI Peripherals (02) 649 1222.

Teco 9503

VGA, 64-shade grey scale; flat display 235 by 175mm; reverse video. Maximum resolution 800 by 480; dot pitch 0.29mm; vertical scan of 70Hz; horizontal 31.3kHz. Twelve-month warranty. Eastern Micro Electronics (03) 699 3088.

Thomson 450W

CGA, 16-shade grey scale; curved display 360mm diag.; reverse video. Maximum resolution 720 by 700; vertical scan of 50 to 60Hz; horizontal 15.7/18.4kHz. 90-day warranty. Peak Pacific (02) 901 0000.

Thomson 460W

VGA, EGA, CGA, unlimited shade grey scale; curved display 360mm diag.; reverse video. Maximum resolution 720 by 400; vertical scan of 55 to 75Hz; horizontal 31.5kHz. 90-day warranty. Peak Pacific (02) 901 0000.

EIZO 3030WL

VGA, 256-shade grey scale; curved display 235 by 170mm; reverse video. Maximum resolution 720 by 480; vertical scan of 60 to 70Hz; horizontal 18.4kHz. Twelve-month warranty. Megavision (02) 975 1877.

HP VGA Display

VGA, EGA, CGA, 64-shade grey scale; curved display 330 by 330mm; reverse video. Maximum resolution 640 x 480; vertical scan of 60 to 70Hz; horizontal 31.5kHz. Twelve-month warranty. Hewlett-Packard (03) 895 2895.

EIZO 4030WL

VGA, 256-shade grey scale; curved display 240 by 170mm; reverse video. Maximum resolution 800 by 350; vertical scan of 49 to 61Hz; horizontal 18.4kHz. Twelve-month warranty. Megavision (02)975 1877.

EIZO 4050WL

VGA, 256-shade grey scale; curved display 240 by 170mm; reverse video. Maximum resolution 720 by 480; vertical scan of 60 to 70Hz; horizontal 31.5kHz. Twelve-month warranty. Megavision (02) 975 1877.

AOC CM-313

VGA, EGA, CGA; flat display 280 by 210mm; reverse video. Maximum resolution 720 by 400; dot pitch 0.31mm; vertical scan of 50 to 70Hz; horizontal 31.4kHz. Twelve-month warranty. Micro Focus (02) 476 5944.

Apple High Resolution

Mac, grey scale; flat display 255 by 310mm; reverse video. Maximum resolution 640 by 480; vertical scan of 66.7; horizontal 35kHz.Twelve-month warranty. Apple Computer (02) 452 8000.

Princeton Max-15

VGA, EGA, CGA, Mac, multiscan, unlimited grey scale; flat display 230 by 173mm. Maximum resolution 1024 by 768; vertical scan of 45 to 120Hz; horizontal 15 to 36kHz. 90-day warranty. Intelligent Systems (03) 583 0666.

Genius

VGA, Mac, grey scale; curved display 210 by 280mm; reverse video. Maximum resolution 1280 by 1024; dot pitch 0.25mm; vertical scan of 63Hz; horizontal 66kHz. 90-day warranty. Datatel (03) 690 4000.

Taxan 770 +

VGA, EGA, CGA, Mac, multiscan; curved display 280 by 210mm; reverse video. Maximum resolution 800 by 400; dot pitch 0.31mm; vertical scan of 50 to 90Hz; horizontal 15 to 34kHz. Twelve-month warranty. Tech Pacific (02) 662 4122.

Radius Full Page Display

MacPlus and SE; 38cm diagonal screen. Maximum resolution of 640 by 864 (virtual 1024 by 864); vertical scan 69Hz, horizontal scan (not specified).Twelve-month warranty. InfoMagic (02) 975 1044.

Cornerstone Single

VGA, EGA, CGA, multiscan, 4-shade grey scale; flat display 300 by 220mm. Maximum resolution 768 by 1008; dot pitch 0.28mm; horizontal scan 62.7kHz. Twelve-month warranty. Micro Focus (02) 476 5944.

EIZO 6500

VGA, Mac, multiscan, 256-shade grey scale; flat display 390 by 280mm; reverse video. Maximum resolution 1664 by 1200; vertical scan of 60 to 80Hz; horizontal 31.5/64 to 78kHz. Six-month warranty. Megavision (02) 975 1877.

Big Picture

Mac; curved display 298 by 235mm. Maximum resolution 1024 by 808; vertical scan of 60Hz; horizontal 50.5kHz. Twelve-month warranty. PICA (03) 370 3566.

Cornerstone Dual

VGA, EGA, CGA, multiscan, 4-shade grey scale (16-shade grey scale $5600); flat display 360 by 280mm. Maximum resolution 1600 by 1280; dot pitch 0.28mm; horizontal scan 879kHz. Twelve-month warranty. Micro Focus (02) 476 5944.

Viking 1

VGA (Mac II $5463); curved display 279 by 356mm. Maximum resolution 1280 by 960; vertical scan 66Hz; horizontal 66kHz. Six-month warranty. Various options including MCA. Megavision (02) 975 1877.

Sigma LaserView

Mac, 4-shade grey scale; curved display 340 by 265mm. Maximum resolution 1664 by 1200; vertical scan 60Hz; horizontal 75kHz. Twelve-month warranty. Computhink (03) 584 3188.

Big Picture IQ

Mac, 256-shade grey scale curved display 298 by 235mm. Maximum resolution 1024 by 808; vertical scan of 60Hz; horizontal 50.5kHz. Twelve-month warranty. PICA (03) 370 3566.

Big Picture C20

Mac, 256-shade grey scale; curved display 340 by 270mm. Maximum resolution 1024 by 808; vertical scan of 72Hz; horizontal 61kHz. Twelve-month warranty. PICA (03) 370 3566.

Wyse WY550

VGA, EGA, CGA, 64-shade grey scale; flat display 238 by 176mm; reverse video. Maximum resolution 640 by 480; dot pitch 0.37mm; vertical scan of 50 to 70Hz; horizontal 31.4kHz. Twelve-month warranty. MPA (03) 894 1500.

Wyse WY700

EGA, CGA, 4-shade grey scale; flat display 385 by 229mm; reverse video. Maximum resolution 1280 by 800; dot pitch 0.24mm; vertical scan of 76Hz; horizontal 32kHz. Twelve-month warranty. MPA (03) 894 1500.

The second category comprises the "S-Pack", GT and Executive models with a wider palette from which to select. These have:-

HIGH RESOLUTION

CK4656

CGA; 35.5cm diag; non-glare screen. Maximum resolution of 640 by 200; dot pitch (not specified); vertical scan (not specified); horizontal scan (not specified). Twelve-month warranty. Samsung Electronics (02) 638 5200.

14-inch CGA

The Versatec 8836 laser plotter gives you 32 AO size drawings an hour, taped and ready to GO

You'll be free from the quality and speed limitations of pen plotters. The Versatec 8836 laser plotter gives you a high-speed, high resolution (440 DPI) mono image on plain paper, any size up to AO, in 500-feet rolls.

That makes the Versatec 8836 ideal for long, unattended runs, freeing your staff for more productive work.

The Versatec 8836 is compatible with most workstations and mainframes and is suitable for networking. You can distribute plotter stations as needed – a major contribution to overall efficiency.

And you have the added security of knowing that your 8836 is fully serviced and supported by the Australia-wide Anitech network.

To see how quickly this high-resolution laser plotter works, call us to arrange an obligation-free demonstration. Bring along one of your most challenging drawings (or its program) so you can fully appreciate the speed and image of the 8836 on your kind of work.

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Melbourne 795 9011, Perth 277 7000, Adelaide 356 7333, Brisbane 844 7211, Launceston 447 433

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CGA; 35.5cm diag; non-glare screen. Maximum resolution of 600 by 285; dot pitch of 0.42mm; vertical scan of 50/60Hz; horizontal scan of 15.6kHz. 24-month warranty. Philips (02) 742 8222.

14-inch EGA

EGA; 35.5cm diag; non-glare screen. Maximum resolution of 640 by 350; dot pitch of 0.31 mm; vertical scan of 50/60Hz; horizontal scan of 15.6kHz to 22kHz. 24-month warranty. Philips (02) 742 8222.

14-inch VGA

VGA; 35.5cm diag.; non-glare screen. Maximum resolution of 640 by 480; dot pitch of 0.31mm; vertical scan of 60/70Hz; horizontal scan of 31.5kHz. 24-month warranty. Philips (02) 742 8222.

AOC CM-313

VGA; 35.5cm diag;, non-glare, 90 degree deflection screen. Maximum resolution of 720 by 400; dot pitch 0.31mm; short persistence; vertical scan of 50 to 70Hz; horizontal 31.4kHz. Twelve month warranty. Micro Focus (02) 476 5944.

AOC CM-314

VGA, EGA, PGC, MGA; 35.5cm diag; non-glare, 90-degree deflection screen. Maximum resolution of 800 by 600; dot pitch 0.31mm; short persistence; vertical scan of 50 to 90Hz; horizontal 15 to 36kHz. Twelve-month warranty. Micro Focus (02) 476 5944.

CJ4681

VGA; 35.5cm diag.; non-glare screen. Maximum resolution of 720 by 400; dot pitch 0.31mm; vertical scan frequency 60/70Hz; horizontal scan 31.5kHz. Twelve-month warranty. Samsung Electronics (02) 638 5200.

Mitsubishi FA3425

VGA, EGA, CGA, PGC, Mac II; 34cm diag.; high-contrast. Maximum resolution of 1024 by 780; dot pitch 0.28mm; long persistence; vertical scan of 50 to 87Hz; horizontal 15.7 to 35.5kHz. Twelve-month warranty. Mitsubishi Electric (02) 888 5777.

EIZO 9060S

VGA, EGA, CGA, PGC, MGA, 8514; 35.5cm diag.; anti-reflective screen. Maximum resolution of 1024 by 768; dot pitch 0.28mm; medium persistence; vertical scan of 50 to 90Hz; horizontal 15.5 to 38kHz. Twelve-month warranty. Megavison (02) 975 1877.

Seiko CM 1430 ***$1850***

VGA, EGA, 8514; 33.3cm diag. Maximum resolution of 1024 by 768; dot pitch 0.26mm; B22 phosphor; vertical scan of 43.5 to 70Hz; horizontal 31.5 to 35.5kHz. Three-month warranty. Mitsubishi Electric (02) 888 5777.

EIZO 9070S

VGA, EGA, CGA, PGC, MGA, 8514; 40cm diag.; anti-reflective screen. Maximum resolution of 1280 by 800; dot pitch 0.28mm; medium persistence; vertical scan of 50 to 80Hz; horizontal 20 to 50kHz; Twelve-month warranty. Megavision (02) 975 1877.

Sampo KDS-1984

VGA, EGA, 8514; 42cm diag. Maximum resolution of 1024 by 780; dot pitch 0.28mm; long persistence; vertical scan of 43.5 to 70Hz; horizontal 31.5 to 35.5kHz., Three-month warranty. TCG Group (02) 699 8300.

Mitsubishi HL6615

VGA, PGC, Mac II; 40cm diag; high-contrast. Maximum resolution of 1280 by 1024; dot pitch 0.28/0.31mm; medium persistence; vertical scan of 50 to 90Hz; horizontal 30 to 64kHz. Twelve month warranty. Mitsubishi Electric (02) 888 5777.

EIZO 6500

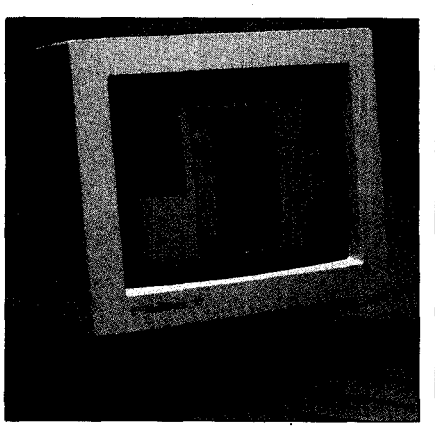
VGA, CGA, 8514; 53cm diag.; anti-reflective screen. Maximum resolution of 1600 by 1280; dot pitch 0.31mm; medium persistence; vertical scan of 55 to 80Hz; horizontal 15.5 to 38kHz. Six month warranty. Megavision (02) 975 1877.

Taxan KX-1901

CGA; 44.5cm diag. Maximum resolution of 1280 by 800; colour multi-scan; short persistence; vertical scan of 63.7; horizontal 63.6. Three-month warranty. TCG Group (02) 699 8300.

Cadvision CPD-2030

High-resolution monitor; 44cm diag.; interlaced screen. Maximum resolution of 1024 by 768; dot pitch 0.31mm; B22



phosphor; vertical scan of 60Hz; horizontal 48kHz. Three-month warranty. TCG Group (02) 699 8300.

Cadvision CPD-2030

High-resolution monitor; 44cm diag.; interlaced screen. Maximum resolution of 1024 by 768; dot pitch 0.31mm; B22 phosphor; vertical scan of 60Hz; horizontal 48kHz. Three-month warranty. TCG Group (02) 699 8300.

Cadvision CPD-2040

High-resolution monitor; 44cm diag. Maximum resolution of 1280 by 1024; dot pitch 0.31mm; B22 phosphor; vertical scan of 60Hz; .horizontal 64kHz. Three-month warranty. TCG Group (02) 699 8300.

Mitsubishi HA3905

VGA, EGA, CGA, PGC, Mac II; 34cm diag.; high-contrast. Maximum resolution of 1024 by 874; dot pitch 0.31mm; long persistence; vertical scan of 50 to 87Hz; horizontal 15.75 to 35.5kHz. Twelve-month warranty. Mitsubishi Electric (02) 888 5777.

EIZO 9500

VGA, CGA, 8514; 51cm diag.; anti-reflective screen. Maximum resolution of 1280 by 1024; dot pitch 0.31mm; medium persistence; vertical scan of 55 to 75Hz; horizontal 31.5 to 78kHz. Six-month warranty. Megavision (02) 975 1877.

The third category comes straight from the custom paint shop and these are:–

MULTISCAN

CM4531 EGA Colour Monitor

EGA, CGA: 35.5cm diag.; non glare screen. Maximum resolution of 640 by 350; dot pitch of 0.31 mm; horizontal scan of 15.75 to 21.85kHz. Twelve-month warranty. Samsung Electronics (02) 638 5200.

Compaq dual mode

CGA, Hercules; 30cm diag; green or amber etched screen. Maximum resolution of 720 by 350; dot pitch (not specified); horizontal scan of 15.8 to 18.5kHz. Twelve-month warranty. CCA Systems (02) 660 0077.

ADI DM2214

EGA, CGA; 35.5cm diag; dark glass screen. Maximum resolution of 720 by 350; dot pitch 0.31mm; horizontal scan of 15.7kHz to 22.0kHz. Twelve-month warranty. Imagineering (02) 697 8666.

Princeton Graphics Systems

HX-12E

EGA, CGA, Hercules; 30.5cm diag; tinted, non-glare, etched screen. Maximum resolution of 770 by 350; dot pitch 0.28mm; horizontal scan of 15.7 to 21.8kHz. 3-month warranty. Intelligent Systems (03) 543 7988.

ADI DM3114

VGA, EGA, CGA, Hercules; 35.5cm diag; dark glass, non glare screen. Maximum resolution of 720 by 480; dot pitch 0.31mm; horizontal scan of 31.4kHz. Twelve-month warranty. Imagineering (02) 697 8666

CT4581 Syne-Master

SuperVGA, VGA, MCGA, PGC, EGA, CGA, Hercules, Macintosh II; 35.5cm diag; non glare screen. Maximum resolution of 800 by 600; dot pitch of 0.31mm; horizontal scan of 15.38kHz Twevle month warranty. Samsung Electronics (02) 638 5200.

NEC JC-1402HMR, Multisync II

VGA, EGA, CGA, Hercules, Macintosh II; 34cm diag; direct etched screen. Maximum resolution of 800 by 560; dot pitch 0.31mm; horizontal scan of 15.5 to 35.0kHz. Twelve-month warranty. NEC Home Electronics (02) 868 1811.

Forefront ECM 5400

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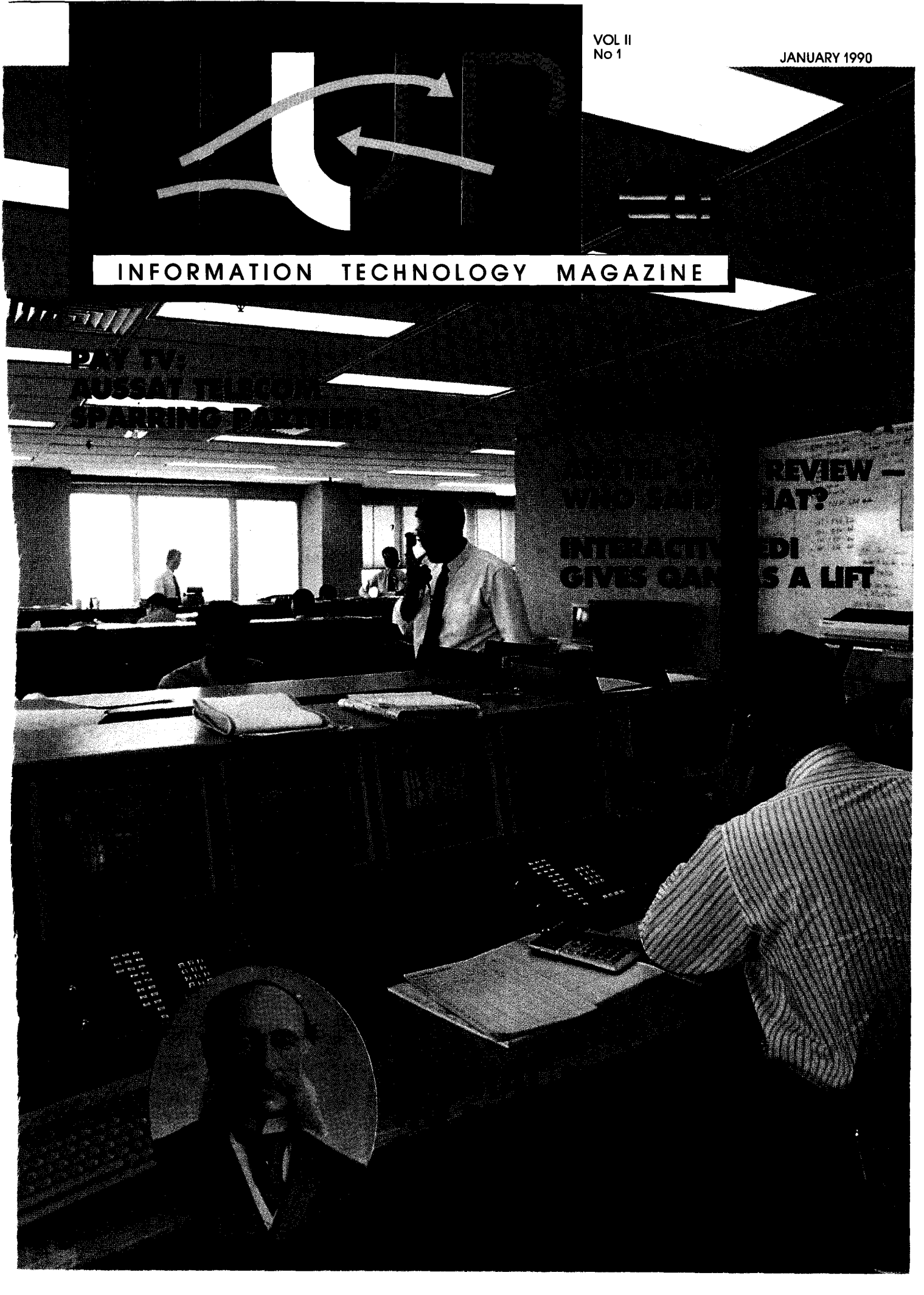

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Telecom's profit result for 1988/89 was a record $973m, up $196m on 1987/88. While such a result has been heralded with a good deal of self-congratulatory noises from Telecom management, and praise for its achievements from the government, Telecom's customers can be forgiven for not sharing in the general rejoicings, particularly those who have recently experienced some very steep price rises from the Big T.

TELECOM AND THE PRICE/PROFIT MIX

BY MARK McDONNELL

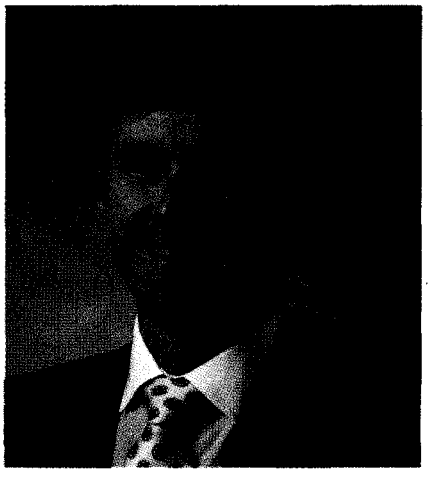
Managing Director, McDonnell Communications Research Pty Limited

On 1 September last year, a range of widely used network services had price adjustments at or above the national inflation rate. Telecom's own calculation of "weighted average increases" saw prices for Datel increase by nearly seven per cent, Securitel by eight per cent, the newly introduced Digital Metropolitan Service by 8.6 per cent, while that staple of the price network market, voice grade dedicated lines, were upped 12 per cent, as was the cost of using the Audio Network Service.

These figures only tell part of the story. As "weighted averages" they gloss over the real magnitude of these increases at the top end of the range. In a number of cases, price rises were significantly higher (by three per cent or more) than the average figures.

Yet the averages are themselves sufficient cause for concern. In an industry renowned for declining costs, with many services subject to formal price control, there is more than a hint of suspicion that Telecom is cashing in where it can.

Of course, Telecom would never admit to such bastardry. And to give credit where it is due, Telecom did not wait for the era of formal price control to arrive before putting up its leased line charges. In fact, for several years in succession Telecom's profit growth has been underwritten by sizeable increases in the cost of its services — increases above ten, and in some cases even above twenty, per cent per annum.



Mark McDonnell

Nor should it be forgotten that in a number of cases Telecom has reduced its prices — sometimes quite dramatically. Many of the price rises have been concentrated in short distance connections and installation charges, with reductions in long haul charges.

To a degree, Telecom's price rebalancing reflects a realignment of prices towards costs — but there is much more at issue.

To a degree, Telecom's price rebalancing reflects a realignment of prices towards costs — but there is much more at issue. Four points are worth considering.

1. Telecom's estimates of its own costs are neither independent nor beyond dispute. As the CSO saga illustrates, Telecom's estimates of its own costs can be vastly different from the measures used by others (such as the Bureau of Transport and Communications Economics).
2. Even where costs are agreed, it does not automatically follow that prices should be established on a cost plus formula. When the simplest telephone installation requires two Telecom teams (linesmen followed by technicians), is a rise in installation charges anything rather than an impact on consumers to prop up inefficient work practices?
3. The direction of price changes has placed acute pressure on Telecom's only competitor in the private network carriage market: is this purely a co-incidence?
4. A major effect of the changes is to reposition Telecom's products so as to incfluence customer choices among a number of possible business solutions. Telecom's price restructuring, viewed strategically, presents opportunities for shaping current and future network use. This process may have little to do with costs, but a great deal to do with broader management objectives, including profitability, investment, control of the market and the size and nature of Telecom as a business corporation.

Beyond these management issues, the September price rises expose problems in the current direction of government policy. The scope for real price reductions under the CPI minus 4 formula is too narrow. Regardless of long term benefits to consumers resulting from strong profit growth (eg increased investment yielding improvements to network performance), there remains a crucial short term trade off in providing strong and effective controls over monopolistic pricing for all reserved services. ■

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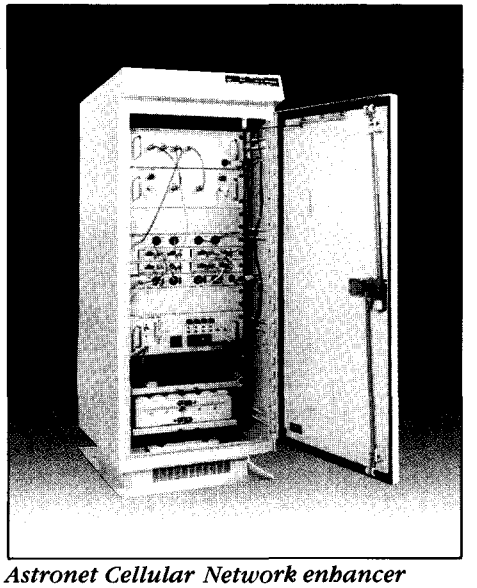

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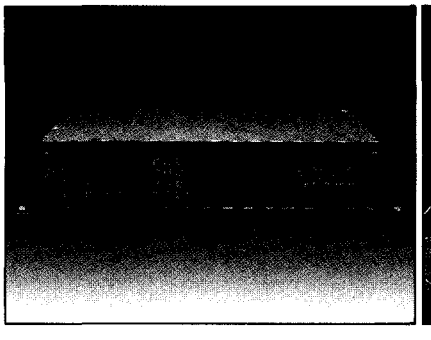
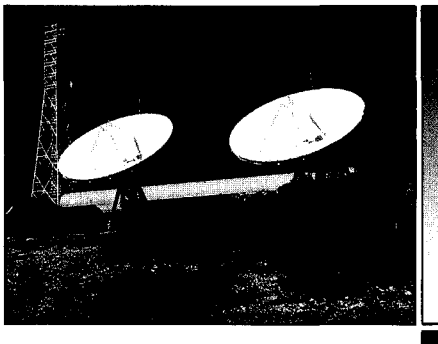
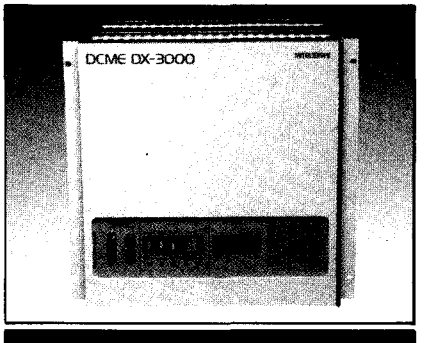


Earth Station



DX-3000 Digital Circuit Multiplication Equipment



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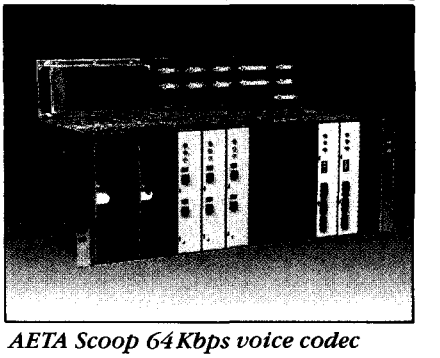

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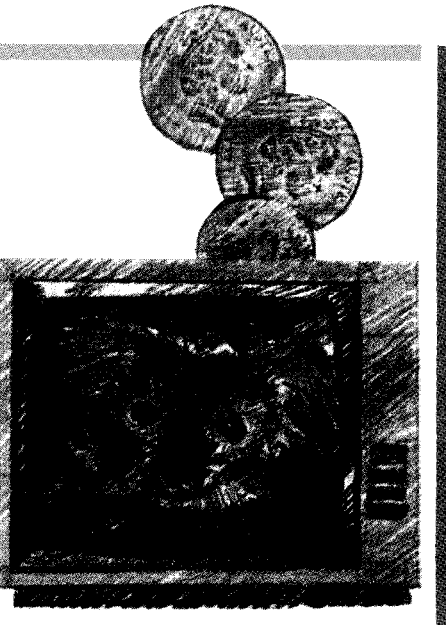
The mix of satellite, microwave radio and optical fibre cables to carry future pay television channels into Australian homes presents new opportunities for Australian industry. Here are highlights from speeches given by Dr Wayne Nowland, chief of business operations, AUSSAT, and Dr Terry Cutler, executive director of corporate strategy, Telecom, at the Australian Investment Conference in Sydney in November last year.

PAY TV — INDUSTRY OPPORTUNITIES

AUSSAT highlights

- AUSSAT is committed to the successful development of Pay TV as a major component of its future 'core' activities.
- A Direct Broadcast Satellite (DBS) service, available from 1992, would support a large national subscriber base in the early years.
- AUSSAT would work closely with Pay TV licensees and the market to achieve the most appealing match of programs on six DBS channels.
- Pay TV could be available to 98 percent of Australians through a 'hybrid' approach using DBS, satellite master antenna TV (SMATV) for apartment blocks and hotels, and microwave radio Multipoint Distribution Systems (MDS).
- Australia-wide coverage could be available by incorporating the current remote area satellite broadcasting (RASB) services into the overall delivery system.
- AUSSAT would share the risk in early years through a soft-entry pricing strategy which would allow licensees to pay a percent of total revenues generated from subscribers.
- In partnership with licensees, AUSSAT would implement retail marketing and subscriber management strategies to promote localism where commercially desirable.
- The subscriber management system would provide individual addressability on a per channel basis for billing, authorisation and 'pay-per-view' services.
- AUSSAT would commence a competitive selection process for low-cost DBS antennae next year.
- The DBS service would use a secure encryption system to protect against pirated reception and would be readily upgradable to HDTV when this is available in the mid 1990s.



- AUSSAT would liaise closely with Telecom on optic fibre cable to ensure that any substantial transition to this delivery mode from the late 1990s would suit subscribers.

Highlights from Telecom

- The Telecom network and broadcasting are converging; broadcasting and Pay TV are where telecommunications meet.
- Pay TV will be the catalyst for new market developments and optical fibre cable will be a key building block.
- Telecom's network is evolving rapidly to embrace optical fibre leading to a broadband integrated services digital network (ISDN)
- Optical fibres are characterised by enormous capacity, high transmission quality and falling costs.
- By 1994, optical fibre will be within 600 metres of 60 per cent of Australian homes with potential connectivity for broadband services, including Pay TV.
- Customer benefits will include 'video dial tone', switched broadband service capability, capacity for around 60 TV channels, customer ability to signal to the network and, ultimately, customer-customer switching.
- Industry opportunities include on-demand control for nationwide broadcast networks and interactive video retrieval services — the 0055 video service of tomorrow.
- Structural regulation of Pay TV is appropriate so that program providers input their TV channels to the national carriers.
- Telecom and AUSSAT are exploring co-ordinated delivery to: avoid duplication of infrastructure, maximise commonality of receiving equipment; provide a transition plan from satellite to cable.

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After four years and as many consultants' reports the NSW government network contract has been awarded to fledgling OTC/Computer Power joint venture, Telepower.

NSW... AND THEN THE WORLD

"You are looking at the start of a transnational company: first Australia, New Zealand, Asia Pacific and then the world. Winning the NSW government network contract has brought that to a head." Telepower managing director David Owen's expansiveness is not just borne of the first flush of success, but the long term strategy for this fledgling OTC/Computer Power joint venture.

After four years and as many consultants' reports the public sector contract was awarded to Telepower ahead of three other consortia — AWA/Telecom/Aussat; Bond Communications/British Telecom; and LM Ericsson. The only joint venture not stitched together specifically for this contract, Owen says the objective for Telepower from the outset has been to expand internationally and make use of the 83 offices worldwide that the parents (companies) have. Says Owen: "We will be going after major contracts for terrestrial networks here and overseas, and we will pull NSW industry behind us."

A winning element of the Telepower bid was the support consortium of 14 companies based or headquartered in NSW (See box this page). One of the principle criteria for selection was opening up opportunities for NSW industry to develop a "leading position in systems, solutions to telecommunications needs."

The ten year contract is for the total management of the NSW government telecommunications facilities encompassing voice, data, video, digital trunked mobile, value added services such as electronic and voice mail, EFTPOS and EDI, and network management. Telepower will have total responsibility for the delivery of services and the on-going management, servicing and maintenance of the network.

The network will be terrestrial, based on bulk capacity leased from Telecom initially, with an option for a fibre optic network should telecommunications regulations be opened up in the future. There are no concrete plans to utilise satellite although Owen has not ruled out the possibility that satellite capacity may be needed to deliver video conferencing to some of the more remote centres.

A winning element of the Telepower bid was the support consortium of 14 companies based in NSW.

All consolidated revenue departments will be included in the network, and outer budget agencies (statutory authorities) may choose their involvement on commercial grounds. Owen said the option to buy capacity from the State Rail Authority or Electricity Commission networks had been left open in the event future regulations permit. He said State Rail and Elcom networks will be linked to the government network and again, regulations permitting, they will form their own common interest group networks with counterparts in other states.

Owen anticipates the laying down

David Owen

of the network will begin mid-1990. First on the shopping list will be major switching facilities and some early value added services. He says redefining some tasks (switchboard operators' jobs will be enriched and upgraded, for instance) and retraining key staff, plus training the users in employing telecommunications in a cost effective fashion, will be priority at this stage. Once the basic infrastructure is in place, value will be added in the form of innovative services over the ten year period.

Figures being quoted by the parties include recurrent cost savings to the State of $85m over the next seven years and productivity savings of $25m over the same period, with the rider that they could be as high as $1b with the introduction of new technologies such as videoconferencing allowing distance education, health delivery and remote court hearings. Telepower will purchase the existing infrastructure, which has a projected value of at least $15m, from the government.

Revenue to Telepower over the next ten years has been estimated at $1b, up to five per cent of which, says Owen, will go into an R&D facility at Wollongong University.

The network will be implemented and administered by a wholly owned subsidiary operating company separate from Telepower headquarters. During the set up phase its 30-odd staff will be drawn from Telepower and its parents, OTC and Computer Power, and a further 300-400 will be recruited within two years when the network is fully operational. Eighty per cent of those employees will come from government departments covering all facets from network operations, switchboard and procurement.

Telepower's next targets are the Defence, Civil Aviation Authority and Department of Foreign Affairs networks and the delayed West Australian network. It will also be actively seeking private sector opportunities and contracts for major terrestrial networks in deregulating countries. ■

Shelley Spriggs

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Digital Equipment Corp	Vax computers for network management and distance learning, cabling and VAS
GPT	Trunked mobile radio
JN Almgren	X.25 networking equipment
JTEC	ISDN terminals
Network Automation	Fast packet switching including technology to carry voice on packet switched network
Tytel	Lanex small business telephone system
Centre for Information Technology Research	R&D and training
Eracom	Security systems
Datacraft	Protocol conversion
OTC	EDI services
Computer Power	Project management software

NSW NETWORK : THE RECOMMENDATIONS, 1985-89

Prepared by Crooks Michell Peacock Stewart Pty Ltd, the *NSW Government Satellite Communications Strategy Study, Final Report, October 1985* observed that NSW was alone among major states in not having a co-ordinated approach to telecommunications which, at this stage, were costing the government an estimated $45m plus each year.

The report recommended the creation of a Communications Policy and Co-ordination Unit which could have, as its first task, the implementation of a pilot or trial network.

The *1986 NSW Department of Public Works Report*, prepared by First Assistant Secretary, John Waring, examined cost savings through traffic aggregation and co-ordinated development and estimated that co-ordinated planning and purchasing could save NSW taxpayers up to $10m a year.

When presented with these figures, Telecom is believed to have offered a 20 per cent discount on its services. The Report was shelved by a committee led by the head of the Premier's Department, Gerry Gleason.

1987's *Sydney — Telecommunications Hub of the South Pacific: A Strategic Plan for the Communication Technologies Industry in NSW*, prepared by the NSW Science and Technology Council for the State Development Council, observed that 35 different departments and government bodies were planning major network expansion (including a satellite pilot), and that all networks were being conceived and developed separately, with a certain degree of duplication.

It called for a high level Task Force to co-ordinate and standardise long-range planning; a telecommunications strategy for NSW government departments to provide opportunities for purchasing from local industry; establishment of a Telecommunications, Aerospace and Industry Desk, and a Communications Industry-Education Forum.

This report, published subsequently as *Telecommunications Development Strategy for NSW*, was adopted by the Unsworth Government and the Treasurer allocated $100,000 for a consultant's report on the formation of a state government network.

In 1988, the Greiner Government's Computer Funding Priorities Committee reported on the lack of co-ordination in both data and voice communications. Consultants, KNG, recommended establishing a private network to achieve economies. ■

READER INFO No. 345

Australia's special conditions of long distances and harsh operating environment create communications difficulties which have forced the Australian Army to become world leading experts in long distance radio communications. The recent four-week defence exercise, Kangaroo 89, in Australia's vast and sparsely populated north, really put the Army's resourcefulness and skills to the test.

KANGAROO '89 : COMMUNICATIONS ON THE HOP

BY TONY HEALY

Noise Everywhere. And dust . ... The big Blackhawk helicopters clatter furiously back into the air and peace descends again. Except that now there is a battalion of infantry — 500 soldiers, in the middle of nowhere.

As you're urgently aware! You are in a clearing, 450 kilometres east of Darwin, in Arnhem Land. And you're the poor bastard who has to plug the battalion back into the rest of the Army so it can receive water, ammunition, instructions, air support, medical evacuations, and generally get on with the war.

Communications, it's called. Not that you've got time to go into it now. Jumping up and down to drape wires between trees and dashing back to your little green magic box. You've finally hit upon an antenna configuration that's just about getting through to Brigade headquarters 200 kilometres away, and now you've got to do something about the earth.

What you do is unbutton your trousers and point Percy at the porcelain, as Barry Humphries would put it. Except that, instead of porcelain, you irrigate your iron earthing stake.

It's not the sort of thing you see in Sydney or Melbourne corporate network centres, but it punched lot of signals across the north of Australia during the four week Kangaroo '89 defence exercise. Believe it or not, the technique is a standard part of Army communications procedures.

Mystical Incantations

Army signallers are almost a breed apart — out in the field, utttering their mystical incantations over lengths of wire as they work the spells that will call up Darwin, 450 kilometres away.

Their special skills are recognised by coveted 20 per cent pay loadings (and even those are being reviewed to ward off increased poaching by business and industry). Less pleasantly, the signaller's special role makes him a prize target for enemy raiding parties seeking prisoners.

Australia's large distances and shallow pockets have forced the Australian Army to become world leading experts in long distance (HF) radio communications. The radios used for communications over hundreds of kilometres, for example, were designed for distances of 50 kilometres and are used with that restriction by the US Army. The Australian Army's ability to coax extra range from the radios derives from superior skill, Australian signallers point out modestly.

Another difficulty overcome by the Australian Army is the paradoxically crowded HF radio spectrum. Settlement might be sparse in the north, but long distance radios aren't.

Communications were particularly important during Kangaroo because forces were spread over such awesome distances.

Lavishly funded US and European armies swapped their HF radios decades ago for sophisticated, compact satellite communication systems, and thus forewent some of the learning experiences of Australian signallers. Now HF radio is returning to vogue.

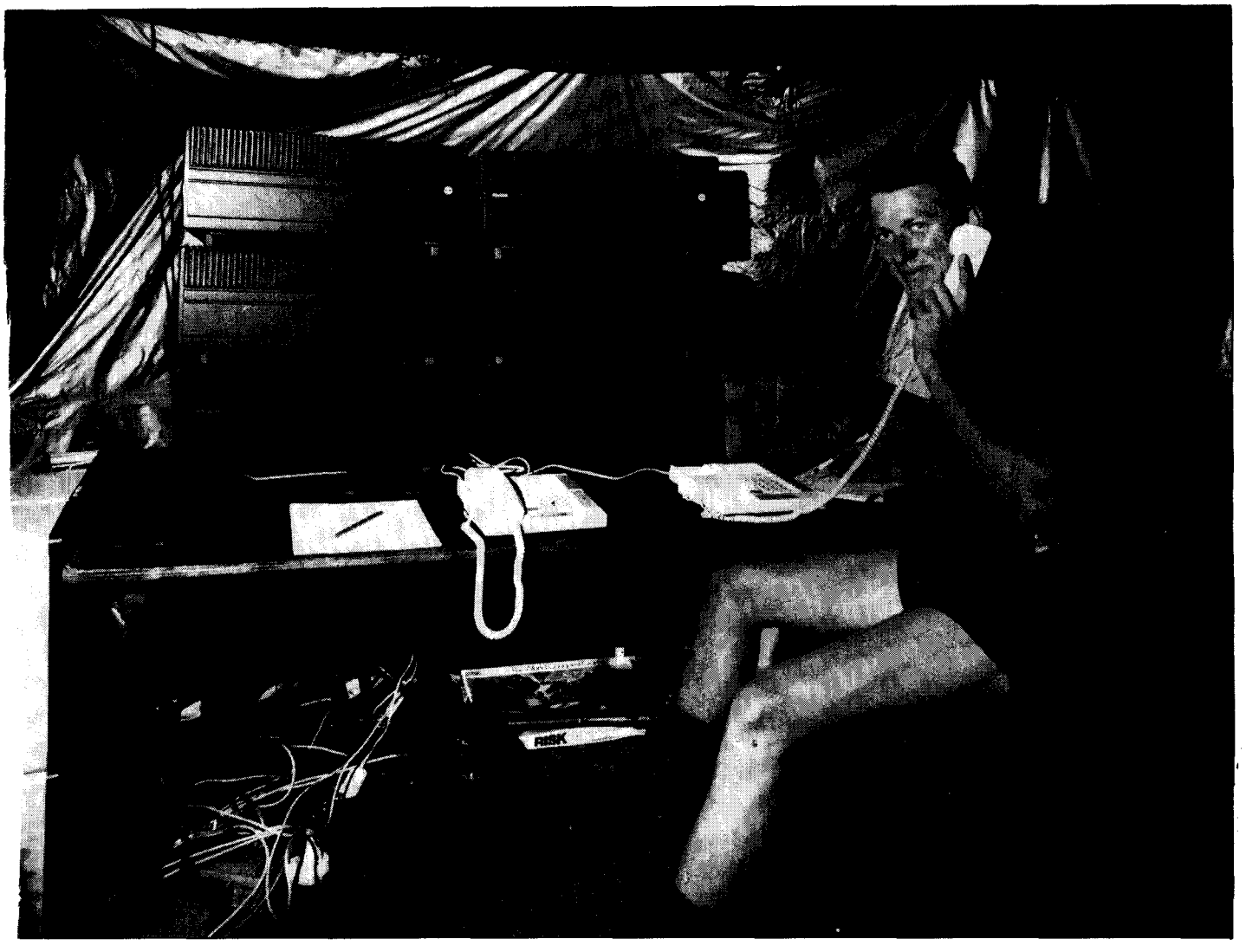
Radio communications were unusually bad during Kangaroo because sun spot activity is the worst it's been for 18 years. Long range reconnaissance patrols found themselves having to send vital daily reports by public telephone or from isolated homesteads, because their radios weren't getting through.

Naughty practices

Headquarters officers were by-passing the military radio net to send important messages to forces in the field, and using telephones instead — a very naughty practice. Almost every third message was sent that way, according to Army statistics. Groups in the field had telephones connected to the public switched network for general access and, as an emergency backup, via direct lines and Iterra satellite dishes. Headquarters was so concerned at the improper use of telephones that they obtained traffic reports from Telecom identifying the destinations and sources of Headquarters calls.

The Iterra dishes that were supposed to provide a redundant path between Headquarters and groups deployed in the field suffered poor voice quality, frequent line faults and problems encrypting data. They also annoyed many officers by standing out so prominently, for they were pristine white and couldn't really be camouflaged. Nor could the dishes be moved without first ringing up Aussat for permission, and then spending up to two hours re-establishing the link up. US forces exercising alongside carried suitcase sized satellite dishes that attracted many envious glances.

The Iterra dishes did come into their own when enemy commandos destroyed a vital radio repeater station



connecting 1 Division, at Katherine, with the Army's Land Headquarters, in Darwin, thus severing the primary link between the two. Bouncing messages off satellites then became the only way of communicating and voice quality ceased to be so important.

Communications were particularly important during Kangaroo because forces were spread over such awesome distances, from the Kimberleys in the west to Weipa in the east, a characteristic of defending Australia. The comparisons with Europe and the USA are dramatic. There, the 12,000 troops of a division would be spread across 20 kilometres. In Australia, they would be scattered across 1,000 kilometres.

This means Australian forces carry two types of radio — a VHF set with a range of 20 kilometres for local communications, and an HF set with a range of 300 kilometres for talking to rear headquarters. It also means Australian commanders must include enough information in radioed instructions to enable subordinate forces to continue their tasks should they lose communication later.

Little wonder the Army is about to acquire a completely new communication system.

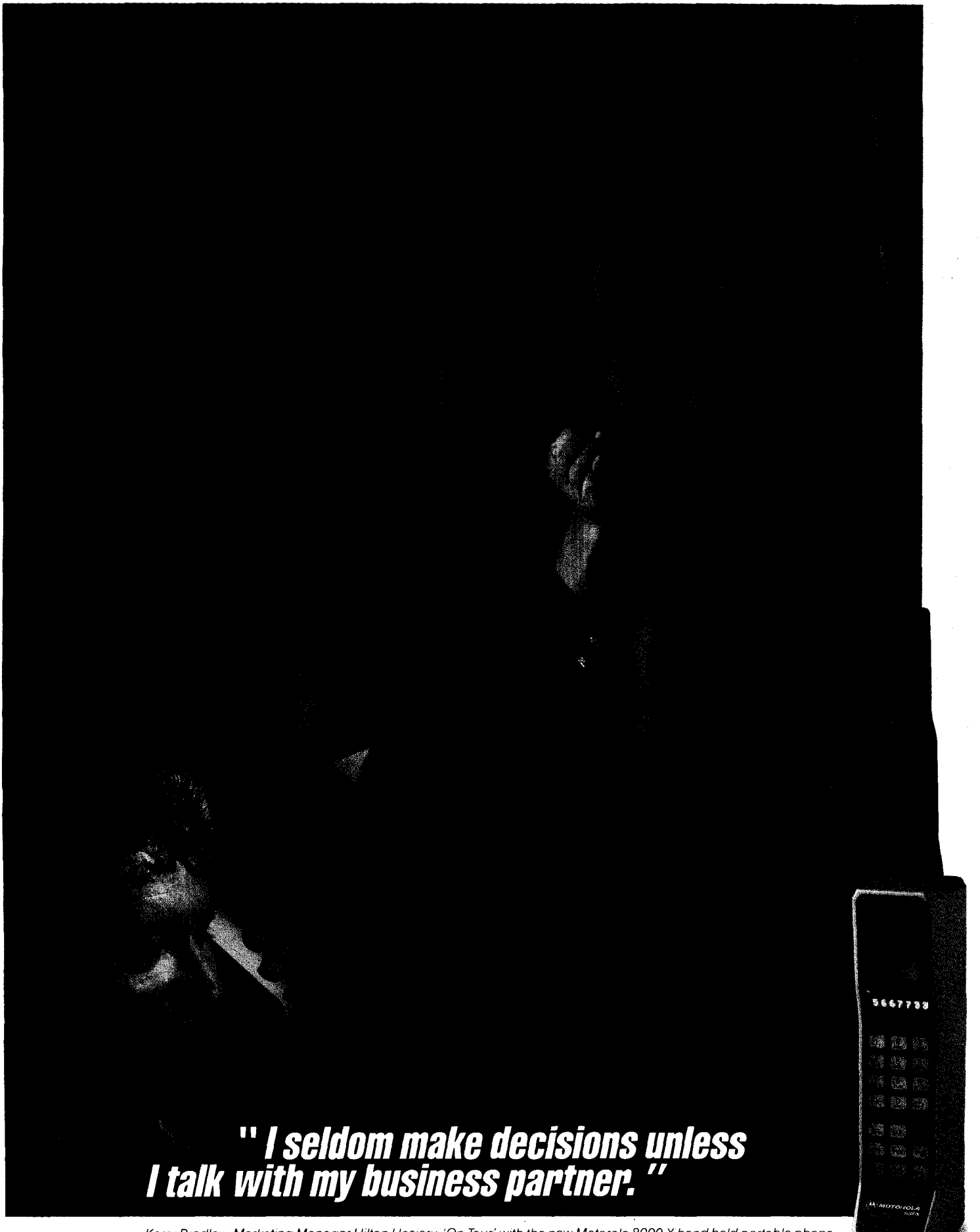
The system comprises a high capacity, secure backbone network connecting the capital city headquarters, a programmable frequency agile backpack radio for combat forces and an innovative tropospheric scattering system to link the other two.

The trospospheric scattering system, Parakeet, will handle the messages streaming between a division in the field and the Army's Land Headquarters, which is hooked into the backbone network. It will bounce its signals off the troposphere, obviating the need for vulnerable repeater stations every 80 kilometres.

Also in the wings is a transmission compressor and electronic encoder for use by special forces such as the Special Air Services, Commandos and Norforce. Called PACE, the device encodes messages keyed into it and then transmits the entire coded message in a rapid burst. It replaces a system where signallers must laboriously hand code messages from one time pads, and then read the coded message. Burst mode transmission reduces the likelihood of enemy listeners intercepting the signal.

At the end of the day

It's night at 1 Division headquarters, the 1,000 troup nucleus that supports and commands 12,000 troops. Signals officer Captain Chris Robbins wends his way unerringly over the square kilometre of featureless bush to find various people. He navigates by the sound of the different generators. Smart. . ■



— *Kerry Bradley, Marketing Manager Hilton Hosiery, 'On Tour' with the new Motorola 8000-X hand held portable phone.*

READER INFO No. 78

Aside from being the marketing force behind Hilton Hosiery, Kerry Bradley is heavily involved in the company's product development. And as such, one very busy man who hasn't the time to waste looking for telephones every time he needs to make a call.

So we invited him to take the new release, *alpha-numeric* Motorola 8000-X hand held portable 'on tour' as his business partner. When he got back, Kerry told us he seldom made marketing decisions unless he talked with his business partner.

"More importantly, my office always knew the **one number** for reaching me – I didn't need to tell them every time I changed location," he said. "To win in the fashion stakes, you need to be in touch, at all times. So my new Motorola portable is my perfect business partner."

The new Motorola 8000-X is a solid, hand-held portable phone with two hours continuous talk time or 25 hours standby, on one battery charge. Plus a new, 'silent ringer' that lets you know there is a call, without interrupting important meetings.

The new *alpha-numeric* Motorola 8000-X – it's the smartest business partner you could ever talk with. So call your Motorola dealer, today. And talk with him.

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Cellular Winning with Quality.

To: Motorola Cellular,
Freepost 22, P.O. Box 294, Springvale, Vic. 3172
Telephone (03) 566 7733, 008 331 703
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Should there be competition in CMTS? Austel's enquiry into cellular mobile telephone services has received lengthy submissions from over thirty interested parties. The matter could well become an election issue.

THE CMTS DEBATE — NO PERFECT WORLD

BY STUART CORNER

This article has a 1000:1 compression ratio; it's about the submissions to Austel's enquiry into cellular mobile telephone services. Austel received over 2000 pages and over 30 submissions; this article is just two pages long. There were also 1000 or so pages from organisations such as Defence and Police; but these were confidential, so we can't talk about them. Austel is selling copies at ten cents per page, which means you can get mountains of information (and the fruits of countless hours of expensive research and consultancy) for about $250.

With only two pages to review 2000, some grand simplifications are obviously required. Austel's enquiry is governed by guidelines issued by Transport and Communications Minister, Ralph Willis. There are 17 points in all, but these can be reduced to three basic issues which Austel is instructed to consider, and which those making submissions to the enquiry were required to address:

(1) Should there be competition in CMTS?
(2) If yes, how should it be regulated? And,
(3) what technology should be used?
(4) When should we get competing services?

Common Ideas

Among the diversity of views, one or two common ideas did emerge. No-one seriously recommended more than two carriers in any area, and auctioning the spectrum capacity to determine who should be that second carrier was not a popular option. Most of the pro-competitive submissions from potential carriers recommended the granting of a licence after a comparative assessment of the merits of the rival bidders. Fearing that any delay would further entrench Telecom's monopoly position, several submissions called for a second operator to be able to resell capacity on Mobilenet as soon as possible.

In addition to the mainstream submissions from organisations lobbying for or against competition, there were a few from organisations with peripheral interests.

Aussat, for example, whose two page submission had the distinction of being the shortest, does not see itself as a provider of CMTS and has not taken any position on the issues above. What Aussat wants is the right to carry traffic between centres for any second CMTS operator. So, for example, if a user on the second CMTS service in Melbourne dials a normal telephone number in Sydney, his call could be carried from the CMTS exchange in Melbourne to the CMTS exchange in Sydney via Aussat, and then into the Telecom public network.

OTC's concern is that it will have to connect overseas calls to and from both the Telecom mobile network and its competitors.

OTC's concern is that it will have to connect overseas calls to and from both the Telecom mobile network and its competitors. It could simply route all calls to mobiles from overseas into the Telecom PSTN but it also wants to have direct connection to separate mobile systems. OTC also wants to exercise its right to bill mobile customers directly for international calls. The fact that it does not bill normal international calls direct to the customer has always been a concern to OTC. It means it has no contact with, and therefore very little market data on, the source of 90 percent of its income.

An interesting submission comes from Vistel Ltd, the company operating the Victorian Government's pri-

vate network. Vistel envisages that the numerous separate mobile radio services it operates for government bodies will be integrated into a single trunked mobile radio system (it is expected that there will be a general shift away from dedicated private mobile radio systems to shared trunking systems over the next few years, because they make much more efficient use of an overcrowded radiofrequency spectrum). Vistel wants to be able to offer use of this service to non-government bodies, and suggests that it should be allowed to do so with a limit of 40 percent of non government usage "so that it would be clear the network was fundamentally established for government."

Hard Information

Austel asked that all submissions be supported as far as possible with hard information. ". . . bare assertions without hard information will be of less assistance than quantitative analysis." Many of the submissions were long on assertions and short on hard data. Not surprisingly, those that did use hard data managed to come up with quite different results. For example, conclusions differ widely on the key question of how inefficient, in terms of spectrum usage, and how costly in terms of duplicated infrastructure, it would be to allow a competing carrier. Figures for spectrum use inefficiencies for two as against one operator range from 11 to 20 percent.

There are undoubted fundamental inefficiences when you split the available spectrum, but several submissions argue that these fundamental inefficiences are outweighed by human inefficiencies in a monopoly situation where there is no competitor to spur the operator to maximum efficiency. For example, in the USA the same amount of spectrum supports more users than in Australia, even though it is shared by two operators.

What will be the outcome? If Austel were to make its decision by ballot among the organisations making submissions then competition should win. Public submissions advocating competition outweigh those promoting the retention of the monopoly.

It has been suggested that the whole affair is simply a public relations exercise, and that the government has already made up its mind. On that score, it is worthwhile noting that this enquiry was foreshadowed in the May 1988 statement. At the time, Austel would be required to simply investigate the impacts of competition and recommend whether it should be permitted. When the ministerial guidelines were issued, the scope of the enquiry had been expanded greatly. Austel was told that should it recommend competition, it should report on how and when competition should be introduced.

This would indicate that some factions in Canberra are for competition. There is, however, the Labour Party Caucus (affectionately known by Opposition Communications Spokesman, Richard Alston, as the Telecom Preservation Society) to contend with. Austel is due to have its final report to the Minister by the end of March, which should be just before the election. Could CMTS become an election issue? Telecom predicts user numbers will reach 800,000 by 1995. That's a lot of votes. ■

SUBMITTING ORGANISATION	Pages	Competition for or against	Proposed start date	Method of introduction	Future technology
AIIA	4	Y	July 1990	—	—
Alcatel STC	35	—	—	—	GSM
ATEA/ATPOA unions	96	N	—	—	—
Attorney General's Department	Cfl				
Aussat	2	Aussat wants to carry traffic for any 2nd operator			
Australian Associated Press Group and Cable & Wireless	105	Y	ASAP	2nd carrier	AMPS
Australian Federal Police	Cfl				
Australian Telecommunications Users Group	132	Y	Nov 91	2nd carrier	AMPS
Baring Brothers Burrows & Partners Ltd and McCaw Cellular Communications	68	Y	—	—	—
Bond Media	164	Y	1990	resale	—
British Telecom	98	Y	late 92	2nd carrier	GSM
Cantel	91	Y	—	—	DAMPS
Defence Department	Cfl				
Ericsson	99	N	—	—	—
Exicom	8	wants maximum opportunity for Australian industry			
Fujitsu Australia Ltd	8	N	—	—	—
Hutchison Telecommunications	98	Y	1993	2nd carrier	—
Link Telecommunications	473	Y	Nov 90	resale	AMPS
Luis M Heusch	85	Y	—	—	GSM
Millicom Australia Ltd	179	Y	1990	2nd carrier	—
Monict	54	Y	ASAP	—	—
Motorola	9	Y	—	—	DAMPS
New Zealand Ministry of Commerce	4	Y	wants equal access to market under CER		
Nokia Telecommunications	11	—	—	—	GSM
OTC	37	submission on interconnection with international network			
Pacific Telesis	170	Y	ASAP	resale	—
Philips	9	N	—	—	GSM
Public Sector Union	17	N	—	—	—
Racal-Vodafone Ltd	8	Y	—	—	GSM
Telecom New Zealand	185	Y	Mar 92	—	GSM
Telecom Australia	84	N	—	—	—
Vistel	6	submission covers resale of trunked radio capacity only			

Notes:
Cfl — confidential
DAMPS (Digital Advanced Mobile System) is the digital evolution of AMPS. AMPS is used by Telecom for Mobilenet.
GSM is the European Groupe Specialie Mobile digital system.
Neither GSM nor DAMPS is likely to be commercially available before 1992.
Resale means the reselling of capacity on Telecom's present network by third parties, so as to allow competition as soon as possible.

READER INFO No. 337

UPPING THE ANTE

BY JANE McSWEENEY

New Zealand Telecom offshoot, Netway Services, is upping the ante in the electronic data interchange (EDI) and electronic messaging business.

Netway Services was set up as a joint venture company between Telecom and Freightway Holdings to capitalise on telecommunications deregulation. It is headed by Malcom Dick, former managing director of the Freightway-owned computer bureau, Computertime.

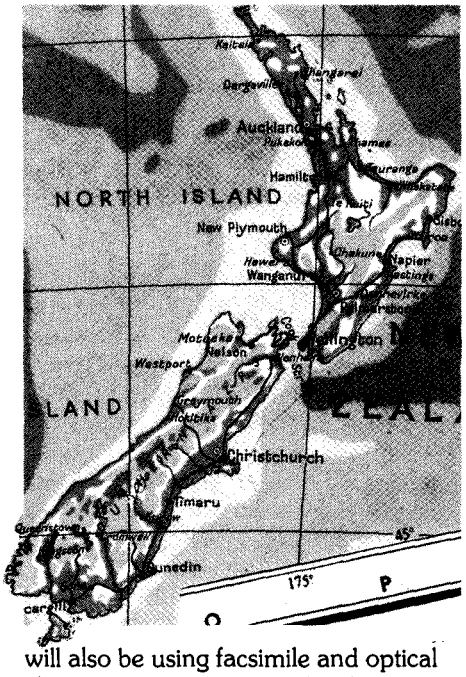
But on October 1 last year, Netway Services merged with Telecom's electronic messaging entity, StarSystems, and Freightway's wholly owned subsidiary, The Telegram Company. StarSystems incorporated Starnet and Startrade electronic mail and EDI services.

The recent mergers capitalise on acquisitions of small communications companies which complement Netway's X.25 packet switching network. All Netway's services have been moved onto a two megabit backbone network installed by Freightway and which connects New Zealand's main centres.

The moving and shaking has effectively rationalised Telecom's electronic messaging services and introduced a big player to rival value-added competitors such as Datacom, Cardinal and Centron.

Netway has already indicated its interest in strengthening EDI. It inherited Telecom's Starsystems bases, which included the Mobil EDI system, one of New Zealand's first EDI sites. It plans to invest millions of dollars in an EDI server this year and has made an alliance with the Society of Customs Agents.

Recently, it won a tender for EDI services for the Justice Department's vehicle securities register. The register



will also be using facsimile and optical character recognition technology.

The tender is the first EDI service to be publicly let in New Zealand and is expected to be the first of many government departments.■

MOBILE AUCTION

Mobile cellphone airways in New Zealand go up for auction early this year, a move which has been severely criticised by users. Subject to the passing of the Radio Communications Bill last November, the Commerce Ministry will start assessing potential bids this year.

A consultant's report commissioned by the government to assess the commercial prospects of selling off radio frequencies, said the cellular phone market could be worth $120m.

The ministry expects bids from around 12 companies resulting in the eventual establishment of three operators.

Announcing the tender process, Minister of Commerce, David Butcher, said bids received will enable the ministry to design packages of frequencies for tendering which will best meet market demand.

Telecom has criticised the auction saying it will have the opposite effect to what the government intended with its deregulation of the telecommunications market.

Speaking at the Telecommunications Users Conference in Wellington recently, Telecom's Auckland managing director, Don Sledge, said deregulation had created an open, competitive market with potential benefits for many users. But, he said, the auction concept would mean substantial price increases. Sledge condemned the auction system as an inefficient form of taxation and inappropriate for New Zealand.

Sledge said there was no guarantee Telecom could match the highest bid. "Recent price offerings for cellular companies in overseas markets indicate speculative transactions which go well outside normal expectations from further earnings generated within the business." Recently, British Telecom bought into McCaw Cellular (US) at a New Zealand cost equivalent of $347m.

Telecom fears the spectrum may be sold solely to overseas interests who might not even want it for cellular phone use.

Sledge raised the possibility of a limited cell phone network. Would it operate nationally as at present, or be a major metropolitan system only? Would it be marketed through existing dealer franchise systems or as a closed shop arrangement? Would customers be able to use the same handsets in which they have already invested some $20m?

The Post Office Union has, for once, agreed with Telecom's Don Sledge, but for different reasons. It believes the government is losing control of a valuable natural resource. It says ownership of parts of the spectrum will give vested interests the ability to make vast sums of money at the consumer's expense.

READER INFO No. 333

A communications network installed by the NRMA in 1986 has provided the company with plenty of scope for future expansion. Now handling twelve million calls a day, the system is a far cry from the 37 choked and disparate switchboards of three years ago.

NRMA: NO MORE CROSSED WIRES

Until three years ago, the Sydney-based National Roads and Motorists Association (NRMA), Australia's largest general insurer, juggled its five million plus calls annually through 37 separate switchboards. Further, the PABXs were of various types, technologies and ages and disparate in that they were standalone branch units. The one centralised enquiry centre, employing up to 80 people, was becoming overloaded; there was

Although this new system will cope with traffic increases for some time yet, the NRMA is looking to cost effective solutions to extend it past capacity.

no co-ordination of technology, no communication between PABXs, and the whole was run by the administration division rather than the Information Systems department.

An analysis of telephone activities found that in the order of 62 per cent of customers made their first contact with the NRMA and that telecommunications represented the NRMA's third largest expenditure item. According to John Woolford, manager/communications, the external analysis served to highlight the need for a co-ordinated, properly managed and controlled communicatory system — the first private ISDN voice network.

When the NRMA went out of tender, the technology they asked for wasn't available. "We asked for integrated ACDs (automatic call distributors) and sophisticated voice data integration," explained Woolford. "Back then, GEC Plessey Telecommunications (GPT) was in the best position to supply it.

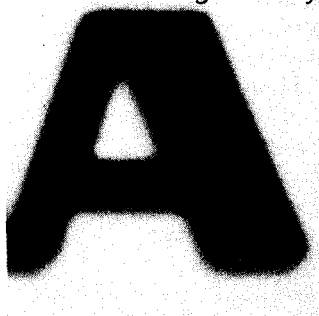
"In 1986, we installed the network, initially consisting of 18 PABXs, all ISDXs with dual processors and battery back-ups. Links between PABXs are two megalink, providing 30 concurrent voice channels at 64Kbit at each link. There are a number of tie-lines to associated organisations' PABXs, like our solicitors, the Ericcson system used in the road service and smaller branches on Commander systems or external extensions."

Implementing the network wasn't entirely painless. According to Woolford, the biggest problems

have been with users. "We moved very quickly to install, putting in a PABX a week, and it just wasn't possible to train people.

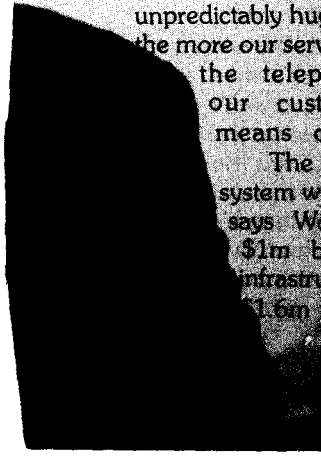
"There were two aspects that had to be faced: a reaction against using some of the better features of the system (people just used it as a basic telephone); and a reduction in the reliability of the whole network — software, firmware and some finger problems. With the old phones you had 99.999 per cent reliability: the new system is 99.9 per cent reliable. The minute percentage drop really kicked us around credibility wise."

Growth over the past four years — including latent demand in terms of people using phones across the branch network — means that the system, which was designed to handle five million calls per day, now handles 12 million. Early activity couldn't be measured because a network management system was not then available. An Orbital system from ANM, a joint venture company between Orbital UK and Telecom Australia, has now been installed and indicates a huge amount of redundancy was inadvertently built into the system which has subsequently proved to be worthwhile.



For instance, a two-node PABX was installed in Head Office because it was thought demand would be such that two distinct processes would be necessary. They have now found they can handle even the additional traffic on one. Says Woolford: "We were the first to install a network of this scope and technology and we had nowhere to go for experience. It has meant we haven't had to panic with the unpredictably huge growth! It appears the more our services are available via the telephone, the more our customers adopt this means of contact."

The original cost of the system was around $6m with, says Woolford, a further $1m being spent on the infrastructure and another $1.6m on integration of the



ACDs and a general clean up of the network.

A major objective was to create more enquiry centres and smaller, more manageable units to give better service to our customers.

The network is configured around a central loop encompassing Blacktown, Hurstville, Sydney and Chatswood and is based on a clockwise overflow of calls. The integrated ACD means if the queue is too long in Hurstville the overflow goes to Blacktown: if Blacktown overflows it goes to Chatswood, and from Chatswood to Sydney. Enquiry centres in Canberra, Newcastle and Wollongong are also connected to the network.

From the outset, the NRMA has been pushing the technology and continues to do so. All but introduced is voice/data integration (it was implemented to a large extent and was taken out again because of too many unreliability problems).

"Most organisations insert data into the system via a box residing on the megalink between PABXs," says Woolford. "If they want a data link it goes onto the megalink through those boxes, basically just using the megalink as a carrier.

"We are using 2B+D handsets (2 baseband plus data channel) and send data through those to the PABX and into the data network." When it is completed and running successfully. Woolford estimates a saving of around $500,000 per year in Telecom charges.

Implementing the network wasn't entirely painless. According to Woolford, the biggest problems have been with users.

Advanced functionality is planned through the installation of ACD software in every PABX.

"Although we won't use an ACD in every location in the foreseeable future, it gives us the ability to set up a queue and an enquiry centre function, or any new business function necessary to maintain our advantage at a moment's notice.

"There will come a time when the enquiry centres in the metro area become congested; or we want to arrange them differently to take advantage of employment opportunities in country areas. In short, it gives us the ability to plan the network to suit our needs,

"One snag arising from the early adoption of advanced technology is the choice of protocol standards that may not fit with future services that Telecom or others may offer," points out Woolford. "This is evident with Telecom's ISDN, which uses Common Channel Signalling No. 7 (CCS7) protocol, an agreed CCITT standard for ISDN. However, our network is based on DPNSS standards which allows for PABX to PABX communications for which no international standards exist. This restricts our ability to adopt public ISDN for contingency purposes as a separate channel is required to carry DPNSS signalling."

Woolford added he was concerned that Telecom appeared to be putting considerable resources and effort into TeLink, which has yet another protocol, and one that is not recognised as an international standard.

Although this new system will cope with traffic increases for some time yet, the NRMA is looking to cost effective solutions to extend it past capacity — radio is one answer. (The NRMA already manages an extensive microwave radio network for the road service, which is a digital VAX based dispatching system interfaced to the radio network through PDP11 processors. It consists of five towers around the metropolitan area, all of which cover most of the metropolitan area. Thus, if one goes out of action the rest cover, so no area is out of reach. It also works on a best reception algorithm where, regardless of proximity to a particular tower, a road service van receives the strongest signal (perhaps from a more distant tower.)

Says Woolford: "There is a point in the size of the network where it becomes cheaper to buy radio links than to buy more mega links. The breakeven point, we believe, is two megalinks per route — beyond that, radio is cheaper. We are investigating satellite for country areas.

"There is definitely a trend towards greater use of the telephone to transact business, so we have made it a priority to continue research into better and more cost effective ways to meet that trend." ■

Shelley Spriggs

READER INFO No. 336

MANAGEMENT

A survey earlier this year of some thirty companies in the plastics industry showed a distinct lack of desire on the part of management to move with the times and employ new communications technology — almost certainly to the detriment of productivity and profit. Why?

AVOIDING THE INEVITABLE?

BY KELVIN FAHEY

How often do we hear complaints that Australian management is slow to adopt new technologies and practices designed to lift productivity and competitiveness? Claims and counter-claims pervade the media as both the business community and government seek causal links to poor trade performance. Little in-depth micro-economic research has been done to evaluate such claims. So what is actually happening out there?

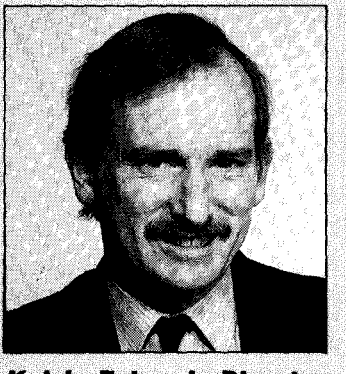
In terms of information technologies — and communications equipment in particular — a recent survey of establishments in the Australian Plastics Industry might serve as an indicator that we do have a long way to go in lifting our technological edge in management and marketing, let alone in production. The survey, conducted by SIRA Australia during July this year, highlighted the short term vision of many managers comprising both small and medium sized businesses in the industry.

Based on individual establishments, rather than overall company operations, the survey pin-pointed what equipment was in place and its level of use in every day work environments. Such environments may alter between straight sales activities, accounts and competitor analysis. Some thirty processing establishments were evaluated in the survey. These represented most mainstream plastic product lines, ranging from pipes to packaging films. Total annual turnover of the combined establishments was valued at $320m, although the size of the firms, on an annual sales basis, ranged from $300,000 to $34m.

An array of findings

The survey produced some interesting conclusions, such as:

- An avoidance by almost all establishments of more complex technologies such as networks, electronic mail and international communication links. Only five firms had installed local area networks, four of these also being connected to international networks, via micro-computer links. Three of these establishments were foreign-owned by firms that had encouraged technology integration in all their world operations. Interestingly, one of these firms had a turnover of less than $4m; the other firms were amongst the largest establishments covered by the survey;



Kelvin Fahey is Director of the Canberra-based consultancy SIRA International.

- All but two operations had installed facsimile equipment. One of these had access to a facsimile next door, whilst the other's management could not see the benefit of such technology. With one exception, management was enthused by the speed and convenience of the humble fax. "It brings in orders, we can chase debts in the time of a phone call but with the urgency of a commandment," and, "We can move mountains faster,' were typical comments;
- There was a marked decline in telex use by all establishments. Of the majority of firms that did not have a telex most had disposed of such equipment over the past five years. All claimed the advent of facsimile equipment had rendered the telex redundant. Of the eleven operations which utilised telex service, in-house management admitted minimal use relative to facsimile, the exception being in transmitting to firms without facsimile equipment, particularly in India, the Middle East and, surprisingly, the United Kingdom.
- The omnipresent personal computer had made its mark in almost all firms. However, this development was only recent, with three quarters of the establishments surveyed admitting that they had purchased the equipment within the past two years — and then largely as either a word processor or accounts reconciliation system.
- Computer and communications literacy was less than suppliers would desire. Few managers had more than a minimal knowledge, if any, of modems, ISDN, OSI, Viatel and networks. This may be seen as understandable by some, but it was the lack of enthusiasm to investigate such options that was seen as perplexing by this writer. In fact, only three operations reported using their personal computers for activities other than word processing, finance spreadsheets and, in a few instances, databases of customers.

Between the lines

Interesting results, but what were the main driving forces behind these patterns? Should we conclude that such manufacturers are up to scratch, in that they have adopted the lowest cost and least time consuming technologies in order to achieve fast results? The answer, for this writer, is *not really,* although your answer may depend upon your perspective of

business.

Virtually all firms that were not networked insisted that the cost and their relative size precluded them from upgrading and integrating their manufacturing and marketing activities with more efficient electronic communications and computing equipment. This was despite an average growth rate in annual turnover of around sixteen per cent

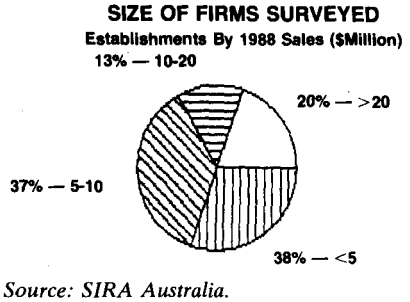
To be fair, many of the operations may well not have been suited for technological integration, just as many establishments could not justify full automation. However, all but two firms had not undertaken any professional evaluation of the potential of adopting more complex or integrated information systems. One comment perhaps summarised it all: "The current routine with our personnel seems to work well enough; and it doesn't get us more sales." Heard that line before?

Other remarks concerned the lack of skilled personnel to operate such technologies. Training time was at a premium, with virtually all operations being classed as lean, driven by profit centre and cost recovery management strategies. In some instances, management-worker relationships were in question. This went to extremes in some cases with one managing director commenting "If I can't understand it, why should I trust somebody else who can? At least manual methods are traceable and therefore accountable." Some truth here, but fortunately this opinion was not shared by other line managers who admitted that senior management bias against new technology was restricting productivity and quality control advances.

In relation to technologies that were readily adopted, such as facsimiles, personal computer and car telephones, three prime reasons stood out for management purchasing:

- First and foremost was the ability to transact business at greater speed and with more flexible time horizons — that is, out of business hours. One manager suggested that he now worked longer hours due to his firm calling him on the car phone.
- Secondly, price was seen as a major factor encouraging small purchases and restricting others. Many establishments had limits on what capital expenditure could be autonomously incurred without redress to head office. Such monetary cut-offs varied between $2,000 and $50,000.
- Thirdly, results orientation that management could physically see or hear was considered crucial. This covered a variety of rationales. For example, much computer equipment and software promoted by local technology suppliers was seen as academic and beyond the needs of the firm, with no chance for obvious runs on the board to be shown to management. Also, some management saw a time lag in training for more complex items such as microcomputers and networking.

Therefore, cheaper communications equipment which could produce discernible visual or audible results were largely favoured by management. This is not to say that such equipment did not lift productivity, as there was strong consensus that in financial management and sales activities purchasing of computer and communications equipment was being regarded as standard issue considerations. All firms using car telephones gave priority to marketing and sales staff with a lone example of a production manager also possessing such an asset.

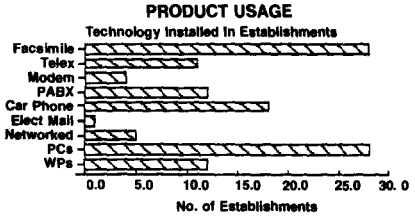


Source: SIRA Australia.

Production technologies

So what about the manufacturing side of the action?

In all but two instances, there was no direct linkage of production line equipment to centralised monitoring for quality control. This is markedly different from many of the American and Japanese counterparts of the firms surveyed. In all cases, numerically controlled production equipment regulated production timing flows and technical parameters. Such machinery has jumped leaps and bounds in recent years, with many containing quite sophisticated mini-computers as an integral operational component. This, however, did not always guarantee consistency within such parameters, with reject rates as high as fifteen per cent. Fortunately most rejects could be regranulated and mixed with virgin polymer raw materials. However, downtime, as any quality control expert will tell us, costs money — better to fix the fault on the line rather than at the end.



Note: Sample size 30 plastics processing establishments with aggregate turnover of $320m in 1988.
Source: SIRA Australia.

In contrast, the two firms with integrated production monitoring/inventory/sales systems had reject rates of less than two per cent in volume terms and minimal stocks, which management argued meant either lower consumer prices for their products or higher unit profit margins if prices were not reduced. The management of these two firms could proudly point to any stage of the production process, cost it, check quality and estimate despatch time — on the spot, not in twenty minutes.

Their cost and quality achievements are tangible; some would say internationally competitive, as they export between ten and thirty per cent of their output.

While some of these results may be seen as extreme, it should be remembered that the plastics industry in Australia is one of the few leading growth sectors of manufacturing, with exports rising in a "J" curve effect (up sixty per cent annually between 1986 and 1988) and employment levels also increasing — both trends against an otherwise lethargic manufacturing industry. What such results hold in store for less growth orientated manufacturing sectors is left to the reader. ■

INTERACTIVE EDI : TAK

With demand for air travel literally booming, airlines are recognising that EDI is the way to go and that the interconnections systems of yesterday are fast becoming dead end streets.

Tony Morris

A travel agent in New Orleans requests a fare quotation from Qantas for a particular itinerary. The message is relayed through an American Central Reservations System (CRS) to Qantas in Australia. The Qantas CRS generates a message to British Airways in London where a data base is scanned to come up with a cash value of the ticket (there are thousands of ever-changing rules and regulations as to how much a fare should cost, so BA developed a fares system accessible to other airlines); that message is relayed to the Qantas CRS, a quote is generated and relayed back to the agent in New Orleans via the American CRS. In the time it has taken to read this far, that message has travelled round the world.

That remarkably fast exchange of information is possible using interactive EDI — the exchange of data within seconds between international trading partners — which has been a feature of the airline industry for some time in proprietory formats. This year, Qantas became the first airline to implement interactive EDI using the emerging international standard, EDIFACT.

According to Tony Morris, EDI manager of Qantek (Qantas Information Technology Limited) interactive EDI is essential to maintain an airline's competitive advantage or, at the very least, parity.

One American CRS processed more than 1600 messages each second during peak periods.

"The industry is very competitive and, with CRSs becoming ever dominant as delivery channels for our products, it is important we employ the latest technology.

"The imperative of adopting an internationally accepted standard like EDIFACT is broader product distribution at a relatively low cost. Information about reservations, schedules, fares etc, can be available to a wider audience."

Interactive EDI allows the introduction of new practices like 'Code Sharing' which Qantas has just got going with the American Airlines. "Code Sharing provides us with the means to sell tickets, for example, from Sydney to New York (a Qantas plane to Los Angeles and an American Airlines flight through to New York) and have the system in Sydney issue a boarding pass for the Los Angeles to New York leg. That means the Sydney CRS must interact with the American Airlines CRS while the passenger is standing at the check-in counter," explains Morris.

"Demand for air travel is booming and, unless systems are in place to speed passenger services like check-ins, departure control and baggage tracking, airports will just break down," he warns. "The more automated you become, the better you can handle large volumes and eliminate double handling, relieving traveller frustration and airport congestion."

Airlines have been using EDI techniques for the last 20 years with airline specific message standards for the exchange of passenger reservations, cargo and flight status data developed by the industry trade associations — Air Traffic Conference of America (ATC) and International Air Transport Association (IATA). The advent of CRSs meant exchange of booking messages and passenger lists between airlines literally took off. To cope, airlines installed high capacity

READER INFO No. 339

NG OFF IN A BIG WAY

shared telecommunications networks like ARINC in North America and SITA internationally. In 1988, ARINC delivered approximately four million EDI messages each day and one American CRS processed more than 1600 messages each second during peak periods.

The evolution of the Mega-CRS as a reservation system for all travel related services including hotels, cars, trains and tours has increased the amount of data exchanged between systems and nudged airlines into the realisation they needed to adopt non-airline-specific standards. In 1987 they settled on the UN-endorsed EDIFACT standard and this year Qantas, with trading partner Thai International, became the first to implement an interactive EDI service using that standard.

Essentially, Qantas is testing the work of two committees within IATA responsible for developing standard messages — Passenger Data Interchange Standards (PDIS) and Cargo Data Interchange Standards (CDIS).

Activities surrounding the flow of passenger data are dynamic and require real-time (less than three seconds) responses and a low cost per message; whereas cargo data can generally be transferred on a store-and-forward basis.

This year, Qantas, with trading partner Thai International, became the first to implement an interactive EDI service using the UN-endorsed EDIFACT standard.

The first messages to be traded interactively in the EDIFACT format were in the Flight Availability and Schedules/Timetables group which had not then been fully signed off by PDIS. "We elected to use the message formats as they existed in May last year to develop the interactive system with Thai International," said Morris. "There has been the odd amendment since, so we are now faced with some minor updating."

Qantas' EDIFACT package works with its Host To Host (HTH) package, which runs under IBM's Transaction Processing Facility (TPF). It includes message encryption and decryption for both the query and response, a security sub-system and a statistics sub-system.

The Qantas/Thai system serves as a base model for interactive EDI. Other airlines and their Mega-CRSs (Sabre, PARS, System 1, Amadeus, Galileo etc) are, says Morris, recognising that EDI is the way to go and that the types of systems interconnections used in the past are now dead-end streets.

Qantas is also developing its store-and-forward capability for cargo clearance by Australian Customs. Systems like EXIT Phase II and Cargo Automation are Customs initiatives that will be made available to Australia's trading community through the Tradegate network.

The carrier also has plans to implement EDI in the area of engineering and maintenance, and commercial purchasing with purchase orders and invoices; with finance groups for electronic funds transfer; and in the ordering and delivery of fuel.

Shelley Spriggs

EDIBITS

Automotive

The automotive industry has become the first Australian industry to universally adopt EDI, after trialling Telecom/ACI Computer Service's Tradelink EDI service between trading partners for almost two years.

READER INFO No. 349

Pharmaceutical

Fifty leading suppliers and two of the largest distributors of pharmaceuticals, Sydney-based Australian Pharmaceutical Industries (API) and Melbourne's Sigma, will implement EDI. The network will be developed by Telecom Plus and Ferntree Computing.

READER INFO No. 348

Primary

A communications network called Meatcom is being set up through a joint venture between T-Net and the Australian Meat and Livestock Corporation. The network hinges around EDI and is intended to reduce the processing delays for export documents in this industry.

And the wool industry has launched Woolcom, a Tradelink venture. Billed as the complete solution for export shipment preparation it is expected to save that industry $5m a year.

READER INFO No. 350

EFTPOS: A REVOLUTION TO COME?

EDI

BY PAUL F TAKAC

Director of the Centre for Technology Policy and Management, Royal Melbourne Institute of Technology

Technological developments are playing an increasing role in changing existing patterns of society. The way individuals conduct their business is being modified by electronics and communication technology. The retail and finance industries are currently experiencing particularly significant changes in this regard.

Only ten or fifteen years ago, it was difficult to obtain cash from financial institutions at weekends. Furthermore, credit cards were neither extensively held by Australian consumers nor accepted by the retail industry. This situation, however, was soon to change.

At the beginning of 1984, an American woman on holiday in Sydney decided to withdraw money from her bank in Arkansas. By using a credit union Rediteller in Bondi Junction and her Visa Card, she requested funds electronically via Telecom landline to North Sydney, satellite signal to Singapore, underwater cable to California and landline to West Virginia, thence to Pine Bluff. This request was authorised, funds were confirmed available and the order for payment returned by the same route. Approximately eight seconds later the automated teller machine (ATM) dispensed the desired amount. This was the first such transaction to take place between the two countries. It highlights the use of electronic funds transfer (EFT).

EFT is not, however, a recent development. Banks have been moving funds electronically to each other since the late 1960s. Since those days, three major developments in ATMs have meant that they can be used for select banking services of a retail nature. Lastly, plastic cards enable consumers to pay for goods and services.

Undoubtedly, one of the most important developments currently taking place relates to EFTPOS (Electronic Funds Transfer at the Point of Sale). The provision of EFTPOS facilities is central to the provision of improved retail and financial services. Furthermore, EFT is important from a business perspective, in terms of the simplification and consolidation of financial and administrative tasks.

A definition of EFTPOS

The most basic description of EFT concerns the paperless exchange of information and/or value relating to financial transactions. In other words, instruments traditionally used to complete financial transactions such as cash and cheques are substituted by electronic messages. EFT requires the use of computer technology and communication systems such as telephones. In the past few years the development of automated teller machines (ATMs) has also become an important component of EFT services.

EFTPOS relates to the application of EFT at the point of sale within retail outlets. In other words, customers pay for goods and services with a plastic card. The POS terminal within the retail outlets checks the customer's account balance to ensure there are sufficient funds and then debits the customer's account for the respective amount while the retailer's account is credited later that same day.

EFTPOS aims to reduce the amount of cash used, the number of cheques issued and the number of manual credit card transactions. The labour intensity and high cost of such transactions, as well as the time-consuming administrative procedures involved in cheques, make EFTPOS a very attractive alternative to financial institutions. EFTPOS then is a way of paying for what we buy through plastic cards rather than cash or cheque.

An important development

Developments in EFTPOS are important from both the retailers' and financial institutions' viewpoints, since usage of plastic cards has been growing significantly for the past five or six years. It is estimated there are some 20 million plastic cards in operation in Australia. Most of these are bank generated cards, including an estimated 5.5 million Bankcards, but an increasing proportion relates to 'in-house' cards. (For example, there are an estimated three million Myercards). Further, debit cards are following cash, credit cards and cheques in popularity. All trends indicate that consumers will increase their usage of cards, be they debit or credit, at the expense of other forms of payment.■

EDIBITS

Trade

The Australian Customs' EXIT systems makes Australia the first country to have a centralised EDI-based export reporting system. Over 800 users — export companies, freight forwarders, Customs agents and carriers — are connected, plus government departments including Defence, Primary Industry and the Bureau of Statistics.

Further plans for EXIT include facilities for payment through EFT, control of transshipment goods and excisable and under-bond products.

EDI for imports is also being developed by Australian Customs in its Cargo Automation scheme being piloted between Customs, Qantas and Air Express International.

READER INFO No. 346

Government

Supplynet, an EDI network for the exchange of purchasing related information between government and suppliers is being developed as a partnership between the WA government and Telecom. It will allow every current and potential supplier to access all the purchasing and tender information it needs on a PC, and keep government departments informed about suppliers and their capabilities.

READER INFO No. 347

Choosing the right computerised business information system for an organisation can be a daunting task, often leading to much greater expenditure than was originally anticipated and with the buyer still ending up with a system unsuitable for his requirements. The solution? Call in the experts.

TAKING OFF THE BLINKERS

BY ERNEST JOSEFIK

Now that it's possible to quickly access information from hundreds of sources around the world it's amazing that so many managers and decision makers continue to be frustrated by the delay of, or lack of, easily accessable information within their own organisations.

So why the frustrations?

Is it because these systems are not very effective? There are many good database software packages on the market. They can still be ineffective, however, if they don't solve an organisation's information requirements, or if it takes a computer science degree and ten spare hours a day to use them.

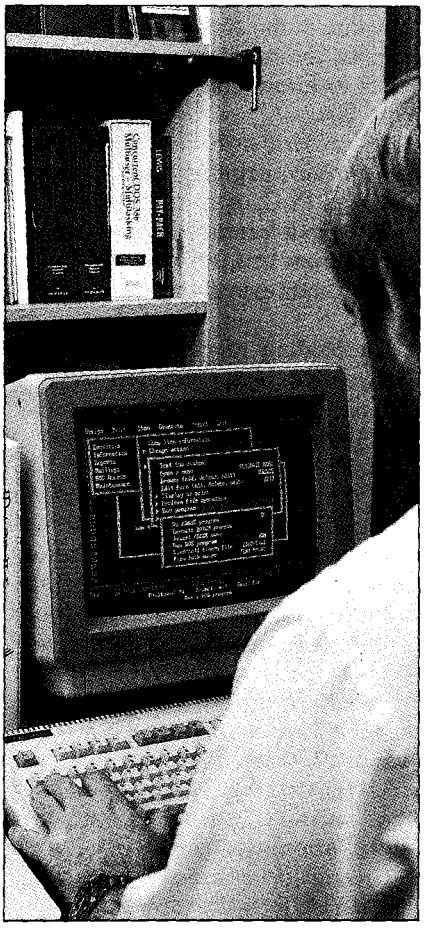
Surprisingly, this is a common situation in both large and small companies and can usually be traced to how a system was implemented in the first place.

There are still people out there who make the fundamental mistake of buying the computer hardware first, imposing huge limitations on the final system while leading to much higher costs than might otherwise have been necessary or expected.

Others have learned that lesson and start by looking for software before selecting the hardware. Whilst this is a better method, it still misinterprets the computer and software as being the complete solution.

As a result, blinkers are put on and the organisation's information requirements are perceived narrowly.

Too often the same limitations of paper forms and filing systems are transposed directly to the computer system. A prime example of this is the masses of accounting systems in



operation. All of these contain data that could yield valuable information for marketing and sales departments to turn to competitive advantage. Few, however, provide access to the information other than in the standard accounting formats such as accounts receivable, accounts payable, balance sheet, profit and loss, etc.

Opportunities are being missed.

The first step in overcoming these limitations is to forget about computers and software for a moment and try to understand what a business information system is and what it can achieve.

The main components of a business information system are as follows:-

1. The data: e.g. customer names, addresses, phone numbers, product names, price, description, customer orders, products, quantities, prices, etc.
2. People to capture and record this data. Almost everyone in an organisation is involved in collecting or recording some form of data. (The dreaded paperwork).
3. A means of recording this data: e.g. forms or data entry screens.
4. A means of storing the data.
5. A means of organising this data into useful information.
6. A means of retrieving this information in the desired form: e.g. management reports.
7. A requirement for this useful information? Strategic planning, the early detection of potential problems, financial reporting, answers to one off queries to aid in making a decision, etc.

Each of these components serves a vital function and lack of consideration in one or more areas could render the whole system ineffective.

One important point to note from this outline is that several of these components have a lot to do with managers and employees, their roles in the organisation and how they use information to fulfill those roles.

Database designers often start by interviewing and observing people at all levels of an organisation who are involved in generating, handling, changing, querying and/or creating reports from data, the objective being to gain a detailed understanding of

each user's requirements. These may vary from the data entry clerk who has to enter the same information twice into two different systems, to the salesman who cannot get quick information on a stock situation, to the marketing manager who might spend days manually charting data because he/she can't get the information he/she requires from the current system.

On the other hand, some procedures may be working very well and to change them could be a step in the wrong direction.

These types of investigations may also reveal that different sections of an organisation are busy collecting and storing some of the same data, for example the accounting, marketing and sales departments may all collect similar data on customers but for different reasons.

It is also a good idea to have people think about what information might help them perform their job better were it conveniently accessible, thus breaking away from current limitations and opening up new opportunities.

Whilst there is a lot more to database design than can be presented here it is hoped that these notes have helped give an insight into how initial design strategies can provide the foundations for an effective information system.

Seeking independent professional help in the design stage can lead to great savings in the future by putting together an unbiased solution (and perhaps alternatives) which are based on your organisation's real requirements. If you're determined to go it alone though, remember that most managers and employees don't have time to assume the dual role of computer expert (nor do they want to). A proper understanding of these people's information requirements will serve as a good indication of what software and hardware features would best serve the overall needs of the organisation. ■

Ernest Josefik is a senior consultant with Professional Advantage, a micro computer software house specialising in developing management information systems and implementing accounting systems.

British-based news and information organisation, Reuters Holdings PLC, moves information from its source to more than 168,000 video terminals in 137 countries around the world.

THE REUTER NETWORK

BY LIZ FELL

When Treasurer Keating makes an announcement that could impact on the value of the Australian dollar, the financial community around the globe wants to know first, and it wants to know fast.

The British-based news and information organisation, Reuters Holdings PLC, is in the business of moving this information from its source to more than 168,000 video terminals in 137 countries in the shortest possible time.

According to general manager, Michael Reupke, *Reuters is best understood in terms of markets rather than the content of its information services.

"We get about 93 per cent of our revenue from the business market such as bankers and brokers, and about seven per cent from the media market. Of course, a lot of information that goes to banks also goes to the media, and vice versa," he explained.

Reupke drew a distinction between Reuters and a newsagency such as Associated Press of America, which regards the media market as its prime business. "At Reuters, we regard news as a commodity that is sold to the media and business markets," he said.

"If a US jet is shot down off Libya, this is important: first of all to the bankers; secondly to television; and thirdly to newspapers, in that order. The bankers want it within one second, television needs it for the next broadcast, and newspapers want it tomorrow."

When Paul Julius Reuter first set up in business in Belgium using carrier pigeons, he would lock the stockbrokers in a room until the pigeon arrived and then read out the stock prices to all of them at once.

Reuters still operates under the principle that clients should receive their services — real-time information, transaction products such as automated trading, historical databases, and daily news stories and pictures — at the same time.

"In our foreign exchange dealing service, for example, we've got to guarantee contact to any part of the world within a certain number of seconds. The average is about 2.4 seconds, and four seconds is the outside limit we set ourselves," Reupke explained.

"So, if someone wants to deal between a bank in London and Singapore, that circuit has got to be there all the time and contact has to be made within that sort of period."

The Reuter reading service handles one third of the estimated US$300 worth of foreign exchange traded worldwide each day and has about 2300 clients.

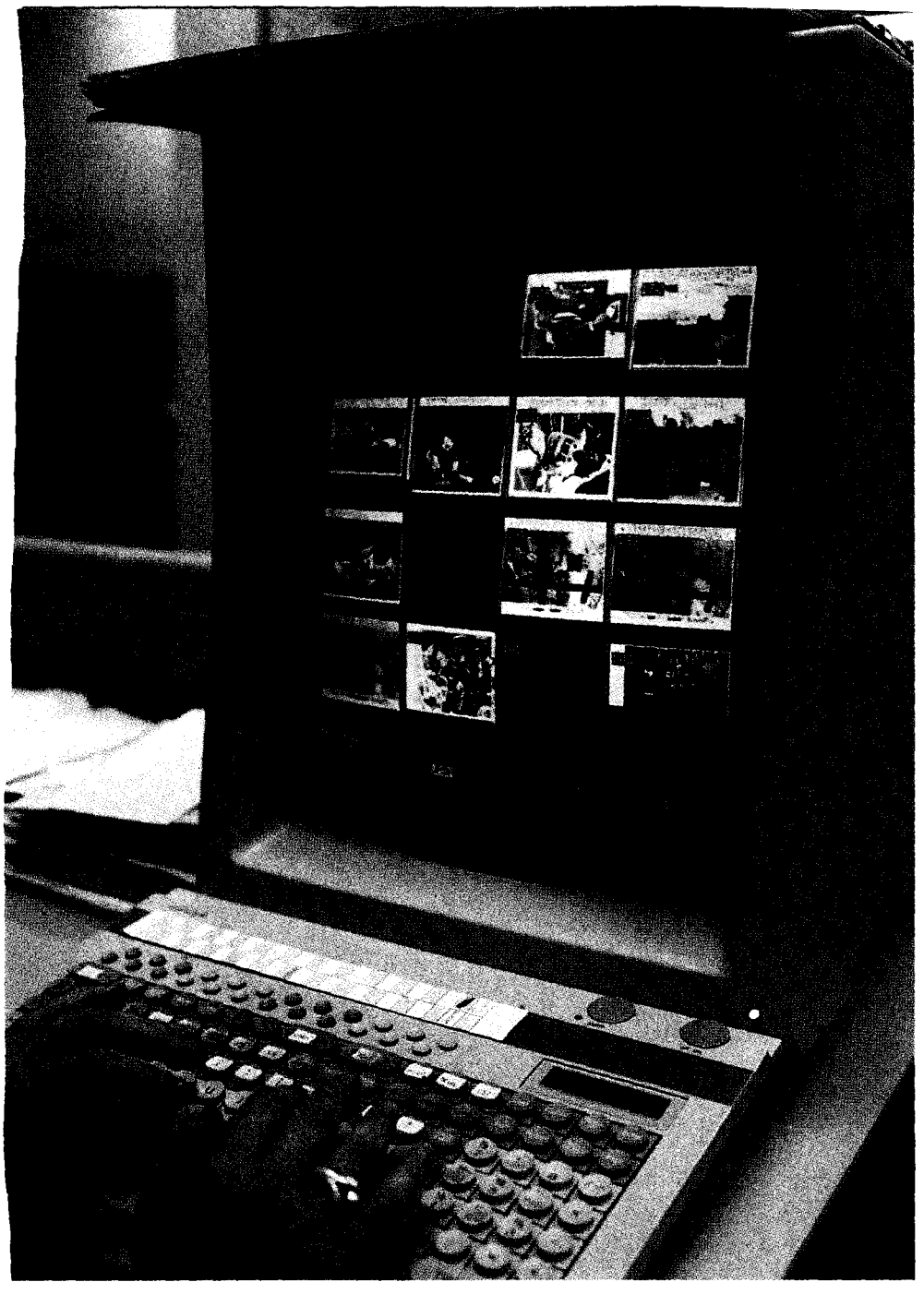
The financial marketplace for electronic information services has exploded since the early 1970s and Reuters is now facing fierce competition.

Lee Casey, chief executive of AAP Information Services, the company that distributes AAP Reuter services in Australia, estimated that the on-line business information market in Australia was worth about A$150m in 1988 and was growing at 30 per cent a year.

Reuter's biggest single global rival is the US-based conglomeration of Associated Press, publisher Dow Jones, and Telerate, a financial information and trading services company in which Dow Jones has a 67 per cent stake.

The US-based financial giant, Citicorp, has also entered the on-line information business through its subsidiary, Quotron. Citicorp has built a sophisticated international network with direct inter-bank links to 93

** Mr Reupke resigned in November 1989.*



countries, and was one of the first financial institutions to integrate its telecommunications, banking and financial services.

Reuters Asia

Reuters spends tens of millions of dollars each year on a co-ordinated network of cables, satellites and computers that transport its services around the globe.

It has divided the global market into three management areas: Reuters Asia, which stretches from Pakistan through to Australia and Japan; Reuters America, which includes North and South America; and Reuters Europe, Middle East and Africa.

Reuters Asia has been on a constant growth curve for a number of years, a reflection of the economic activity in the area. From the headquarters in Hong Kong, it operates one of the largest — if not *the* largest — private networks in the region.

Satellite circuits are used for international point-to-point links on trunk routes such as London-Hong Kong, though Philip Arnett, Reuter technical director, Hong Kong, said that reliable submarine cable circuits are preferred if these are available.

"We do find a marked resistance by the PTTs (Telecom authorities) to move public telephone traffic off the cables to make room for more time-critical services," he observed.

The PTTs have also proved resistant to Reuters' new one-way satellite broadcast service that was launched in Asia last year.

This service, which delivers stock prices, news and pictures to very small aperture terminals (VSATs), is uplinked from Hong Kong to an Indian Ocean INTELSAT satellite.

While it is "technically" alive and well, Arnett said, "panic sets in and a dozen hitherto unknown rules and regulations emerge from the woodwork" when the principle of a small dish on a customer's premises is outlined on to the PTTs.

When asked about these problems, Reupke replied diplomatically, "I suppose one has to say that monopolies always like to protect their position. We have found the situation most open in the USA, Latin America, and in some of the less developed countries where people are open to new ideas and technology."

Reuters requires separate transmission facilities for the daily television feeds from its Visnews subsidiary which now includes a special service in Asia, though Reupke envisages the day when an integrated services digital network will be able to accommodate all services comfortably.

Reuters Australia

Reuters Australia Pty Ltd has a long-term arrangement with AAP Information Services (AAPIS) for the distribution of news, real-time information and dealing services in Australia.

The local subsidiary, which employs some 55 staff in the technical and sales areas, remains responsible for sales of historical database services.

These services have recently been augmented through Reuters' acquisition of I.P. Sharp, which has specialist databases covering finance, economics, energy and aviation, and Finsbury, a leading textual database company.

The databases are delivered through I.P. Sharp's worldwide packet switched network, IPSANET, which is gradually being integrated into the Reuter communications system.

The local Reuter subsidiary also retains control over the news picture service which is received on an advanced Reuter News Picture Terminal. This enables clients to receive, store, zoom, size, crop and

enhance pictures and output them in an edited form for publication.

While the regional base for Reuters Asia is Hong Kong, Scott Thornton, manager, Reuters Australia, said the company had decided recently to shift the headquarters of its burgeoning Trading Room Systems division to Sydney.

These financial trading systems, which were developed by Reuters and its subsidiary Rich Inc of Chicago, are moving from video to digital switching as people learn the benefits of adding value to raw data and creating personalised screen displays.

The latest digital product, Triarch (Trading Information Architecture) 2000, allows clients to capture, display, analyse and integrate large volumes of market data and information from global and local services with the client's own computer system and data.

The ANZ Bank, the most recent purchaser of this system, is expecting to save about 15 per cent on its telecommunications line costs by moving from a Reuter Hub, which requires dedicated lines, to Triarch 2000.

Percentage Revenue by Product

Real-Time Information	**65%**
Trading Room Systems	**13%**
Transaction Products	**12%**
Media Products	**6%**
Historical Information	**4%**

Source: Reuters Holdings PLC, Annual Report 1988.

Percentage Revenue by Area

Reuters Europe, Middle East & Africa	**61%**
Reuters Asia	**20%**
Reuters America	**19%**

Source: Reuters Holdings PLC, Annual Report 1988.

AAP Reuters Network

Reuters holds a minority 43 per cent stake in AAP Reuters Communications Pty Ltd which was established as a subsidiary of AAPIS in 1984 with a charter to introduce new communications technology to Australia.

Reupke, who spoke with *HUB* when he visited Australia to attend a board meeting of this company last year, said Reuters' shareholding is unusual and is "not" the type of relationship it would normally establish in other places.

The reasons are mainly historical. When AAP Pty Ltd became one of Reuters' four joint owners in 1946, "it had a kind of national identity and strength which the other owners, at that stage, did not have."

AAP sold its Reuters' share holding last year, leaving the AAP Group with an information services company (AAPIS) and a communications subsidiary in which Reuters maintains a share.

AAP Reuters Communications provides network services for its parents using AUSSAT capacity, Telecom leased lines and private microwave links.

"We act as a kind of Telecom for Reuters and AAPIS," said general manager, Barney Blundell.

A master satellite earth station at its headquarters in Glebe, Sydney, is the focal point for this private network which extends to all capital cities, more than 50 regional centres, and to Auckland in New Zealand.

Network services for clients other than its parents are also provided by the company. At an inter-city level these include video-conferencing, financial data networks linking banking terminals and automatic teller machines to city computers, and PageFax for high speed transmission of newspaper masters to interstate printing facilities.

It also provides remote telephony and data networks for mining companies and has developed an Integrated Satellite Business Network for clients seeking to transmit and receive voice, data and images — often in a compressed form — to VSATs on their own premises.

The relationship with Reuters has also benefitted the technical services division of AAP Reuters Communications which operates as a subcontractor for the installation of Reuter Trading Room Systems and services about 6000 video terminals around Australia. ■

- **1849: Paul Julius Reuter started his news business in Paris, subsequently transferring to Brussels and Aachen, where he used carrier pigeons to bridge a gap in the European telegraph system.**
- **1851: Reuter moved to London, the move coinciding with the completion of the first cable link across the channel between France and England.**
- **1866: Reuters was among the users of the first permanent telegraph link established between Europe and America.**
- **1872: The first direct telegram of news delivered from Reuters England by submarine cable to Australia Associated Press was published in the Sydney Morning Herald.**
- **1923: Reuters initiated transmissions by long wave radio to broadcast commercial news internationally.**
- **1946: AAP became a part owner of Reuters along with the NZ Press Association, the Press Association of Great Britain and the British Newspaper Proprietors' Association.**
- **1964: Reuters took a major step in pioneering the use of computer technology to transmit financial data on international circuits.**
- **1973: It launched the computerised Reuter Monitor Service which gave clients access to real-time databases.**
- **1981: It introduced the first transaction service, the Reuter Monitor Dealing Service, which became a major element in the globalisation of foreign exchange markets.**
- **1984: Reuters Holdings PLC was floated as a public company.**
- **1985: It acquired Rich Inc of Chicago, the world's leadng supplier of trading room systems.**
- **1986: An integrated Data Network designed to deliver more data at higher speeds to sophisticated workstations was introduced.**
- **1987: The acquisition of I.P. Sharp Associates of Toronto and Finsbury Data Services of London signalled Reuters' entry into historical databases.**
- **1989: Reuters introduced a new transaction product, Dealing 2000, to provide an international matching system for automated execution of foreign exchange transactions.**

READER INFO No. 334

NEW PRODUCTS AND SERVICES

VERBATIM

External database access for 1-2-3 users

Lotus has released a software developer's toolkit for 1-2-3 Release 3 which will enable third party developers to build drivers between external databases and Lotus applications and ultimately enable 1-2-3 spreadsheet users to access a wider variety of databases.

Called DataLens, the Developer Toolkit is being used by more than a dozen international database vendors including Gupta Technologies, Microrim Inc., Oracle Corporation, Teradata Corporation and Novell Inc. to provide access between their products and Lotus 1-2-3.

Lotus is developing a number of DataLens drivers to support Sybase Inc's SQL Server, IBM's Extended Edition Data Manager and Borland's Paradox.

Developers can use the DataLens Toolkit with database systems based on DOS, OS/2, mainframes, minicomputers, or other media, such as CD-Rom. The kit includes the DataLens specification, code libraries, diagnostic tools, documentation, and a test application.

It requires: a C compiler; an IBM PC AT, PS/2, Compaq or compatible with a minimum 80286 microprocessor; a hard disk with one megabyte of system RAM under DOS or 3 megabytes under OS/2; and a DataLens application such as Release 3.

READER INFO No. 328

OTC Dialcom automated facsimile system

Network Innovations Pty Ltd, a joint venture between OTC and British Telecom has introduced Faxmail — a service that lets you send fax messages using a personal computer.

All that's needed to use the system is a personal computer running a standard communication program, and a modem connected to the phone lines.

You enter your message into your usual word processor and send the text into the system (at up to 40 words a second).

You provide a list of fax numbers or tell the system to use your regular distribution list. Up to 30 destinations can be included in a single batch.

The Faxmail service lets you send electronic mail and faxes at the same time.

READER INFO No. 329

Upgrade to PC fax card

Communications manufacturer NetComm has announced Version 2 of the software for the NetComm PC Fax Card, a major upgrade to the Fax Card that turns an IBM PC/XT/AT or compatible computer into a full speed Group III fax machine.

The NetComm PC Fax Card is designed for use by large businesses where the Fax Card supplements the fax machine as well as low volume fax users and small businesses who cannot afford a standalone fax machine.

Version 2 enables users to transmit faxes from within other PC programs. For example, faxes can be prepared from within a word processing package and, using the fax port facility, the message can be transmitted without having to exit the application.

When fax messages are received they are automatically saved on disk as a file which can be printed and/or displayed on the monitor.

Version 2 also includes a built-in database editor for compiling and maintaining an address book.

The NetComm PC Fax Card operates in background or foreground modes at user selectable speeds up to 9600 bps with automatic to 7200, 4800 or 2400 bps. The Fax Card receives fax messages without interrupting the application and when the PC is unattended.

The NetComm PC Fax Card Version 2 is available at a suggested retail price of $995.00. Software upgrades for registered NetComm PC Fax Card owners are also available.

READER INFO No. 330

Strata title search in minutes

A new computer-based service at the Victorian Land Titles Office allows a search of a strata title to be conducted on the spot and a copy of the strata plan to be obtained in a few minutes instead of hours.

250,000 paper-based strata titles have been converted to computer format and marks the completion of the first stage of a project to computerise all 2.5 million paper titles held at the Land Titles Office.

READER INFO No. 331

Netway 7.0 software

NetComm is now shipping the latest release from Tri-Data Systems Inc. — Netway 100SNA software version 7.0. The new software release is fully compatible with the entire Macintosh product line (512K (enhanced), Plus, SE, SE30, Mac II, IIcx and IIx). The Netway 1000 and the recently announced high performance gateway, Netway 2000, use the same workstation software and gateway management functions, hence the user learns only one interface.

The Netway workstation software has been enhanced to include a 3270 Application Programming Interface (API), extended colour and attributes, "virtual" light pen support, multiple screen size support, integrated international language support, multiple zone configuration and network management.

READER INFO No. 332

NEW PRODUCTS & SERVICES

VERBATIM

SNA LAN gateway for QuickMail

NetComm Australia has announced QM-Professional for QuickMail from Tri-Data Systems and CE Software Inc. QM-Professional utilises Tri-Data's Netway 3270 SNA LAN-based gateways to access IBM mainframes and provides a transparent, two-way mail exchange between QuickMail and IBM PROFS via the Netway SNA gateways.

QM-Professional Gateway utilises the Netway SNA gateway's 3270 API from Tri-Data to enable QuickMail users to exchange mail with IBM PROFS E-Mail participants through a consistent, user-friendly interface.

READER INFO No. 321

16-Bit Ethernet controller

LAN distributor, Com Tech Communications, has announced the N16510 from Racal InterLan, a 16-bit Ethernet network controller initially targeted for performance sensitive networks using Novell NetWare workstation and servers.

Initially, the set of software drivers that will be released with the product are workstation and server drivers for Novell NetWare 286 v2.15, a NetWare v2.15 client driver for TCP/IP, menu-driven diagnostics and a boot ROM driver for use with diskless PCs. In addition to a driver development kit, additional drivers will be forthcoming for such popular network operating systems as LAN Manager, 3+Open and the newly released NETWARE 386.

The product works with most AT-compatible computers that use an 80286 or 80386 microprocessor, including systems made by IBM, Compaq, AT&T and Philips. Processor clock rates that are accommodated include 8, 10, 12.5, 16, 20 and 25 MHz and host clock rates of 8.12 and 16 MHz.

The N16510 achieves its high performance through a combination of bus-mastering techniques, 16-bit data paths and 24-bit address space. A proprietary custom chip set and the use of high quality components contribute to performance gains and a Mean Time Between Failures (MTBF) well in excess of 25 years at 100% duty cycle.

READER INFO No. 322

NETFAX — the network fax solution

NETFAX, a combined hardware and software subsystem, allows facsimiles to be sent, viewed and printed from LANs and multiple server network workstations.

NETFAX manages fax traffic, removes paper jams, ensures the right fax gets to the right person and offers PC users total background facsimile and electronic mail functions without degrading PC performance.

Users can access the fax and E-mail software by using a 'hot key', regardless of the word processing package they're using on their computers at the time.

Once inside the application, they can pick the desired file, type a cover letter with NETFAX's editor, incorporate a company logo and send a high quality, first generation fax to any fax machine.

NETFAX will confirm transmission of a fax with a pop up window appearing on the computer's screen, giving details on the status of the document.

PC users receiving faxes are also alerted by a pop up window on their PC. Incoming messages are routed automatically to a user's mailbox on the LAN as specified by a four digit code.

The ability to store incoming fax messages on the computer's hard disk permits users to edit material and make clean copies and serves as a filing system for all fax communication.

READER INFO No. 323

First printing solution for LANs

Com Tech Communications has announced PRINT+, the first complete printing solution for 3Com local area networks (LANs).

PRINT+ turns every local printer into a network printer and requires less than 2K of RAM per workstation.

PRINT+ supports all existing DOS, BIOS, 3Com MS/REDIR commands and current 3Com printing utilities, and commands such as Qstat and Del.

Requirements for PRINT+ include 3Com 3+ or 3+Open network. PRINT+ is licensed for up to 3 PRINT+ servers.

READER INFO No. 324

QPSX goes commercial

Telecom has committed to spending $75m over the next four years in introducing FASTPAC, its first broadband switched data service, in 1991. Fastpac will use the Australian-invented QPSX (Queued Packet Synchronous Switch) technology from its joint venture company QPSX Communications Ltd in Perth.

QPSX is an information transfer system which allows rapid transmission of large amounts of tele-communications traffic through the public network.

It turns any form of transmission into discreet packets of information which are individually directed to their destination by attached codes.

Export earnings of over $100m are expected to arise from royalties and from design licence fees from the $1b overseas Local Area Network interconnect market.

FASTPAC will enable the multi-megabit per second services provided within Local Area Networks, usually confined to within a

single building complex, to be extended across Australia as easily as using the telephone.

READER INFO No. 325

Programming services for voice applications

Connect International has launched a software development service for human voice messaging systems.

Voice technology is growing at an enormous rate. The current world market for voice equipment surpassed one billion dollars in 1989.

Connect can provide the software solutions for most available voice messaging systems.

Examples of applications for this voice technology are:

- Order tracking
- Order entry
- Credit authorisation
- Flight schedules
- Courier taxi services
- Inventory control
- Home banking
- Market research surveys
- Rate/price information

READER INFO No. 326

Brilliant colour on plain paper

Mitsui has unveiled the Howtek Pixelmaster, a full capability colour printer that delivers brilliant colours, high resolution and integrated text and images on most standard plain paper. Mitsui claims up to 262,000 different colours can be printed.

Pixelmaster uses solid plastic inks in cyan, magenta, yellow and black, which are automatically heated to liquid form before an image is acually printed; it is designed around a highly efficient method of placing dots via ink-jet on to the paper. It is the combination of the density and the extreme accuracy of placement of these inks that enables Pixelmaster to generate such vivid colour printed output.

A full colour document can be produced for around 25 cents per page and takes about two to three minutes.

READER INFO No. 327

CONTRACTS AND AGREEMENTS

TCP/IP for PC Lans now available

The US-based Wollongong Group has appointed Interface Technology of Australia distributor of its TCP/IP products for PC LANs.

The previously Australian Wollongong Group, based in Palo Alto, California, is recognised as a US leader in open systems interconnectivity, specialising in data communications among dissimilar systems, operating systems and networking based on current industry and government standards.

Over the past three years, The Wollongong Group has signed development and/or distribution agreements for its TCP/IP-based communications software with most of the major computer manufacturers, including IBM, DEC AT&T, Hewlett-Packard and National Semiconductor.

Through Interface Technology of Australia, The Wollongong Group's PC LAN integration products, the 'Pathway' suites of products, are now available.

Pathway Client Plus will run on any compatible PC, AT or PS/2.

PathWay is the integration of the Performance Technology POWERLan network software, POWERServe dedicated fileserver software, POWERMirror disk mirroring software, POWERSave file backup software and POWERBridge network bridging software with the Wollongong WIN/TCP for DOS.

READER INFO No. 320

AT&T wins Trans-Pacific Cable contract

AT&T has been awarded $US191m in contracts to build a fibre optic cable across the Pacific that will almost double the number of telephone circuits between North America and Japan.

Scheduled for completion in 1992 at a cost of $US372m, the new cable will connect the USA and Canada to Japan. The 9,843 kilometre cable will consist of six optical fibres jacketed together. It accommodates voice, data and video calls. If used entirely for voice, the new cable could handle 80,000 simultaneous calls, twice the capacity of the first transpacific fibre optic cable installed in April.

AT&T will own approximately one quarter of the cable with the balance owned by telecommunications companies from 23 countries in North America, Europe and Asia.

Landing points will be in Point Arena, California, Port Alberni, British Columbia and Chikura on the island of Honshu in Japan.

READER INFO No. 315

AT&T and Du Pont announce electronic components alliance

Du Pont and AT&T have announced an alliance to design and develop electronic components to meet new global standards in the computer and telecommunications markets.

The alliance is centred around the "Metral" two millimetre connector system, a modular interconnection packaging system providing high signal line density and electrical performance for advanced data processing and telecommunications applications. Applications for the Metral connector system will include mid-range computer systems, transmission systems and switching systems, such as PBXs.

The Futurebus Plus standard, being developed by the Institute of Electrical and Electronics Engineers (IEEE), will use a two millimetre connector. The Metral connector system is the first commercial system designed for this next generation standard in computer architecture.

Each firm will manufacture and market the products independently to the USA, Europe and Asia Pacific markets.

READER INFO No. 316

AT&T and Pyramid team up on UNIX project

Pyramid Technology and AT&T have announced a strategic partnership agreement to jointly develop a new generation of high-performance UNIX(R) computer systems. The agreement also contains provisions for AT&T to market the systems on an OEM (other equipment manufacture) basis.

The joint project will include the design and manufacture of high-performance, multiprocessor systems based on industry standards. The systems will use the latest version ot the AT&T UNIX System V operating system, Release 4.

READER INFO No. 317

ETSA goes to live with CASE

The Electricity Trust of South Australia (ETSA) has announced plans to implement both administrative and operational strategic data communications networks using the international standard protocol X.25 with equipment supplied by CASE Communications Systems.

The administrative network will link a number of ETSA EDP centres in South Australia to offices in regions throughout the state as far afield as Leigh Creek, Port Lincoln and Mount Gambier. The operational network will be used to transfer data between the Power System Control Centre in Adelaide and the corresponding state centres in Victoria and NSW.

READER INFO No. 318

MILESTONES AND FORECASTS

VERBATIM

More export orders for Alcatel STC

Alcatel STC has won export orders worth $260,000 from Fiji for its small business communications systems and from Kiribati in the South Pacific for telephone handsets.

The small business system is manufactured in Australia by Alcatel STC and sold here by Telecom as the Commander BN system. Also made locally, the handsets are Telecom Australia's standard Touchfone 200 units.

READER INFO No. 313

Complex commercial communications satellite launched

The International Telecommunications Satellite Organisation (INTELSAT) has launched the first of five satellites in the new INTELSAT VI series.

With an in-orbit weight of nearly three tons, the INTELSAT VI (F-2) has the greatest mass and complexity of any commercial communications satellite ever built.

It has 38 C-band transponders and 10 Ku-band transponders. From its orbital location over the Atlantic Ocean region, the INTELSAT VI's beams will provide coverage on the west to the Americas and on the east to Europe and Africa.

READER INFO No. 314

It's a record!

GEC Plessey Telecommunications' (GPT's) record-breaking event in successfully processing 1.5 million Busy Hour Call Attempts (BHCA) has been acknowledged by the Guiness Book of Records, which has agreed to inaugurate a brand new category for the World's Busiest Telephone Exchange.

GPT established the record at the Beeston exchange in Nottingham, U.K., when System X processed 1,558,000 calls in one hour.

READER INFO No. 319

GOING UP GROWING OUT

GPT takeover bid for Heyden Spike succeeds

Last October, GEC Plessey Telecommunications Australia (GPT) successfully acquired a controlling interest in radio communications company, Heyden Spike.

Heyden Spike controls and operates a series of trunked mobile radio networks in Sydney, Melbourne and Brisbane which can interconnect to the Public Telephone Network and will complement GPT's development projects in futuristic personal and portable communications systems.

GPT was keen to gain access to the technology developed by Heyden Spike, which is expected to have applications in the new mobile communications developments of the 1990s.

READER INFO No. 312

BSA Australia

To undertake an ongoing campaign against software theft, the Business Software Association of Australia was formed in September 1989 in Sydney by five major software companies; Ashton-Tate, Autodesk, Lotus Development, Microsoft and WordPerfect Pacific.

BSA has announced a far-reaching education and enforcement campaign directed at major users of business software products.

Announcing the campaign, BSA Australia director, Glenn Miller, said the primary objective of the campaign is to ensure strict compliance with current legislation protecting the intellectual property rights of software developers and manufacturers by major corporations, government departments, the professions and educational institutions.

BSA Australia estimates more than half the business software in use by companies, government departments and businesses throughout Australia has been obtained illegally, and current sales statistics compiled by BSA indicate the industry will forego more than $300m in revenue in 1990 as a result of unauthorised software copying and piracy.

READER INFO No. 311

Frenchs Forest in high tech shock

The establishment of major computer companies and allied industrial organisations in Sydney's Frenchs Forest area has led to the formation of The Frenchs Forest Technology Society.

The aim of the Society is to promote technical co-operation between companies in the Frenchs Forest area; the ultimate intention is to increase the efficiency of Australian industry.

The Society meets at three monthly intervals and plans to expand its horizons beyond the Frenchs Forest area. Membership currently includes representatives from Apple, Gestetner, CASE, Microsoft and ICL. The Society was formed originally by Neil Hardie, R & D Manager of Gestetner and CASE's Andy Plant. The Society has been focussing its attention on industry developments such as Local Area Network (LAN) and optical fibre technology as well as methods of quality assurance that relate specifically to high technology manufacturing.

READER INFO No. 310

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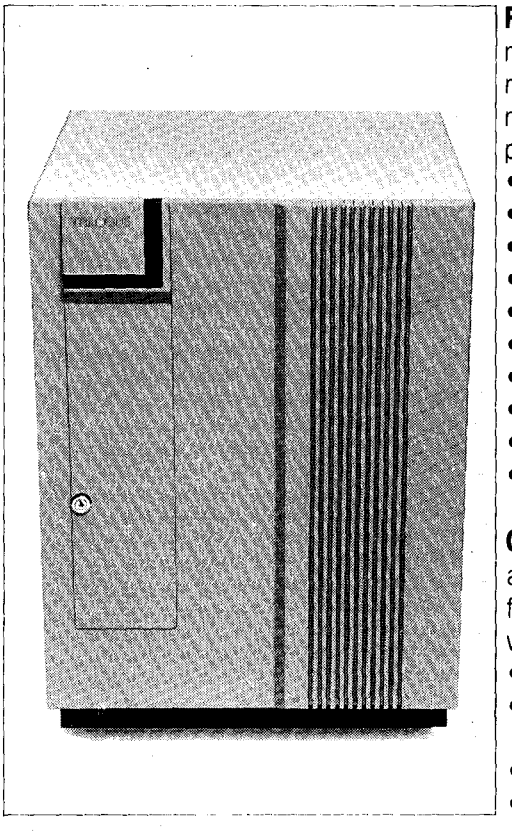

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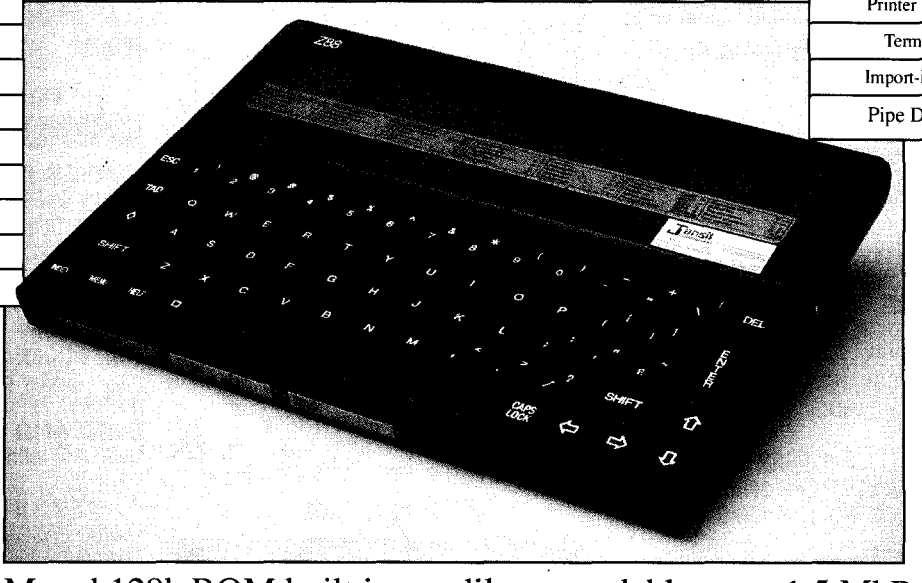

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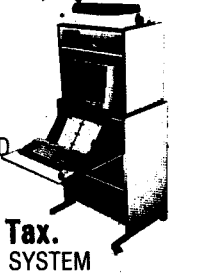

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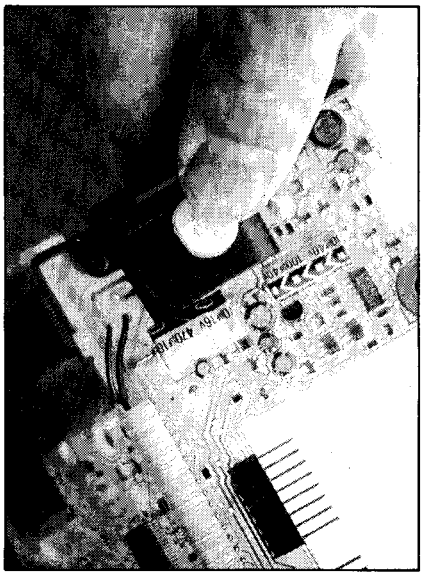
RCS: FROM SPARE ROOMS TO SIGNWRITING

More than seven years ago, RCS Cadcentres (the trading name of RCS Design Pty Ltd) started business under a sole trader arrangement in the spare room of the director's home, providing a printed circuit board (PCB) design service. Every aspect of the design process was manually completed and required dedication, many hours and considerable patience to complete. To many, the PCB designer was an artisan in the traditional sense – a true craftsman with an eye for balance and aesthetics.

RCS Cadcentres grew quickly to become a major bureau service to the Australian electronics industry. Considerable investment, very significant for a company the size of RCS, was made in state-of-the-art Computer Aided Design systems. Continued investment has kept RCS Cadcentres up to date with the technological rush. In fact, the staff of RCS has accumulated many years of experience with CAD and this has led to the diversification of their business interests.

RCS Cadcentres was not the only company getting involved in CAD/CAM; however, few companies had enough experience to implement their systems, or manage them effectively. RCS Cadcentres was in a position to advise and assist, so it was not surprising that they were approached in 1987 to represent Racal-Redac as national distributor of their range of Electronic Design Automation software tools. This arrangement coincided with the release of Cadstar, Racal-Redac's PC based design and documentation software.

RCS Cadcentres' Melbourne office is the base for nationwide technical support for Racal-Redac's products and a range of related software and hardware. Based on their own experience within the bureau, the staff at RCS can advise on all areas of PCB design and artwork plotting using



penplotters or photoplotters, manufacturing requirements and computer/plotter interfacing.

The latter knowledge has led RCS to further diversify its sales and support into CAD related vertical markets. One such market is the signmaking industry, where a similar explosion of design automation is taking place. The RCS Signmaster range provides signwriters with the latest tools for vinyl and masking rubber cutting for quality graphics and signs as well as interfaces to CNC machines such as routers, laser cutters and water-jet cutters. Similar vertical markets where products are handled under the guidance of RCS engineers are constantly sought after. The important consideration is to put together a system or network that best suits the needs of the customer, not just what a particular vendor wants to sell.

To package such systems requires a knowledge and experience only gained after "hands-on" working with such systems.

RCS Cadcentres now provides the most complete CAD service including design, documentation, computer service, programming, network installation, CAD sales and training.

For company directors Ray and Debbie Smith, many years of hard work are beginning to show signs of paying off. RCS Cadcentres has a thoroughly professional team of specialists with one priority in mind – satisfied customers. eti

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JIM TUCKER

THE FILES COMMAND, AND FURTHER THINGS

Jim continues with his exposé of PC system files. You too, can be boss of the DOS!

DOS is a prisoner of its past. Original IBM PCs came with only 16K of memory (can you believe it!) so when DOS boots up it sets aside memory for various purposes in an incredibly frugal manner.

The defaults for three regions of memory set aside for file handles, disk buffers and environment are woefully inadequate. If you know what you are doing it's easy to change these defaults but it's unfortunate that those who know nothing get stuck with these small values.

In any event, FILES and BUFFER commands are most important in your CONFIG.SYS. Do not boot your computer without a CONFIG.SYS file else you will be doing yourself, and the speed and memory of a modern PC, a great disservice.

When DOS opens a file, it keeps certain information in memory to be able to access the file quickly. This information is called a file handle. During bootup, memory is put aside for these file handles so a limit is placed on the number of files that can be open at one time.

The default is eight, which may seem adequate, since programs normally close files when they are done allowing the file handles to be reused. However, eight is often not adequate. DOS uses four of the handles itself for "files" like con and prn. Therefore, you have only four for your programs.

Some resident programs leave files open, and even the ones that don't may need to open a file for initial access at the same time an application program has several files open. Database programs often have separate index and data files and nearly always need more than four open files.

If DOS is asked to open a file and a handle is not available, DOS issues an error message and the running program may drop dead. Experts recommend that you place the line

FILES = 20

in your CONFIG.SYS file. Don't be too frugal. The cost of increasing files is less than 40 bytes per handle; you could even use a number larger than 20. For most purposes 20 should suffice but ever since it wasn't enough for me in a rather specialised situation, I've used FILES = 30. The maximum number is 99.

Buffers

You may have heard of disk caching. As you've noticed, diskette access is very slow and even a hard disk has access times about 50 times greater.

Disk caching sets aside some RAM to keep a copy of the most recently accessed disk information so, for example, if a database is continually accessing a disk, the first time the disk is really read but the next time the copy in cache memory will be read instead.

This is not the place to discuss the pros and cons of commercial disk caching software but you should know that DOS comes with some free rudimentary disk caching. It keeps N buffers of 512 bytes each with the copies of the last N disk sectors accessed. By default N is only two (three on the AT). You should certainly make this number larger by including the line

BUFFERS = N

in your CONFIG.SYS file. Recommended values of N are between 10 and 25.

Here's a story. The first time a friend ran his tape drive to backup a 30 meg hard disk, he was bitterly disappointed. Despite what he'd been told by the salesman, it took over 45 minutes! The next day it took only 8 minutes! What had happened? The first time he had used an original DOS disk in drive A.

This disk had no CONFIG.SYS so it was running with the default three buffers. The next day, he used his regular hard disk boot with BUFFERS = 20 and that made the difference.

Even simple tasks such as copying a directory from a hard disk to a floppy can decrease times by 30 or 40 per cent. So *USE YOUR FREE DISK CACHING.*

How many buffers? Increasing the number of file handles has little effect on memory or efficiency so you can freely take files = 99 if the mood strikes you.

This is not so with buffers.

Each buffer takes 512 bytes of RAM so buffers add up. But the real problem is that at some point it will take DOS longer to check through all its buffers looking to see if a file is there than it would take it to access it directly.

I've seen the number 25 given as a dividing line. I've settled on BUFFERS = 20. With a floppy based system, you should probably take a higher figure.

The environment

Greenies beware – this has nothing to do with you! DOS sets up a special section of memory called the *environment* which has a default size of 160 bytes. This area must hold your path, your prompt, the place that COMMAND.COM can be found and various other strings. Programs can communicate with you by asking you to place information in the environment with the SET command.

In addition, you can keep global variables in the environment to pass between BATch files. If you attempt to place more there than it has room for you'll get a message "Out of environment space". With DOS 3.x there is a CONFIG.SYS command allowing you to increase the amount of space reserved for your environment. The syntax is

shell = C:\command.com /P /E:nnn

where n is the number of bytes you want to set aside for the environment. For DOS 3.1, nnn represents the number of 16 byte paragraphs you want to set aside. So for a 512 byte environment, take nnn = 32 in DOS 3.1 and 512 in DOS 3.2 or later. Obviously with a floppy based system, replace C: by A:

How much space do you

need for your environment? That depends on your path, applications and how fancy a prompt you make. Maybe you should do nothing until you have a problem at which point you should remember that there is something that you can do.

For more advanced users, note that the environment is not as benign as you might think. People on bulletin boards have talked about several programs which crashed if there was too much in the environment and one that crashed if the PATH was the last thing set in the environment. In this world, nothing is absolute.

Other CONFIG.SYS commands

There are some other commands you can put into your CONFIG.SYS:

• You can turn BREAK ON – that is, have the operating system check for control-C more often than just during disk I/O. This slows down certain processing but gives you more safety from certain kinds of dead ends. The syntax is a line saying
BREAK = ON

Unlike any other CONFIG.SYS command, this one can also be issued from the DOS command line or in your AUTOEXEC.BAT file.

• Some versions of DOS have a STACK command. From what I've read this is a real kludge and added at the last minute to solve a problem. If your DOS has it and you have unexplained crashes, try adding
STACK = 20
to your CONFIG.SYS.

• DOS 3.1 and later allows you to use the SUBST command to assign drive letters to directories. In addition, with several RAM disks you may want to assign a letter beyond the default last drive of E. DOS 3.x allows you to add a command
LAST DRIVE = x
where x is any letter and then you can assign any drive up to and including that letter. Even a last drive = z only takes about 1K of RAM.

• There is a COUNTRY command to control things like the time format. The default is USA. Countries use the telephone country codes with three digits. To get the DOS date in DD/MM/YY in Australian format put this into CONFIG.SYS:
COUNTRY = 061

Just a warning, it won't work for programs which extract the date from memory directly and make their own assumptions. DOS will display the date as we know it – other programs will not.

One final remark about your CONFIG.SYS. The order of the commands doesn't matter except to the extent that certain device drivers like to be loaded before others (and if you are loading two RAM disks of different sizes you may care which is assigned which letter). As with most DOS commands the syntax is not case sensitive.

As a review of what a CONFIG.SYS can contain, let me list the CONFIG.SYS from my machine which is running DOS 3.3:

```
break = on
buffers = 20
files = 30
lastdrive = z
device = C:\devices\mouse.sys
device = C:\devices\ansi.sys
shell = C:\command.com /P /E:512
```

The AUTOEXEC file

Most of my AUTOEXEC.BAT file loads my own particular blend of resident programs. This is not the place for me to advise you on what resident programs you might want to put into your system but I would like to make some comments about DOS and general aspects of what goes into your AUTOEXEC.BAT file.

First, if you have very many resident programs, they may have conflicts and you must be prepared to permute the order of loading which often cures some or all of the conflicts. For technical reasons I won't go into here it really does pay to listen to SIDEKICK's demand to be loaded last, although you need not take all the other Borland program demands quite so seriously.

In addition to loading a stable of resident programs, your AUTOEXEC.BAT can contain some of the following:

• VERIFY ON command. This slows down copying because DOS checks that the copy at least has consistent CRCs; this is not the same as comparing after copying but it is a fairly good check. Only several compensating errors could pass this test after an incorrect copy.

• Set a PROMPT. This sets the prompt like A:> but extends it. At a minimum use include this in your AUTOEXEC.BAT:
PROMPT = pg

Mine uses ANSI.SYS to set colours just because I like to show off.

• Set a PATH. If possible, keep your path short since every time you type in a bad command, DOS will have to read every directory in the path before responding "Bad command or filename".

Also try to list the directories in the path in the order of how many times you expect to access a given directory. Place the directories you call most often early in your path. If you have a RAM disk, place its directories first in the path. (Saves looking at the hard disk grubbing around only to find out it isn't there).

• It really is important to put the proper date and time in your system. Be sure to include the DATE and TIME commands in your AUTOEXEC.BAT file or else (most likely, these days) place the clock or timer program into AUTOEXEC.BAT.

• If you want to keep track of how often you boot, keep a record in a convenient directory. Make a file called CRLF consisting only of a carriage return line feed and include the lines
date >> directory\logon < crlf
time >> directory\logon < crlf
You will then get the lines
Current date is Wed 7-23-1986
Enter new date (mm-dd-yy):
Current time is 16:29:22.70
Enter new time:

This is advanced stuff – but each time you boot, the date and time will be automatically appended to the file logon in the directory specified.

Speed tips

BATch files are read by DOS a line at a time so BATch files really do get processed much faster from a RAM disk than from a floppy. There is a small difference between a hard disk

Continued on page 24

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READER INFO No. 45

THE FIRST AUSSIE '486

COMPUTING

The first PC using the latest generation super processor was released recently by a Melbourne computer company. Jon Fairall was there for ETI.

Terran Computers, the Melbourne-based computer manufacturer, recently released a PC based around Intel's new 80486 processor. The result is, without question, the fastest desk top computer ever designed in Australia.

The new machine is called the Terran T-40. It comes in a package with a high resolution (800x600) monitor, one meg of memory on board (which can be expanded to 16 megs) two serial and one parallel ports, and an inbuilt keyboard security system. There are also four slots for expansion boards, as well as slots for the disks and a mouse.

With the T-40, Terran joins IBM and Apricot in having '486 product on the market in Australia. Other makers have announced, or even demonstrated, computers with the new chip, but most manufacturers are being plagued by supply problems, as Intel tries to fix a series of bugs apparent in early releases of the device. Terran is currently taking orders for its machine, and assures availability by early 1990. The assembly line will be able to churn out 400 machines a month.

During the course of the press briefing to celebrate the release of the T-40, Terran's Peter Swann described the machine as 'awesome'. If you like your computers small, tight and fast, you will probably forgive the hyperbole. During the course of his demonstration, Nunn loaded a complex architectural drawing created on AutoCAD into the machine. If nothing else, it demonstrated an ability to recalculate and display a CAD drawing that is simply, well, awesome.

The T-40 project began with the company's attempts to design a really fast 80386 based machine. This chip is rated by the makers as a 33 MHz device. However, testing in the Terran labs showed a bag of problems in the design, even at 30 MHz. "We had all sorts of troubles, including overheating, when the '386 chips were tested at 30 MHz, at least in some applications. It started to look like a recipe for disaster. As a result, we decided it wasn't worth the effort to continue and jumped directly to the '486", says Nunn.

The T-40 runs at just 25 MHz. However, the processing efficiency of the '486 is such that it outperforms a '386 running at 33 MHz by at least a factor of two. The secret is the design of the chip. It consists of a processor, functionally similar to an 80386, a co-processor that owes a lot to the 80387 maths co-processor, plus an 8k cache and a bit of input/output logic, all on one piece of silicon. There are a number of advantages. Firstly, Intel has shoehorned the functionality of the '386 and '387 into a much smaller area. The smallest artifacts on the 80486 chip are less than a micron across. Electrons have a shorter distance to cover, and, so, do it quicker. Also, the on-board cache memory means more effective use of processing time.

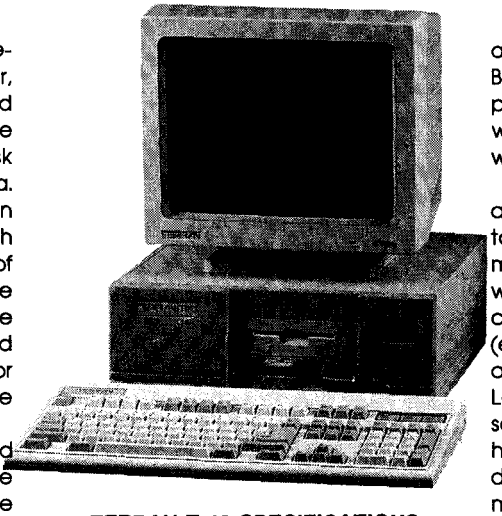
The interesting thing about this is the realisation that the '486 is not so much *faster* processing as being able to more efficiently process. Don't expect your word processor, or even your simple computer game, to go any faster. The speed of such applications is not really processor-limited. But a spreadsheet calculation, a graphics package or a data base search, all of which involve intensive processing power, will quickly separate the men from the boys.

This, in turn, leads to several specific applications for the T-40. Nunn is hoping to sell a considerable number of the machines into the CAD/CAM market, where, at $14,000, they are extremely cost competitive with equivalent machines (essentially the low-end work stations). They are also expected to find application in Local Area Networks, as file servers. (A file server is a machine that does the LAN housekeeping. Typically, its performance dictates the performance of all the machines on the LAN.)

The T-40 is the second time designers at Terran have lurched onto the technological leading edge. At Earth Computers, back in the early 1980s, they at one time held the record for the fastest 80286 powered machine on the market. However, accountants are not respecters of technological genius, and Earth Computers wound up in the hands of the receivers. But its technology was revived by the staff, in particular Nunn and the other designers, who banded together to form a new company under the Terran name.

The experience of financial calamity has imposed a certain discipline on Terran. The company is underpinned by some lucrative, if not spectacular, business. It has built up a small but impressive range of computers (with '286, and '386 based machines) and is selling them in significant quantities. The manufacturing business is bolstered by subcontract work for other companies, and the design staff have designed computers for Microbee and gate array specifications for AWA and Motorola.

Terran looks like a company to watch. Nunn says rough times are ahead for the local computer industry, especially now that all Government purchasing preference has stopped. But he knows better than most that making computers is a rough, tough business. He has the right product. It only remains to be seen whether he can tell enough people about it. eti



TERRAN T-40 SPECIFICATIONS

Processor:	**80486**
Clock:	**40MHz**
Memory:	**(Standard) 1M**
	(Optional) 16M
Operating Systems:	**MS-DOS**
I/O:	**two serial**
	one parallel
Dimensions:	**375 x 390 x 155 mm**
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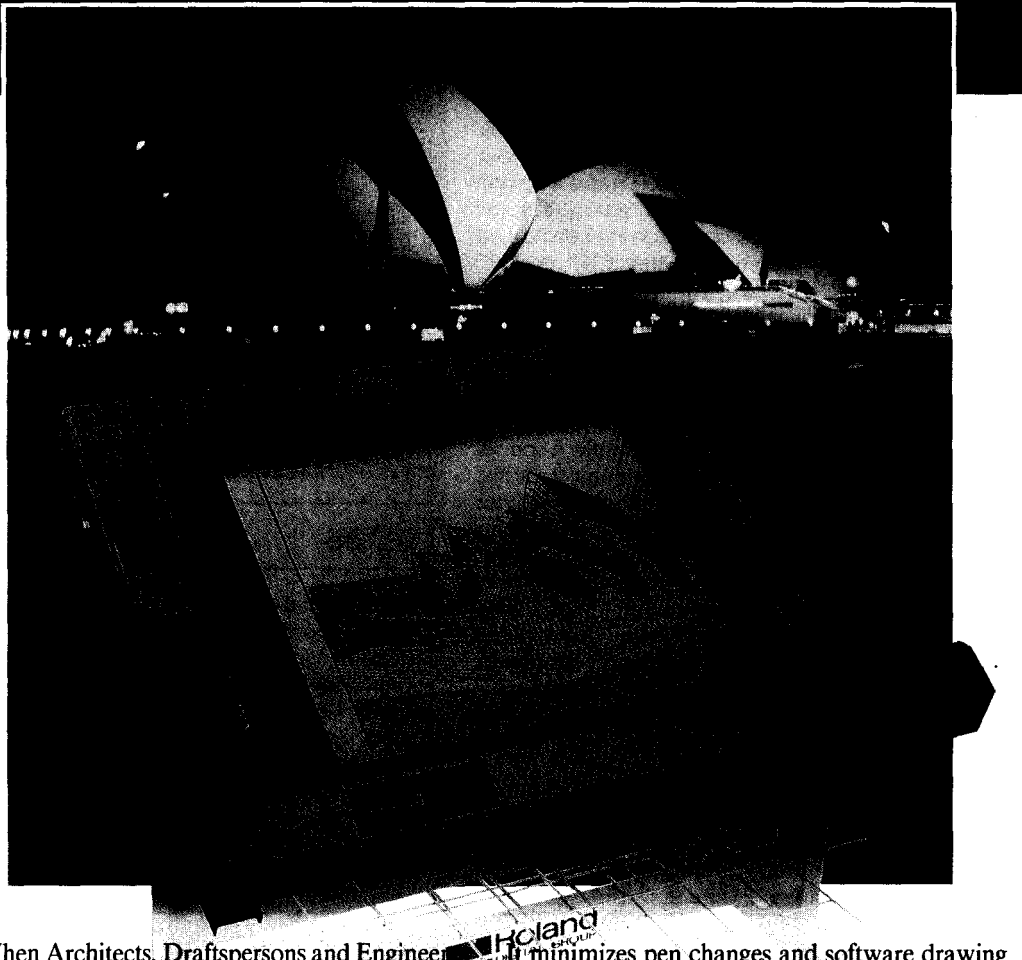
ROLAND. DRAWING AHEAD OF THE REST

Something intelligent has happened to Roland's new DPX Flatbed Plotters.



When Architects, Draftspersons and Engineers complete their plans or designs, they don't need to give them another thought, because Roland's brilliant new DPX plotters quietly fill-in the final details. With fully automatic communications, pen and pencil recognition, interactive LCD, 1Mb memory and data compression, the inbuilt intelligence quickly calculates the most effective and efficient drawing parameters.

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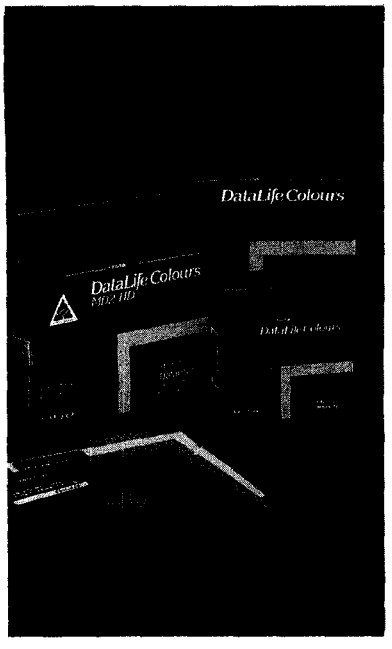
READER INFO No. 46

COMPUTING

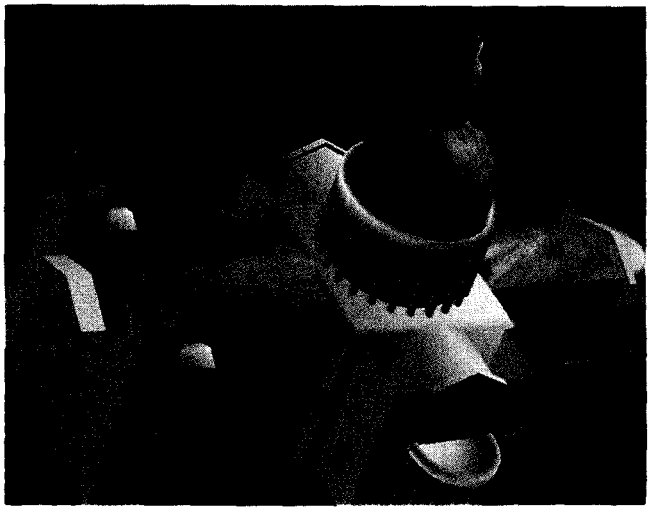
Colour diskettes



VERBATIM has announced the introduction of colour-coded disks. The DataLife diskettes, available in red, orange, yellow, green and blue, make filing and identification much simpler. They are made in Australia and come in either 5¼" or 3½" sizes. All have a lifetime guarantee and are certified 100 per cent error free.

The DataLife 2S/HD and DataLife 2S/2D 5¼" diskettes have 1.6Mb and 360Kb of memory respectively. A special liner disperses dangerous static and a media coating reduces damaging head wear. The DataLife 2S/2D Microdisk 3½" diskette has a capacity of 720Kb. It has an integral write protection system to safeguard against accidental erasure. A feature of the diskettes is optional foil stamping.

READER INFO No. 196



Topas

TOPAS (Three-dimensional Object Processing and Animation Software) is a program for applications in creative design, presentation graphics, video production and video animation. TOPAS consist of five standalone, yet fully integratible modules, the Modeler, Pro-Modeler, Animator, AutoAnimator and SuperShade. For further information contact Vision Control Australia 30 Miles Street Mulgrave Vic 3170 ☎ (03) 560 2444 or ☎ (02) 954 4311.

READER INFO No. 197

Continued from page 21

and a RAM disk. If you have a RAM disk and a floppy based system, it is well worth your while to place what would have been your AUTOEXEC.BAT in a file called startup.bat and have your AUTOEXEC.BAT read:

copy startup.bat C:
C:startup.bat

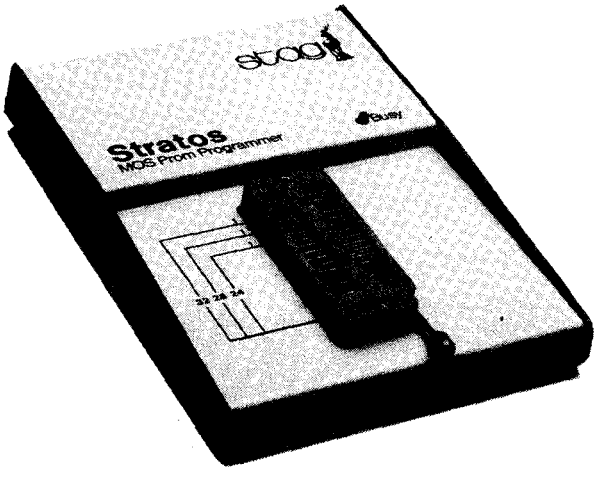
assuming your RAM disk is C:. To conserve space, you can have the last line in startup.bat say

erase C:startup.bat

You'll get a "batch file missing" error message but other than that the method will work perfectly. This procedure can also be used on a hard disk. The saving when I did it on my hard disk was two seconds out of about 65 so you may not feel it's worthwhile.

Stag's Stratos

ANITECH has released the new STRATOS EPROM Programmer from Stag which turns any PC, XT, AT or compatible into a fast and powerful EPROM programmer. Sratos is suitable for programming most currently available EPROMS in 24 to 32 pin dip packages up to 1 Mbit in size.



Stage Microsystems is the leading European manufacturer of standalone device programmers and has invested some 450 man-years of R and D into this type of system over the last 15 years. Stratos was built using the latest SMD technology and can program a 1 Mbit device in 25 seconds. For futher information contact Anitech 1-5 Carter Street, Lidcombe NSW 2141. ☎ (02) 748 1711 & 648 4088 Fax: (02) 764 2360.

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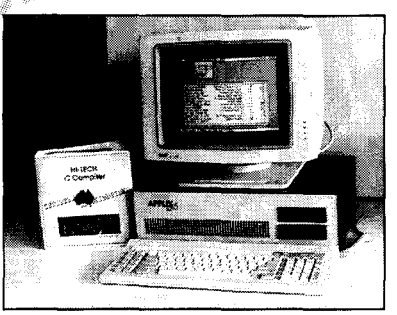

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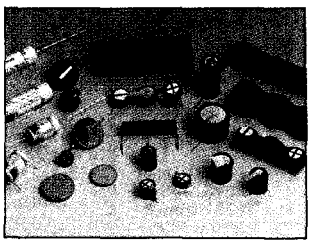
NEW PRODUCT



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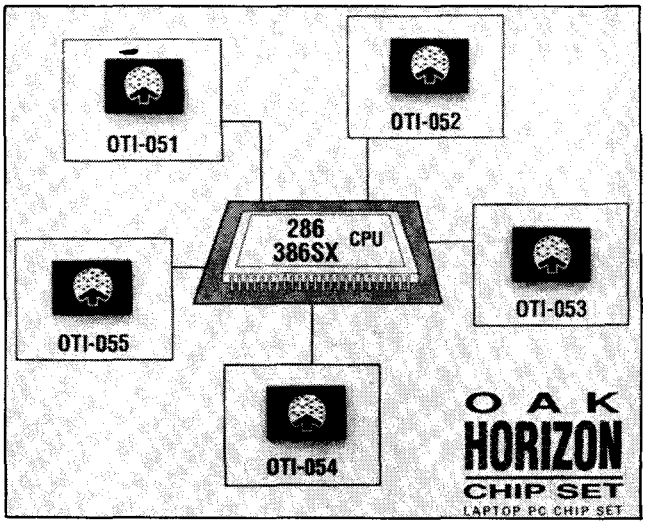
286/386SX Laptop chip set

OAK Technology Inc has announced the OakHorizon Laptop PC chip set consisting of five highly integrated ICs for the 286- and 386SX-based laptop personal computers. The OakHorizon is targeted for use by original equipment manufacturers seeking a competitive advantage in the laptop market. To simplify system integration, Oak is also supplying an Oak-developed Basic Input/Output System (BIOS) system software ROM.

The OakHorizon chip set provides all of the system logic required to create a high performance 286- or 386SX-based system. Included in the five chips are system control logic, clock circuits, serial and parallel peripheral controllers, DMA and memory controllers, address buffers and data buffers. With the addition of the 286 or 386SX CPU chip, memory and only two additional TTL devices, the OEM can produce a complete system. Packaged in five 100-pin PQFP packages, the chip set is ideal for high volume automated production lines.

"The OakHorizon provides a proprietary power management system that can greatly conserve power consumption during operation. The key to this system is the ability to monitor system and peripheral device activities and to turn on and off peripheral devices when they are not in use. This is accomplished by including activity monitors and timer/counters that measure the start and stop of various events and by including control and status lines that turn on and off devices. In addition, the Oak Horizon BIOS system software supports the customisation of the power management facilities so that OEMs can either customise their system



for particular applications and/or create a setup menu that the end user can use to configure power conservation characteristics.

The OakHorizon laptop chip set consists of the OTI-051 System Controller, the OTI-052 I/O Peripheral Controller, the OTI-053 DMA and Memory Controller, the OTI-054 Address Buffer/Real-time Clock and the OTI-055 Data Buffer/Power Manager. Also available is the Oak BIOS System ROM. Evaluation boards are available now. For futher information contact Scott Alberts, Oak Technology Inc. 139 Kifer Court, Sunnyvale, CA 94086 USA ☎(408) 737-0888.

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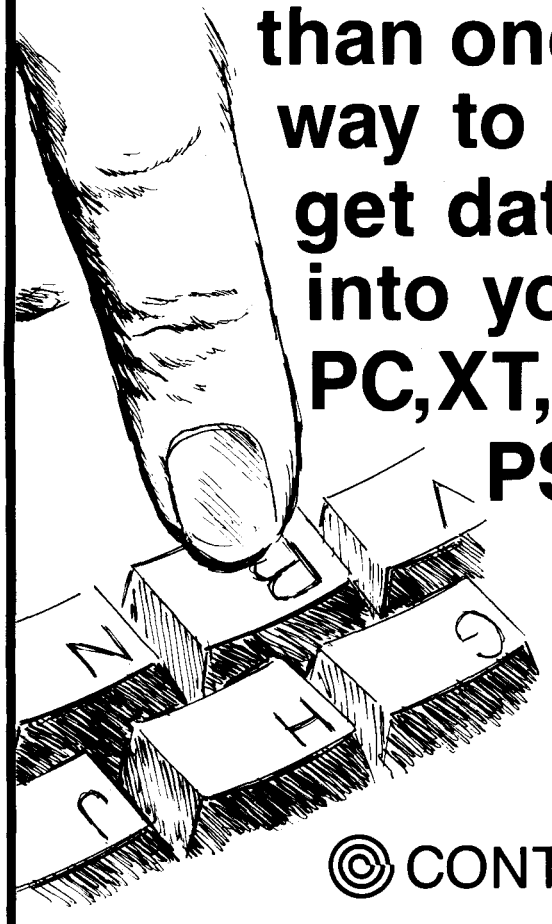

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HARD COPY was formed in 1981 primarily as a software documentation company. Most of its work has been in the area of manuals and handbooks for the computer industry.

However, according to Phil Cohen, the company's managing director, Hard Copy feels the industry may be getting too small for it. It wishes to expand into other industries including the mining and chemical process industries.

So Hard Copy is now looking for new areas of technical writing to service. According to the company, its writers are skilled in areas as diverse as electronics, typesetting, building, chemistry, astronomy and high-energy physics.

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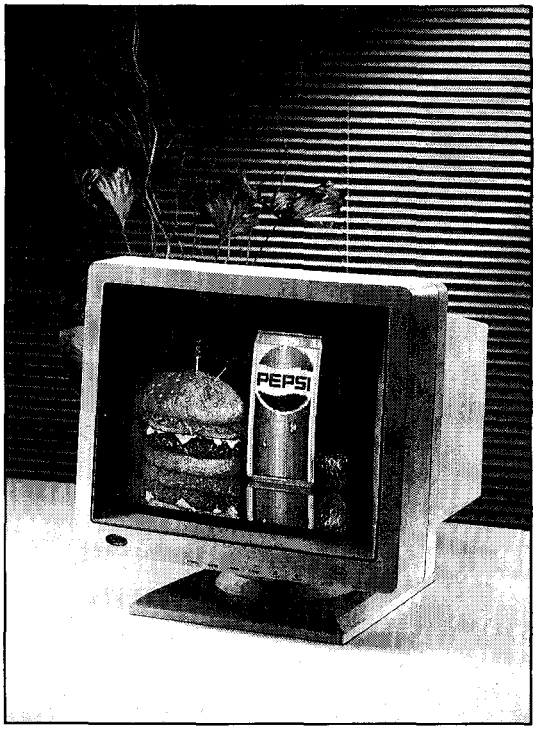

THE latest range of Tystar monitors is about to be launched in the Australian market place. The launch is significant due to the product's enhanced specifications, quality and performance. Although most current monitors, including Tystar, use a 0.31 dot pitch, future Tystar monitors will feature 0.28 dot pitch and will therefore have a display sharpness and resolution unknown to most users.

The company says that not only have they managed to refine the standard of their monitors through extensive and substantial commitment to Research and Development, but they are now also able to offer the facility of being able to support all the current graphic display modes with absolute clarity. The company claims that this is truly an impressive achievement. With specifications such as these, they say demand is almost certain to exceed supply and early expressions of interest are essential to ensure availability.

Tystar will shortly be opening its own Australian sales office, but all enquiries at this stage should be directed to AllData on ☎ (03) 794 5099.

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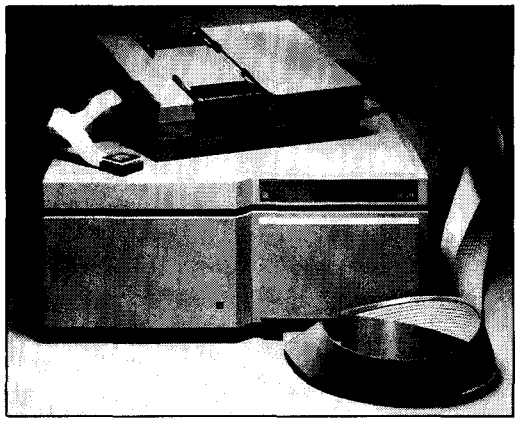

THE first in-circuit emulator for 32-bit microprocessors running at 33 MHz and faster has been announced by Applied Microsystems Corp. Based on a new architecture, the EL 3200 will enable engineers to quickly find and fix both software and hardware problems in embedded systems. The first probe modules for the new emulation system support Motorola's 68020 and 68030 chips. Further, the 68030's cache burst and synchronous cycles are supported.

The modularly-designed EL 3200 runs on Sun Workstations and PCs. It is also available for Sun workstations on standard Ethernet TCP/IP networks. The EL 3200 provides a clear path from today's 32-bit microprocessors to the much faster chips of the mid-1990s, with full emulation functionality at 33 MHz and above.

Modular design allows easy system configuration with stackable overlay memory modules of up to 1 MB per module, for a total of 2 MB. In addition, the overlay mémory is fast, running with no wait states at 33 MHz. It can also be mapped in 4K segments. For further information contact Anitech, 1-5 Carter St, Lidcombe NSW 2141 ☎ (02) 648 4088.

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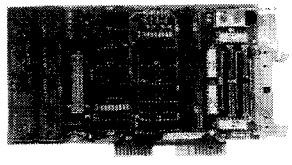

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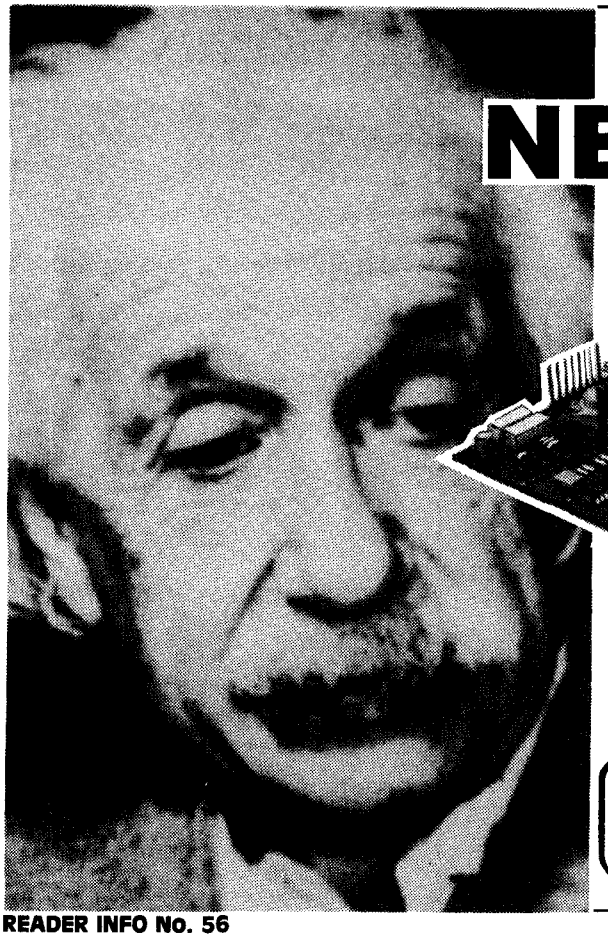

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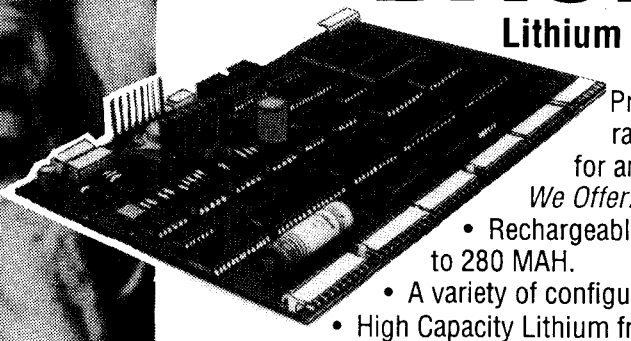

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4	29	54	79	104	129	154	179	204	229	254	279	304	329
5	30	55	80	105	130	155	180	205	230	255	280	305	330
6	31	56	81	106	131	156	181	206	231	256	281	306	331
7	32	57	82	107	132	157	182	207	232	257	282	307	332
8	33	58	83	108	133	158	183	208	233	258	283	308	333
9	34	59	84	109	134	159	184	209	234	259	284	309	334
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11	36	61	86	111	136	161	186	211	236	261	286	311	336
12	37	62	87	112	137	162	187	212	237	262	287	312	337
13	38	63	88	113	138	163	188	213	238	263	288	313	338
14	39	64	89	114	139	164	189	214	239	264	289	314	339
15	40	65	90	115	140	165	190	215	240	265	290	315	340
16	41	66	91	116	141	166	191	216	241	266	291	316	341
17	42	67	92	117	142	167	192	217	242	267	292	317	342
18	43	68	93	118	143	168	193	218	243	268	293	318	343
19	44	69	94	119	144	169	194	219	244	269	294	319	344
20	45	70	95	120	145	170	195	220	245	270	295	320	345
21	46	71	96	121	146	171	196	221	246	271	296	321	346
22	47	72	97	122	147	172	197	222	247	272	297	322	347
23	48	73	98	123	148	173	198	223	248	273	298	323	348
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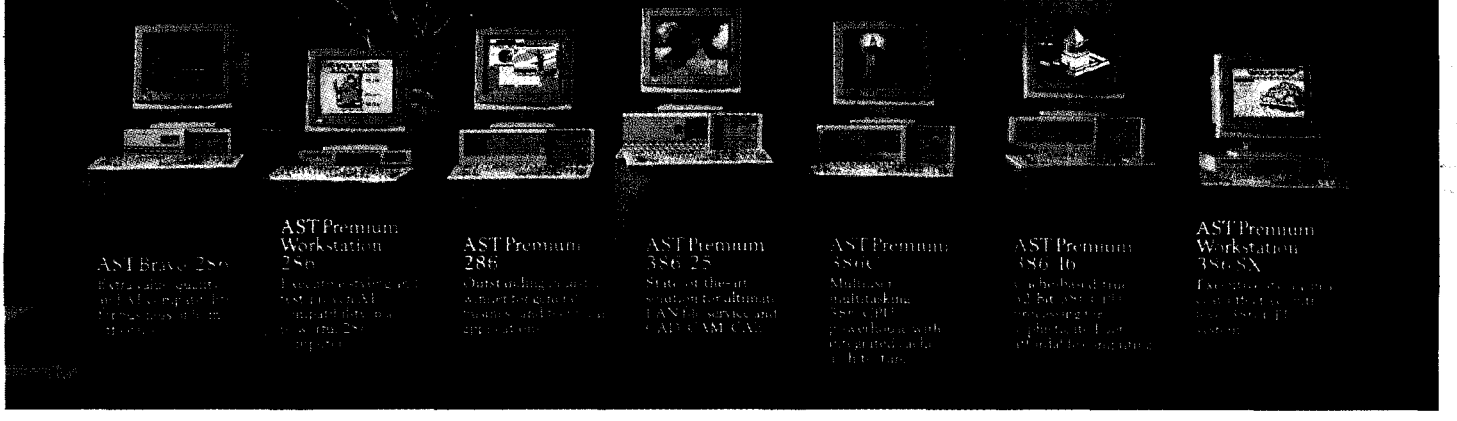

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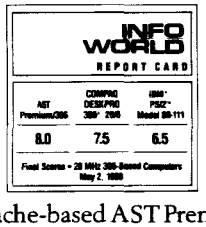

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TABLE 1

Meter	Reading	SWR
0.8	full scale	3.0:1
0.42	full scale	2.5:1
0.34	full scale	2.0:1
0.2	full scale	1.5:1
0.1	full scale	1.2:1
0.05	full scale	1.1:1

If you are using the same sort of edge meters as I've used in the prototype, then you can make yourself new scales from the artwork reproduced here. If you have MU45 or ST38 type panel meters on hand and wish to substitute them, I've presented artwork for new scales to suit them, too. You can make your own replacement scales from Scotchcal, or kit suppliers may include them with kits. Quite serviceable scales can be made simply by taking a good quality photostat of the artwork published here.

Replacing the scales on edge type meters is quite simple, provided you go about the task with a little care. The transparent fronts are actually held on to the body with sticky tape. Carefully peel this away – you'll find two separate pieces. Put them aside where they won't pick up dirt or curl back on themselves. The scale is held in place, you will notice, because it is slid beneath small ledges at each end, and secured by two small tabs on the needle side. Carefully bend these tabs back straight and you can gently slide the aluminium scale out.

If you have Scotchcal scales, they can be stuck on in the usual way. Photostat scales can be stuck on with a suitable paper glue, such as 'UHU Stic'. (I did – worked fine!). Cut away the overlaid scale where the securing ledges rub against the scale. A sharp penknife or hobby knife (scalpel) is useful here.

Check and reset the mechanical meter zero on each meter, if necessary. Now you can put the transparent fronts back and replace the sticky tape.

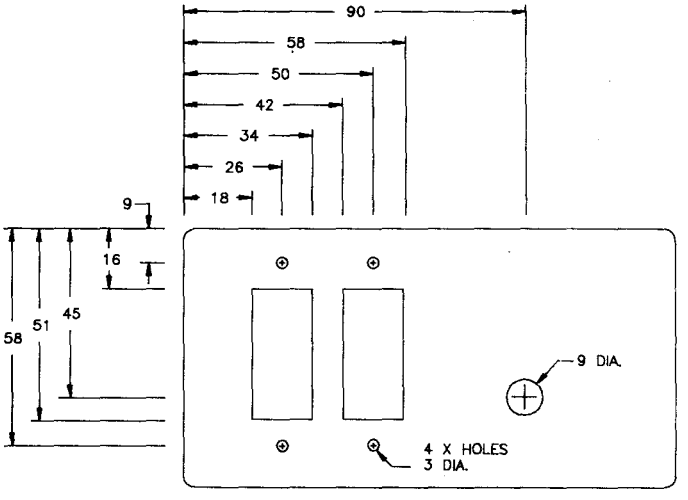
Construction

The first thing to note about this project is that, in the RF Head Unit, all the components mount on the *track* side of the board – as can be clearly seen from the accompanying photograph.

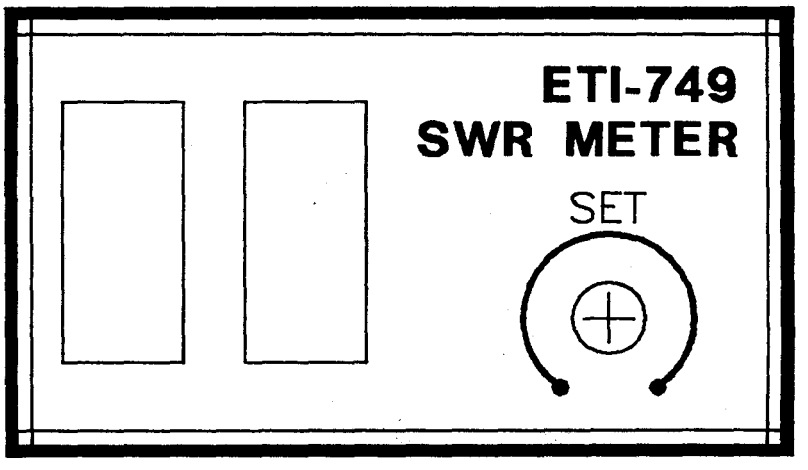
The first stage is to tackle all the mechanical work. The Meter Unit I housed in a simple plastic jiffy box, while the RF Head Unit I mounted in a small diecast box. The pc board is mounted simply by soldering it to the pins of the input and output coax sockets. The appropriate pads should be drilled to accommodate them. The board measures about 60 mm long by about 50 mm wide. Measure two points on the input and output pads that are about 50 mm apart and some 5 mm in from the board edge. Drill the holes.

Then, using the drilled board as a template, lay it on the inside surface of the lid, centrally positioned, and mark the location of the coax sockets' centres through the holes you just drilled in the board. Now drill the case lid to take the coax sockets you're using. Don't forget to de-burr the holes afterwards. If you can't drill a hole of this diameter, drill a smaller hole and ream it out. When drilling large diameter holes like this it is always wise to drill a small 'pilot' hole first, to help locate the larger drill.

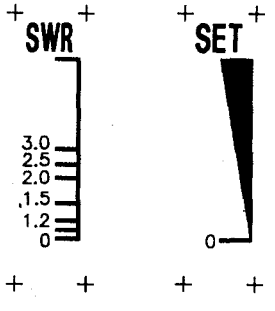
Mount the coax sockets, using a suitable solder lug on the output



Drilling details for the front panel of the Meter Unit jiffy box. All dimensions are shown in millimetres.



Artwork for the Meter Unit front panel, shown actual size.



Full-size reproduction of the artwork for the edge meter scales.

socket. This will be used for grounding the board later.

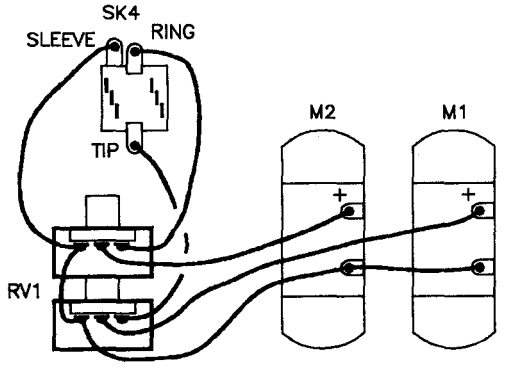
Next, locate a suitable position to mount the 6 mm jack socket on one side of the diecast box. Just make sure the components on the pc board won't foul on it later.

Tackle the Meter Unit case next. Drilling details for the front panel are given in the accompanying diagram. Or, you could use the front panel Scotchcal artwork as a template to mark out hole positions for the meters and potentiometer. Once you've completed the meter cutouts by whatever means you generally use, do a trial fit, then file the necessary edges until the meters make a snug, but not tight, fit. The holes for the meter securing screws should be countersunk on the face of the front panel. This will enable the escutcheon to sit flat.

Temporarily fit the meters and pot to the front panel. Then find a suitable location for the 6 mm jack socket on a side of the case bottom so that either the meters or the pot won't foul it when the front panel is screwed in place.

With all the mechanical work completed, now for the electronics. First, wind the toroid. You'll need about one metre of the enamelled wire. Find the centre, slip it onto the toroid and start winding from the centre outwards – it's the easiest way, believe me! Each turn is counted as one pass through the centre of the core. Make sure you keep the windings close together on the inside of the core. A dab of glue at each end will hold the winding in place when finished. Put the completed toroid aside.

Now cut and strip the short length of RG58 as shown in Figure 2. Fan back and dress the braid at one end – and one end only – as the drawing shows. On the other end cut the braid back where it protrudes from beneath the outer sheath. Put the piece of coax aside for now; we'll get back to it shortly.



Wiring diagram for the Meter Unit. You may have to use a 1.5 V battery and a 10k resistor to determine the positive terminal of the edge meters.

Tin the pins of the coax sockets. Take your pc board and place it, track side uppermost, over the coax socket pins. Solder the pins to the board using a fairly liberal amount of solder to provide a little mechanical strength. Tin the ground lug under the output socket, fold it back over onto the ground track adjacent to the output pad on the board and solder it in place.

Now the reflectometer components may be assembled to the pc board. The accompanying overlay diagram shows general placement of the components. Note the symmetrical layout of the board; this is done to best maintain balance between the two halves of the circuit.

First, solder the output end of the piece of RG58 (that end with the braid) in place (output). Then, slip the toroid over the other end, position it and solder the coil's leads to the board as indicated. Now solder the centre conductor of the coax's free end to the input.

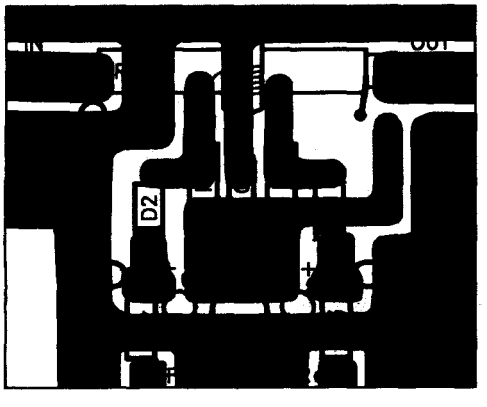
The rest of the components are soldered in place next. For components such as the resistors and diodes which will sit horizontal to the board, their leads should be dressed down from the body and then out at right angles so that the component body sits slightly above the surface of the board and no strain is placed on the point where the lead enters the component body. For those components with radial leads, such as the capacitors, just bend the leads at right angles out from the body at a point close to the body (to minimise lead length).

The wiring of the 6 mm jack socket for the RF Head Unit is shown adjacent to the pc board overlay. Note the separate earth wire. This is there so that the whole thing still works when you've got the lid off the diecast box. One last thing here – mark either the input socket (SK1) or output socket (SK2), or both, in order to identify them.

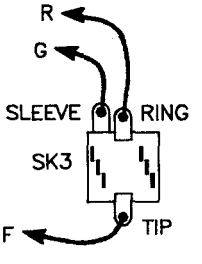
Next, the Meter Unit. Dismount the pot you trial-mounted earlier, if you haven't already done so. Using a steel rule and sharp hobby knife (scalpel), carefully remove the meter cutouts on the front panel escutcheon. Try it for fit and carefully cut those edges which might need it.

You can now apply the front panel escutcheon. If you're using Scotchcal, remember that it's easier to work with if you soak the Scotchcal for a few minutes first to soften the glue and then apply it to the front panel which has been dampened first with a sponge. While it's still wet, you can carefully cajole it into position. When it's dry you can cut out the pot hole using a sharp hobby knife. Take care, though, or you could ruin the Scotchcal at this stage.

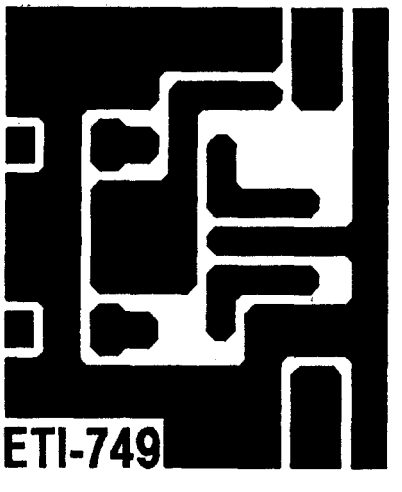
When it's all done, mount the dual-gang pot, taking care not to damage the escutcheon so carefully applied. Mount the jack socket to the case bottom, if you haven't already done so. Wire



Component overlay for the pc board in the RF Head Unit. Note that the components mount on the track side of the board. Wiring of the 6 mm jack socket is also shown.



Full-size reproduction of the pc board artwork.



PARTS LIST ETI-749

SEMICONDUCTORS
D1, D2 ..... OA47, OA90, OA91, OA95

RESISTORS all 1/4 W, 5%
R1, R2 ..... 150R
R3, R4 ..... 2k2
RV1 ..... 10k lin. dual-gang pot.

CAPACITORS
C1 ..... 10p ceramic
C2 ..... 100p ceramic
C3, C4 ..... 10n ceramic
C5, C6 ..... 1u/35 V tantalum
CV1 ..... 5-40p or 5-65p film trimmer

MISCELLANEOUS
M1, M2 ..... 250 uA/500 uA edge-type panel meters (e.g: DSE Q2110 or Ritronics Q10400); or 100 uA MU45 or ST38 panel meters.
RFC1 ..... 1 mH moulded RF choke
Toroid ..... Amidon T50-2 or T50-6
SK1, SK2 ..... SO239 single-mount coax sockets
SK3, SK4 ..... 6.5 mm stereo jack sockets
ETI-749 pc board (50 × 60 mm, no holes); two 6.5 mm stereo plugs; two metre length of twin-core shielded (stereo) cable; 50 mm length of RG58 coax; one metre of 0.2-0.25 mm enamelled wire; one diecast box 120 × 65 × 40 mm (or other box – see text); one plastic jiffy box 130 × 68 × 41 mm; Scotchcal front panel escutcheon and meter scales; knob to suit pot.; 4 × 8BA 6 mm countersunk bolts and nuts; hookup wire.
Approximate cost ..... $30-$45 (depending on boxes and meters used).

up the Meter Unit according to the separate diagram here. Make sure you get the jack wiring correct in each unit, else the meters won't read what you expect!

The only remaining thing to do construction-wise, is to make up a suitable length of twin-core shielded cable with 6 mm jack plugs on each end.

As usual, thoroughly check all your work on completion. Picking up and fixing any problems at this stage certainly saves grief and frustration later.

Setting up

To set up the instrument, only C1 needs to be adjusted. You will need a transmitter or other suitable RF source, a 50 Ohm dummy load and perhaps another SWR meter for comparison. You can buy low power dummy loads quite cheaply; high power ones come somewhat more expensive so you might consider borrowing one. Otherwise, you can make your own. They're described in such good texts as the ARRL Radio Amateurs' Handbook. It is best to carry out this procedure at a low power, if it can possibly be arranged, and at as high a frequency as can be managed (but within the expected scope of the instrument's usage).

This procedure is carried out with the lid of the RF Head Unit removed to gain access to trimmer CV1. Link the RF Head Unit and the Meter Unit. Plug the dummy load into the output socket (SK2). Link the transmitter into the input socket (SK1). Turn the SET pot fully anti-clockwise. Key on the transmitter and then slowly advance the SET control. The SET meter needle should start to rise at some setting. If nothing happens, release the transmitter, unhook everything and check all your wiring.

Assuming all's well, turn the SET pot until the SET meter reads full scale. The SWR meter will likely be showing some reading or other. Adjust CV1 to minimise this reading. You should be able to make the meter read zero. When the reading gets very low, like 1.2 or below, you can advance the pot to gain more sensitivity. Adjust CV1 to get a minimum in the reading on the SWR meter.

When you've got that, "it's a wrap", as they say.

FEATURES
- Twin meter readout – no FWD/REV switching needed
- Covers 1 MHz through 50 MHz
- Suits powers from 1/2 W to 500 W
- Simple construction
- Low cost, despite the two meters

Epilogue

This unit will give full-scale deflection on the SET meter with powers of a few watts. And it maintains that sort of sensitivity right across the HF band; it falls off a bit at 50 MHz. Its contribution to SWR in a matched line is hardly measurable.

To squeeze the last ounce of possible accuracy out of this unit, 10-turn trimpots may be substituted for resistors R3 and R4, which are then adjusted to equal the M2:M1 meter readings when the RF unit's input and output are swapped. This will provide some compensation for tracking error in the dual-gang pot and also allows adjustment of the power sensitivity. If you're working with QRP (low power) equipment, you can wind more turns on T1 to gain more sensitivity. An additional 10-20 turns is enough to get full-scale deflection on powers under one watt. Increasing the values of R1 and R2 also helps, as does lower values for R3-R4.

If you're working with high powers, in the 100-400 watt region, you can reduce sensitivity by decreasing the values of R1 and R2 – even down to 10 Ohms, as well as increasing the values of R3-R4. With high powers, it may be a good idea to put 10n ceramic bypass capacitors directly across the signal and earth (sleeve) pins of the jack socket in the RF Head Unit, as well as on the one in the Meter Unit. This precaution will bypass any RF pickup within the Head Unit and on the interlinking cable.

For protection against severe meter 'slamming' (0.25 V across the meters gives full-scale deflection), which might happen if you inadvertently take a reading with the SET control well advanced, you can install a diode across the outer pins of each of RV1a and RV1b, cathode to ground. The diodes' forward voltage will clip excess voltage here. Germanium diodes are best as they conduct at around 0.3 V, or else OA47s.

Using the general details of the construction principles described here, there's no reason why you can't put the reflectometer and metering sections in the one box – just choose something of the right size to accommodate everything. An all-metal box is the best choice because it will provide some overall screening for the circuit. Different meters are readily accommodated and you can derive your own SWR scale from Table 1 for whatever meters you choose.

With suitable values chosen for R1-R2 and R3-R4, to suit the power levels you're working with, meters M1 and M2 can be substituted with two bargraph displays such as that designed for the ETI-748 RF Power Monitor, to make a continuous in-line SWR monitor with flashing LED bargraphs. More fun when you're on the air than King's Cross on a Saturday night!

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Test Equipment for the Radio Amateur, by H.C. Gibson G8CGA, published by the Radio Society of Great Britain (RSGB).

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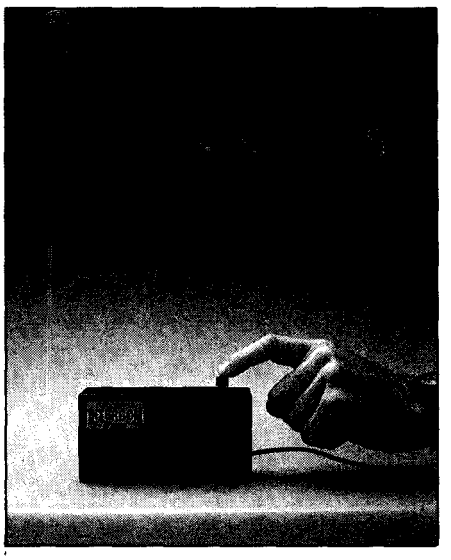
Inductors – Unravelling a Few Myths, by John Day VK3ZJF, Australian Electronics Monthly, January 1988.

Build this TWO-STATION INTERCOM



How's this for a simple intercom? Here's a practical project that's ideal for beginners, or anyone who wants a straightforward intercom between two rooms, says Roger Harrison.

An intercom is a handy facility to have around the home. If you have a workshop in your garage, like a lot of enthusiasts, you'll know what I'm talking about. Or, an intercom might be handy between a downstairs laundry and the house upstairs, for example. Between the front door and the kitchen. Or between the rumpus room and the kitchen, perhaps. Think about it for a few moments and I'm sure you'll see situations where you could use an intercom.

This low-cost intercom only requires running a simple two-wire cable between the two stations. Each station has a microphone and loudspeaker in it, along with a TALK/LISTEN pushbutton.

In the past, many intercom designs have used an amplifier at one station only, with perhaps the speaker doubling as a microphone. This requires, at the minimum, a three-wire cable. That's OK, but experience shows that such circuits are prone to problems with noise, particularly if a long cable run is required. Even if that may not be a problem, one of the significant costs in installing an intercom is the cost of the cable (unless you've scrounged it!).

Now, two-wire bell cable (for electric/electronic doorbells) costs around 30-40 cents/metre. To get a three-wire cable, you have to buy a four-wire cable and waste one wire. The cheapest four-wire cable is telephone-type cable; at 70-80 cents/metre it's twice the cost of bell cable. Because you need to hide the cable, runs of 30 metres are not uncommon, and can be much more. The electronics for an extra amplifier in this project is a fixed cost, and the ability to use bell cable keeps the total cost down no matter how far the required cable run might be compared to a unit with one amplifier and requiring a 3-wire cable.

As you can see from the circuit, each station is based on a single IC, an electret mic insert, a speaker and a handful of parts, so construction is simple enough that you can complete it in a few hours. Run a little wiring between the kitchen and the garage – or wherever – and, in one Saturday afternoon, you've got an intercom!

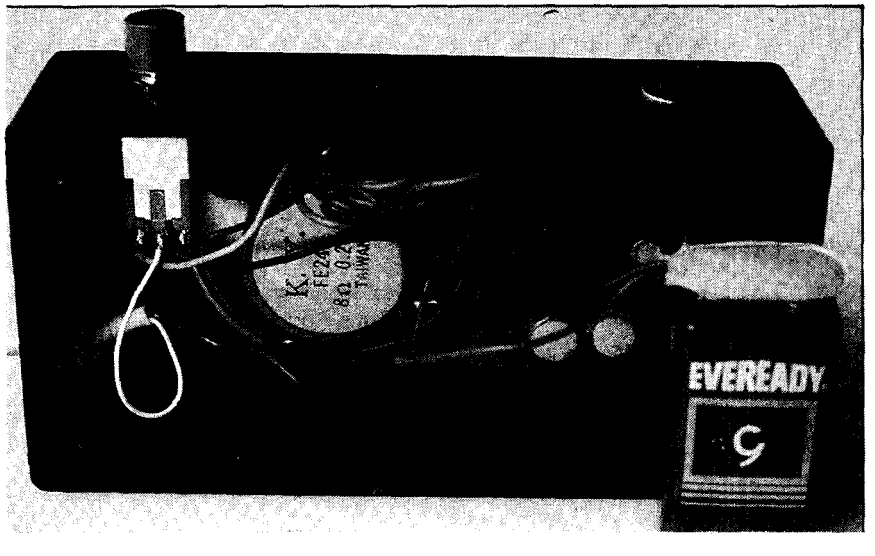
The components chosen for this design are all commonly available parts, obtainable from any of the popular electronics retailers, so you should have no trouble locating components. If you're on a budget, or simply looking to save money, a little judicious catalogue flicking and shopping around should enable you to get parts at the keenest prices. Some retailers may offer complete kits, which is certainly a convenient way to buy, and often at a saving on the cost of the individual components. Eager to start? Let's go!

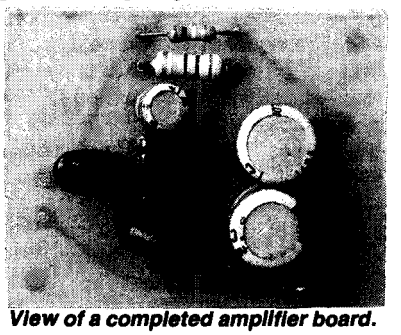
Construction

Each amplifier is built on a small printed circuit board measuring 40 x 50 mm. Each station in the prototype project was housed in a small plastic jiffy box. A 57 mm diameter mini loudspeaker just fits in the bottom, allowing enough room for the pc board on one side of it, as you can see from the accompanying internal photograph.

You can start by assembling the components to the pc boards. But first, make a visual check of the board, no matter whether you've made it yourself or have a ready-made board. See that all the component holes are clear and of the right diameter to take the component leads. Check that there are no small copper whiskers bridging closely-spaced tracks and pads. If there are, use a sharp penknife or hobby knife to get rid of them. Fix any problems you find and things will go very smoothly.

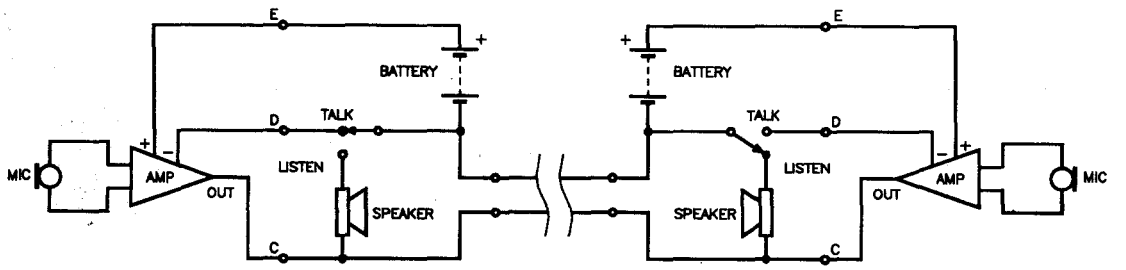
Lay out your components so you can easily identify them and tackle one board at a time. The component overlay, shown with the general wiring diagram, shows how the individual components.





View of a completed amplifier board.

Inside a completed intercom station. I used double-sided sticky pads to hold the pc board in place, and glued the speaker in position.



ELECTRONICS
ETI-1201

Figure 1. Overall arrangement of the two-station intercom, showing how the hookup and TALK/LISTEN switches work.

are placed. You'll find it easier to solder the IC in first. Make sure you insert it the right way round. Take care not to keep the soldering iron on a joint too long when soldering to avoid too much heat being transferred to the IC.

Then solder the resistors in place, followed by the capacitors. Note that C3, C5 and C6 are polarised types, so make sure you get them the right way round. The components should be seated as close to the board as they will go so as to minimise lead length. This ensures mechanical stability, so that vibration doesn't mysteriously break a lead some time in the future, as well as preventing unwanted feedback around the circuit which is likely to make your amplifier an oscillator, instead!

Check your work at this stage. You can solder the electret mic insert to the board now. Electret mic inserts are supplied with a variety of connection methods. Some have two leads attached; generally one lead has red insulation, the other black. Other types simply have two solder connections on the rear of the insert. Attach two leads to the latter type, using colour-coded wire. Or you could use a short length of shielded cable. Whatever you use, a lead length of about 80-100 mm is adequate.

As the mic insert pinout with the circuit shows, usually one terminal is connected to the mic's case. This goes to the B connection on the circuit and pc board. If your mic insert has red and black leads, this is the black lead. If you're connecting it with shielded cable, the B terminal should be connected to the shield.

OK, put your completed amplifier boards aside. Now you can tackle the cases. I haven't given specific drilling details here as individual constructors will have differing requirements. In any case, you can get the general drift of how the prototypes were arranged. As I said earlier, these were mounted in small plastic jiffy cases. You can largely suit yourself about what housing to use. Indeed, the same goes for the speaker.

HOW IT WORKS

The important circuits of two IC amplifiers each driven from electret microphone inserts. The output of each amplifier is fed to a twin line via push-to-talk switches.

The amplifier circuit uses an LM386 audio power amplifier IC. This was chosen because it was made for applications such as this! It can be battery operated as it draws very little quiescent (non-operating) current, delivers good power output from a single rail, low-voltage supply and requires a minimum of external parts. It's widely available and cheap, to boot!

The LM386 will deliver around 550 mW into an 8 Ohm speaker powered from a 9 V supply, as it is here.

The electret microphone connects at points A and B. Bias for it is supplied by R1 and C1 ac-couples the signal to the input of the IC.

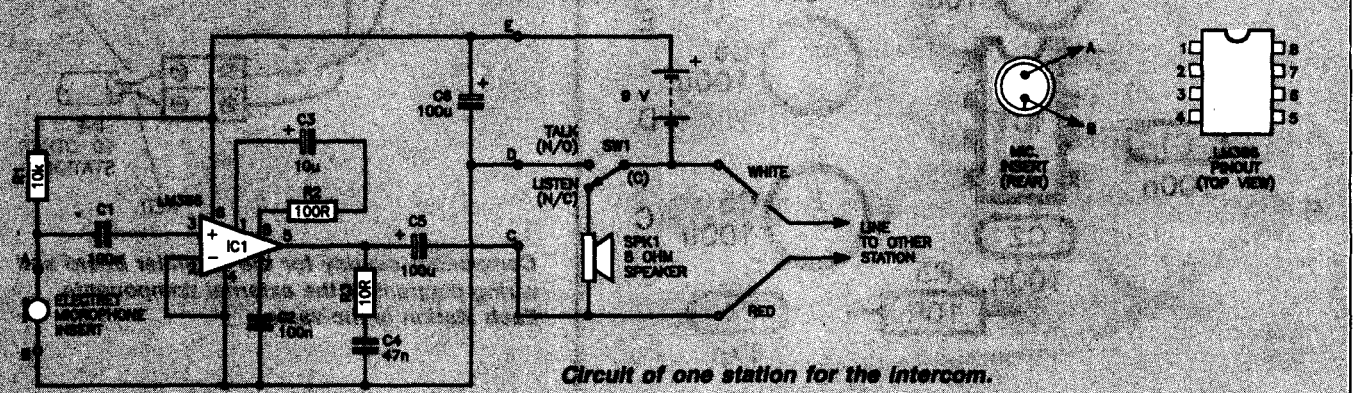
The gain of the LM386 is variable and is set by the components R2 and C3. The gain can be varied between 20 (R2 open circuit) and 200 (R2 short circuit) to suit the microphone and sensitivity required.

High frequency stability for the IC is assured by R3, C4 and C2, while C6 provides decoupling on the supply line for low frequency stability. The output is ac-coupled to the line and remote loudspeaker by C5.

Now to explain the interconnections between the two stations and the TALK/LISTEN switching. The general arrangement is shown in Figure 1 here. Normally, with the push-to-talk switches not operated, the amplifiers are both disconnected from the line and the two speakers are connected together. As the negative terminal of the batteries is connected to the circuit through the push-to-talk switches, no power is drawn from the batteries until one of the switches is pressed.

When you press one push-to-talk switch – for example the one on the left in Figure 1 – the speaker in that station is disconnected and the output of the amplifier is connected to the line. When you speak, your voice signal will be transmitted down the line to the remote speaker.

If both talk switches happen to be pressed at the same time, both the amplifier outputs will be connected together. This would normally be damaging to the ICs but the peak current that arises when one output is high and the other low are limited to a safe level by the internal resistance of the small 9 V 'transistor radio' batteries. These batteries should not be substituted for any supply of a higher voltage without using a series resistor of about 47 Ohms in one supply lead.



Circuit of one station for the intercom.

Two-station intercom

Larger diameter speakers are more sensitive (they don't require more power, as you might think) and will give more volume. So, you might choose a 100mm (4") diameter speaker, or a car replacement speaker. Or you might use something out of your junk box. If so, this will determine the size and type of case you house the stations in. If you're into woodworking, you might like to knock up a nice timber or timber veneer case to suit. The choice is yours.

Whatever case you use, plan where you need to place the speaker, switch, microphone, amplifier board, battery and where the line enters. In my case, I determined a position for the speaker first, marked it and then drilled sound outlet holes. The switch, line inlet hole and mic locations were determined next, then marked out and drilled. After you drill holes, make sure you 'de-burr' them. A sharp penknife or hobby knife is good for this, but take it easy – plastic jiffy cases are quite soft.

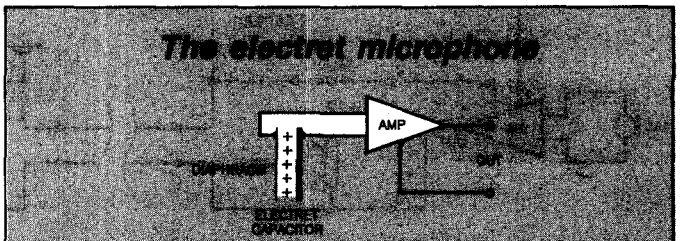
The mic insert I glued into a 9mm diameter hole in the top of the case, using Superglue. Carefully drill the hole and check the fit. You may need to ream it out a little (one blade of a pair of scissors is good for this!), but take care. I also glued the speaker in place, smearing a smidgeon of Superglue at several points around the speaker's rim (but keep it away from the cone suspension!)

I positioned the microphone on the top of the case, rather than the front, so that the sound reaches it obliquely, rather than more directly. This reduces mic overload and consequent distortion (some people automatically shout – as if the intercom is two tin cans and a length of string!).

I made up a simple escutcheon for the front, the artwork for which is reproduced here. You can make Scotchcal labels from this to dress up your stations. While I'm on the subject, there's a trick to attaching Scotchcal adhesive labels. First, soak the

Continued on page 135

The electret microphone



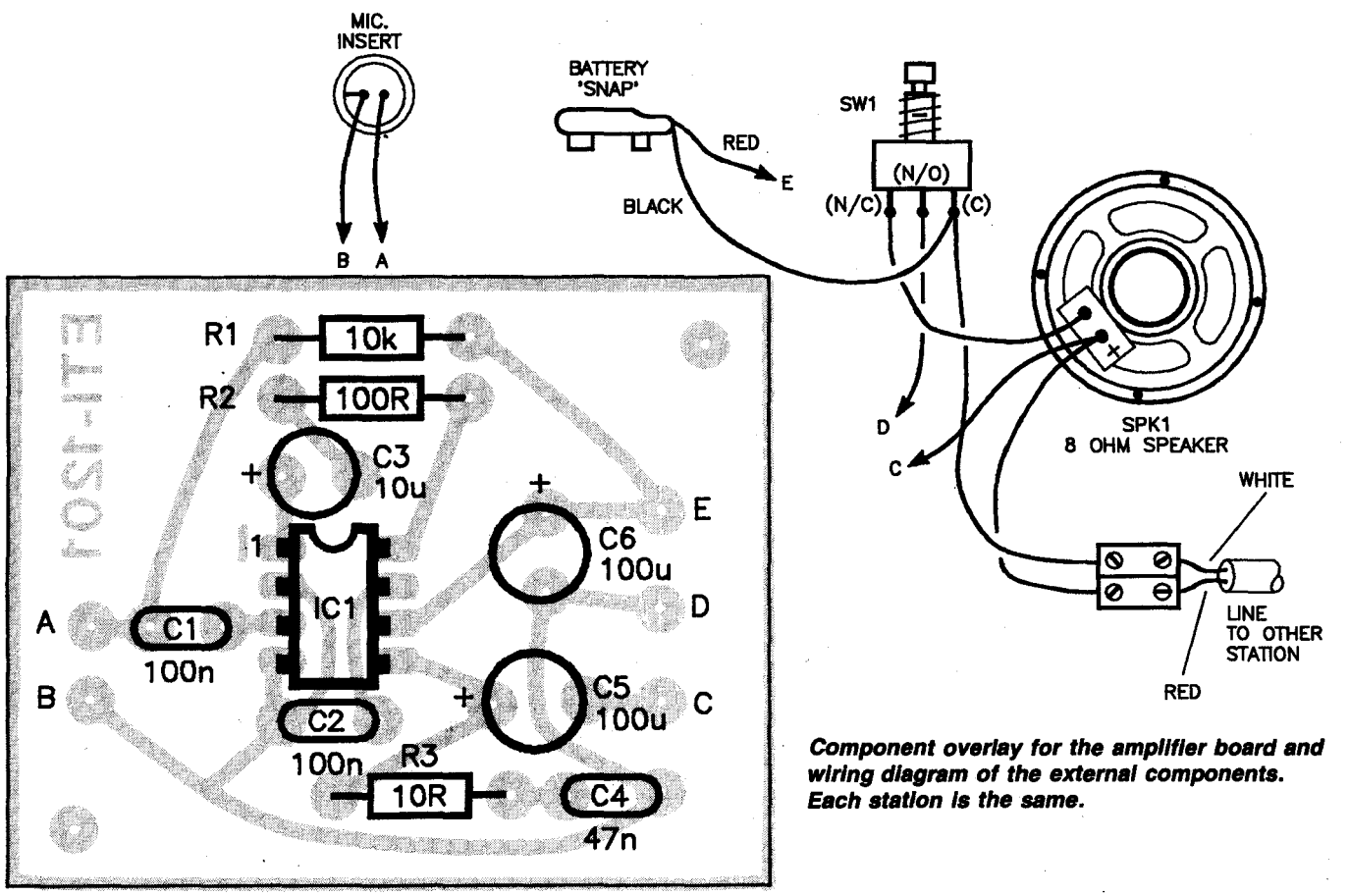
Block diagram of an electret microphone, which is a class of capacitor microphone.

This is a type of microphone, built as a capacitor, the value of which is varied by the sound pressure level impinging on one of its plates. Capacitor microphones require a charge applied, so that the variation of capacitance is translated into a voltage variation.

An electret is a permanently charged dielectric – the electrostatic equivalent of a permanent magnet, if you need an analogy. It may be a special plastic or ceramic material that is polarised by a process of heating the material and then placing it in a strong electric field as it cools.

In an electret microphone, this pre-charged material is used as part of the dielectric of a capacitor where the microphone's diaphragm forms one plate. This is then encapsulated with a tiny FET amplifier stage. A small external bias is required to power the FET amplifier which provides a comparatively high level output.

Electret mics offer good sensitivity, high output and wide frequency response in a small package at low cost.



Component overlay for the amplifier board and wiring diagram of the external components. Each station is the same.

PARTS LIST ETI-1201 (Single station; get two of everything.)

SEMICONDUCTORS

IC1 ..... LM386

RESISTORS all 1/4 W, 5%

R1 ..... 10k

R2 ..... 100R (see text)

R3 ..... 10R

(R2 may be varied to increase or decrease mic sensitivity)

CAPACITORS

C1, C2 ..... 100n (0.01u) greencap

C3 ..... 10u/16 V pc-mount (RB) electrolytic

C4 ..... 47n (0.047u) greencap

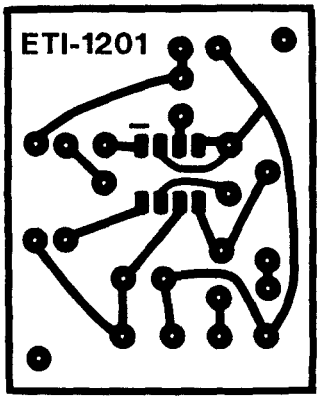
C5, C6 ..... 100u/16 V pc-mount (RB) electrolytic

MISCELLANEOUS

ETI-1201 pc board; electret mic. insert, e.g. Ritronics C10170 or DSE C-1160; SPK1 – 57 mm diameter 8 Ohm mini speaker (but see text); pushbutton switch – single pole double-throw (SPDT) momentary action type (or DPDT type), e.g. Ritronics S11050 (SPDT) or S11062 (DPDT), or DSE S1220 (DPDT); plastic jiffy box 130 × 68 × 41 mm; No. 216 battery snap; No. 216 9 V battery (optional); two-way terminal block or polarised plug and socket (see text); length of twisted-pair cable; Scotchcal escutcheon; hookup wire.

Approximate Cost: ..... $33-$39 for two stations (not including twisted-pair cable).

Artwork for a front panel escutcheon.



Full size reproduction of the amplifier printed circuit board. Two are required, one per station.

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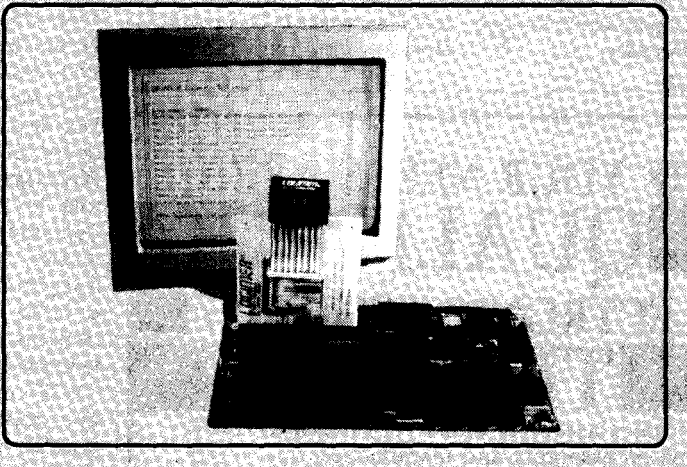

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READER INFO No. 19

TECHNOLOGY

SEMICONDUCTOR WATCH

Roger Harrison reports on what's happening in the world of semiconductors.

Field programmable gate arrays

ACTEL late last year announced release of the first members of a family of desktop (user) configurable channelled gate arrays. Designated the ACT1010 and ACT1020 these devices respectively provide 1200 and 2000 equivalent gate array gates. Actel will release a 6000-gate equivalent in the first quarter of this year.

Together with Actel's anti-fuse technology the ACT family uses a basic logic module building block which is similar in implementation to a gate array macro.

The logic module has eight inputs and one output and is capable of implementing functions similar in complexity to standard gate array macros, in fact they can be used to implement multiplexers and D or JK flip-flops; as such the ACT 1 Family is the first programmable array family which contains no dedicated flip-flops.

The ACT1020 contains 546 logic modules and can implement a maximum 273 D flip-flops or 546 latches. The Actel Macro Library contains over 200 standard logic functions including a selection of commonly used TTL functions including 74181, 7474 and 74109.

The major features of the ACT 1 family are: – high gate and I/O count; 1200 gates with 57 I/Os – 2000 gates with 69 I/Os; toggle rate to 70 MHz; system level performance to 40 MHz; non volatile, permanent programming; on-chip diagnostic probes; on-chip clock distribution network; low power CMOS technology.

ACT 1 devices are supported by a sophisticated design and development system.

Designers use their workstation to capture schematics, simulate, verify, place and route, perform timing analysis, program and debug the chip at their desk. A outstanding feature claimed for this system is the ability to place and route 100% of a design automatically for 85% – 95% of the available logic module utilisation.

The ALS is currently available on an 80386-based PC and provides an interface to and includes Viewlogic's schematic capture and simulation capabilities. Actel's Logic Design System, programmer and diagnostic software are provided with the system. Mentor Graphic's workstations are also supported.

Full details from Reptechnic, PO Box 417, North Sydney, NSW 2059. ☎ (02) 953 9844.

READER INFO No. 256

Siemens' EPIC

SIEMENS has now started volume production for the Extended PCM Interface Controller EPIC 1, which provides up to 32 ISDN subscribers with access to digital exchanges. Siemens is also introducing the simpler, lower cost EPIC 2 which can connect up to eight subscribers to the switching exchange.

Compared to conventional digital networks, ISDN networks offer extended functions using two message channels with 64 kbits/s each and a separate 16 kbits/s signalling channel. The EPIC 1 (PEB 2055) acts as a non-blocking multiplexer or concentrator and can, for example, be used in private communication systems as the central switching unit for up to 128 channels. It is programmable for data rates of 16, 32 or 64 kbits/s. Transmission rates of 128 kbits/s are also possible by cascading two B channels.

The EPIC 1 chip, currently in volume production, has an IOM 2 interface which has been established as the standard link between ISDN ICs.

The newly introduced EPIC 2 chip (PEB 2056), too, has an IOM 2 interface. This baby brother of the EPIC 1 has been developed for subscriber line cards which connect up to eight ISDN subscribers to the switching system. This makes it less expensive. This chip is also available in DIP or PLCC packages. Samples can be ordered.

For further details, contact Edgar Sandy, Communications Equipment, Siemens Limited, 544 Church St, Richmond, Vic 3121. ☎ (03) 420 7314.

READER INFO No. 257

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★ automatic wire cutting and stripping
★ wire termination and related services

READER INFO No. 20

RTD conditioner

ANALOG Devices claims its 1B41 device is the industry's first isolated signal conditioner for RTD transducers (used to measure temperature in many lab and industrial process control applications).

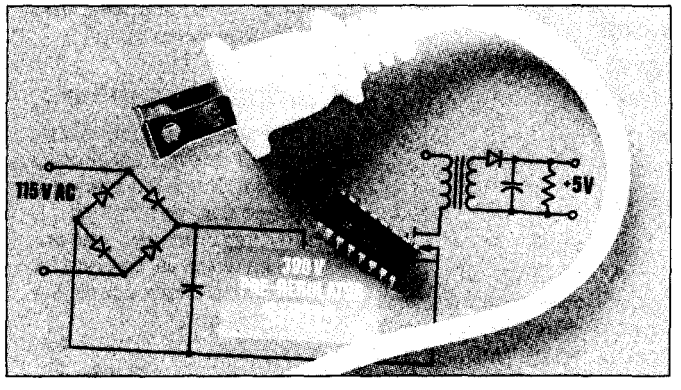
It's a compact, complete solution for providing stimulus to the RTD and then properly filtering, amplifying, and linearising the resultant RTD output.

The 1B41 generates its own isolated power, providing true channel isolation; its small size makes it appropriate for closely spaced circuit boards.

For application engineering information, contact Priority Electronics. ☎ (02)905-6024 or ☎ (03)521-0266.

READER INFO No. 258

Switchmode controllers



TO accommodate off-line applications, Siliconix has expanded its popular SI91XX family of Smartpower CMOS switchmode ICs to include the SI9115 and Si9116, increasing the input voltage range to 300 V.

Designed for reliable, high performance from 5 to 250 W, the new controllers operate from rectified, filtered power lines.

Unlike their bi-polar counterparts, which are limited to 60 V input capability, these high-voltage CMOS ICs allow a reduction in parts and greater reliability in high performance dc-to-dc converter applications, such as medical equipment, instrumentation and oil well logging equipment.

In most applications the need for an external resistor and capacitor is eliminated and, in many cases, the step-down transformer and linear regulator are also eliminated.

Contact Anitech, 1-5 Carter St, Lidcombe. ☎ (02)748-1711.

READER INFO No. 259

New neg. reg.

THE HO711 negative voltage regulator, produced by EM Microelectronic-Marin SA, is a low power device accepting supply voltages from −2.5 to −10 V and providing an adjustable output voltage of −1.3 to −10 volts at currents beyond 40 mA.

Thermal and remote shutdowns provide protection of both the regulator and the circuits powered. The regulator is also protected against reverse polarity supply voltages. The device is particularly suited for portable battery-driven equipment and applications requiring a very stable supply voltage. It will power CMOS and TTL circuits equally well.

Features include a very low drop-out voltage (0.2 V is typical) and a wide range of supply voltage. The H7011 has an internal 1.3 V bandgap voltage reference. Output voltage ranges from −1.3 to −10 V with currents up to 60 mA. Output shutdown via external control signal is another feature.

Contact Dice Engineering, PO Box 278, Lilydale, Vic 3140. ☎ (03)739-5455.

READER INFO No. 189

Triac optocoupler switches

WITH a 2 A rating, the new IL 428 coupler from Siemens can switch almost ten times as much current as conventional devices of this type. And with the greatest of ease, too, because the IL 428's novel single in-line package (SIP) requires no additional cooling when operated at 2 A and a maximum of 55°C.

With its extremely high capacity, the IL 428 will help electronics gain increased application in ac-powered load-switching equipment and replace more and more mechanical parts. The new optocoupler from Siemens was designed for use in semi-conductor relays, industrial control equipment, office machines and consumer electronics.

The IL 428 consists of a GaAs infrared LED optically coupled to a phototriac without a zero voltage switch. The chips are housed in a 4-pin SIP power package measuring only 23 × 20 × 5 mm.

The phototriac's sensitivity is so high that very low currents of less than 8 mA (typically 4 mA) are sufficient for the infrared LEDs to switch a maximum of 2 A efficiently. The 600 V repetitive peak forward off state voltage permits operation on 230 V ac power systems with a safety factor better than two. Additional features offered by the new Siemens coupler include the ability to handle dv/dt ratios as high as 10,000 V/μs and to withstand a 7.5 kV insulation test voltage.

The IL 428 provides isolation between logic and power circuits and can therefore be used to switch resistive, inductive and capacitive loads supplied from 120 V, 230 V and 380 V ac power systems. The very low control current of typically 4 mA permits motors, power thyristors, triacs, inductors and lamps up to 750 W to be directly driven through the logic circuit.

For further details, contact Edgar Sandy, Communications Equipment Department, Siemens Ltd, 544 Church St, Richmond, Vic 3121 ☎ (03)420-7314.

READER INFO No. 190

Single-chip encryption system

THE first of a series of single-chip high-speed public key data encryption systems designed for digital voice/data communications is now available in Australia through Dynamic Component Sales Pty Ltd.

Dynamic Component Systems recently signed a formal distribution agreement to represent Calmos products in Australia.

The data encryption and key management processor, CA34C168, complements both Public Key systems and conventional cryptosystems and is intended for use in both real-time file encryption or message forwarding environments, the company says.

According to Neville Westbury of Dynamic Component Sales, the Data Encryption Processor (DEP) has 150 Kb/sec throughput, making it the fastest general purpose public key processo available.

"The DEP offers 50 times faster transmission performance of the RSA implementation and is compatible with current Data Encryption Standard (DES) systems," Mr Westbury said.

The CA34C168 can be programmed to work in either block or stream cipher mode. In block mode the device can be used for interactive key exchange, standalone key exchange, asymmetric key block data encryption, or symmetric (conventional) key block data encryption.

The 8000 Series includes an 80C85B microprocessor at 5 and 6 MHz, and a range of interface, controller, timer and communication element devices.

DCS also distribute the Calmos Bipolar products, including power supply monitors, cellular radio receivers, codecs, dc-dc converters, programmable Schottky diode arrays and SCSI interface controllers.

Contact Neville Westbury, Dynamic Component Sales Pty Ltd, Showroom 6, 17 Heatherdale Rd, Ringwood, Vic 3134. ☎ (03)873-4755.

READER INFO No. 191

ROGER'S COLUMN

ROGER HARRISON

ANSWERS & ARGUMENTS

This column is intended as a forum for exchange between you, the readers, and the magazine. Via this column 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.

'Building Blocks' too technical?

I was hoping to use *Building Blocks of Electronics* to help introduce my son to that field and to use as a reference when he encountered it at school. Unfortunately the contents appear too technical and likely to get more so. I'm disappointed, but the article is still very interesting.

I.L.,
Mt. Kuring-gai, NSW

See below.

Same opinion

Your section on electronics for beginners is quite useful to myself, as I have not done much of this work for some years. But fair go, do you really think a beginner knows the meaning of "impedance" or "dielectric"?

A.B.,
Ballarat, Vic.

Maybe I could ask you the same question? I guess the whole question of the 'level' of Jack Middlehurst's otherwise popular series hinges on the interpretation of "beginner". Adapting an old maxim, I guess "...there are beginners and there are beginners..."

Jack's introduction to the series, published on page 41 of the August '89 issue, gives a clear exposition of the series' aims and objects. He wrote the series for enthusiasts who are past the 'raw beginner' stage, who are familiar with components and can find their way around a circuit diagram, and who want to understand circuits up to the point where they can look at a circuit they have not seen before and recognise the various elements or blocks comprising the whole circuit and predict typical dc and ac (signal) levels likely to be found in it.

There is a yawning chasm for enthusiasts, that lies between following instructions published in books and magazines and getting a project going, to looking at a piece of equipment or a new circuit and understanding how it works right down to the quantitative level of expected voltages present at various points. It is this sort of knowledge that helps you understand how a circuit should behave when it's not behaving and needs to be fixed.

The knowledge you gain by virtual 'osmosis' from entertaining tales or war stories of "how I fixed faulty fingle in a Fony brand TV set" is an incomplete sort of knowledge, specific to specific situations – I'm not saying that information isn't useful, because it certainly is when you meet it yourself – but when faced with a different fault in the same sort of circuit, you'll be stumped unless you can understand from basic principles what the circuit's supposed to be doing.

All circuits comprise an assembly of basic circuit 'blocks' which have given characteristics, hence the name for the series. Jack unravels the mysteries of "...the various analogue circuit blocks that you are likely to find in both modern and ancient electronic equipment."

For something 'less technical' I suggest you collect the articles in the series titled "Starting Out in Electronics", published in ETI between August 1984 and November 1985. There were nine articles in the series. I understand they will shortly be published in book form under that title – look for it at your newsagent.

More computer plug-in projects, please

I am pleased to see a 'back-to-basics' approach for the August issue.

Could I suggest a series on computer option plug-in cards ranging from test equipment to D-A Converters for IBM PCs etc. I enjoy the magazine.

J.H.,
Roseville, NSW.

I assume you mean Jack Middlehurst's 'Building Blocks of Electronics' when you refer to 'back-to-basics'.

On the question of more computer plug-in cards, no doubt you'll welcome the ETI-1626 Digital to Analogue Converter project featured in this issue. Yes, we have more in the pipeline. Stay tuned!

A different opinion

ETI is a very good magazine. I am starting a hobby in electronics and want to make a career of it. This magazine has made me understand more about electronics which will be good for my education. Thank you for the top magazine.

P.T.,
Benalla, Vic.

Thank you for the complimentary words. I trust ETI can continue to provide stimulating and educating reading.

Yet more computer projects, only different

I think ETI is a great magazine, and I'm especially pleased to see the increasing number of computer related projects. However, some of us don't have IBM PCs, or compatibles. The VGA card in August was great, and I enjoyed reading the article, but for people like myself – sans IBM or a compatible – it's not much use. Could you see your way clear to publishing projects designed to work on a wide range of computers?

Otherwise, keep up the great work.

R.N.,
Malvern, Vic.

I guess we can't please all of the readers all of the time. However, we aren't ignoring owners of 'other' computers and we have a few projects planned, some for specific computers, some of a more 'universal' nature (like the ETI-1626 D-A Converter project in this issue, which I've already mentioned). Keep reading!

Problem with the '563 Fast Nicad Charger

About two to three years ago I built the Fast Nicad Charger, (Project 563 in Top Projects Vol. 8 and also July 1980 magazine). The problem I have is – it 'cooks' the power transistor.

Each year when I buy your January Yearbook, I look up the project index to see if the publishing mistakes in the text have been corrected, but I haven't seen any to date. Some I have found are as follows:

(a) R12 is "10R" in both diagrams but 100R in the Parts List.

(b) R13 is missing from the Parts List and is only shown on the circuit diagram as 100R.

(c) Point "N" on the overlay diagram is in the wrong place.

(d) There is no hole in the circuit board for point "p" (for the lead to the yellow "charging" LED).

I have built the charger up twice. In both instances I have obtained the same result, viz:

- The heatsink for the TIP32 (Q4) gets sizzling hot and eventually the transistor burns out.
- The coil L1 runs quite cool (opposite to what is suggested in the text).
- The charger delivers only about 1.75 amps to the cells (the rest must go up as heat in that transistor!)

I really would appreciate any suggestions as to what might be going wrong. (I've decided that, if no luck soon, I'll cannibalise it – my first failure ever!)

I have enclosed a copy of the circuit diagram (*reproduced here – R.H.*) with some voltage readings from my DMM. I have not made any changes to the circuit or the board and have used all recommended parts. I used a 10R resistor for R12 and a 100R for R13.

Any advice you can give me would be greatly appreciated.

Incidentally, the coil I wound with the 1 mm wire has a resistance of 0.652 Ohms (I haven't built a device for measuring inductance yet!)

B.J.P.,
Warners Bay, NSW

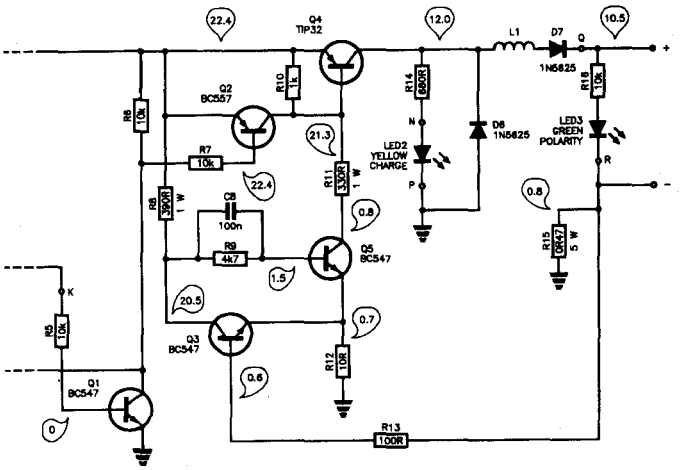
From the symptoms you describe, and the voltage measurements you've supplied, it's clear that Q5 is hard on all the time, thus holding Q4 hard on all the time. Hence, Q4 has about 10 volts drop across it and 1.75 amps flowing through it. That's 17.5 watts – no wonder it gets stinking hot!

Transistors Q3 and Q5 form a pulse oscillator, the mark:space ratio (or duty cycle) of which is controlled by the voltage drop across R15. But nothing's happening as is obvious from the base-emitter voltage measurements on Q3. There SHOULD be 0.6 V or so there, not −0.1 V!

Now I don't know about R12, but you could try a 100R resistor here and see if that kicks it into life. The BC547s specified should have sufficient gain to operate here, but from experience some types sold over the counter in past years have been low on gain. You might try changing Q3 and Q5 to BC549 types.

One thing I know that has caused trouble in the past is diodes D6-D7. These MUST be 1N5625 types. 1N54xx-series diodes don't have the switching speed necessary.

I trust these few hints will get your project going. ETI

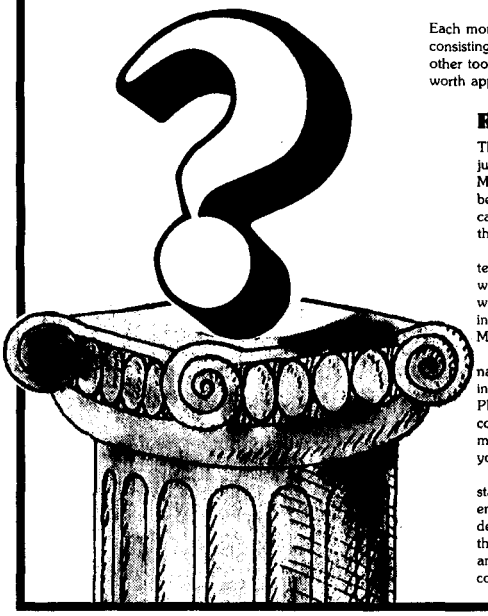


Portion of the circuit of the ETI-563 Fast Nicad Charger, with voltage measurements taken by reader, B.J.P.

"IDEA OF THE MONTH" CONTEST

TO WIN THIS $150 KIT ENTER NOW!

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, proudly sponsors this contest with a prize given away every month for the best item submitted for publication in the "Ideas for Experimenters" column — one of the most consistently popular features in ETI magazine.



Each month we will be giving away a Scope Presentation Tool Kit, consisting of a Scope Soldering Iron, a Desoldering Tool and various other tools from Scope all neatly presented in a tough durable tool roll worth approximately $150.00

RULES

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The winner will be advised by telegram. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each coupon. Photostats or clearly written copies will be accepted. You may send as many entries as you wish.

This contest is invalid in states where locals laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

COUPON

Cut and send to: **Scope-ETI 'Idea of the Month' Contest, ETI Magazine, PO Box 227, Waterloo NSW 2017.**

"I agree to the above terms and grant *Electronics Today International* all rights to publish my idea/program in ETI Magazine or other publications produced by it. I declare that the attached idea/program is my own original material, that it has not previously been published and that its publication does not violate any other copyright."

* Breach of copyright is now a criminal offence.

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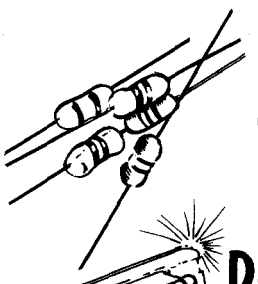

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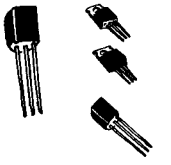

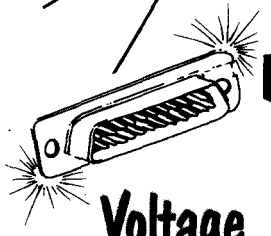

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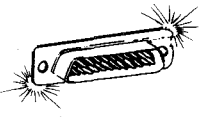

Voltage Regulators & Linear IC's

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7906	$0.55ea	$0.49ea
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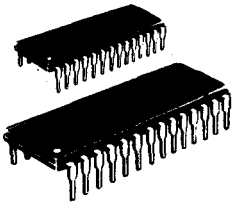

MEMORY
41256LP-120ns DRAM
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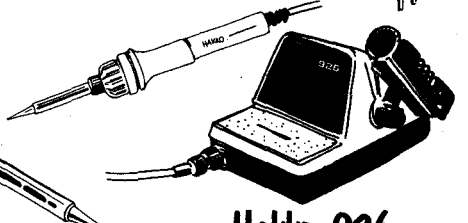
10+ $8.20ea
62256LP-100ns SRAM
1-9 $35ea
10+ $32.50ea

portasol PROFESSIONAL

Portasol gas powered soldering iron $36.95ea

Portasol Pro gas powered soldering kit $79.95ea



Hakko 980
20 watt hand-held soldering iron. $39.99

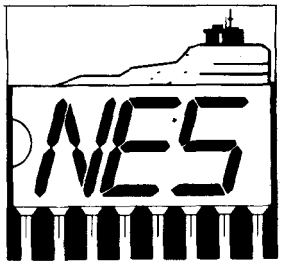
Hakko 926
50 watt soldering station. $169

Hakko 700B
40 watt solder/desolder station $1020

Memory

Code	1-9	10+
41256LP-12ONS	$6.95	$6.45
62256LP-1OONS	$32.5O	$29.95

Only one place to go. . .



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		$100+	$7.50

READER INFO No. 15

Continued from page 128

completed label in a saucer of water for some minutes. This will soften the glue. When it's ready, dampen the panel to which it's to be applied using a sponge. Then, peel off the backing paper and press the Scotchcal into position. You can gently move it into the required position now. Sponge away any bubbles that occur, rubbing from the centre outwards.

With your cases prepared, mount the major components and then wire everything up as shown in the accompanying wiring diagram. Note that different switch manufacturers have differing connections for their switches. First determine the common (C), normally open (N/O) and normally closed (N/C) connections using your ohmmeter or a continuity checker. The switch you have may not have the same connections as the switch shown in the wiring diagram.

The line between the stations may be wired to a terminal block, as shown here, or the leads directly soldered to where they have to go. You may want to use polarised plugs and sockets (such as 6 mm jacks). Make sure you wire the cable correctly. I tied a knot in the cable just where it comes through the case and soldered the wires directly to the switch and speaker. The knot prevents any tension on the cable pulling on the joints.

To attach the pc boards in their cases, I used double-sided sticky pads. Simple, and it saves drilling. But before you do, you'll need to try out your intercom and perhaps alter the value of resistor R2 to suit the microphone sensitivity and loudspeaker volume you want.

Try out

First, thoroughly check your work. Fix any errors you find. Place each station at opposite ends of a room, to avoid feedback during this test. Temporarily hook up a line between them and attach the batteries. Cajole a helper. Place them at one station then press your station's button and talk in a normal voice about 400-600 mm away from the microphone. You should be clearly heard at the other station.

A value of 100 Ohms for R2 was determined by a little experimentation to suit the prototype amplifiers; for this reason that's what has been specified in the Parts List. Good results were obtained even with about 100 metres of light duty cable between the stations. Note that the amplifiers will be most sensitive with R2 shorted out.

Overall sensitivity and speaker volume depends on the individual microphone characteristics, size and efficiency of the loudspeaker used, component tolerances, etc. With a lot of sensitivity, the microphone is prone to picking up background noise. This may not be a problem in situations where there is little or no background noise. Reducing sensitivity by increasing the value of R2 will knock back the background noise, but the station may need to be located such that you can talk at a fairly close distance from it – say 200-300 mm, rather than at arm's length.

Final

With the value of R2 determined, assemble your stations, locate them where you want them and install the cable, dressing it out of sight. For safety's sake, keep the cable clear of power cable junction boxes, outlet sockets ('GPOs') and light fittings, etc.

If you wish, rather than power the stations from batteries, they may be powered from 6 V plug pack adapters. Generally, they have sufficient output capacity such that they will be only lightly loaded current-wise, and being unregulated, will deliver about 8-9 V, from experience. The amplifiers may be run from a 12 V supply, but you should insert a 47R, 1/2 W resistor in series with one lead of the supply to limit the peak current should both TALK buttons be pressed together, thus preventing possible damage to the LM386s. eti

SHOPAROUND

ELECTRONICS

ETI PROJECT BUYERS' GUIDE

ETI-1626 Digital to Analogue Converter

This low-cost, extremely simple project is sure to be a winner – as all projects of this type are. Basically, this project allows you to interface your computer to the real world – all you need is the ETI-1626, a computer with a parallel port, a bit of programming effort and some imagination.

The project should cost in the vicinity of $15. At the time of writing, Rod Irving Electronics, Geoff Wood Electronics and Stewart Electronic Components were stocking the necessary components. For those who are after pc boards for the 1626, try some of the board stockists listed later in this column.

ETI-1201 Two-station Intercom

So you're sick of yelling from one end of the house to the other just to find out where the peanut butter is kept. Well then, this is the project for you!

All the resistors and capacitors are common values so you should have no trouble obtaining any of these. As for the LM386, if you don't already have one in your junk box then just about any electronic shop around should have this too!

Again, try any of the board stockists listed below for the pc board. The electret mic. insert can be obtained from Rod Irving Electronics or Dick Smith Electronics – Ritronics catalogue no. C1017O, DSE catalogue no. C-116O. As for the pushbutton switch, All Electronic Components, Rod Irving Electronics and Dick Smith Electronics should all stock the required type; catalogue numbers are as follows; RIE S11O5O (SPDT) or S11O52 (DPDT) and DSE S122O (DPDT). Other miscellaneous components are reasonably common.

ETI-749 SWR Meter

You should have no trouble in locating the semiconductors, resistors and capacitors for this project. Rod Irving Electronics and Dick Smith Electronics both stock the required panel meters: cat. nos – RIE Q1O4OO or DSE Q211O.

Dick Smith Electronics, Stewart Electronic Components and All Electronic Components carry the 1 mH moulded RF choke as standard items. See board stockists for the pc board.

The Amidon toroid is the only component that's in any way 'special'. Stewart Electronic Components stock a considerable range of Amidon products and the T5O-x cares we understand are a stock item. You might also check out R.J. & U.S. Imports, whose retail agencies are; Geoff Wood Electronics, Lane Cove NSW; Webb Electronics, Albury NSW; Electronic Components, ACT; Truscott's Electronic World, Croydon Vic; Willis Trading Company, Perth WA and Associated TV Service, Tas.

PCBs — general

All Electronic Components 118-122 Lonsdale St, Melbourne, Vic 3OOO ☎ (O3)662-1381
Acetronics 112 Robertson Rd, Bass Hill, NSW 2197 ☎ (O2)645-1241
RCS Radio 651 Forest Rd, Bexley, NSW 22O7 ☎ (O2)587-3491. eti

BUFFOONERY

SUMMERTIME, MURPHY & THE MALODOROUS

So, summer. And the fields and parks, backyards and alleyways resound to the clack of leather on willow.

And so does the TV screen.

Your Dregs hack, in the dim dark days of school, when Jerry Lee Lewis was himself just out of short pants, was inducted into the ritual battle known by the curious term of "cricket".

There was a problem with my induction (my inductors never actually *explained* what the game was supposed to be all about) and, as a consequence, I never embraced its philosophy or its practice.

Many years later, I worked for a subsidiary of Kerry Packer's publishing empire. One fateful year, he launched World Series Cricket on an unsuspecting world. (Well, Australia, at least). The Sports Publications Division went into paroxysms. (Paroxysms are like orgasms, in that the affected person utters strange and strangulated cries at rhythmic intervals...)

Seeking to understand this phenomenon, being eternally curious, I asked the senior sports sub-editor just what *was* the philosophy behind this game of cricket. So, he arranged to discuss the matter over lunch at the local – the Bilgewater (so named probably because a lot of bilge was spoken there...).

He explained; "Cricket is quite simple. You have two sides, ours and theirs; one out in the field and one in. Each man in the side that's in, goes out, and when he's out, he comes in and the next man goes in until he's out. Then, when they've all been in and are all out, the side that's been in the field goes in and the side that's in goes out and tries to get out those coming in.

"Sometimes," he went on, "you get men still in and not out. Then, when both sides have been in and out, including not-outs, that's the end of the game. It's really very simple!" he exclaimed.

Now I see.

So what has all this got to do with electronics or technology and why has it appeared in a magazine such as this?

Dunno, but why let such considerations get in the way of a good story?

Murphy, again

Those brought up in the vacuum tube era will know well Murphy's Inverse Law of Proportional Value. This states that, in any workshop mishap, the likelihood of a particular component surviving the mishap unscathed is inversely proportional to its value or scarcity. Or both.

Thus, the last spare valve of a given type would mysteriously catapult itself off the shelf and smash upon the floor just as you reached for it to complete a job that had to be despatched in 30 minutes. Cost of replacement? Half your week's wages. After that, the six week delay on back order was a mere annoyance.

Phew!

We understand a certain electronics company located in that area of the world once deprecatingly known as the Far East, has produced a device that detects when you've got bad breath – a halitosis detector.

Numerous chemical substances can contribute to bad breath in sufferers of this socio-medical problem. Garlic and onions are excluded. Bad breath comes from the production of chemicals in the mouth from accumulated dental plaque.

Up to now, because you can't smell your own bad breath, there's only been one sure-fire halitosis detector. Somebody else's nose.

But that's where the social problem lies. So, how to detect if you have bad breath without going to a colleague and risking ostracism, criticism and rancour? (A trio adjudged worse than that antisocial trio of yore – sunstroke, syphilis and varicose veins.)

This new halitosis harrier (don't say that if you've got it) warns you with a discreet beep when it detects the malodorous exhalations from your mouth and also provides a reading on a panel meter.

In addition, it will tell you if it gets a whiff of some odour *you're* likely to find objectionable. The instructions recommend you don't carry it in your back pocket.

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Test and measurement in electronics today: Part 2

RH, ETI September 1989, p28

CONCLUDING our overview of test and measurement instrumentation in electronic applications.

CONTRIBUTORS

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Brian Hammill	**Terry Kee**

Flowcharting II+

JM, ETI September 1989, p78

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.

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.

Datron 4708 calibrator

LC, ETI April 1989, p86

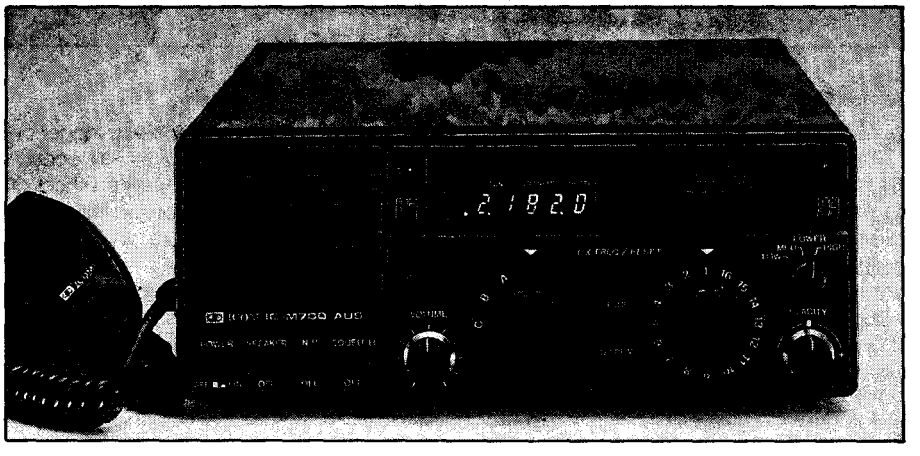
THE 4708 comes in its basic form as a mainframe unit to which dc voltage, ac voltage, resistance and current options may be configured in various combinations. For example, the mainframe might be set up initially with either the dc voltage option, the ac voltage option or both. The 4708 can also be rack-mounted using the kit from the range of options and accessories available.

AutoCAD Release 10

ETI January 1989, p57

AUTOCAD Release 10 is equipped with a host of new features which will provide flexibility and versatility for users of computer-aided design systems.

Release 10 has improved in three major areas – drawing and editing, display and new drawing entities.



ICOM IC-M700

ETI June 1989, p83

THE IC-M700 provides full coverage of all marine bands, instant access to the 2182 kHz emergency channel, together with reception fo news broadcasts, weather reports, time signals and facsimile weather chart frequencies.

The operation is further enhanced by the provision of all radio-telephone channels and the option of a choice of high seas transmission modes.

ICOM also has a 55-channel handheld known as the IC-M5. This is water-resistant with 10 owner-programmable memories, scanning and the sea watch emergency channel monitoring system. Channel display is provided digitally and a keyboard controls the programming and channel change functions.

Yokogawa LR8100 recorder

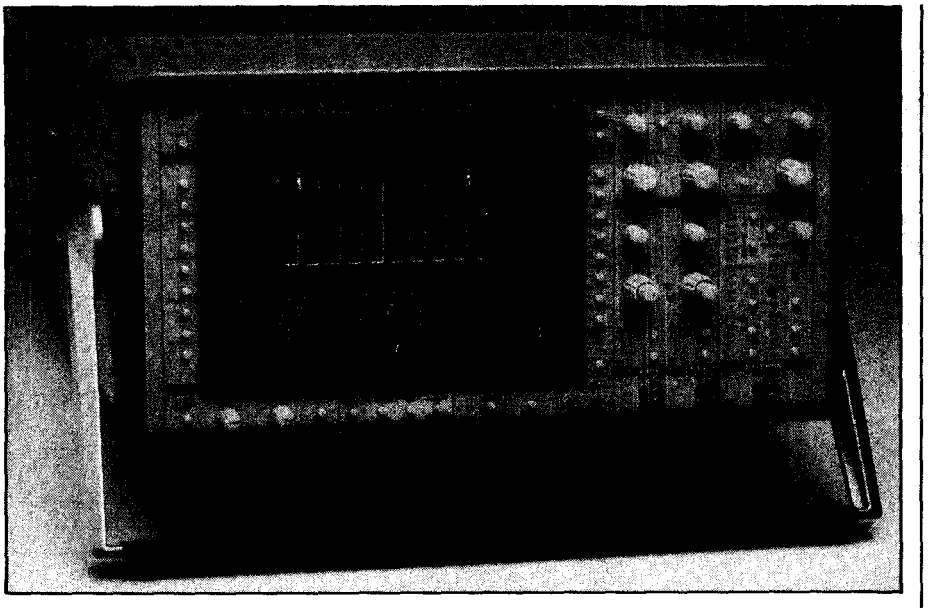
RH, ETI June 1989, p72

THE LR8100 Model 3701 is described as an 'intelligent' recorder with 250 mm wide chart and four, six or eight channels and powered from 100, 115, 200 or 230 volt 50 or 60 Hertz ac mains. It provides a wide range of inputs: dc volts, 12 types of thermocouples (TCs) and four types of RTD resistance bulbs (the TCs and RTDs for temperature measurement). The type of input is individually selectable for each channel.

JED STD-801 CMOS computer

ETI June 1989, p68

THE JED STD-801 single board computer is intended to provide system developers with a CPU card usable either as a single card computer or as the main computing element in a multicard system made up of a number of STD bus cards in a rack. It is especially useful in data acquisition applications where the built-in analogue-to-digital converter and the battery-backed RAM allow data to be gathered and stored.



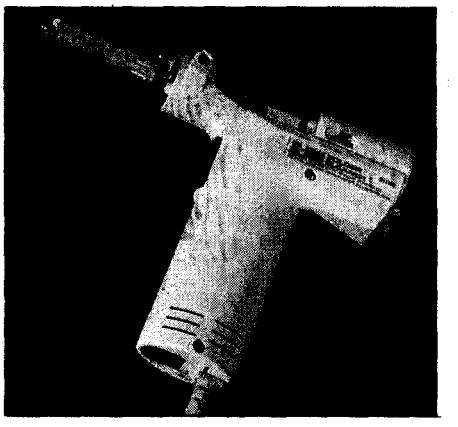
LeCroy 945 oscilloscope

JF, ETI January 1989, p116

THE 9450 is a 350 MHz oscilloscope. Fast, you might say, and you would be right, especially in a digital product. However it turns out that bandwidth is a pretty misleading way to categorise a DSO.

The 9450 has a circuit called Fast-glitch, with reads on any spikes as narrow as 2.5 nS. What's more, it is linked through to the trigger mechanism so that it is possible to trigger on the glitch, no matter where it may occur. A second, and more profound method of extending the effective bandwidth of the LeCroy is called random interleaved sampling.

Using this technique, the effective sampling rate can be pushed up to 10 Gs/s. This mode is used whenever the timebase is set between 1 nS and 5 uS.



Den-On's SC-5000 solder cleaner

JP, ETI May 1989, p108

THE SC-5000 is a self-contained, mains-powered de-soldering tool that comprises a hollow heating tip (similar to a soldering iron tip only with a hole in the middle) which is attached via a filter and solder collection chamber to a compact diaphragm-type vacuum pump. The unit is pistol-shaped with a trigger switch to operate the pump.

I found the SC-5000 an excellent unit and easy to use. The SC-5000 has the advantage of being quite compact and fully self-contained with the mains lead the only external connection needed.

Power Connectors by Cannon

The CANNON ENVIRONMENT RESISTANT MS-E CIRCULAR CONNECTORS designed to MIL-C-5015 are particularly suitable for both Commercial/Industrial and Military applications. A wide range of Connectors are available incorporating • Numerous contact arrangements
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READER INFO No. 13

Tektronix 222 CRO

JF, ETI May 1989, p103

AT long last an oscilloscope manufacturer has put together the elements of modern digital design in a way optimised for small size and battery operation. The 222 is just over 250 mm deep, 150 wide and only 86 high. It weighs barely 3 kg. When Tek says this is a hand-held CRO it really means it – this is the CRO you can climb Mt Everest with.

The genuine analogue-equivalent Nyquist bandwidth of the 222 is just 1 MHz. However, with the usual range of digital tricks this can be improved by an order of magnitude. Tektronix claims a bandwidth of 10 MHz on repetitive waveforms and a front end rise time of 15 nS.

PM3320 200 MHz DSO

ETI February 1989, p95

ENGINEERS at Philips' laboratories at Enschede, the Netherlands, have carried out an in-depth program of tests that clearly shows that DSO users should look closely at both resolution and bandwidth specifications for single-shot signals before choosing a particular instrument.

In the case of the PM 3220A, the instrument displays the initial captured signal and then modifies it progressively to create a high resolution, very low noise trace.

The PM 3320A has a sampling rate of 250 megasamples per second and – as far as single-shot work is concerned – the instrument is most likely to be used with signals containing important harmonics up to 25 MHz. Given that the aperture uncertainty is specified as less than 20 ps. It is clear that – at least as far as sample timing is concerned – the instrument can easily achieve 8 bits within this frequency range.

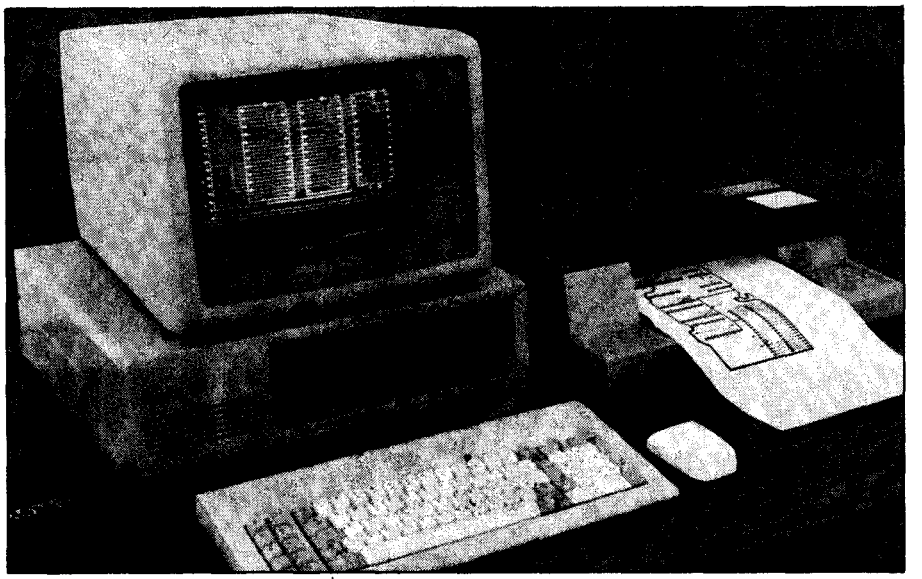
Microtest disk drive tester

JP, ETI April 1989, p91

WESTINGHOUSE has released a portable test kit called Microtest designed to provide full diagnostic and calibration facilities in one small easy-to-use package.

The test kit comprises a small box called 'the pod', various test leads and probes and the necessary software on floppy disk, all of which is housed in a compact lunchbox-sized carry case. All that's needed to complete the system is a standard test disk and host computer in the form of an IBM PC or clone that has at least one working floppy drive, 256K on memory and an RS-232 port.

Also available is what they call 'Repair' mode which turns the system into a simulated set of ordinary test instruments.



OrCAD:AutoTRAX review

TP, ETI January 1989, p44

IN this article we review two printed circuit design tools: OrCAD/PCB and Protel/Autotrax that herald a new, smooth and easy-to-learn environment. Both systems include automatic track routing and component placement aids. eti

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Vital Communications Pty Ltd, who design and manufacture personal medical alert systems under the name of Vitalcall, are seeking a young, enthusiastic person who has an abiding interest in electronics and/or radio technology.

Established in 1976, Vitalcall is the market leader in this field, dedicated to performance and service. The company has offices in five states and exports to New Zealand, Pacific countries and the United States.

Formal qualifications? Not essential. Age? 17-20ish. Other qualifications? Enthusiasm, dedication, motivation.

Write or call:

Phil Wait, Technical Director
Vital Communications Pty Ltd
329 Pacific Highway
ARTARMON NSW 2064
Ph: (02) 438 3311 Fax: (02) 438 3249

GOVERNMENT INITIATIVES ON SCIENCE AND TECHNOLOGY

We invited The Hon. Barry O. Jones, Minister for Science, Customs and Small Business and Minister assisting the Prime Minister for Science and Technology, to address ETI's readers, prompted by our perusal of the Science and Technology Budget Statement 1989-90, Budget Related Paper No 10. We thank the Minister for his contribution to ETI's Yearbook, confident that readers will be interested in what he has to say.

It would not be surprising to you at this time to see an article reflecting upon all the great initiatives and achievements of the Hawke Government. Well, I won't altogether disappoint you in that regard, but I do want to mention some of the areas where I am not totally happy with what we have managed to do so far, and where even more attention is needed in the future. We still have quite an unfinished agenda.

People familiar with my views will be well aware that I have long argued (and loudly) that Australia has to undergo considerable adjustment to our economy; a change of attitude is needed to enable this to happen. The alternative may be to become the poor whites of Asia, not a prospect which appeals to me.

If we continue to rely heavily on the export of largely unprocessed primary products, then we will continue with the decline we have recently experienced. It is imperative that we greatly increase our export of world-competitive products, processes and services. I am heartened by progress in certain areas, by the increasing numbers of us who are saying the same thing in Government, business and academia. But we still have a long way to go, much to do. And there are still lots of people yet to hear and understand the message, or, if they have heard, to get going in the right direction.

Enough momentum

Senator Button was moved to say recently that he despaired of ever being able to get enough momentum into the restructuring of industry. Often, I share his frustration. Fortunately there are at least a few encouraging signs that our mixture of harassing and imploring, of carrots and sticks, is having some effect. One has to remember that there are considerable limitations on what Government can do, but we have attempted to make well known our view of desirable broad directions and more detailed strategies. We have also provided funding via the generous 150 per cent R&D taxation concession and by a variety of direct granting mechanisms. We have sustained and revitalised some exciting industries, whilst increasingly paying attention to the new (but not yet enough attention for my liking).

Many of the means of assistance will be familiar to readers, but obviously the message hasn't reached all quarters because the move into new technologies is still slow. The matter of achieving awareness of, and commitment to, new directions is one area where I believe we have to continue to get everyone enthused in working towards a new competitiveness. We have to continue to explore options for future directions. The work of the Commission for the Future is important in this regard.

As I said, some quarters of business are saying the right words, and some enterprises have always known (unfortunately, many of them weren't identifiably Australian). The challenge is to make the enterprising, creative, innovative approach the norm rather than the exception. This is a matter which goes to the heart of Australian culture. Often, it seems that we have no conception of the long term scales and efforts which are required to become – and remain – world class; and yet in other fields, such as sports, we know what is required, make the effort enthusiastically and do relatively well. We have to do the same in building upon our talents and advantages in all fields. Some of these advantages are natural – our location, geography and natural endowments; some are inherited – our use of English, the world's commercial language; an inheritance of quite good educational, scientific and commercial infrastructure (even if we've been slow to adapt it to new times and needs); some are emerging – our potentially powerful ethnic diversity, for example, which might be used to help interaction with many countries, while at the same time contributing to forging our own, new identity.

The Government generally, and myself in particular, will continue our proselytising about where Australia is and what structural and other changes are needed to free our economy, our society and our mind from old and outdated attitudes and conservatism. Make no mistake, there has been considerable change in the past few years, and maybe the fruits of the Government's repositioning will soon start to appear; but only if we continue further down the road and take concrete action based upon the awareness of the potential of science and technology – amongst other things – to make Australia more robust and competitive.

All of this is by way of a very long introduction to a few lines on the things which the Government has done recently.

Main lines

The main lines of the Government's approach were laid out in *"Science and Technology for Australia"* delivered in Parliament in May by the Prime Minister. That statement provided details on a number of initiatives further to the many things already being done.

Additional monies of $390m was promised over a five year period. This is in addition to extension of the 150 per cent tax incentive to June 1993, reducing to 125 per cent for a further two years, which represents an additional tax foregone of some $600m: a real and handsome reward for businesses to undertake R&D.

The major organisational change announced in May was the creation of the Prime Minister's Science Council, consisting of senior Ministers with key responsibilities contributing to, or using, our science together with leading industrialists and members of the scientific community. This high level group symbolises the Government's understanding of the importance of science to our economy and our commitment to get the priorities right and to properly integrate the diverse, complex – and potentially contradictory – array of relevant activities. The Prime Minister chairs the Council and, as Minister Assisting the Prime Minister for Science and Technology, I deputise.

Broad lead

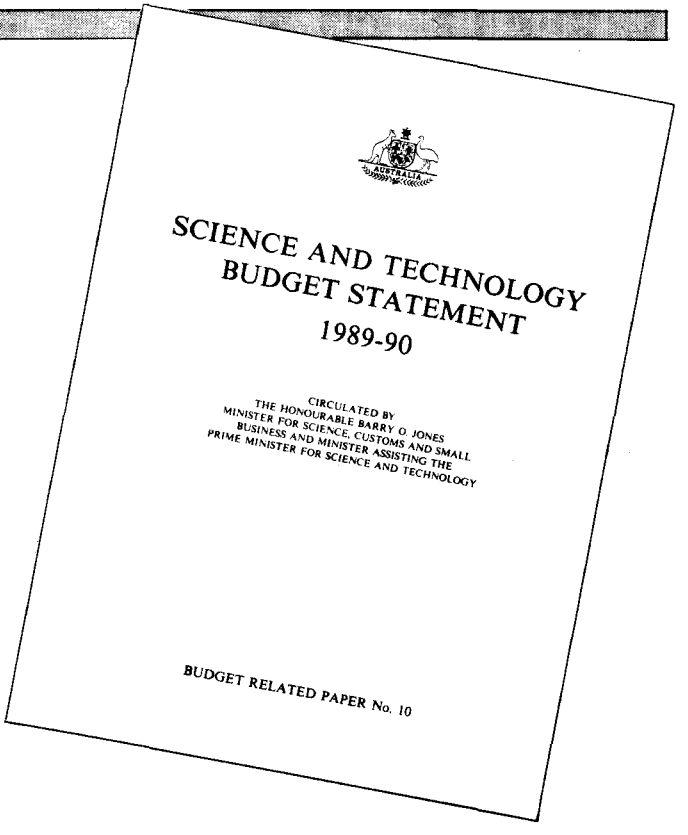
The Council will give a broad lead to the various other bodies undertaking specific advisory or administrative roles. An additional body to ensure greater coordination and efficiency in Commonwealth activities is a new Coordination Committee of senior officials. It is chaired by the Chief Scientist, who is also the executive officer for the Prime Minister's Science Council. The Chief Science Adviser in the Industry, Technology and Commerce portfolios is the deputy in this Committee.

In other sectors we are also reviewing and upgrading mechanisms to ensure that the ways in which science can contribute to economic and social goals are best served. I have no doubt that we will have to keep all these measures under review and adapt them flexibly and pragmatically to meet emerging circumstances. There are no perfect models and the main thing is to ensure that all parties have access to means to express and develop their views – cooperatively, guided by common acceptance of the objective which I mentioned earlier of a more creative, competitive, robust economy. It cannot be a matter of us and them, it has to be a joint effort and it has to be based on access to proper information – one area where we need to increase efforts.

Declining enrolments

Several of the measures announced in May dealt with the problem of declining enrolments in many areas of science and engineering. We will continue to give great attention to this threat to our science and technology competence. Upgrading our effort relies very much on the quality of the people involved. It is another area where I'd like us to do even better.

Further detail on the many Science and Technology related activities of the Government are found in Budget Related Paper Number 10, the Science and Technology Budget Statement 1989/90, released in August as a further attempt to inform people of the array of activities and expenditure. I commend that paper to you as a further piece of evidence of the relevance and importance of science and technology in our economy. It shows that, although much of the Government's efforts are directed to education and training, and to basic and strategic research and its infrastructure, there is much more involved in the process of gaining maximum benefit. I am proud that I have been able to contribute to the new awareness of the complexity and importance of science and technology in the economy – but I am not at all complacent, because there is very much more for all of us to do.



NEXT MONTH

Mains conditioning

The 240 volt ac mains carries some mean and evil baggage into your electronic and computing equipment: spikes, hash, surges and sags, to name a few items. This feature exposes the menaces on the mains, explains the causes and explores the cures.

RISC computer board

Here's an add-in card for an IBM PC/AT or close compatible that will allow you to explore the world of RISC technology at minimum cost — and should we say, minimum risk? It uses the low-cost VL86C010 from VLSI Technology, plus memory controller (MEMC) and I/O controller (IOC) devices with memory ranging from 1M up to 4M on-board. Software support includes ANSI C, Fortran and assembler. A board-resident assembly debugger permits debugging of programs on the RISC itself with download capability on the target system.

ICOM R9000 receiver review

ICOM's IC-R9000 communications receiver boasts 2 MHz to 2000 MHz coverage and can receive many modes. Featuring a unique CRT display, it can show receive frequencies, modes and additional data for ease of use, and has a spectrum scope for visual signal confirmation. Roger Harrison gives this marvellous piece of communications technology the once over, twice over, thrice over . . .

THE ETTIES '89: ALL IS REVEALED

INNOVATION

The announcement of the winners in ETI's inaugural Industry Awards in the October issue last year promised more details would be forthcoming in a later issue. Here they are! By Roger Harrison.

Some 40 or so expectant people crowded into the Victoria Room of the Melbourne Exhibition Buildings on the morning of Thursday 15 September last, while the 1989 IREECON Convention was in full swing. The occasion was to present the ETI Industry Awards – handsome brass plaques featuring prominent, embossed black lettering, and mounted on heavy acrylic panels – to the deserving recipients.

It was an occasion for short speeches, congratulations and smiles of satisfaction.

To reiterate, four product categories were identified for the purposes of judging, these being:

- Test & Measurement Instruments
- Board Level Products
- Pro-sound and Broadcast Equipment
- Communications Equipment

An additional award was also mooted, to be presented in special recognition of an Australian designed and produced product showing particular innovation or engineering endeavour.

The three judges – ex-CSIRO physicist Jack Middlehurst from Sydney, teacher/author/engineer John Day from Melbourne, and yours truly – nominated a series of products to be considered under the following broad criteria:

1. They should be well designed.
2. They should be functional.
3. They should give value for money.
4. They should show innovation.
5. They should be obtainable for or applicable to Australian industry, and
6. They should have technical support and after-sales service available.

So, on to the products, the 'stars' of the show.

The Fluke 45

Fluke has been a leading name for over a decade in the digital multimeter market, no matter whether it's handheld or 'system' multimeters being discussed. In R&D labs, in service workshops, in factory production test areas, and so many other places in the electronics industry, Fluke DMMs hold sway. And when you ask why, people generally cite: accuracy, reliability and value for money.

The Fluke 45 is a bench/portable digital multimeter that features a dual display with a standard 4 1/2-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.

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 counter ranges from 1000 Hz to 1 MHz. You can select autoranging mode or use pushbutton manual range selection.

In addition, the Fluke 45 allows you to compare measurements within predetermined limits, to make readings relative to a reference measurement, to take decibel readings with selectable reference impedances and audio power measurements up to 1000 watts – 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. Selectable count resolutions of 100,000, 30,000 and 3000, are provided, with reading speeds of 2.5, 5 and 20 per second, respectively.

The instrument includes an RS232 interface as standard, which allows measurements to be printed, filed, manipulated or transmitted by modem. The 'QuickStart 45' accessory software package facilitates RS-232 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.

An IEEE-488.2 interface can be added without removing the RS-232 port, and provides full programmability and automated calibration facilities. Its command set is identical to the RS232 interface commands wherever possible. It boasts built-in self-test facilities with closed-case calibration requiring no internal calibration adjustments.

All this and it can be battery-operated, too, from an 8 V lead-acid rechargeable battery providing an operating time of typically eight hours, according to Fluke.

GSA's Secure Voice Module

One could say – there are speech scramblers, and then there's GSA's Secure Voice Module...

While we described this product as a speech scrambler in the October issue, that description is not strictly true. It employs a sophisticated digital signal processing and encryption technique that makes it impossible for eavesdroppers to decode. It can be used in telephones (and secure telephones using the SVM1400 will be on the market soon, if not already), radio transceivers – any voice communications system.

Its cost is substantially lower than the nearest competitive products and it has wide application, not just in the traditional areas – diplomatic corps, military, intelligence, etc – but in government departments and business, too. Its comparatively low cost considerably broadens its areas of application and its commercial appeal. What's more, it is entirely Australian designed and manufactured. GSA has succeeded in getting this product to market against some incredible odds, including the might of the US Government. Already they're exporting, too – having won a contract to supply the Hong Kong police department, no less.

The SVM1400 samples and digitises a

speech signal. A digital signal processor on board then transforms blocks of the digitised speech, encrypting it using a complex "multi-dimensional" technique. The encryption process is governed by a code key that can be programmed into the SVM1400. The encrypted signal is then converted back to analogue form again for transmission. But this signal is unintelligible to anyone tapping the line or eavesdropping on a radio transmission. Indeed, it is unintelligible to anyone without a similar SVM1400 system having the same encryption code entered into it.

On reception, the analogue signal is digitised once again and 'restored' by the digital signal processor using the code entered previously, and converted back to an intelligible analogue speech signal. The encryption and decryption process is continuous, operating as you speak. The GSA SVM1400 overcomes the limitations of earlier, and most current, competing voice encryption systems. No mean achievement.

The SVM1400 "models" the external communications path and adjusts the transmission characteristics to compensate somewhat, improving the ultimate speech quality. It remembers the last iteration of the model for a particular path and successively improves the performance. Bloody clever!

All this in a board that comfortably fits in the palm of your hand.

Now, while you marvel at that, the choice of this product for the award gave the judges some considerable brain strain because the category was hotly contested by a considerable variety of worthy products. In the end, other criteria were invoked and the competing products all considered against each separate criterion, tables of 'pluses' and 'minuses' being drawn up to aid the deliberations. They made things worse! Eliminations were achieved on some very fine points indeed. It just goes to illustrate that the Australian Electronics Industry can produce some fine, world-class products.

The AVM200 Presentation Switcher

This is another locally designed and manufactured product, produced and marketed by a dedicated team in this family company. It is designed for Australian industry, to suit the needs and wants that prevail within it.

The AVM200 is a sound and vision switcher that has been specifically designed to simplify on-air presentation through the following features:

- 24 inputs
- two bus operation (preset/take)
- restricting the choice of special effects
- direct cutting on program bus
- three preset transition rates
- a downstream keyer
- tied audio follow with separate audio over inputs
- manual and/or automated operation.

It has what Talia describes as a 'user friendly' panel – a description with which the judges concurred. Layout is such that it accommodates either right or left handed operators, something many equipment manufacturers overlook (maybe Talia didn't plan it that way...)

Talia's equipment enjoys an enviable reputation, their designs being conservative, economical, reliable and well-marketed. It seems the award was timely for Talia Sound & Vision.

The Sepac-ATR Wide Area Trunked Radio Communications System

The infrastructure of Australian government and business operations depends heavily on many and varied communications systems, radio communications being but one avenue for voice communications.

As I pointed out in the October issue, a trunked two-way radio system offers a large number of radio users a common pool of radio channels automatically allocated by a microprocessor. The radio user is no longer tied to a single base station with its inbuilt congestion and range limitations. A trunked radio system helps conserve valuable radio spectrum, reduce congestion and improve communications efficiency.

The Sepac-ATR SWAT (Sepac Wide Area Trunked) system – again, an Australian designed and manufactured product – is specifically aimed at solving the problems unique to our local requirements and conditions. It offers features, functions and performance that were considered to place it alone in this category, making the judges' choice a comparatively simple one.

Sepac Industries was founded in 1975 by Graham Comber, an escapee from the CSIRO, and a band of dedicated engineers who set out to supply tone encoding and decoding equipment for the radio communications market. Today, Sepac, and its sister company, ATR, have developed this trunked radio system that is widely used throughout Australia – and in Hong Kong. Sepac's use of custom-masked microprocessors has allowed them to offer a degree of skill in solving problems fraught with dangers and difficulties for other companies.

Austek Microsystem's Frequency Domain Processor Chip

The A41102 is a fine example of what can be achieved from a collaborative effort between business and government enterprises. The conception of the A41102 was by a team of DSP scientists and engineers working at the CSIRO Division of Radiophysics, Epping NSW. CSIRO and Austek cooperated to develop this commercial implementation of that work.

This FDP tackles "...the three biggest concerns of digital signal processing (DSP) engineers: performance, system cost and design complexity", I wrote in the October issue.

"It is the first processor chip of its kind to bring high performance and affordable processing power to medical, industrial and military DSP applications, and opens up DSP to many new applications which have used either older analogue technology or not used DSP because of its high cost to date."

The A41102 can perform continuous fast Fourier transforms (FFTs) at input rates up to 2.5 million complex samples per second. It contains 167,000 transistors on an 8 × 9 mm chip, fabricated in a 1.5 micron CMOS process. It is leading-edge technology in this field. Its architecture allows for simple system-level designs – very important in engineering terms – and provides considerable flexibility.

The A41102 is already finding its way into many design applications, both here and overseas. Peter Single, an engineer from Austek, will be travelling the country this year to show off 'real' applications of this device in working prototype product designs – like a smart audio graphic equaliser, for example. Austek expects the A41102 will find applications in Doppler radars, video signal processors, medical ultrasound equipment etc.

Dataquest, the specialist market research company based in San Jose, California, in late 1988 estimated the worldwide DSP market, measured in sales dollars, to be $750 million. They estimated it would grow to $2 billion by 1992. They also estimate that roughly 30 per cent (and growing) of this market is for high performance processing, such as that offered by the A41102. Austek seems well-placed for making this another export success in electronics.

The Viterbi Chip

Known as the AWM1637 Viterbi Forward Error Correcting Codec, this product was developed as a joint project by AWA Microelectronics and Sydney University Electrical Engineering Department under contract to the Overseas Telecommunications Commission.

It is a CMOS integrated circuit that provides "forward error correcting" for high speed data communications via satellite. It is also suitable for a wide range of communications applications which require a high level of accuracy in the transmission and reception of data signals.

It employs the 'Viterbi algorithm' which encodes and decodes data, providing complex correction functions ensuring data is transmitted with high accuracy (see "Modern Modem Technology", ETI June 1989, p.40).

The AWM1637 works to the Intelsat transmission standard for digital satellite transmission at a maximum data rate of 2048 Kbits/sec.

CONGRATULATIONS

As our October issue reported, ETI presented Industry Awards this year. The venue was IREECON '89 in Melbourne. Here we record some photographic impressions of IREECON together with reportage of the Award presentation and acceptance speeches.

John Monty, of Entertainment Services of Australia, was kind enough to provide a P.A. system for the event.

Ladies & Gentlemen – Welcome to the Inaugural Presentation of the ETI Industry Awards. My name is Kim Bucknole, editor of ETI magazine. Let me give you a little background. ETI is published by the Federal Publishing Company, which is Australia's leading special interest consumer magazine publisher. It publishes a wide range of titles covering Golf, Motorcyling, Fishing, Motoring, Lifestyle, Health, Boating, Computing, Electronics and more. A number of these titles sponsor annual awards appropriate to their subject matter.

This year, ETI was 18 years old and so, having reached the age of majority, we felt sufficiently mature to initiate these awards, appropriate to our industry. To this end we assembled an independent panel of judges and asked them, in this inaugural year, to make submissions as to which products should be considered. We ended up with a sort of punditorium which resolved to the awards we are going to present today.

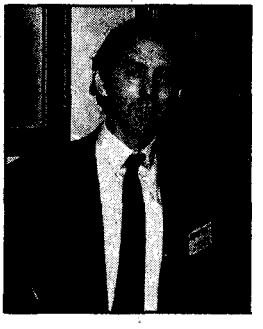
We trust that these awards will be viewed in the spirit in which they are made. That is, for the encouragement of local electronics, technology, and innovation based industries. Accordingly, our criteria concerned themselves with design, functionality, value for money, innovation; applicability, serviceability and technical support in the Australian environment. Given these criteria we trust you'll find merit in the decisions of our judges.

I'd like to move straight on to the presentations. I'm going to ask Roger Harrison, our Electronics Editor, to say a few words about each winner, and then call on a representative of the winning organisation to accept the award, and, if they wish, say a few words.

The first award is for Test and Measuring Instruments and goes to the Fluke 45 Dual Display Multimeter.

Roger

It was fortunate that, having had a little experience in researching products in the industry over the last 18 months or so, we were able to get the award program together fairly swiftly. It became very obvious, very quickly that in this category there was no contest. This instrument stood out head, shoulders, feet, arms and legs above everything else that was either considered or put forward and it just made our job that much easier. The decision was made in all of 30 seconds at the meeting between the judges, unlike other categories. So it really is an outstanding instrument and I think particularly deserves the award.



Geoff Ross, managing director of GSA Technology, presents his thanks.

Now, would Tim Wortman from Philips please come forward to accept on behalf of their T & M Division.

Tim

Thanks, Roger. Yes, I'd just like to say that we are proud and delighted to be among the first recipients of these awards from ETI. It's particularly nice for us in Philips Test and Measurement, because we are just about to celebrate the first anniversary of the Fluke/Philips alliance in Australia. I would say the Fluke 45 is a typical example of the sort of technology we are now seeing from both Fluke and Philips, which is very market-led; in other words, we do go out nowadays and ask people in the market place what it is that they want from instruments. There was a time when the designers would sit in an ivory tower and design the piece of equipment and then come down to us guys (who have the responsibility for marketing and selling) saying, "Hey, this is a super piece of equipment, now go out and sell it." Nowadays we actually talk to the customers beforehand and they are very much involved in the design process. Thank you very much on behalf of Philips Test and Measurement.

Kim

The next category is Board Level Products; the winner here is GSA Technology's SVM1400 Secure Voice Module Scrambler.

Roger

This was an extremely interesting category to consider. Out of a field of probably 20 odd products that came forward, it was very difficult to make a decision. The greatest time, in fact, was spent on judging this area. The arguments went to and fro probably for the best part of 2 hours, but after a lot of special mental manouvering it was decided to award it to GSA's SVM1400 Secure Voice Module. It really is an extraordinary product, wholly Australian in design, and we wish the company every success with it because it absolutely deserves it. One of the judges made the comment that it really was "a bloody clever endeavour." Would Geoff Ross come forward and accept on behalf of GSA Technology.

Geoff

Thank you very much for this award; we are, indeed, very pleased to be one of the first receivers of such an award from ETI. We do read your magazine. In fact, as far as we can detect from our accounts, we have subscribed to it about 10 times over. So, we are very pleased to get this. The product, as you observed Roger, is entirely designed and manufactured in Melbourne. It is in fact the heart of the Telecom secure phones. It's the phone that has caused a lot of political problems. In fact, if you watch TV tomorrow you'll see a tremendous outburst from a National Party Senator about the product. It is a world-leading product; we've been successful in tapping the world markets with it and defeating some of the very large multi-national companies we compete against, so I am very proud to receive this on behalf of GSA Technology and the people who have worked so hard to bring it to fruition. I thank ETI very much for the award.

OTC's David Charrett.

Kim

Thirdly, we turn to Prosound and Broadcast Equipment and here our award goes to Talia Sound and Vision's AWM 200 Presentation Switcher.

Roger

This category I suppose, fortunately, was also much of a no contest. John Day, from Stewart Electronic Components – he is a well known engineer and business person in the electronics industry in Melbourne – did some very fine detective footwork to sort out this enormous field. To sort out innovative products from very

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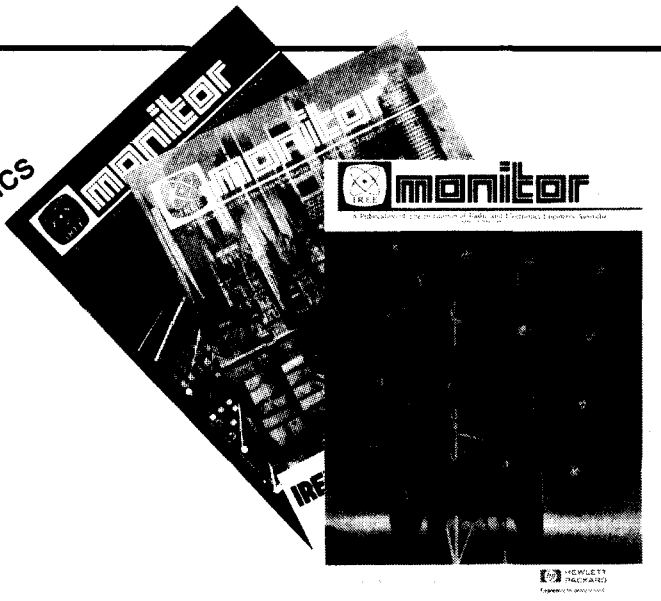

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READER INFO No. 21

much a broad field of me-too products, if I can use that expression, was quite a feat, and all credit to John Day for that. When we came to consider it, this was quite clearly a product head and shoulders above so much else in a very crowded marketplace and it was also very – shall we say – revealing, or rewarding, to find that it was entirely locally designed and manfactured, another clever Australian endeavour. So would Joe Talia, managing director of Talia Sound and Vision, please accept the award.

Joe

Well, I would like to thank ETI. I think that the awards are a very good thing for local manufacturers; we've had a 12 year struggle, trying to reach this status and to be recognised, finally, is really terrific.

Kim

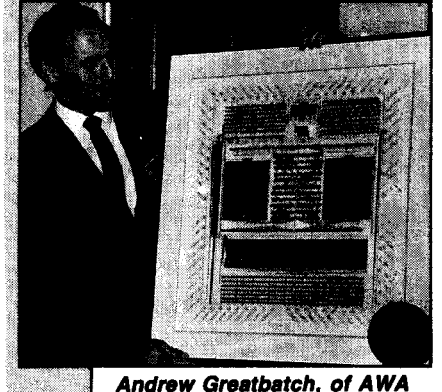
Our fourth category is Communications Equipment, where Sepac-ATR's SWAT system is the winner. Roger, please.

Roger

This category produced some surprises, because what the judges put forward was an incredibly diverse range of equipment. Some very interesting technology was involved, including some consumer product which was quite surprising in its range and diversity. But when it came down to the arguments, Sepac's SWAT system really came to the fore and the decision was quite easy once we established exactly what was in the running. So, would David McQuie come forward and accept this award.

David

Thank you. I'm pleased to be here to accept the award on behalf of Sepac-ATR. We have put a lot of work into making this Australian product and we're looking forward to being able to put it on the world market. Thank you.



Andrew Greatbatch, of AWA Microelectronics, shows the audience the 'inside story' of the Viterbi Chip.

Kim

The next category is a special award for Australian Innovation and Endeavour. There was a very interesting debate in arriving at the winner here and we decided to make a special commendation in this category. The product in question for the special commendation is known in short hand as the Viterbi Chip and in long hand I'd have to read what it says on the Award. The special commendation is awarded to AWA MicroElectronics and OTC.

Roger

We had so much trouble with this particular category, it was decided to put this special commendation forward despite the fact that we had no brief to do anything of the sort. In researching this, we had to go up quite a number of what turned out to be blind alleys. But we learned a lot of things on the way, and when it came to putting forward the short list for the award, there was considerable debate as to how and why and what effect on the industry these products may have. What influence they would have in both the local electronics industry and perhaps in the broader world markets became the deciding factor. It was very difficult to make a particular distinction. So, in recognition of that, AWA and OTC get this special commendation for their production of the Viterbi Chip.

Now we need David Charrett from OTC and Andrew Greatbatch from AWA to come forward.

Andrew

I think there is a tendency in the electronics industry for people to look down their noses at Australian technology. Being in the micro electronics industry we get a lot of innovative products coming through. It is really good to see so much innovation in Australia and so many clever designs coming out. And in, fact, we've seen some here this morning.

What I thought I'd do is actually show you what a Viterbi Forward Error Correcting Codec looks like. *Editor's note – Here Andrew displayed a rather large visual of the Viterbi Chip.*

Joe Talia, of Talia Sound and Vision, accepts the award for the company's AVM 200 Presentation Switcher.

David

Thank you. I would just like to add my thanks to ETI for this award in recognising where the true future of Australia lies in terms of wealth creation. It is in the industry of Australia, not in the paper shuffling that sometimes is taken as adding to the wealth of this country. OTC, in this case, was the supporter of this development. We are an international carrier responsible for Australia's international communications, but technology is the key to our business. It is the foundation of new services, the reduction of prices and things such as that. Accepting this award on OTC's behalf, I will be somewhat immodest and say that we see this as a recognition of our faith in, and the capability of, Australian industry and design, in terms of Sydney University's design of this chip and AWA's manufacture. Thank you very much.

Kim

The winners in this category, again it is a joint award, are the CSIRO Division of Radiophysics and Austek Microsystems for the A41102 Frequency Domain Processor.

Roger

As I said in the previous award, this was a very difficult decision and the arguments certainly went to and fro for some considerable time. But this can be said to be a revolutionary product. It is interesting in its gestation, probably born out of frustration more than anything else, in talking to people involved in CSIRO in particular, that they have pioneered this sort of research and development to end up with a marketable product. Their partnerships in this sort of area seem to be leading Australian industry and certainly providin successful examples to the rest c the world.

We need Dr Andrew Seago from CSIRO Division o Radiophysics and Peter Singl from Austek Microsystems.

Peter

I would like to thank ETI for thi award. Designing this was a ver long, hard fight and I would like tc thank a lot of other people whc helped with that fight – CSIRO, o course, who started it, and the I & D Board which funded part o it and a lot of people who helpec us along the way.

Andrew

I'm very pleased to be here tc accept this award on behalf o the CSIRO Division o Radiophysics. I think this produci is the result of a really worthwhile collaborative project between ar Australian research organisation and Australian industry. I hope we will be able in future to continue with such collaborative projects between CSIRO and loca manufacturers. Thank you.

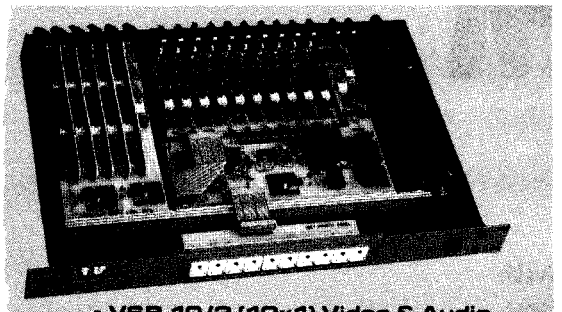
Kim

Ladies and Gentlemen, that i the last of the awards we are making this year. Would you join me in acclaiming the winners.

Finally, but not least, my special thanks to the IREE, especially their officers, their Executive Director, Heather Harriman, and Convention Administrator, Cherie Morris, for their gracious hospitality, kindness and co-operation in enabling us to present these awards during IREECON '89. I would like to record my thanks to John Monty of Entertainment Services for the provision of the P.A. system, and I'd be very pleased now if you would join us for a little while in a celebratory drink.

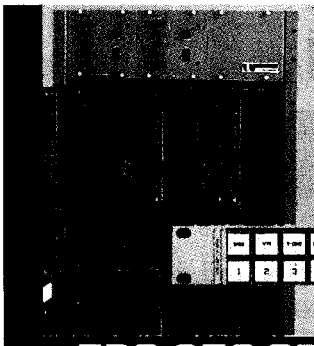
Thank you very much. eti

TALIA



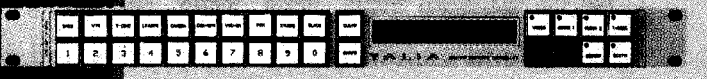
• VSB-10/2 (10x1) Video & Audio

UTILITY SWITCHERS

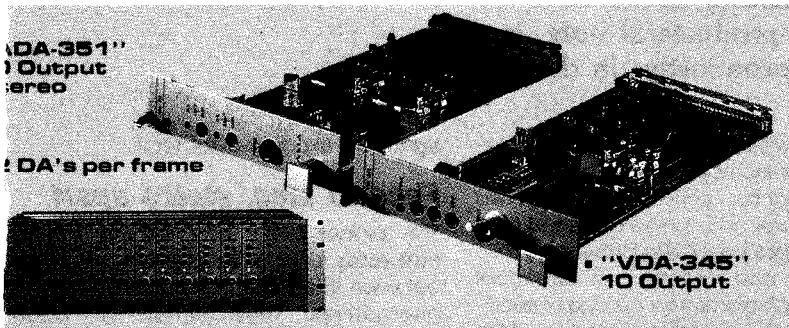


• 16x16 up to 256x256 – 8 Level

• RCU-251 Control Panel Slimline (IRU)



TRS-256 SERIAL ROUTING SWITCHER

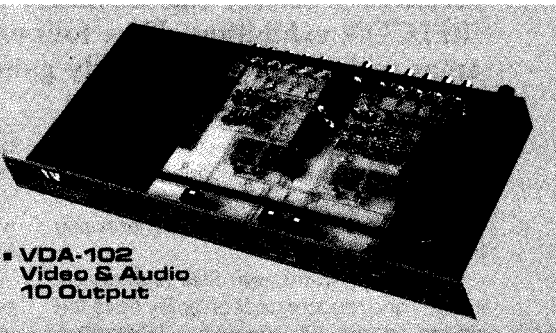


DA-351"
Output
ereo

DA's per frame

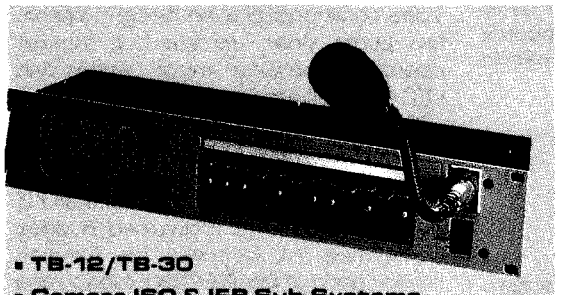
• "VDA-345"
10 Output

SERIES "E300" EUROCARD DA's



• VDA-102
Video & Audio
10 Output

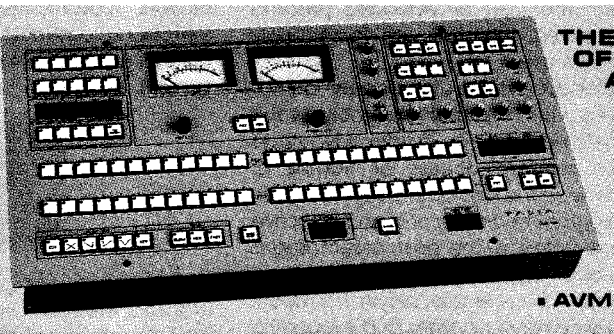
DUBBING DA



• TB-12/TB-30

• Camera ISO & IFB Sub-Systems

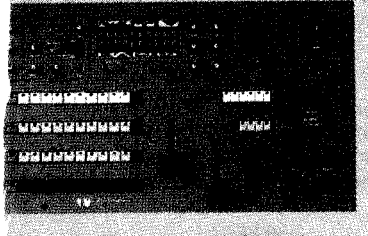
TALKBACK SYSTEMS



THE WINNER OF THE ETI AWARD

• AVM 200

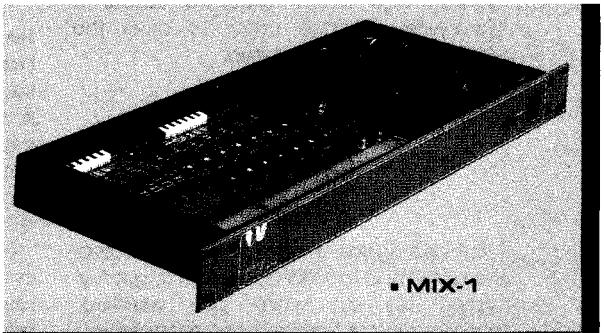
PRESENTATION SWITCHER



• VM-124

• VM-63

PRODUCTION SWITCHERS



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GOODRICH GRAPHICS

READER INFO No. 22

REPORT FROM IREECON

Sound and vision broadcast products and services, along with test and measurement products, dominated the show, as they have done for some years now. But telecommunications, as an identifiable sector, was definitely in ascendancy at the '89 IREECON exhibition. Here follows a few products of note, in areas which will undoubtedly gain some prominence in the 1990s. By Roger Harrison.

Audio-visual presentations are increasingly becoming part of everyday communications in commercial and industrial environments and in public displays.

Videodisc systems, with their high quality images and random access facility have the ability to provide complex, interactive displays for a wide variety of applications. And with the cost of videodisc pressing coming down, they will see increasingly widespread use.

But videodisc players are basically "dumb" machines. Just a transport assembly for the disc with limited control. To take advantage of rapid random access of frames or sequences on the disc and to recall them in a pre-programmed order or in an interactive system required, in the past, assembling a system of off-the-shelf components.

Apart from the videodisc player, this meant getting a computer system and supporting videodisc controlling software with touch screen and other required features. Hardware interface cards to drive the devices were also required.

But getting the system going didn't stop there. You had to write a program to get the system to do what you wanted, incorporating all the ideas and features you wanted to achieve. For the producer, this meant having his or her ideas translated by a specialist programmer, isolating the creative process from the production process.

But a little "BRAT" has changed all that! Victorian company, Alchemy Research, demonstrated a controller it has developed to overcome the previous limitations of videodisc systems, putting the "authoring" directly into the hands of the AV producer.

Dubbed the BRAT, it is a microprocessor-based controller which has been purpose-designed for this application. It is about the size of a cigar box, consumes less than two watts of power and can be operated from mains voltages anywhere in the world.

Alchemy also claims it is an ideal programmer/controller for a range of audio-visual systems apart from videodisc, which include such elements as U-matic video players, touch screens, video and audio switchers, pushbuttons and keyboards, lighting controls, infrared and radar people sensors.

No computer programming knowledge is required. The BRAT controller uses an English-like instruction or authoring language called BRATCHAT. It is built-in to the unit.

The BRAT provides connection for up to two videodisc or U-matic players, or one player and a touch screen. You can connect keyboards, video and audio switchers. There is provision for connecting three remote control inputs and two power switching outputs. Up to 30 BRATs can be chained together providing up to 60 vision sources that can be controlled as a single system.

Program storage does not depend on disc or tape. The story, or program, is stored in non-volatile memory chips that do not require battery backup.

An optional control module provides switching on and off external mains operated equipment. This feature, in conjunction with the internal clock, allows unattended operation so that a presentation in a shopping centre, for example, could be switched on at a given time in the morning and off again each evening, or even operated only between certain dates.

The BRAT was developed entirely in Australia and is totally manufactured locally. Alchemy Research expects to attain a significant export market for it.

Face to face, states apart

The airline pilot's pay dispute forced businesses unable to convene meetings between interstate colleagues to look at alternatives. They turned to video conferencing. Australian business has lagged behind the rest of the world in exploiting video conferencing even though Telecom has public video conferencing facilities operational between major centres and OTC offers international facilities.

Video conferencing allows parties at separate locations to communicate via a video, speech and data connection.

Philips, in association with the German PTT and Australia's OTC, maintained a video conference link between the German Pavilion stand at the IREECON Exhibition and a selection of 12 West German private and public facilities.

The equipment used in Melbourne was a portable, wheel-in video conference facility from Philips Kommunikations Industrie AG (PKI) of Nuremberg. The control unit stands less than two metres tall and about a metre and a half wide. It features two cameras, providing coverage of up to six people, a large video receiving monitor and two small video monitors to show the pictures being transmitted and received. A document

camera mounted above a desk can be used to send documents or illustrations.

The system uses a 2 Mbit/s transmission channel which provides for economical use of satellite channels. For international video conferencing, the Philips equipment only needs a Telecom Megalink or microwave channel connecting it to one of OTC's satellite earth stations.

See no evil, speak no evil

The video telephone, mooted since the 1920s, is closer than you think. It will be the introduction of the integrated services digital network, ISDN, that finally makes it a reality.

After four years of research, a group of CCITT experts in Europe has presented a standard for video telephones which employs low bit rate transmission of images. The research group included members of the German PTT research centre, the AEG research centre and Philips Kommunikations Industrie AG (PKI).

A new development of PKI, the Videophone, is a multifunctional system which combines an ISDN telephone set with the transmission of what PKI terms "full-motion" colour video. Subscribers using the system are able to see each other clearly, as was apparent from the demonstration unit, as well as talk.

The Philips Videophone is a compact unit which fits on any desk. It is as easy to use as any other phone. You dial the call and send a picture at the press of a button when your call is answered. The picture connection is not set up until the party called also consents to exchange pictures. So, you can't be caught with your tie undone, or whatever!

The Videophone has a nine-inch monitor with a solid state camera above the screen. The picture has 288 lines of 256 pixels per line. It samples eight and one-third times per second, providing staccato, but quite acceptable motion.

You can add a document camera for interactive 2D and 3D transmission which accepts documents from the desktop in full colour, provides on-screen zooming and other facilities. This obviously has many advantages over fax document transmissions.

The Videophone operates at a transmission rate of 64 Kbits/s for full-motion colour video, with an additional 64 Kbits/sec channel for voice transmission. For improved video quality, a second standard of 112 Kbits/sec for video and 16 Kbits/sec for audio may be used. eti

The HDTV debate

Support for HDTV standards comes down to countries, or regions, and the prevailing system developments, aided' and abetted by essentially parochial interests. Japan's position is to support the NHK's "MUSE" system, best described as a bit of a maverick because there's no evolutionary path from current systems into it, and line and frame rates have no correspondence with any other TV system. Prognosis: doomed. But it might 'get up' in Asia through sheer marketing muscle. So,it comes down to: where do we go from here?

The two major television systems of the world have a number of fundamental differences that frustrate the development and introduction of a single world-wide HDTV standard. Two standards may be introduced, and this will have a cost to both the industry and the consumer. But there may be a way out, according to Les Free, of Kerry Packer's PBL, who delivered a paper at IREECON on the Australian position on HDTV.

The 625 line/50 Hz TV system used in Europe and Australia is basically incompatible with the 525 line/60 Hz system used in North America, Japan and Asia, the frame rates being based on the ac mains frequency of the country. This pretty well constrains the evolutionary path for HDTV, so the prevailing thinking goes.

As HDTV offers high quality, large-screen viewing, not just for television viewing in the home but in public theatres, industrial and commercial applications, there are aspects of production which are important to meet the pyschophysical requirements of large screen viewing. And for these, differing frame rates would be ideal.

In recording pictures, it has been established that continuity of motion is achievable at exposure rates above 45 frames per second. But the reproduction rate, at the receiver, can be greater.

It is accepted that any HDTV standard must take into account film standards. For large screen viewing, some in Australia believe that film material must be reproduced at an exact multiple of the exposure frame rate, which is 24 frames per second.

Free suggests HDTV might benefit by embracing a family of specifications for production to meet differing requirements, for example for news, sport and drama, and use different frame rates for production and reproduction while maintaining regular repetition rates for picture information. An HDTV production frame rate of 48 frames per second and reproduction frame rate of 72 frames per second has appeal, he argued.

The concept of a common image picture format has arisen recently. This envisages an identical picture or common image that can be used in systems with differing reproduction rates or scanning methods, so it's independent of picture scanning standards. This image commonality includes one set of values for the aspect ratio, number of active lines, pixels per active line, pixel shape and other things.

But Free expresses doubt that some of the overseas approaches to using the common image format will lead to a single world wide HDTV standard. He says the Australian approach involves a common image, a common frame and "agile receivers", which would be akin to multi-sync monitors in the computer world, for use by consumers.

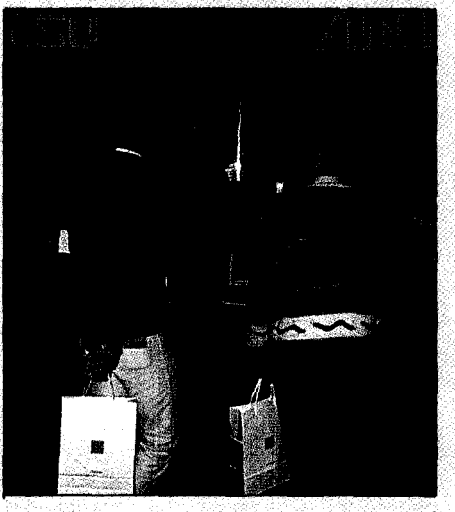
Free says, "In respect of a global television standard, Australia believes that picture or frame rates other than 50 Hz or 60 Hz will be used. Both higher and lower values are anticipated. Variable data rates are expected to be a feature of future digital technology. Studies about a future digital HDTV standard should consider possibilities other than a fixed 50 Hz or 60 Hz frame rate solution. The ultimate aim is to achieve a common value for the picture or frame rate, which might not be either 50 Hz or 60 Hz, as part of a single, world wide HDTV standard."

He suggested the TV and computer industries should get together to see what common elements of display technology could be adopted in hardware for both fields of application.

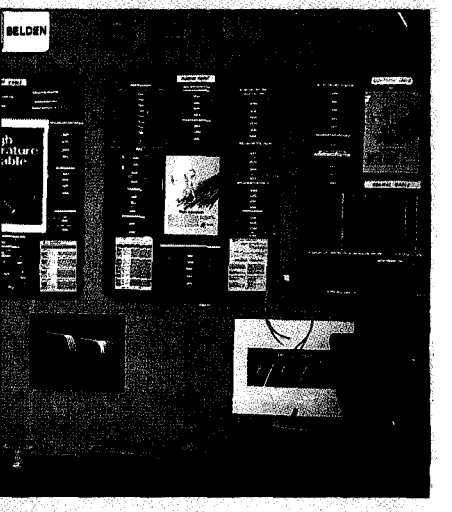
The way ahead for HDTV will not be a smooth path.

THE THINGS THAT WEN

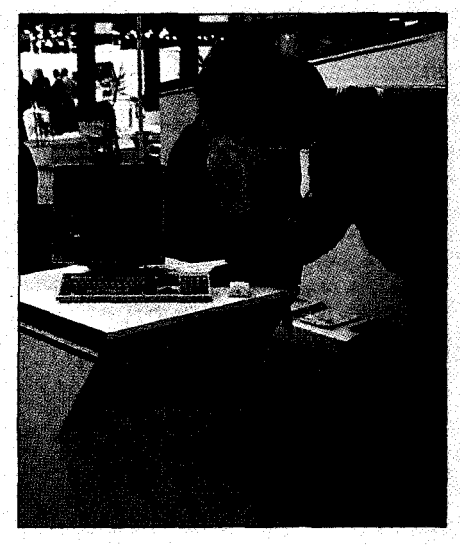
BTS Bosch



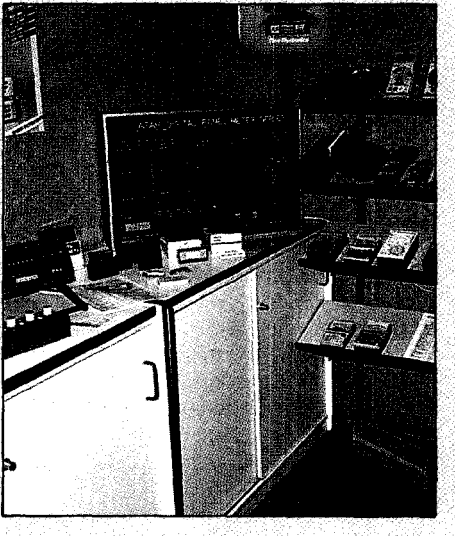
Alcatel STC Anritsu



Belden



RCS Cadcentres

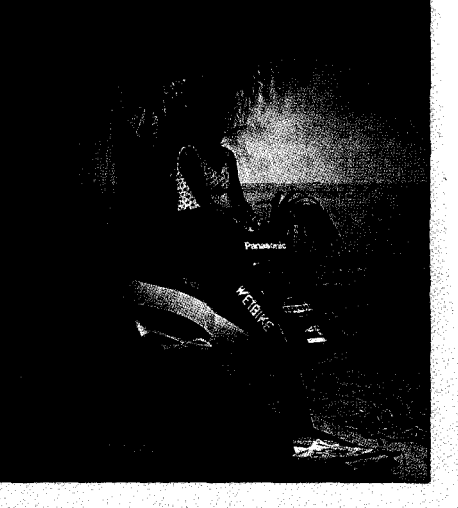


Emona

Protel

Cima

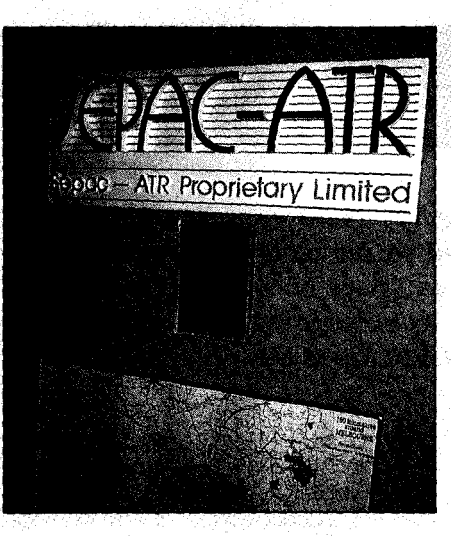
Telecom Iterra Satellite Services



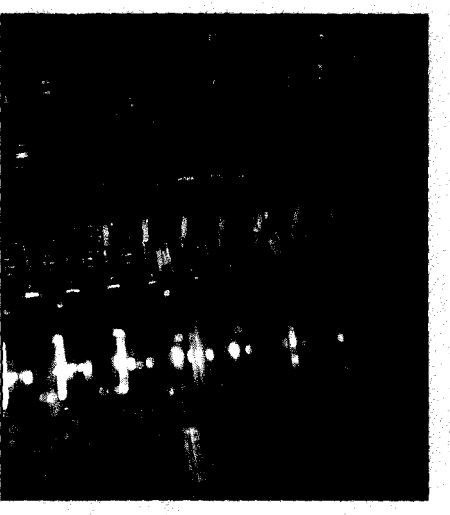
GEC Panasonic

ON AT IREECON!

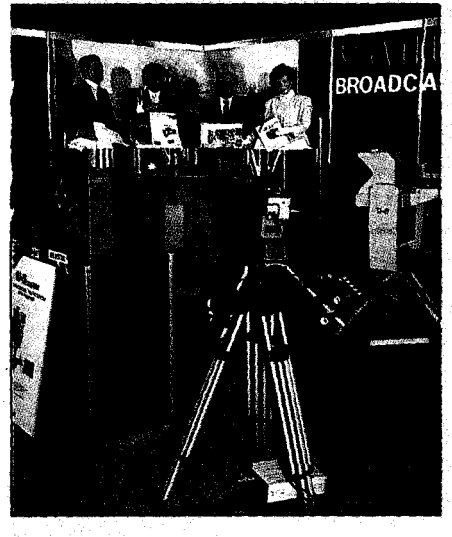
Texas Instruments



Sepac-ATR

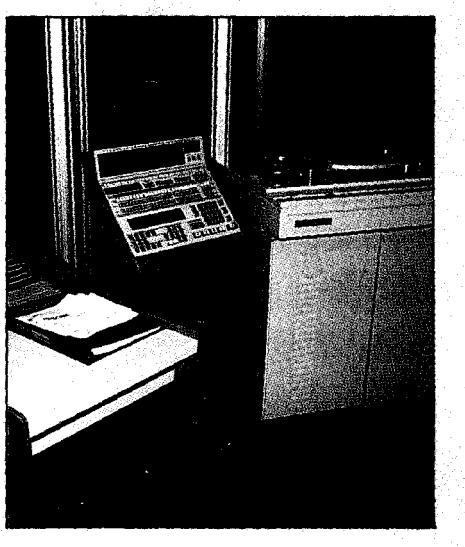


Yamaha SMD

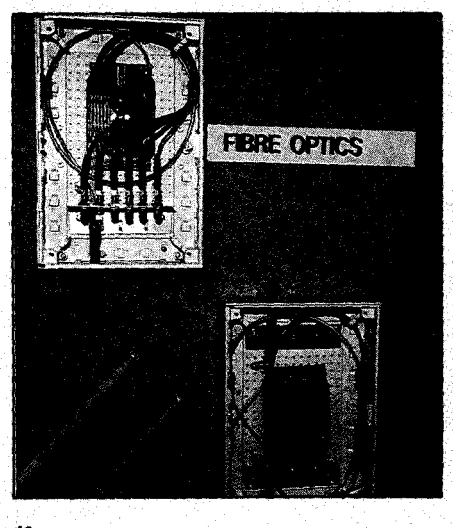


Canon

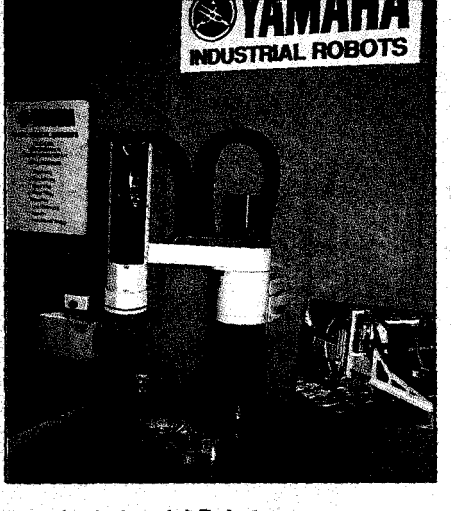
Talia Sound and Vision



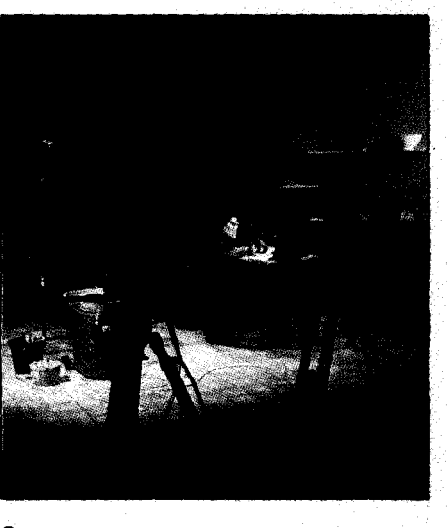
Tascam



Krone



Yamaha Industrial Robots



Sony

FANTASTIC HOLOGRAMS

Have you viewed a hologram lately? Holograms are three dimensional images that help you to see things that really are not there. They may be created in space or mass-reproduced on reflective foil. There is more to holograms than meets the eye, as I recently discovered. By Les Cardilini.

TECHNOLOGY

In order to view, or see, an ordinary object or scene, it has to be illuminated by visible light rays; turn out the light and everything disappears, or at least its image does.

What we 'see', then, is really only a pattern of light waves of varying frequency, amplitude and phase that enters the eye and is decoded by the brain. If we could artificially recreate and look at the same pattern of light wave characteristics then we would perceive an image indistinguishable from the real thing.

And that is what holograms attempt to achieve. In fact, they do it very impressively. So impressively that it seems their potential uses are limited by only the imagination. Holograms are an art form; they have applications in security and forgery detection, such as holographic keys and on credit cards and banknotes. Holograms are also used in non-destructive testing to reveal otherwise invisible flaws inside metal and pneumatic components, for example.

Advertising and promotion in product and service areas, too, are possible boom areas for holograms. Holograms are attractive, have visual impact and are not the kind of things you would be tempted to throw away, perhaps mainly because of the fascination they engender. For example, looking at the hologram on a VISA card through a magnifying glass and twisting the card to see from how many angles the object may be viewed can keep you occupied and puzzled for a long time, if you have even a wisp of interest. Imagine the fun people could have with a holographic letterhead or logo.

The history of holograms dates back to around 1949 and their development, using lasers, to 1963. The significant history of holograms in Australia, however, is relatively short, spanning perhaps the last decade.

In order to undersand how holograms work, it is necessary to know a little about the physics of light. Ordinary 'white light' as we know it contains many colours; this is obvious when we see it reflected in a prism.

Falling raindrops, like the prism, also refract sunlight, hence the rainbow which displays the constituent colours of white light. Each of these colours has its own unique wavelength ranging from around 780 nanometres (a nanometre is one millionth of a millimetre or 1 x 10 (exponent -9) metres) at the Red end of the spectrum to 380 nanometres at the Violet, or higher frequency end. These colours and wavelengths are the extremeties of the visible spectrum.

Holograms are made using coherent,

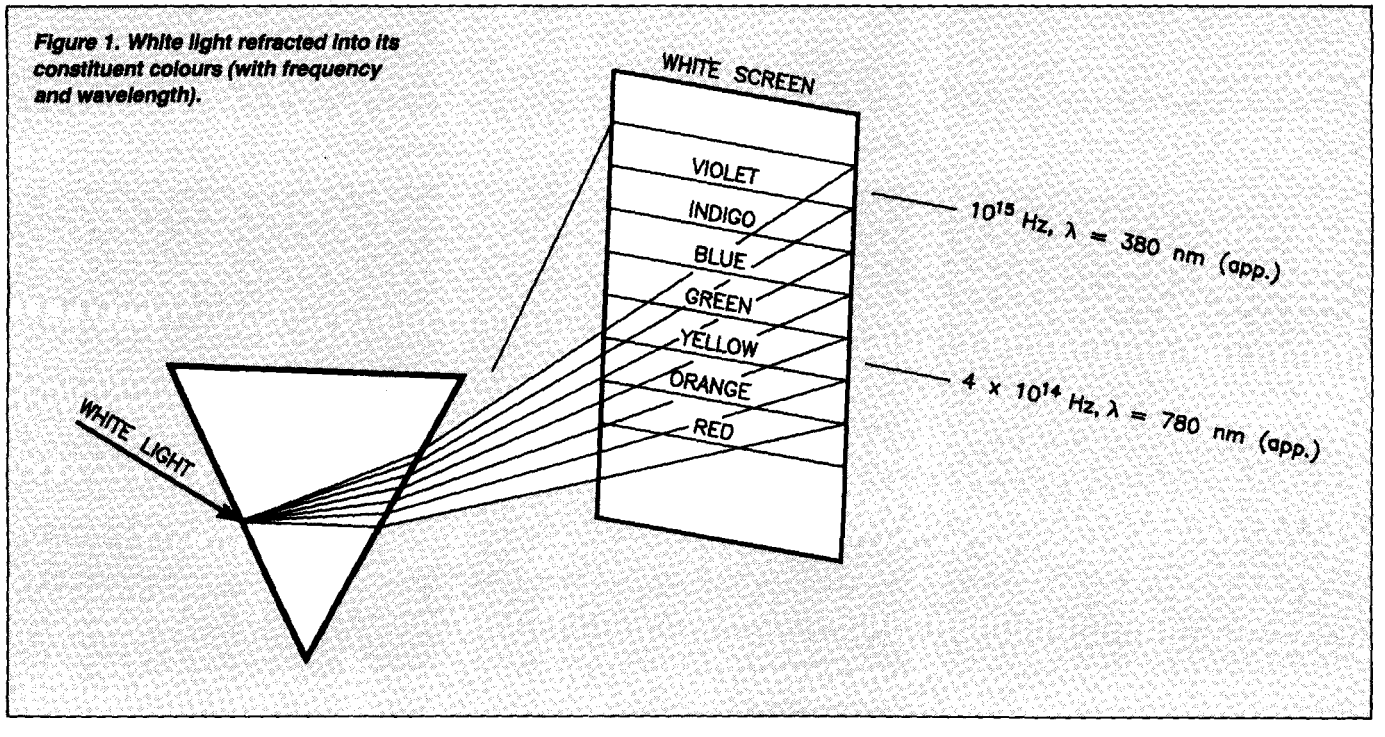


Figure 1. White light refracted into its constituent colours (with frequency and wavelength).

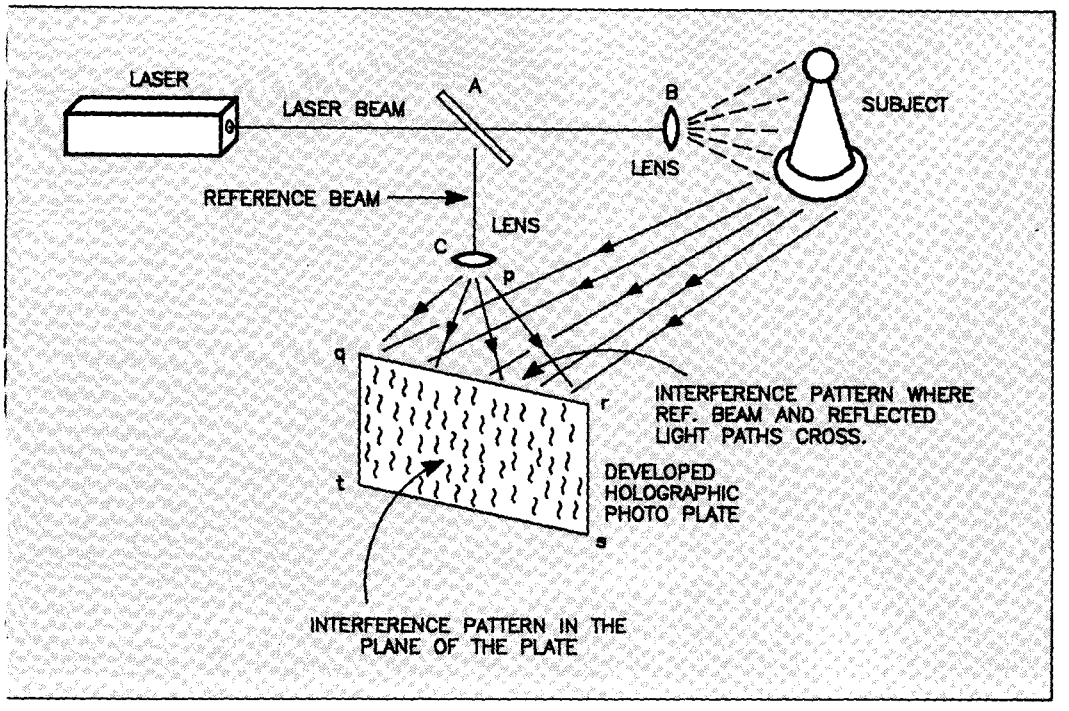


Figure 2. Creating a holographic pattern.

monochromatic light; that is, light having as close as possible to a single frequency and colour. The narrower the bandwidth of the light used to make the hologram, the sharper the image will be. For example, Helium-Neon, and Krypton lasers, provide a reddish light at around 630 nanometres. Green light at 580 nanometres and blue light at 530 nanometres are obtained from Argon lasers; and there are others, of course. Since only a single frequency is desired then only one laser is used to make a single hologram.

The hologram is created by first exposing a high resolution photographic plate sensitised to the wavelength of the laser beam.

The laser beam is passed through a semi-transparent mirror, A, which reflects some of the light in the beam and allows the rest to pass through in a straight line. The beam which passes through the mirror is then spread, or fanned out, by a lens, B, so as to illuminate the subject of the hologram. This beam is called the Objective Beam.

The part of the laser beam that is reflected downwards (in the diagram) by the mirror is called the Reference Beam and is also spread out by another lens, C.

Now, light from the Objective Beam striking the subject is reflected by all points on its surface. As a result of their striking the subject the reflected lightwaves are changed in intensity and phase compared with the Objective Beam.

More importantly for the creation of the hologram, light energy reflected by the subject is also changed in amplitude and phase with respect to the Reference Beam.

The light rays from the Reference Beam and the light rays reflected by the subject cross each other in the space, p-q-r-s-t. The result is a complex, interference pattern of light and dark areas or, perhaps more correctly, lines, where the interfering waves reinforce or cancel each other depending on their respective phases of arrival at any point.

To be successful, the whole system must be virtually vibration-free. Adjacent nodes and antinodes of the interference pattern are only a half a wavelength (just a few hundred nanometres) apart and so the whole system must be free of vibration to at least an order of magnitude less than that minute distance in order not to blur or destroy the pattern.

The holographic pattern of nodes and antinodes created where the reflected light rays cross the rays from the Reference Beam can be captured on a high resolution photographic plate placed, say, in the plane, q-r-s-t. The plate is then developed in a photographic process. Rather than a recognisable image at this stage, however, the developed plate viewed under a microscope would reveal something more like a dense, fine lace-like matrix, or the pattern gorged out on the face of a piece of wood by a miniscule grub.

The grain in the photographic emulsion also has to be much finer than that used for ordinary photography. In fact, it must be able to resolve detail in the order of 1000 lines per millimetre to faithfully record the holographic interference pattern. Unfortunately, such fine grain and high resolution also makes the emulsion 'slower', in photographic terms – an ASA-2 rating would be typical, according to one source.

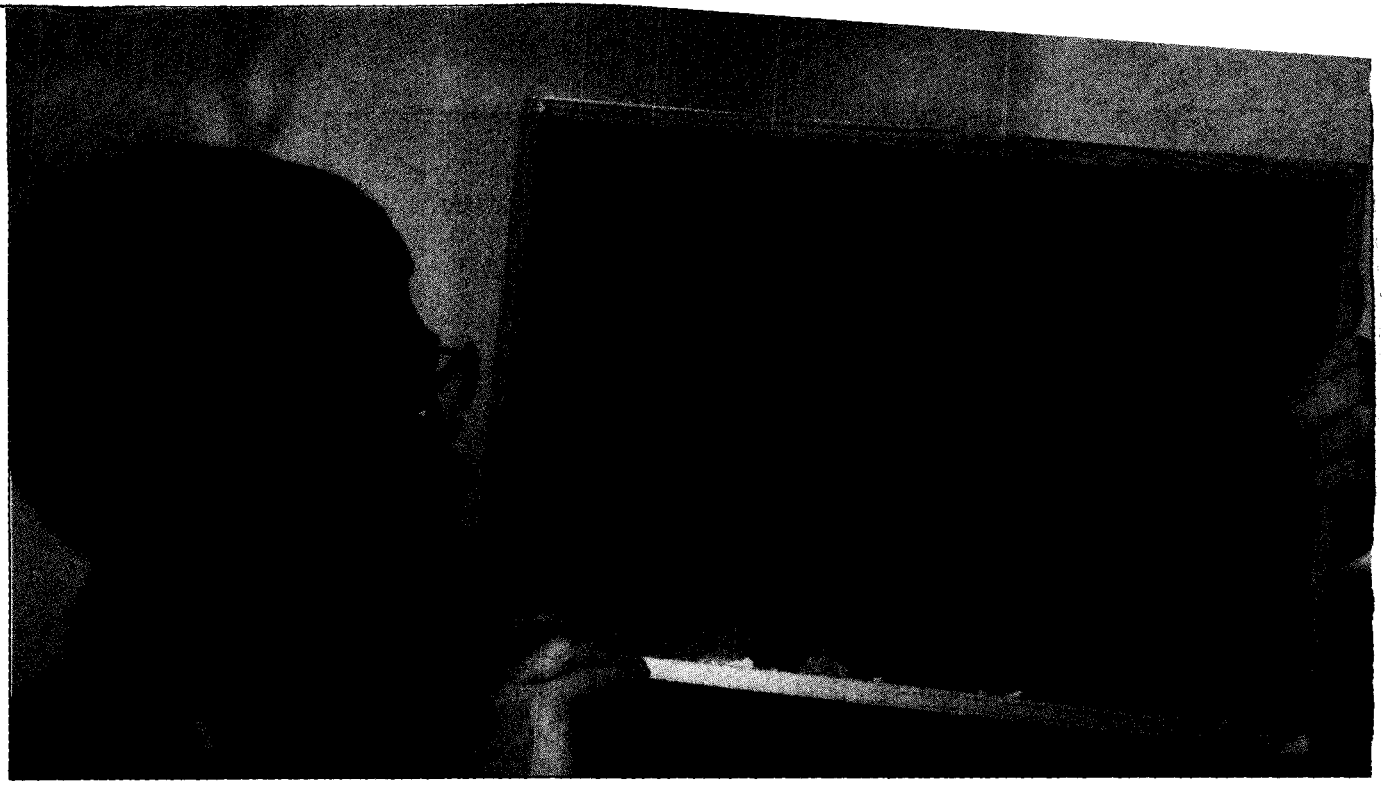
Slow photographic speed means that more illumination is needed, especially for larger subjects where the available light has to fall over a larger area and is thus diminished in intensity. This calls for bigger and better lasers or the use of pulsed lasers to obtain the Objective and Reference Beams. Pulsed lasers have the advantage of higher power for shorter exposures. Alternatively, of course, longer exposure could be used, but this increases the likelihood that the exercise might be thwarted by the vibration of the system during prolonged periods of exposure.

When the exposed emulsion is developed, the interference pattern remains on the plate, which is typically made of glass. If the emulsion was originally applied to the plate in only a thin layer, then those parts which were exposed to the brighter antinodes in the pattern are removed in the process of development, leaving the fine lace-like pattern adhering to the plate. Light can shine through the plate, between the crisscrossing 'threads'.

In order to see a realistic likeness of the subject in a hologram, light of the same wavelength used to make the pattern is passed through the interference matrix on the plate. This could be thought of as again illuminating the plate with the Reference Beam. This time, however, there is no Objective Beam.

Ideally, the laser light should strike the plate at the same angle as the Reference Beam did in the exposure phase. Light passing through the developed area is diffracted by the pattern, or grating, on the surface of the plate. Keep in mind that the grating pattern has dimensions related to the wavelength of the light. Accordingly, the light is diffracted or dispersed in many directions from every point on the holographic plate as it passes through the matrix and plate.

An observer on the opposite side of the plate to the laser sees the dispersed patterns of light that are transmitted through the



plate, as though they had come from the original subject from which the matrix was obtained. In other words, the observer appears to see a réalistic, 3-D image of the subject in its original perspective, behind the plate, an image that tempts you to reach out and touch it to see if it is real. Moving out of the viewing angle simply makes the hologram image disappear, adding a touch of mystique. Incidentally, if the plate were reversed the holographic image would appear on the same side of the plate as the observer – all very intriguing.

In fact, I should relate an experience I had in researching the subject of holograms for this article. At the Applied Physics Department at the Royal Melbourne Institute of Technology, I was shown several holograms. One of these was a microscope which appeared to be standing in space. In itself the hologram of the microscope was awe inspiring enough, but on seeing a bright spot of light in the hologram at the viewing point on the microscope I moved my eye towards it. I did this more in a gesture to acknowledge its realism. Lo and behold, however, I saw a magnified version of the subject under the lens in the hologram!

Of course, it makes sense. The magnified image was formed by light reflected from the target and up through the lens in the microscope to the eyepiece – all in the hologram. Nonetheless it had a profound impact.

A hologram can also be viewed from different angles in order to obtain different authentic visual perspectives of the subject. This is because light passing through the diffraction grating pattern on the plate – like the light dispersed from the subject when exposed to the Objective Beam – is similarly dispersed in all directions from different points over the entire plate. For example, moving to the left enables the observer to see more of the left hand side of the subject (Try it using the hologram on the credit card), and vice versa. Similarly, by changing the viewing position up and down you should see more of the top and bottom surfaces, respectively, of the subject in a hologram – true, dynamic 3-D.

An interesting twist to that example is obtained when the plate is turned around so that the hologram is viewed from behind the plate. Now, when the observation point is raised, more of the bottom of the hologram image becomes visible, not of the top as is anticipated. Similarly, moving to a lower viewing angle reveals more of the top – sort of like seeing the image, inside out, in an optical sense.

The foil hologram, the readymade kind that you can hold in your hand and view under ordinary white light, without the need to set up relatively powerful lasers and optical systems, involves a number of processes beyond the master hologram. One of the difficulties in using white light is the many wavelengths of light it contains. Each wavelength refracts and diffracts at different angles from the diffraction grating and this is why the angle is changed vertically. Basically, a different coloured hologram is seen for each angle.

To overcome this problem the holomaster from which the foil will eventually be made is obtained by making another hologram plate, as before, but this time passing the laser beam through a narrow slit. This retains the three-dimensional effects over a wide angle horizontally but limits the vertical viewing angle – as may be observed by tilting the flat plane of the foil hologram in those directions under the light source.

In the next step, the holomaster is coated with photoresist and the softened parts of the exposed emulsion are removed in a bath. What remains is the hardened grating which will disperse white light in its separate wavelengths to produce the hologram in one colour at a given angle.

Replication or mass production of the hologram is then made possible by first silvering and nickel plating the holomaster in an electroplating process to obtain a nickel master, a much more robust, version of the original. From the nickel master, stampers made from harder metal can ultimately be obtained by a similar plating process. The procedure for obtaining masters and stampers is fundamentally the same as those used for making vinyl disc records and compact discs.

The stampers contain a negative impression of the holomaster which is used to impress the diffraction pattern into reflective, plastic foil. Needless to say, the general characteristics of the foil that enable it to mould faithfully to the holographic pattern will affect the final quality of the printed hologram.

A foil hologram provides the best image when viewed below a point light source such as the Sun or an incandescent lamp at an angle of 45 degrees or thereabouts, to both the light source and the viewer.

Two organisations in Melbourne, Holograms Fantastic and Holographic Worlds Pty Ltd at Abbotsford, together already manufacture different kinds of holograms including ones on film and glass. According to a spokesperson for Holograms Fantastic, the companies have been doing their homework on holograms both commercially and technologically. They see a huge potential for local and export marketing of holographic products made in Australia and are keen to see that such an industry and expertise is developed rapidly in this country. More information: Holograms Fantastic, 269 Victoria Street, Abbotsford, Victoria 3067, ☎ (03) 429 3711. eti

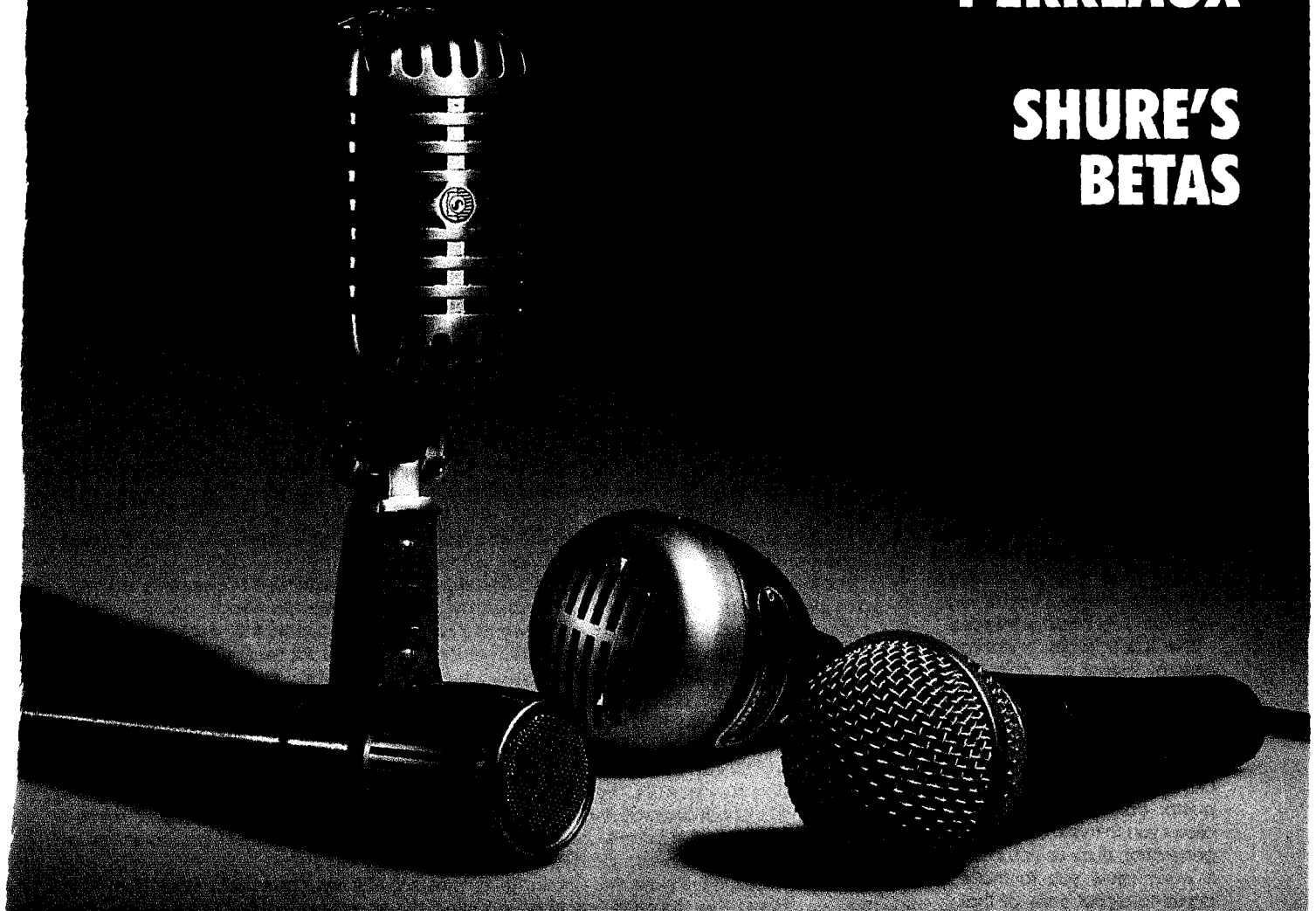
SOUND INSIGHTS

ETI'S AUDIO & HI-FI SUPPLEMENT

'89 IN REVIEW

CHALLIS ON PERREAUX

SHURE'S BETAS



INNOVATIVE PAs

DAT TIME HAS COME

Well, it seems real DAT machines which permit digital-to-digital dubbing (albeit only first generation) will reach the consumer market this year.

With the ink hardly dry on the Serial Copy Management System (SCMS) for digital audio tape recorders agreement (see details in this column last month), DAT machines boasting SCMS chips that free them of the earlier copy protection limitations were shown at the annual Japan Audio Fair last October.

Some two dozen companies, including all the big name consumer electronics manufacturers, had machines to show off. SCMS provided them with the moment they'd been waiting for. With the SCMS agreement signed, sealed and delivered in July, designers have had a few scant months to respond.

The new DAT machines shown were prototypes admittedly, but real machines will probably be on-sale in Japan by the time you read this. DAT recorders with SCMS should reach Australia during the first half of this year, according to industry sources.

The SCMS facility is incorporated by means of a chip which the Dutch consumer and industrial electronics giant, Philips, designed. It will allow direct digital copying of compact discs onto blank DAT tape (and LPs and audio cassettes, too). SCMS allows you to make as many first-generation dubs as you like, but it won't allow you to make a digital-to-digital copy of that.

Direct digital-to-digital copying is near-perfect, hence the recording industry's original worry about serial copying when DAT machines first appeared because, theoretically anyway, you can make an almost infinite number of digital dubs. The SCMS restriction only applies to copying from source material which is both protected by copyright and which already has been copied at home.

1990 will undoubtedly go down in audio history as 'DAT Year'. It just goes to show what can be achieved in resolving industry problems when the industry gets together.

Will DAT toll the bell for the compact audio cassette? Only time will tell. DAT's expected initial high cost will ensure continued life for the audio cassette for some time to come. And DAT tapes' single-side play (just as with video tape) will probably make consumers reluctant to adopt the format wholeheartedly – at least in the beginning.

But compact discs are only one-sided, and that doesn't seem to have proved a damper on their acceptance after consumers have been used to double-sided vinyl discs for years. Then again, a single CD holds much more than an LP's-worth o music and DAT tapes will hol more than a cassette's-worth c songs, too.

There is scant news on the horizon about pre-recorded DA software at this stage, but I gues it won't take long for the recording companies to provid product for the new hardware now that it's underway.

It's the old chicken and egg problem here, just as we saw when compact disc players firs appeared. Sales were sluggis because there was little software Little software was released unti there were more machines being sold, and so on. But, seven years on, CD is truly the 'boom' product of the sound industry, as evidenced from the figures released by CESA for 1989-90 which I discussed in last month's column.

COVER STORY

Our cover pic (by Helmut Mueller) shows the latest releases from Shure – the Beta 57 and Beta 58 – together with two classics from the Shure inventory – the 55SH Series 2 and the 520D (the Green Bullet, as it has been affectionately known by generations of harmonica players.)

Most of us who have been involved in the music business have used SM57 and 58 Shures – they are industry standards worldwide.

The Beta models are said to be the culmination of the most extensive microphone research and development project ever undertaken by Shure. Both are claimed to exhibit a "true" supercardioid polar pattern to reject unwanted side and rear sounds at all usable frequencies, to provide higher volume and fidelity from monitor systems whilst minimising feedback.

The Beta 58 is said to have the low-frequency warmth of the SM58 with the smoother presence rise and extended top end of the SM87 condenser mike. Such a combination of characteristics should mean the Beta 58 will prove to be an exceptional dynamic microphone for live vocals. Other design criteria includes the minimisation of pick-up of stage rumble and cymbal leakage.

The Beta 57 owes much to the SM57 but has an extended low-bass response and a smoother, more gradual presence rise. The SM57 has been the industry favourite instrument mike for years. The Beta 57's enhancements, including extended VHF response, better isolation of unwanted sounds and freedom of off-axis colouration due to its supercardioid polar pattern, should ensure a wide and willing acceptance.

The engineering considerations of handling noise and EMI have been addressed. Hum from lighting and power supplies has been handled by an advanced humbacking coil. The microphones are supplied with a clip and storage pouch.

Further details from Audio Engineers ☎ (02) 29 6731 or in Victoria ☎ (03) 879 0320 or in WA, Marketec ☎ (09) 242 1119.

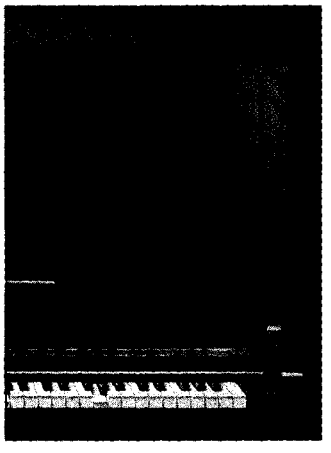
— By Kim Bucknole

The modern 'player-piano'

REMEMBER the pianolas and player-pianos which comprised a piano with the addition of a mechanical mechanism that played music 'recorded' on a roll of punched paper?

Well, the modern equivalent is here – the Disklavier, brought to you by Yamaha.

The Disklavier is an upright acoustic piano, with all the features of a conventional piano, except that it comes with an inbuilt computer that can play from music 'recorded' on a 3.5" computer disk. You can also record your own performance on disk and play it back for enjoyment, or self-criticism.



Yamaha says the Disklavier will be a boon to music teachers as a teaching tool. It features Midi-compatibility and an infra-red remote control unit.

The keys and dampers are driven by electrical solenoid units for playback and have optical sensors to pick up every facet of a player's performance – notes, note intervals, duration, touch and pedal action.

Pre-recorded discs featuring an extensive range of pop, classical and easy listening music are available. Just imagine the scenario: welcome your special guest, sit her/him down, put on a Chopin nocturne, turn down the lights and...

READER INFO No. 192

In-line speaker protector

POWER Shield is a loudspeaker protection device which can be easily installed in line with any loudspeaker to prevent driver failure due to excessive volume levels. It differs from a fuse in that it automatically resets when the volume level is reduced.

Power Shield has been a standard feature on Allison Loudspeakers for several years and, according to Roy Allison, the founder of Allison Acoustics, "We developed the technology to increase customer satisfaction with our own loudspeakers. Power Shield has virtually eliminated driver failure in our loudspeaker products.

"All too often a customer damages a tweeter just learning how loud he or she can play a new set of speakers or a new amplifier. Or, in the middle of a party, the music dies because people don't understand how much power it takes to punch through the noisy conversation in a room full of party guests."

There are four power ratings available, which equate to four different wattages depending on the impedance of the customer's loudspeakers.

The lower wattages are ideal for automotive applications. A blown loudspeaker in a car means you have to give up your transport for a day while it's repaired. Contact W.C. Wedderspoon P/L, 3 Ford St, Greenacre NSW 2190. ☎ (02)642-3993.

READER INFO No. 193

Stand-alone D-A unit

THE world's first digital-to-analogue converter able to handle present and future signals from compact disc, digital audio tape (DAT) and broadcast satellite signals has arrived in Australia.

The European-designed Marantz CDA-94 can produce high quality sound from the growing number of compact disc players with direct digital outputs – or from any other digital audio source, present or envisaged.

An auto-change circuit automatically adjusts the sampling frequency to suit the selected input: 44.1 kHz for compact disc; 48 and 32 kHz for DAT and broadcast satellite.

Marantz' National Manager, Mr Kym Biddell, expects the CDA-94 to be in great demand among both audiophiles and professional users.

"These two very fine pieces of equipment will meet all digital audio requirements of today and tomorrow", he said.

The player and CDA-94 can be linked by optical cable, which transmits digital signals as pulses of light. Because light is immune to electrostatic or electro-magnetic interference, an exceptionally clean, noise-free signal arrives at the receiving end, according to Marantz.

In addition, the digital filter and the twin D-A converter chips are connected by optical coupling and there are independent left and right channel amplifier circuits. Three separate power transformers provide total circuit isolation and protection from interference, the company says.

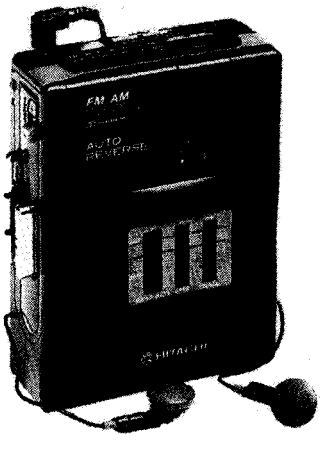
Another feature is Absolute Phase Control which can correct accidental inversions of phase of the original music signal. This restores musical harmony and is especially valuable in vocal performances.

The CDA-94 sells for a recommended $1799. It carries a full two-year warranty. Phone ☎ (008)22-6861 to get more information, for the price of a local call.

READER INFO No. 194

New radio cassette with super bass

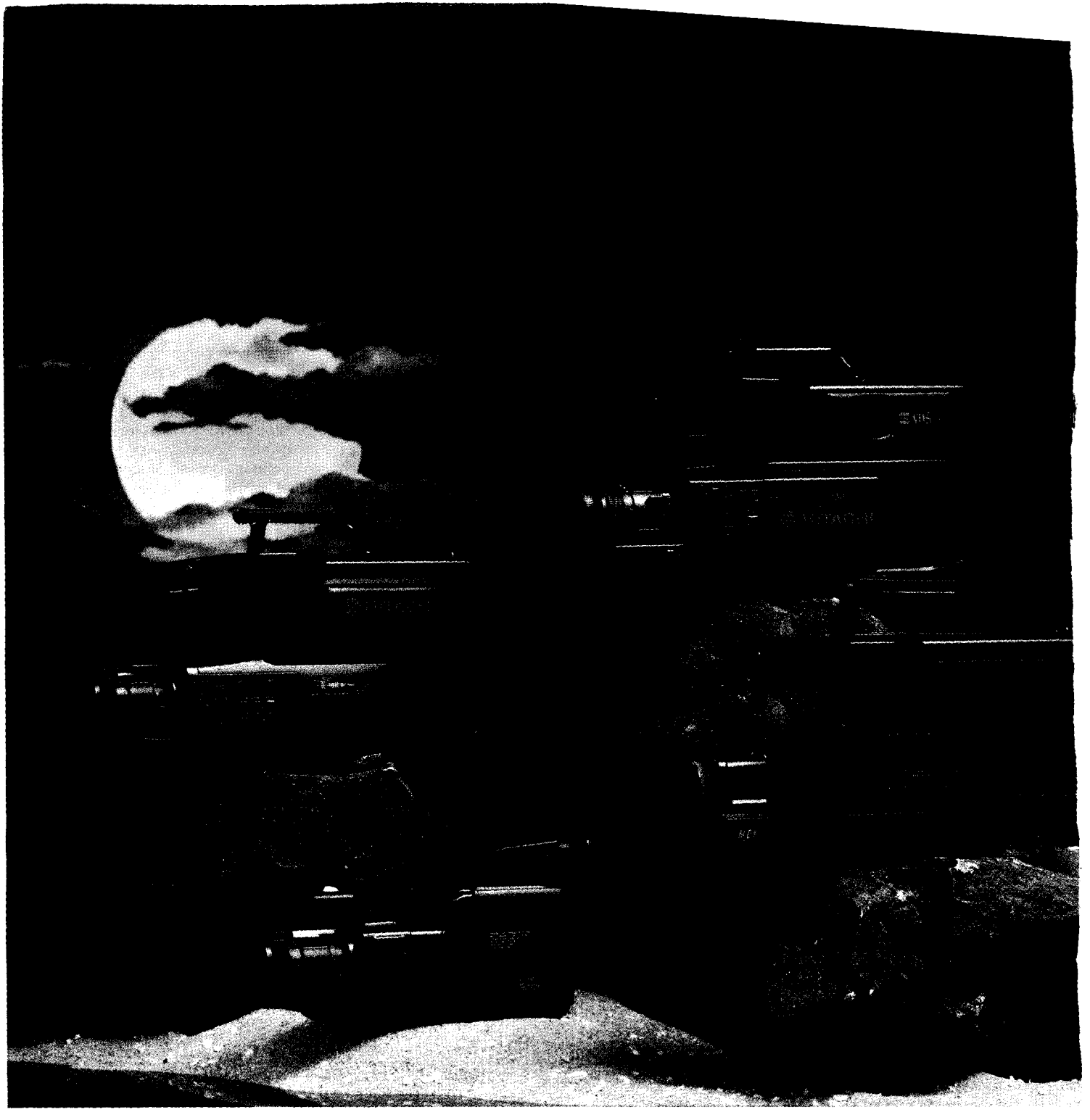
HITACHI has released a new portable mini size stereo radio cassette featuring a super bass equaliser. This 3-band graphic equaliser provides boost right down to the deep bass end of the audio band.



The cassette player features auto-reverse, giving automatic playback of alternate sides of a tape, selected by the touch of a button.

The unit, known as the CP207R, also features Dolby B noise reduction and comes with an AM/FM stereo tuner built in. It measures 95 x 120 x 45 mm.

READER INFO No. 195



THE AUTOMATIC CHOICE.

The dynamic new range of Hitachi video cameras offer a selection to suit the most discerning enthusiasts.

Ranging from the VM-C528E compact VHS C 625 weighing 1.2kg through to the VM-S7280E full size S VHS Camera with in-built colour character generator. All models feature electronic image sensor recording, providing brilliant picture reproduction. Low Light performance is exceptional with minimum illumination sensitivity from 10 to 7 lux.

HITACHI

Other features include • Auto-focus, white balance and exposure • High speed shutters • Fade control • Flying erase head • Interval recording and an array of accessories — complete with carry case. The ergonomic design provides greater user control and handling comfort. Hitachi video cameras, the choice is Automatic.

Victoria: (03) 555 8722 New South Wales: (02) 666 3088 Queensland: (07) 260 1344 South Australia: (08) 268 7670 Western Australia: (09) 277 9955 Tasmania: (002) 72 5651

READER INFO No. 23

SOUND INSIGHTS IN REVIEW

'echnics SL-P770 CD player

:h, ETI January 1989, pSI6

IE SL-P770 offers most of the best features the SL-P1200 but supplements these with hers which are more practical and, for a rious audiophile, far more beneficial.

The SL-P770 is one of the most potent and st effective CD players that a semi-ofessional musician would wish to buy. My dy criticism is that it doesn't have remote lume control. When it does, it will be tremely hard to get any CD player to tter its functionality and performance!

CONTRIBUTORS
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Tony Pugatchew
Terry Kee

Roland DSP-2000

LCh, ETI February 1989, SI14

THE Roland Corporation's new digital sound processor, Model DSP-2000, exploits very well the phenomenon of hearing. In the DSP-2000, early reflections and reverberation are derived from a normal stereo program and then played back into the room with the 'direct' sound from the regular stereo pair of speakers in the system.

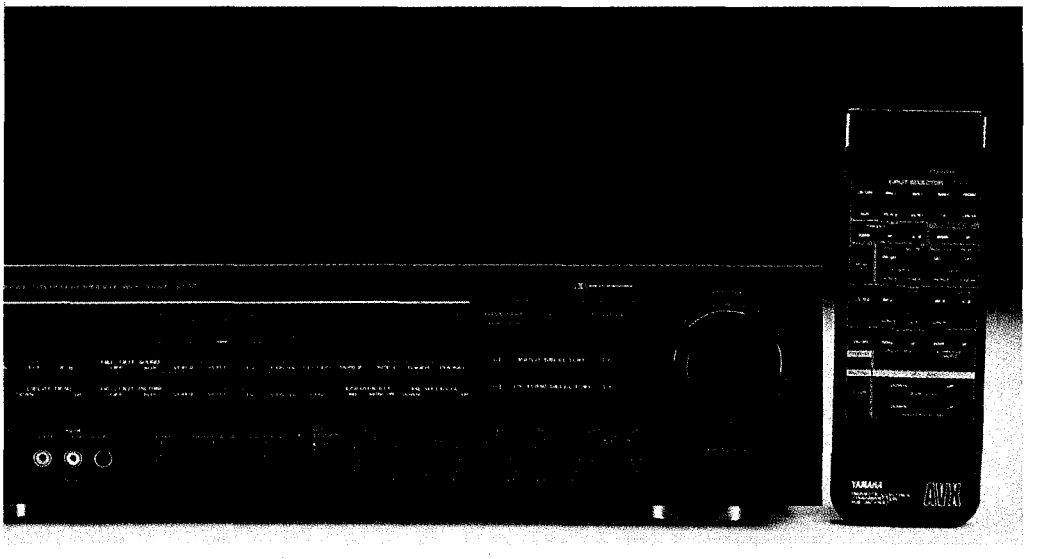
Positioning the left and right presence speakers relative to the rest of the system would be a matter of choice.

'amaha's AVX-100 tereo amp

:h, ETI January 1989, pSI22

IE Yamaha AVX-100 comprises four power mplifiers; an eight-mode surround rocessor, including a Dolby surround sound ode for suitably recorded soundtracks on isc and video movies; a video enhancer to nprove picture quality in both record and lay modes; and a title edit function for lubbing or inserting your own sub-titles onto ideo recordings and home video movies.

As well, the AVX-100 has provision for 10 tereo audio and six video inputs. Any of em may be selected individually, for cording or playing in conjunction with each ther in a totally integrated home tereo/video system.



)ali loudspeakers

H, ETI May 1989, p126

HE Dali speakers available fall into two basic amps – those with black vinyl finish and nose with a choice of real wood veneer although they can also be black).

The vinyl finish range, the Dali 1a, 2b, 3b, 4b, and 5a models, range in price from $498 to $1498 and slug it out, frequency for frequency, in the hi-fi shops with the better quality speakers, most of which are imported but which bear measurements remarkably similar to the optimums worked out at Sydney University by Small and Thiele.

This range of Dali speakers is basic, honest and, if the dealer is not offering run-out discounts on one of the lookalike competitors, good value for money.

The second range of Dalis, those with real wood outside, are the more fascinating ones. These are the speakers that have emerged from the testing laboratory where computers and a willingness to try new approaches have resulted in some esoteric designs with true high fidelity.

Akai GX-95 stereo cassette deck

LCh, ETI September 1989, p108

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 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 subjective evaluation of the Akai GX-95 confirmed that it is a well designed, delightful piece of consumer electronics which offers the best of both worlds.

Continued on page 165

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.

The research: three dimensional sound.

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 dimension to music—giving the sound depth, height and width. In short, it seems to come alive!

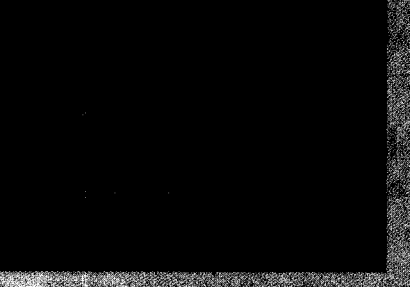
In a live performance, the majority of sound reaches your ears after being reflected off the walls, floors and ceiling. With conventional speakers, you mainly hear only direct sound. Bose Direct/Reflecting® speakers add the missing elements of music by bringing you the natural combination of direct and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

The performance: ideal for audio, video and digital.

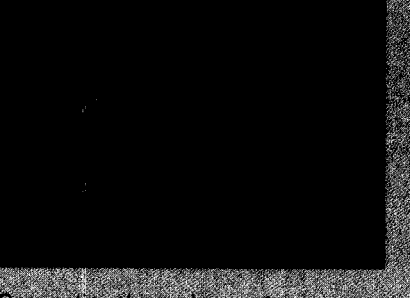
With most conventional speakers, you hear stereo in one or two parts of the room. Everywhere else, you hear primarily one speaker. The 601 system allows you to hear true stereo *everywhere* in the room—even when you are directly in front of one of the speakers.

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.

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Bose Distributors:
NSW and VIC: Bose Australia (Reverse charge (02) 684 1022); QLD: Stereo Supplies (07) 229 7930; WA: Prosound (09) 325 1066; SA: Blackwood Sound (08) 278 1281; TAS: Chessman Distributors (003) 26 4622.

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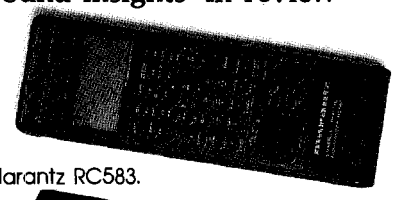
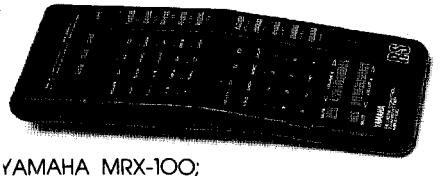
Sound insights in review



Marantz RC583.

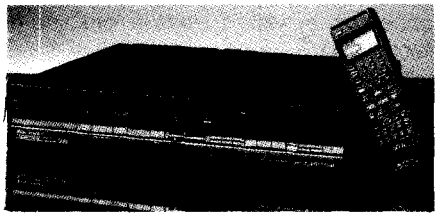
Pioneer CU-AV1000;



YAMAHA MRX-100;

Remote controllers

rK, ETI February 1989, pSI6



Hitachi's VT-588E (AU) VCR

LC, ETI May 1989, p122

HAVING had the opportunity to put Hitachi's new model VT-588E (AU) hi-fi VTR with digital video signal processing through its digital hoops I was surprised to see how quickly I changed my opinion that digital effects tended to be a bit on the gimmicky side.

For example, on replaying the videotape of a wedding it was apparent that some of the digital video 'stills' of bust shots and larger subjects were perhaps sharp and stable enough to photograph. By utilising the Frame Advance the subject could be stepped forward until a suitable pose or shot appeared on the screen and then retained indefinitely while the scene was assessed for artistic merit and the film camera readied.

The Hitachi VT-588E (AU) allows a TV picture, with the vital numbers intact, to be captured and stored by simply pressing the right button on the remote control, provided the system is using the stereo TV tuner.

The new, digital video side of things tended to overshadow the fact that the set, like a number of its peers, also has HQ circuitry for higher quality analogue pictures and, importantly, VHS video hi-fi audio recording (up to eight hours of high quality stereo sound) and playback.

Continued from page 159

Akai AT-93 tuner

RH, ETI November 1989, p120

AKAI'S flagship, the AT-93 AM/FM stereo hi-fi tuner, incorporates a number of automatic operating features designed, Akai says, to optimise performance. These include two antenna inputs, the tuner deciding which of the two inputs provides the best signal; selectable wide or narrow IF bandwidths, the tuner deciding which gives the best recovered audio; stereo blend facility to reduce noise from a weak stereo signal, and a high cut filter to further reduce noise and interference. These automatic facilities can be simply overridden by a manual-select control.

The Akai AT-93 stereo FM/AM tuner is a very sophisticated, high performance piece of equipment, delivering excellent sound within the constraints of the medium. For all its sophistication, it is very simple to learn to operate.

For $1099 rrp, you should expect a lot of a tuner. The AT-93 delivers it.

Thorens turntables

RH, ETI October 1989, p106

AMONG the names that have an established reputation for producing quality, high performance turntables is Thorens, a company that is as old as and has grown along with the sound-on-disc record. They have recently released a new turntable and an upgrade kit for one of their earlier models.

Marantz CV55 video disc player

LCh, ETI November 1989, p110

IT comes as no surprise that the Marantz CV 55 Video Player – and probably all the other multidisc players which will be released in Australia – is designed to play up to 5 differently sized, different formats of laser discs. The most common disc likely to be played will be the 120mm diameter audio CD. These, of course, are soon to be complemented by the compact disc video systems (CDVs), which are not yet being marketed in volume by the record companies. A 120mm diameter gold coloured CDV is capable of providing 6 minutes of video with stereo digital sound, supplemented by an additional 20 minutes of conventional digital audio sound.

The CV 55 also plays 200 mm diameter single sided video discs which hold 40 minutes of video with matching digital sound.

This medium is exciting. If you are prepared to spend a little more money on your CD player (and to purchase a CD video player), you then have access to both video and audio for a cost which seems quite reasonable.

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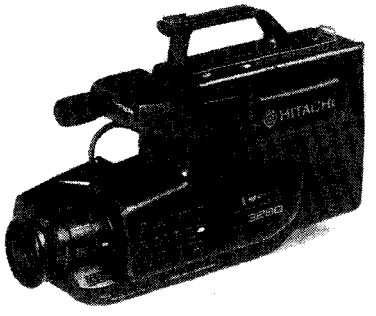

Hitachi VM-C528E camcorder

LC, ETI July 1989, p110

AT a moment's notice you can start shooting with a lightweight video camera-recorder (camcorder) like the Hitachi VM-C528E (AU). The VM-C528E (AU) takes shots in candlelight if necessary, records HQ video and sound on a small cassette that slips inside the camera, and is powered by a quick change, clip-on rechargeable ni-cad battery that doubles as a comfortable hand grip, on the camera.

The VM-C528E (AU) balances well and is easily supported at eye level to record a scene or to preview a tape already recorded. The camera can also be mounted readily on a tripod (not supplied).

Eurovox MCC 6860E car sound system

LC, ETI July 1989, p102

ANTI-theft electronic security coding is featured in the Eurovox Model MCC 686OE stereo AM-FM car radio along with other sets in the Eurovox range.

Minimal attention from the driver is needed to select stations and operate other functions.

The stereo cassette player has a number of attractive features including auto-reverse, Dolby noise reduction, automatic program selection in both forward and reverse, and metal tape facility.

Technics SB-AFP10 panel speakers

LCh, ETI July 1989, p106

TO provide these unusual speakers, which look more like esoteric musical instruments than loudspeakers, the Technic's design engineers redefined acoustical enclosure theory and almost the very basis of conventional electrodynamic speaker construction as well.

No other speaker that I have ever listened to has been able to produce such spine-tingling sensations and such acoustical intimacy coupled with superb fidelity.

Yamaha's Active Servo Technology

LC, ETI August 1989, p124

YAMAHA has developed a very small speaker system that virtually leapfrogs both bookshelf and satellite speaker technologies. In fact the first model released here in recent months, the AST-S1, can be used either as a small main or bookshelf system, or in Yamaha's new, Active Servo Technology (AST) mode which extends the bass response of these mighty midgets down to a body-pumping 28Hz.

Pioneer Z770

PH, ETI September 1989, p106

PIONEER'S Z77O system is a midi uni comprising a combined amplifier-twir cassette deck-graphic equaliser, a belt-driven turntable, a twin compact disc playe and a pair of three-way bass reflex speakers It has been designed to look like a stack o individual components and has a stylist appearance with a suitable amount o illumination.

It is essential that this sort of equipment which is likely to be used by every membe of a family, should be as user-friendly as possible. The Z77O, despite its myriac functions, is as amiable as a labrador pup

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NAD 7600

LCh, ETI March 1989, p109

THE NAD 76OO conforms to the company's low key profile with dark grey front panel, black central escutcheon display and white silk screen lettering for each of the major controls.

The NAD 76OO receiver is not the most powerful that I have ever tested, but the quality of its amplifier and tuner sections along with the simple sophistication of its front panel puts it in a position where it runs rings round most competitors.

Perreaux PMF 2350 200W amp

LCh, ETI February 1989, pSI8

THE Perreaux PMF 2350 has a number of refinements over the previous generation, which it now replaces. The first of these relates to the use of much heavier internal wiring to lower the impedance of the internal circuitry. The second improvement is the use of a double thickness of copper laminate on the printed circuit boards. The third is to add more effective heat sinks on both sides of the amplifier casing, to provide more effective heat dissipation. The last improvement is to upgrade the electrolytic capacitors to enhance the filtering of the power supply circuit.

The Perreaux PMF 2350 is an exciting amplifer which, supported by good software and good speakers, can produce brilliant sound.

Sony PCM-2000 DAT recorder

LCh, ETI April 1989, p107

SONY has brought in a consignment of its first portable, professional PCM recorders, the small and exciting PCM-2000 digital audio recorders.

This machine has not been designed to deceive nor to pull any punches when it comes to ergonomic design, functional performance and the important conveniences of small size and light weight.

I didn't take very long to learn how to use the PCM-2000. Its major and minor controls are both simple and straightforward.

They are well set up for serious recording of music or outdoor sound signals.

You may not have the $6500 plus tax that you will need to purchase this recorder, but if you have, rest assured, you will undoubtedly get the finest portable battery-operated recorder that money can buy.

Jamo Concert VIIs

LCh, ETI August 1989, p127

JAMO had to offer some sort of revolutionary departure from their previous design philosophy and develop some practical advances to attract new buyers. As I found, the Concert VIIs are precisely the real advance that they sought.

The Jamo design engineers' innovative flair really has come to the fore, for not only have they ported the two sides of the woofer enclosures to precisely the same frontal drive point on the cabinet (which is really neat) but they have also used the structural requirements of the two separate enclosures to stiffen up the cabinet.

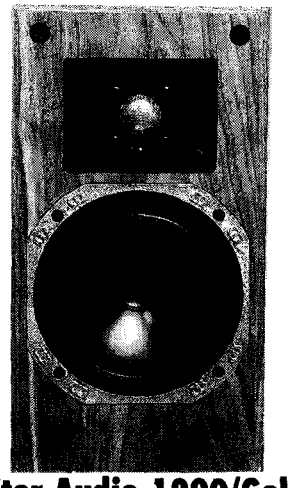
The most outstanding feature of the Concert VIIS was their bass response which rivalled that of any speaker I have ever brought into my home.

Videonics DirectED home video editor

PH, ETI June 1989, p129

THE Videonic DirectED is a machine that uses computer technology and some delightful lateral thinking to produce a home editing suite for under $1000.

It allows you to combine your favourite scenes, in any order, with special effects, graphics, titles and backgrounds to make a production you'll be proud to show. The system has no knobs, buttons or switches. A video recorder (with remote control, ordinary play-search capabilities and video and audio connectors) and a camcorder with playback ability (or a video recorder) make up the running gear.



Monitor Audio 1200/Gold loudspeakers

LCh, ETI October 1989, p109

THE Reference Monitor 1200/Gold MD is one of the latest speaker developments from Monitor Audio Limited in England. The design of these cabinets is both interesting and unusual, in that this two-way speaker system tries to achieve an unusually wide range response.

The Reference Monitor 1200s are well suited to a small apartment where their visual attributes are important, where listening to classical music is their primary function and where listening levels are likely to be below 90 decibels at 2M.

Sansui Bar system

RH, ETI August 1989, p118

AMONG a crop of new Sansui component hi-fi equipment releases, Atsui launched the new Bar series midi system which comes in two models – the 770 and the 970. The Bar series consists of separate components, plus speakers: these include an amplifier, equaliser, CD player, dual cassette deck, tuner and turntable. A 57-key multifunction infrared remote controller comes with either system. eti

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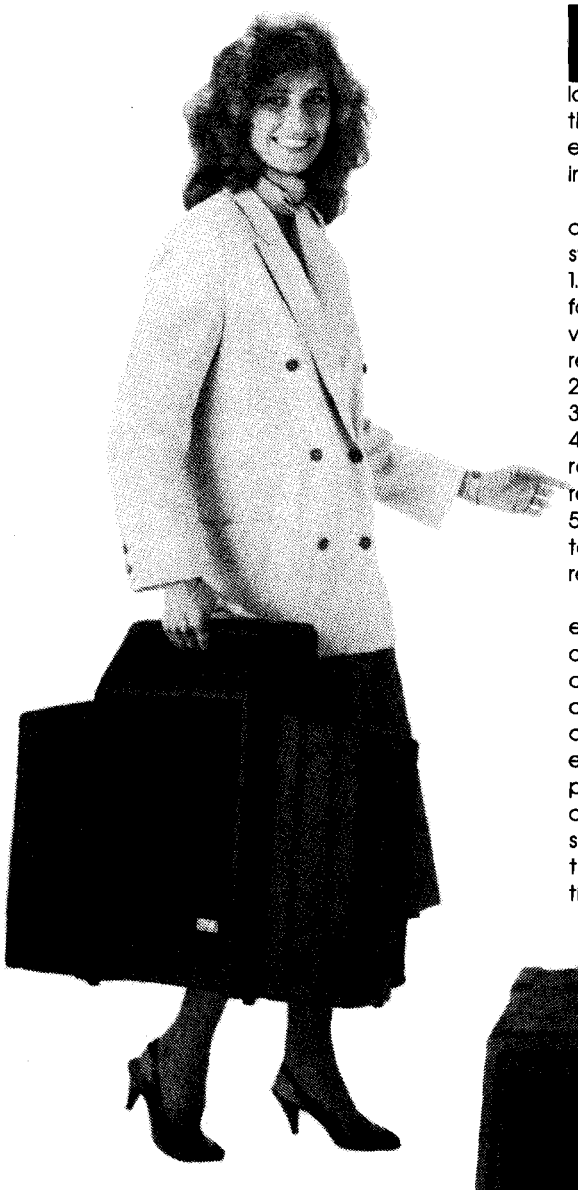
PORTABLE SOUND SYSTEMS

These days, a variety of portable sound systems exists to suit a myriad of purposes. US company, Anchor Audio, has them all. By John Monty of Entertainment Services of Australia.



Portable sound systems are suitable for many purposes: meetings, concerts, shopping centre promotions, product launches, guide tours, crowd control, calling times and positions, officiating events, emergency and civil defence, outdoor instruction, auctions and so on.

Many considerations must be taken into account when designing a portable sound system. These include:

1. Whether the system will be used primarily for projecting sound with emphasis in the vocal frequency range or full range music reproduction.
2. Quality & type of amplifier to be used.
3. Power supply to be used.
4. Casing materials to be used and their relation to weight, durability, impact resistance, looks.
5. If the system is to be used outdoors, ability to withstand weather conditions including resistance to heat, rain, ice and dust.

Most people have not in the past expected portable systems to exhibit a high degree of fidelity, appearance or quality of construction. But, today, with the high level of sound quality we are used to in our domestic environments, together with the ever increasing standards of company and public presentations, many people are demanding much more of their portable sound systems. For instance, people want their sound systems to reflect the quality of their CDs.

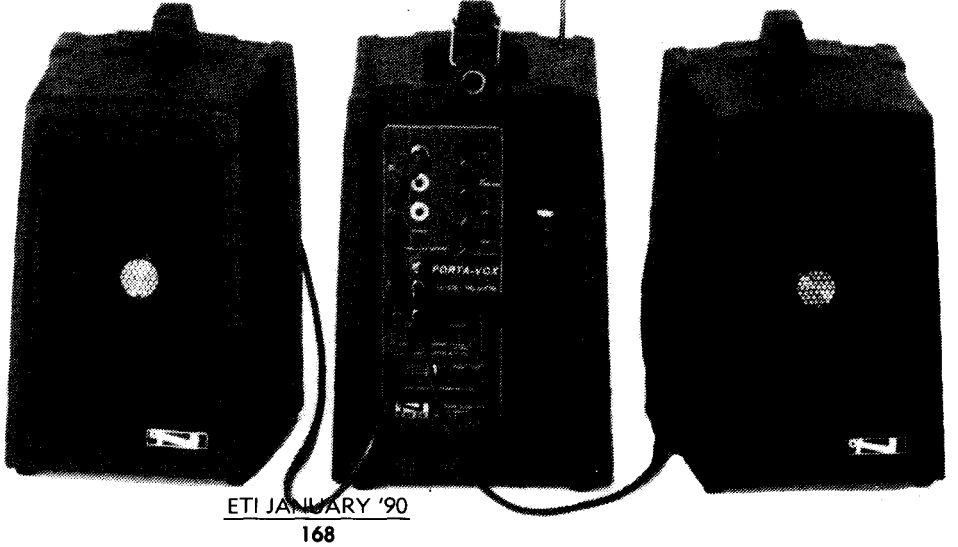
When considering the purchase of a portable sound system, you will also want to weigh the benefits of the many options which modern technology has made available to us. Some of these options are:-

1. Battery operation, including built-in re-chargeable batteries.
2. Tone controls.
3. Phantom power, balance microphone inputs.
4. Ability to input cassette tapes, VCR, radio or instrument.
5. Line output for recording directly from the amplifier of the system.
6. External speaker outputs and whether switched or unswitched extension speakers.
7. Wireless microphones, lapel or handheld.

One company which specialises in portable sound systems is Anchor Audio Inc. of California USA. Anchor Audio is noted for good quality, innovative portable sound systems which offer more than others in terms of versatility and capability.

One model which illustrates just how far portable systems have come and the choice of options available to the consumer, is Anchor's Liberty MPB-3500A 'DUAL' Sound System.

In fact, the MPB-3500A is two sound systems in one, operating on its own rechargeable batteries. In its Project Mode, it utilises an efficient voice projecting horn electronically coupled at 1000 Hz with an 8" bass driver for optimum efficiency and speech articulation. At the flick of a switch you can set the Liberty model to Music Mode where it utilises a high frequency tweeter instead of the horn, this time electronically coupled with the bass driver at 3000 Hz for smooth extended frequency response from 70 Hz to 16 kHz.



Above: the Ensign lectern — tough, compact and lightweight.

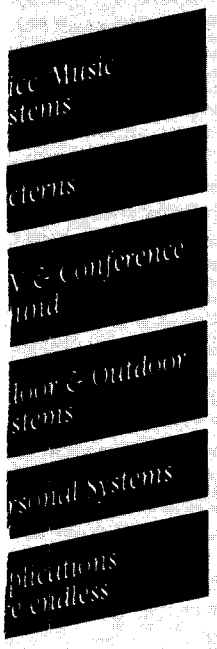
Right: Portavox wireless portable sound system — can cover a crowd of 5000.

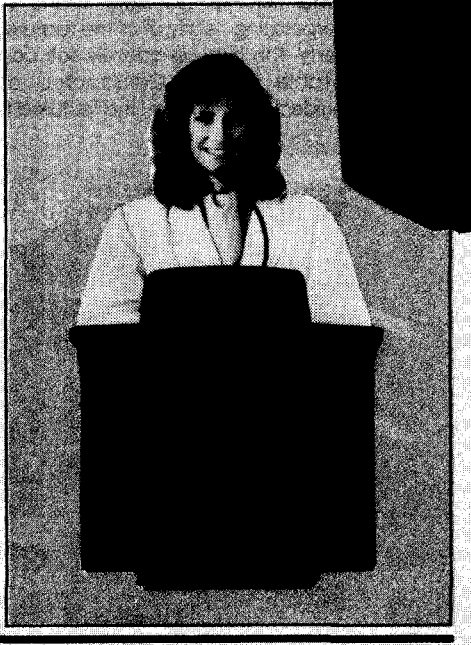
Come through loud and clear!

When you need efficient voice reinforcement or full range music, Anchor can do it all with powerful, high fidelity sound.

ach model is completely self contained and ready o use, with a powerful built-in amplifier, multiple iput mixer, auxiliary output and power supply. nhance their versatility with optional extension peakers, wireless microphone, cassette or CD.

oused in compact, rugged, lightweight nclosures, there's an Anchor Audio PA ready to o to work where ever you need to be.





ANCHOR

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Steiner Electronics Products Pty Ltd
Ph: (08) 799 381
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Intercity Sales & Installations
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Fax: (07) 846 2054

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Multivision Intercity Hire
Ph: (09) 381 5666
Fax: (09) 382 4008

CANBERRA
Topstage Productions
Ph: (062) 80 5710
Fax: (062) 80 7545

DARWIN
Top End Sound
Ph: (089) 81 7744
Fax: (089) 81 7525

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Intercity Hire - Tasmania
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NEWCASTLE
Precision Audio Electronics Pty. Ltd.
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Fax: (049) 57 2133

GEELONG
Music Workshop
Ph: (052) 21 5844
Fax: (052) 21 6036

READER INFO No. 30

Portable sound systems

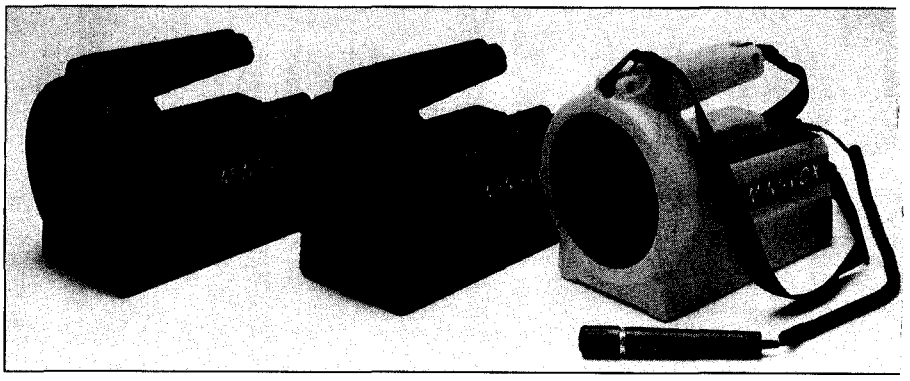
A cleverly designed state-of-the-art MOSFET amplifier provides a full 50 watts of continuous average output power in battery operation. MOSFET amplifiers give an extended bandwidth, thermal stability, low distortion and output protection. An automatic DC Servo circuit maintains zero offset voltage for lifetime reliability of amplifier and therefore speaker protection.

The Liberty produces an SPL level of over 105 db for six to eight hours before re-charging is required. So with one system you can handle crowds of 1000 or cover live performances and AV presentations in banquet facilities, churches, auditoriums, presentation centres, whether you have access to AC power or not.

The Liberty also features Anchor's exclusive battery protection circuitry. The sound system is automatically switched off when batteries approach the critical discharge point. A built-in two-stage recharger automatically controls the charge rate for optimum battery recovery and charge maintenance. The charge is automatically reduced to maintenance level when the batteries have reached their full charge.

Other standard Liberty features are:

1. Two balanced microphone inputs each with phantom power for use with any low impedance or condenser type microphone.
2. Treble and bass controls.
3. Line output for recording directly from the amplifier or fed to the auxilliary input of another sound system for greater output and broader coverage.
4. Switched and unswitched external speaker outputs.



The Minivox personal announcement system weighs less than five pounds but has lots of power.

Options include:

1. Wireless microphone receiver can be installed in the rear panel and has its own volume control. The wireless mic signal is mixed with the other inputs for a composite output.
2. An auxiliary panel can be installed in the rear of the Liberty for use with external wireless microphone systems or as another audio input.
3. A cassette tape player can be installed in the rear panel.

All of these components are housed in Liberty's stylish foam moulded case. Utilising the latest in polymer plastic development, the casing is lightweight and virtually indestructible while exhibiting excellent acoustic properties. Naturally, it is weatherproof. The case dimensions are 56

Anchor's Ensign Lectern is a unique product in the field of portable sound systems. Incorporating nearly all of the features of the Liberty, this is a completely self contained portable lectern. Constructed of roto-moulded polyethylene, the textured finish will neither show scars nor lose colour. It folds to a compact size of 53 cm high by 61 cm wide by 25 cm deep and weighs less than 14 kg including batteries.

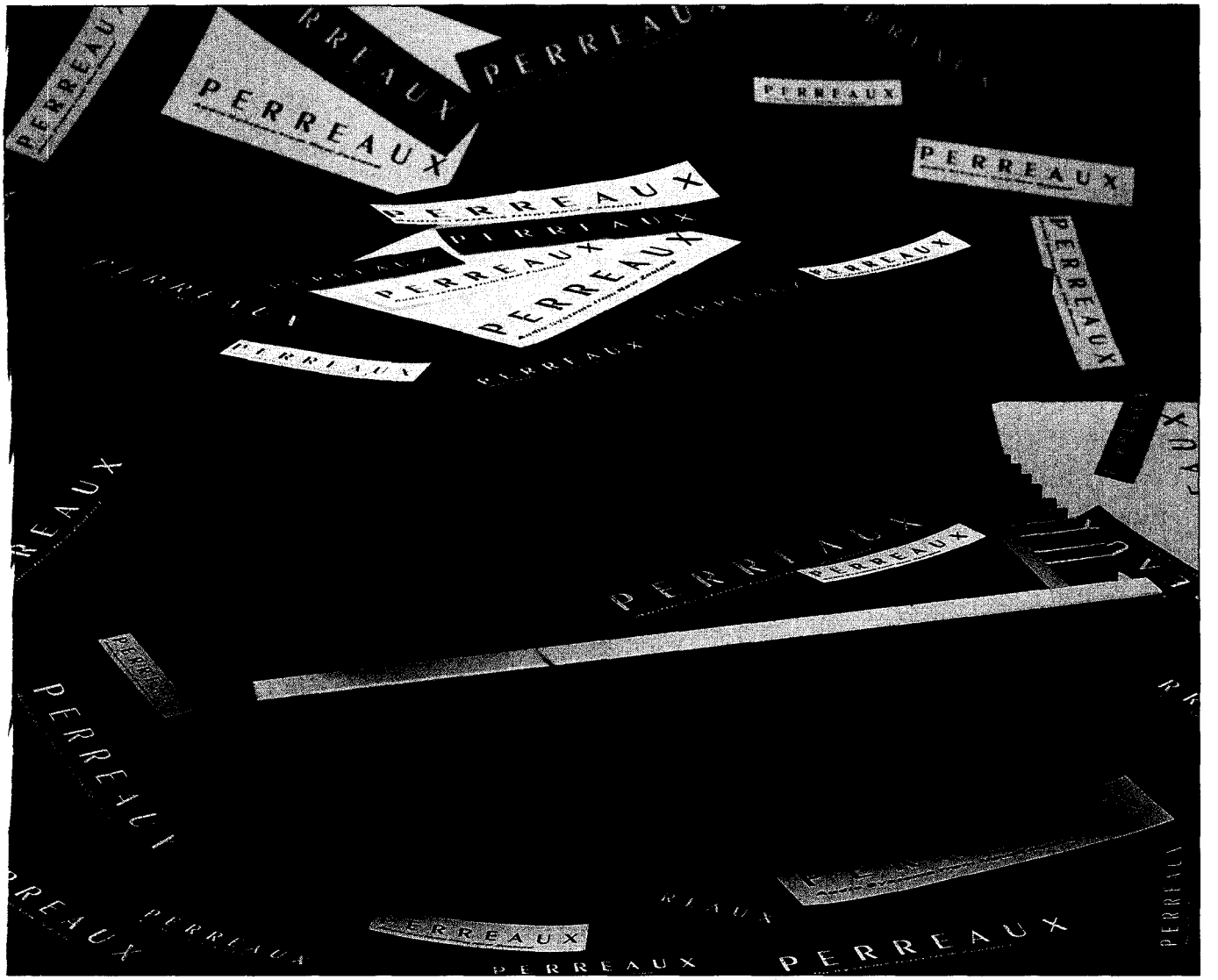
Anchor Audio manufactures two other products which use the ultra tough lightweight, non-scuff properties of roto moulded polyethelene. Generally, portable systems use conventional wood or an moulded ABS. Neither of these two types of construction have the strength to resist hig impact and wood is not suited to use outdoors as it is not weather resistant.

The Mini-Vox is a personal announcemer PA system. Looking more like a Dolphi flashlight, and weighing less than 5 lbs, potent 15 watt fully integrated amplifier drive a powerful 5" speaker, projecting clear voic commands for hundreds of feet. This is nc the common horn type loud hailer, but a hig fidelity sound system. Drawing its power from nine size "C" batteries, it can deliver up to 108 db SPL for 50-100 hours of continuous operation. A 'Walkman' cassette or CD car be plugged into its auxiliary output. Options include a choice of colours (red, black yellow), rechargeable batteries, attention getting signal alert and wireless microphones.

If you need to cover a large crowd outdoors, you may want to use the Porta-Vox. It is a compact system which sets up in under one minute and will operate for more than five hours on a single battery charge It weighs a mere 11 Kg and can be easily carried to any location. Two 20 watt amplifiers, one for each output, achieves an SPL of 120 db through two detachable re-entrant horn speakers with 30 feet of speaker cable. Two additional speakers can be daisy chained for a broader coverage It is ideal for athletic competitions, water sports, band and military exercises, disaster and emergency coverage, parks and recreational gatherings.

Features include rechargeable battery with protection circuits, two low impedance microphone inputs, a hand held microphone with 6' coil cord and on/off switch, auxiliary input for tape player or radio play-back and tone control to accommodate varying acoustical conditions. The combination of its virtually indestructible casing, together with rugged state-of-the-art electronics makes this unit capable of withstanding the roughest of treatment.

The Liberty MPB-3500A: two sound systems in one.



A POWERHOUSE FROM PERREAUX

Louis Challis takes home the Perreaux El dual channel amplifier and transports his unwitting family to the third row of the Opera House.

Had Perreaux had a less solid international reputation, I might not have had the pleasure of reviewing the El dual channel amplifier. Perreaux recently avoided an untimely demise at the hands of its venture capital lenders, themselves stricken by hard times in the New Zealand money market.

Fortunately, the company's strength and vigour has won through and its creditors have given it the 'thumbs up', instead of the 'thumbs down'.

The El amplifier is the new "small" amplifier in the latest Perreaux line-up – but don't be fooled, this amplifier is small only in size, not in performance.

The El is the simplest, most straightforward and economically designed Perreaux amplifier I have tested. Its cabinet, with a bright, anodised silver front panel has only a single protuberance, a black power ON/OFF switch with integral LED to tell you that the power is on. At the top left-hand corner, the manufacturer's name is emblazoned as a grey, silk screened 'Perreaux' label.

Both sides of the amplifier are taken up by deeply finned heat sinks, the edges and corners of which, unfortunately, are much

PERREAUX

BY
PERREAUX

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READER INFO No. 31

sharper than they ought to be in the interests of user safety.

The back of the amplifier is only a trifle more complex than the front, with two well-spaced pairs of gold-plated, colour-coded universal speaker terminals for left and right channel, between which are a pair of gold-plated colour-coded RCA coaxial input sockets. The only other facility on the back panel is an IEC fused mains power socket on the right-hand side. This socket is an improvement on the hard wired mains leads that most of the competition still uses.

With so little to examine on the outside of the amplifier casing, I prepared to delve inside to find out what makes the Perreaux EI tick.

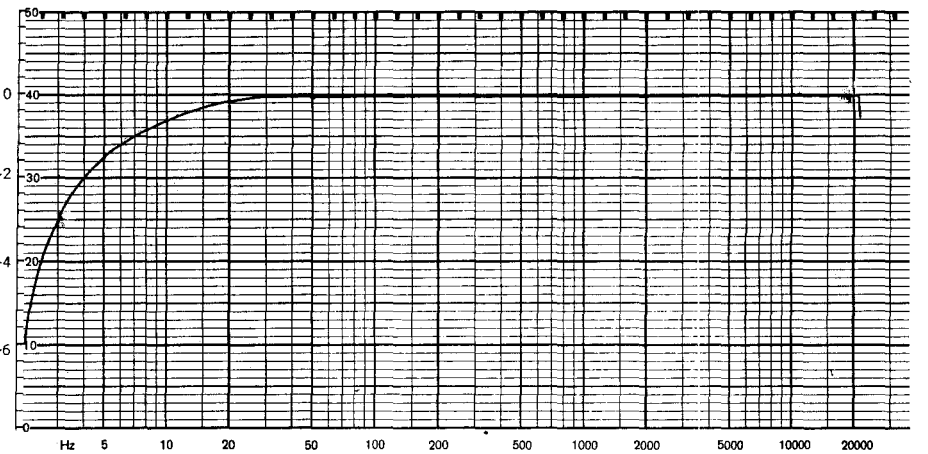
The first thing that caught my eye was the large printed circuit board that reduces the inter-connection wiring to almost nil. The second feature was a torroidal power transformer that provides copious quantities of power without any of the mains leakage problems that tend to be a feature of the normal E-core transformers. All of the components are well selected, but I was surprised at how small the latest generation of electrolytic capacitors have become.

The component count on the board is only marginally less than the previous generation of their 100 watt amplifiers, but it's the performance that counts.

Laboratory test results for the EI were pleasing, for although billed as an 'economy' amplifier, the E1 can easily deliver a genuine 100 watts of continuous power into 8 ohms and happily feel close to 200 watts of continuous power into 4 ohms.

The clipping point using the IHF-A-202 test is 176 watts into 8 ohms and 242 watts into 4 ohms, which can be an awesome amount of power to feed into domestic loudspeakers, even on transients for the most demanding musical passages.

Not surprisingly, the FET output stage provides superb frequency linearity with a geniune 3Hz to 212kHz bandwidth at the 3dB points; this corresponds to 2OHz to 2OkHz at the ±0.2dB points, which really conforms to laboratory class performance.



Measured frequency response 2Hz to 2kHz.

As I discovered, the measured distortion figures at 1 watt for the 100Hz test frequency are a trifle deceptive. Although the printed results show -77dB of THD (total harmonic distortion), at 100Hz, those figures are modified by the leakage of mains frequency harmonics. By contrast, the values at 1kHz and 6.3Hz provide a much more accurate assessment of the amplifier's real THD potential, with total harmonic distortion figures of -100dB below the fundamental. At rated power output (100 watts into 8 ohms) the 100Hz figures are once again modified by the mains leakage harmonic components, but as expected, the total harmonic distortion figures at 1kHz and 6.3kHz are still better than -90dB relative to the fundamental.

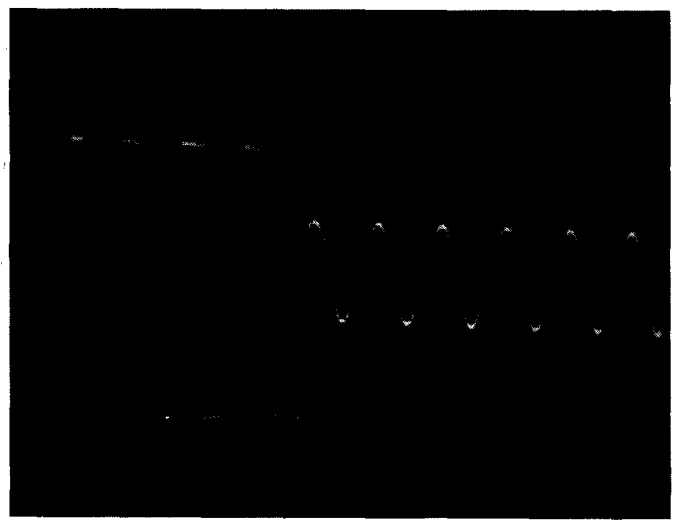
In a similar manner, the IEC High Frequency Total Difference Frequency Distortion figures are a low 0.001% at the half watt level, .008% at 10 watts and still only .037% at the 100 watt level which is pretty good for an 'economy' amplifier.

The hum and noise figures are good, (but not outstanding) being -84dB(A) re 1 watt and absolutely inaudible on my monitor speakers, even with the input level of the pre-amplifier set to maximum gain.

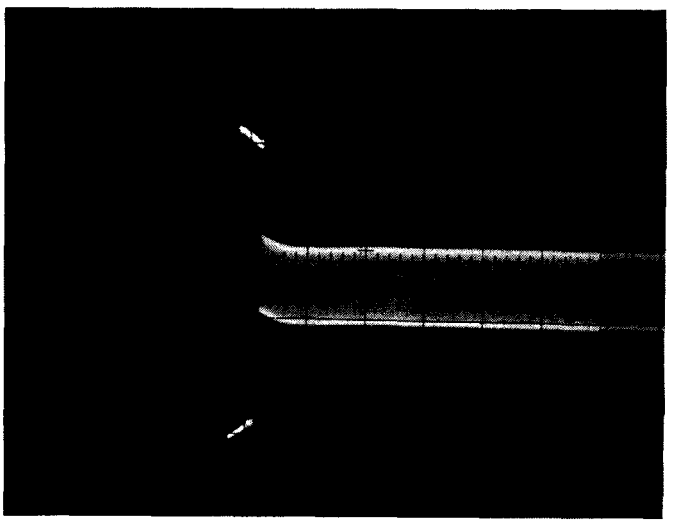
The transient recovery test confirmed that the amplifier is not fussed by short term overloads, although there is a trace of assymetry in the recovery after the overload is removed. The amplifier was also quite happy with our 'Nasty Speaker Load' test, and showed absolutely no signs of instability.

Having passed all of the objective laboratory tests I took the EI amplifier home for the acid test. I wanted to see just how well it would cope with the current generation of monitor speakers and the latest quality discs and records.

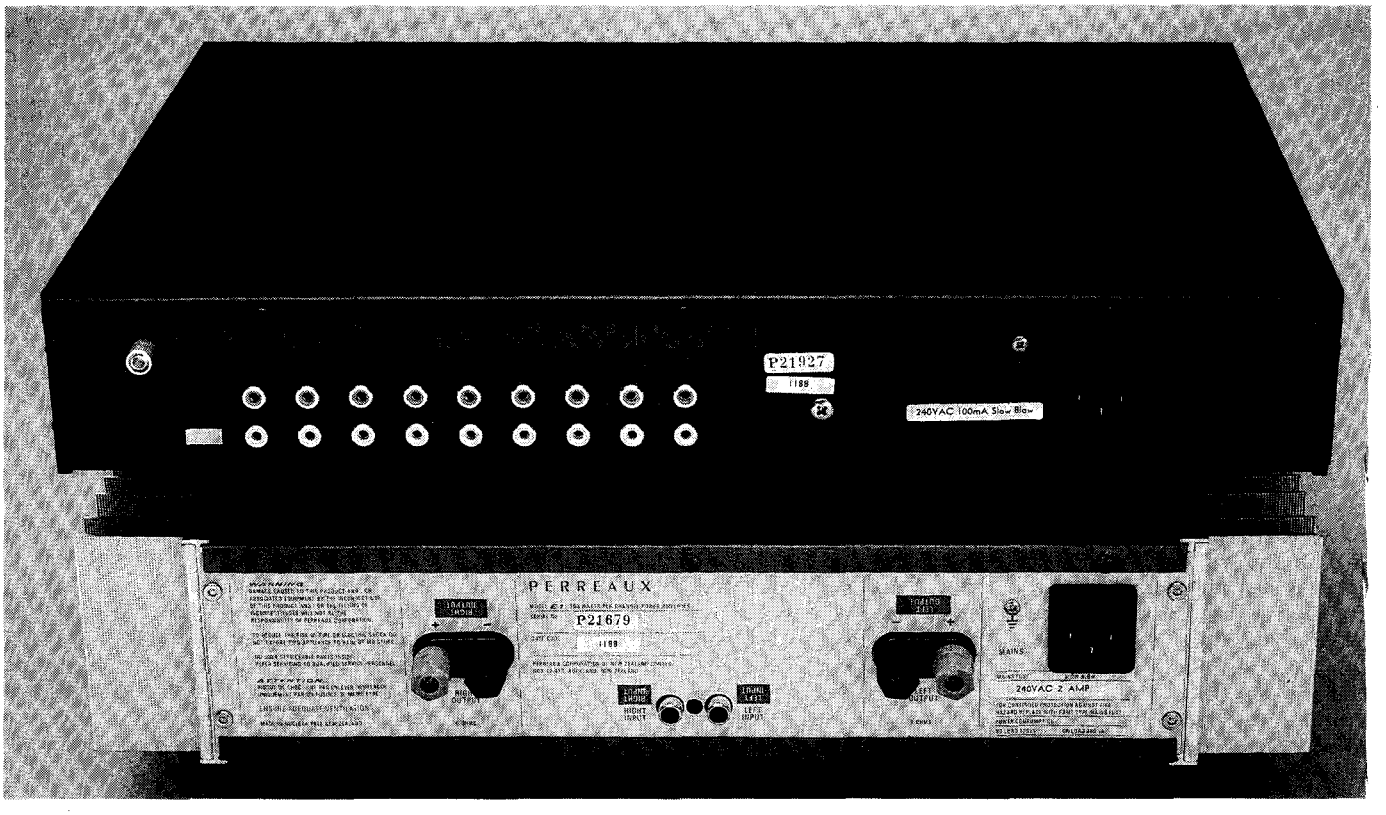
For the subjective evaluation I used a matching Perreaux EP pre-amplifier, which is just about the most straightforward low noise control unit one could possibly use. I chose a Pioneer PD71 CD Player, plus a Sony CDP555

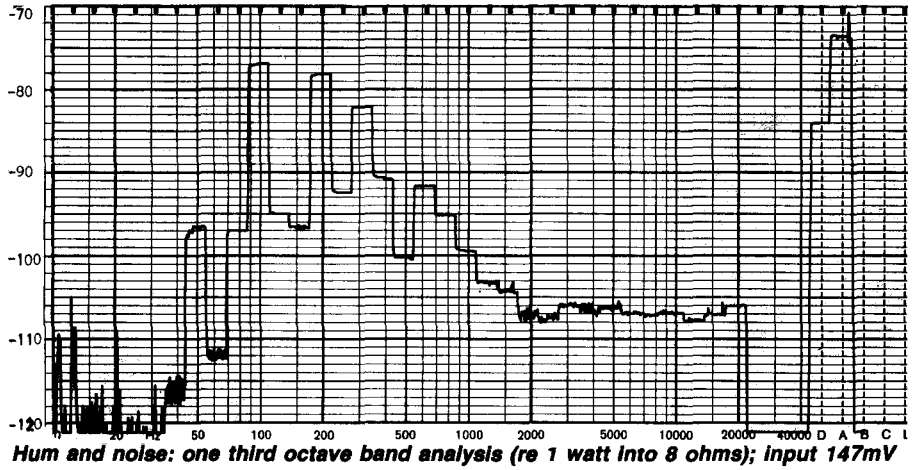


Measured performance of transient overload recovery test (INF-A-202) — 1mS/div.

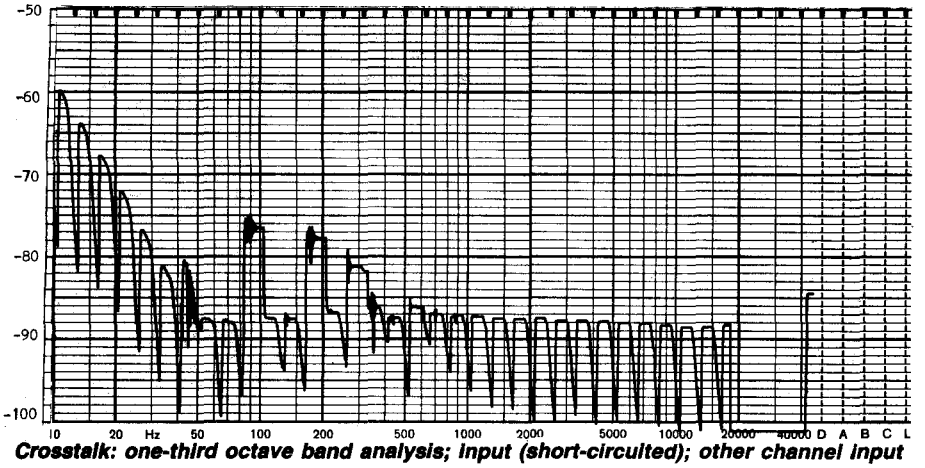


Measured performance of transient overload recovery test (INF-A-202) — 50mS/div.





Hum and noise: one third octave band analysis (re 1 watt into 8 ohms); input 147mV (short-circuited).



Crosstalk: one-third octave band analysis; input (short-circuited); other channel input = 0.5V RMS; sine wave output = 1 watt into 8 ohms.

ESD CD Player for CD inputs.

The outputs were fed respectively to a pair of B & W 801Ms and a pair of Jamo Concert VIIs to assess the audible quality of the amplified output, as well as to find out how much 'real' power I could safely extract.

Improved quality

The quality of CD material now available has certainly improved since the first and second generations I have been using for most of the past seven years. The first two discs I played were provided by the ABC, which has some of the best recorded material that money can buy – the problem being that, until recently, we couldn't buy it! Auntie has finally decided to market its software under the title 'ABC Classics'. The first I have seen is Vivaldi's *The Four Seasons*, with the Tasmanian Symphony Chamber Players (ABC 838904-2). The disc is one of the most delightful renditions of this Vivaldi piece I have heard. The Tasmanian Symphony Chamber Players are relatively unknown outside the confines of the Apple Isle, but with a series of pieces as well played as these, I forecast a great future for what I suspect are the little Isle's sweetest fruit.

The second disc I played was Bruckner's Symphony No. 4 *The Romantic*, with Hubert Sondart conducting the Melbourne Symphony Orchestra (ABC 426425-2). *The Romantic* has proved to be Bruckner's most popular symphony with the public, and the most often performed by Australian orchestras. More significantly, this work

encompasses a true 80dB+ dynamic range for which you need a good amplifier and, I would note, good speakers! This piece has a positively Wagnerian touch with its massed strings and rich bass scoring, and it really put the Perreaux amplifier through its paces.

Next I chose *The Jennifer McGregor Album* (CBS Masterworks 462793-2). If you missed Jennifer in her latest Australian Opera performances in *Lucia di Lammermoor, Le Nozze Di Figaro* or *Mignon*, you missed a breathtaking performance by a wonderful soprano who, I believe, will soon be number one in the world. Jennifer has a delicate figure, a beautiful face and a full bodied voice which is well developed and exquisitely presented. I enjoyed this disc because it contains the pick of her arias with excellent Australian recordings of wonderful music. Much to my family's disappointment, I was able to play the music at the same levels at which I hear them in the third row of the Opera House.

This music, and all the other pieces I played, displayed the benefits that are derived from a good, clean amplifier, without vices, when you want the best from your music.

The Perreaux EI amplifier is a particularly good unit. Inside that simple case lurks a veritable powerhouse. eti

MEASURED PERFORMANCE OF PERREAUX MODEL EI AMPLIFIER
SERIAL NO. P21679

FREQUENCY RESPONSE (-3dB re 1 watt)

Input to Aux = 0.5V	Left			
	less than	3.0 Hz	to	212 kHz
	Right	3.0 Hz	to	213 kHz

SENSITIVITY (for 1 watt in 8 Ohms)

Left	Right
147 mV	147 mV

INPUT IMPEDANCE (at 1kHz):

Left	Right
42k ohms	42k ohms

OUTPUT IMPEDANCE (at 1kHz): 30 milliohms

NOISE & HUM LEVELS (re 1 watt in 8 ohms):

Input 147 mV	Auxiliary	74 dB(Lin)	84 dB(A)

HARMONIC DISTORTION:

At a power of 1 watts into 8.0 ohms

	100Hz	1kHz	6.3kHz
2nd	-87.9	-109.5	-111.4 dB
3rd	-88.9	-114.6	-116.3 dB
4th	-97.0	-	-115.3 dB
5th	-105.8	-	-
T.H.D.	0.014	0.001	0.0009%
= db	-77.1	-100.0	-100.9

At rated power of 100 watts into 8 ohms

	100Hz	1kHz	6.3kHz
2nd	-94.5	-100.0	-101.7 dB
3rd	-104.9	-113.1	-108.6 dB
4th	-105.2	-111.7	-108.3 dB
5th	-110.0	-115.3	-
T.H.D.	0.0057	0.003	0.0026%
= =dB	-84.9	-90.5	-91.7

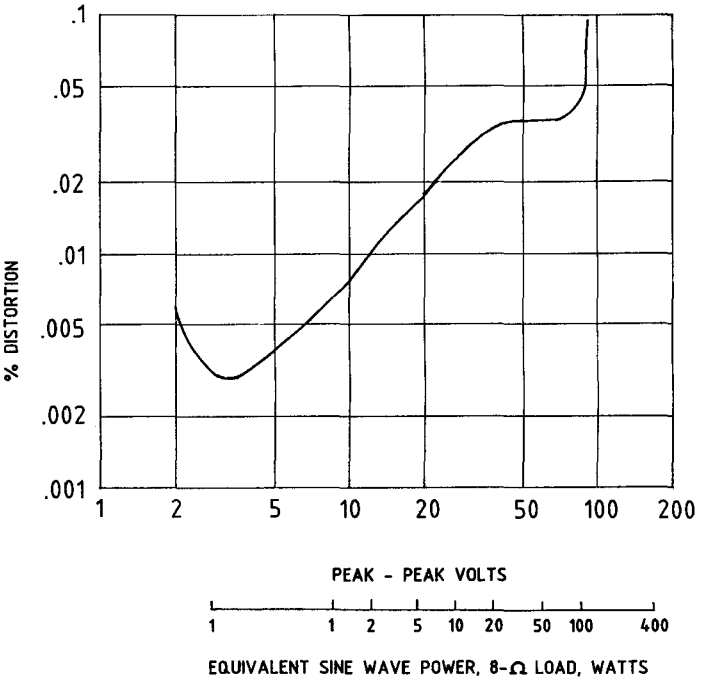
IEC HIGH FREQUENCY TOTAL DIFFERENCE FREQUENCY DISTORTION

8 kHz and 11.95 kHz mixed 1.1

Load	8.0 ohms
At rated power	0.037%
At 1 watt	0.0056%

MAXIMUM OUTPUT POWER AT CLIPPING POINT (IHF-A-202);

	2.0	4.0	8.0 ohms
(20 mS burst repeated at	-	88	106 V p-p
500 mS intervals)		242	176 watts
Dynamic Headroom			
(re 100 watts)		1.8	2.4 dB
(re 160 watts)			



IEC high frequency total difference frequency distortion.

BIGGER AND BRIGHTER THAN EVER

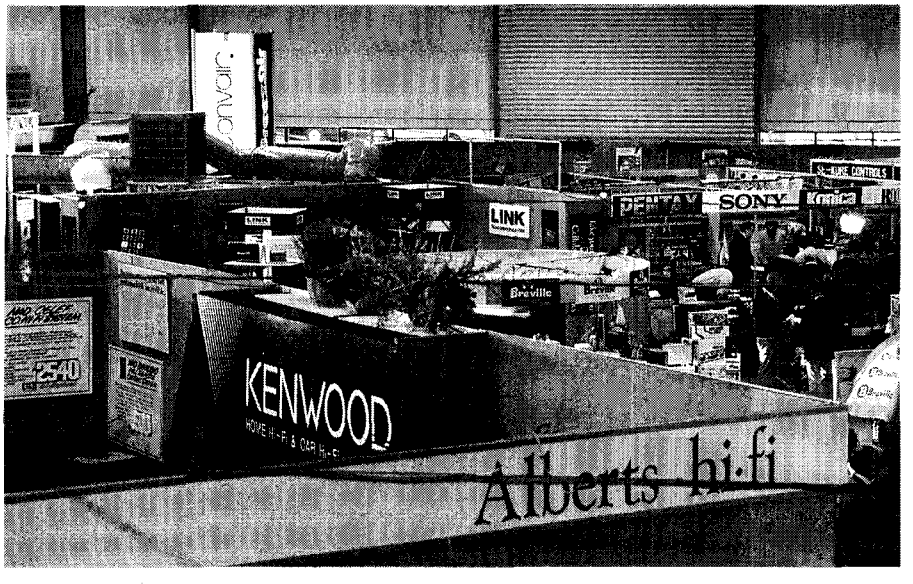
The Perth Electronics Show was held for the eleventh time in Perth at the end of August. Ex-editor Jon Fairall was there, and had fun despite gloomy predictions.

The Perth Electronics Show is the nearest thing Australia has to an international consumer electronics show. Although show organisers worry about the centralising of buying decisions in Sydney and Melbourne and the creation of big buying chains in the industry, as well as falling attendance (down to 40,000 this year) Perth is still the only viable consumer electronics show in the country.

Perth this year suffered a number of problems. The pilot strike effectively isolated the West, preventing senior executives travelling to Perth. The technology on display was pretty much a rerun of last year's, and the economic forecasters predict a squeeze on the disposable dollar in the near future.

Even so, the majority of punters still looked contented as they peered, prodded and poked at a sea of gadgets - albeit the show wasn't quite up to the standard of previous years.

Retailers warn they must have new technologies to revive flagging consumer interest. With TV and VCR at saturation levels, and Compact Disc achieving sizeable penetration, the industry needs something to tempt consumers.



Digital Audio Tape (DAT) recorders should be on line by now, but DAT technology has been stalled due to opposition from the record companies. The only bright spot on the horizon is recordable compact disc, which is not expected to hit the shops for several years yet.

However, one exciting new development is the advent of solid state cameras. Canon introduced a Still Video Recorder at the show, basically a conventional camera that records an image magnetically on a disc rather than on film. The two inch, removable disc stores 50 images.

Images can be played back directly from the camera into a TV or from a special player. A printer unit demonstrated at the show will be available later in the year. Canon's Bernard Malone said the system would be on sale for about $1400.

The system uses 320 lines on a TV screen so that the quality of the images is good enough for mixing with computer graphics but not as good as broadcast quality video. Thus, in terms of quality, still video poses no threat to conventional film cameras. However, it does have two advantages. One is that the image information can be sent straight down a telephone line with great application in news gathering. A second advantage is that the image can be easily stored in a computer via a digitiser.

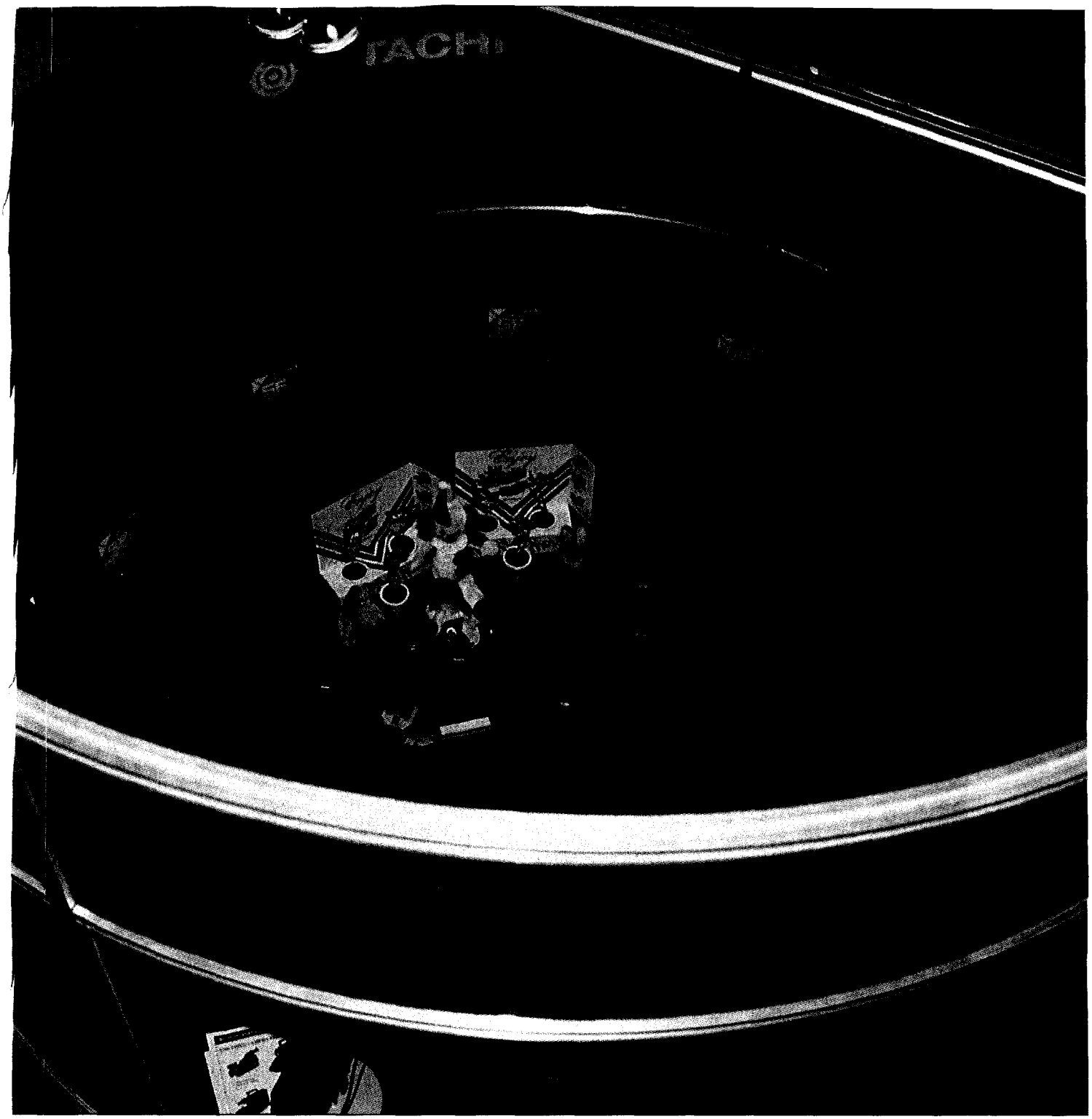
Nigel Headlam, a Perth Commodore computer dealer, demonstrated a graphics/database package at the show that allows one to sort and recall thousands of images easily. He used the Canon camera to obtain an image,, a digitiser to enter it into the computer's memory, the graphics program to manipulate the image and the database to store it.

Another trend visible at the show was that the technologies enabling very big and very small TV displays are finally giving satisfactory results, although prices are still too high for dealers to move really significant numbers.

For instance, Hitachi showed off its latest 42 inch TV. It's a rear projection system. This has the conventional three R, G and B tubes of a projection TV system, but they shine onto the back of the screen. To make a neat package, the whole thing, tubes, screen and electronics, are all packaged in one box. Such systems have been around for years, but the display has been dim, and one needed to be right in front of it to see it. Now, Hitachi has solved these problems. Its new machine has a bright screen, and you can sit anywhere within a 110 degree arc.

Apparently, the screen geometry has been altered to disperse the light through a wide angle, the transmission of light through the screen has been improved and the power of the projector guns has been pumped up.

At the other extreme, Sony has its Video Walkman on display. This incorporates a 3.5 inch LCD screen, an 8mm VCR and a TV tuner in a package small enough to fit in a shoulder bag. Screen brightness and contrast



have both been increased to give a practical display.

There were a number of interesting exhibitors, apart from all the usual ones. Goldstar and Samsung, the Korean mavericks, were out in force. By and large, their product is cheaper than comparable Japanese product, and just as good. It's all very me-too, however. In contrast, consider Hinari. This oriental sounding brand name actually belongs to a rather smart Scots lad called Brian Palmer, who runs a design team at home, manufacturing operations in South East Asia and marketing in Hong Kong.

They have repackaged the CD player, for instance, as a flat bed unit standing on a pedestal, complete with graphic equaliser, radio and twin cassette decks in one box. It will sell for about $1000 when it is released later in the year. According to Phil Blint, Hinari's Hong Kong based sales director, there are plans to release an alarm clock TV, a home entertainment centre with full TV, video and hi-fi functions and a TV remote control unit with a synthetic voice in it.

Hi-fi at the show continued much of a muchness with most manufacturers rearranging the knobs on the front panel. A couple of things caught my eye. Yamaha has introduced its AST speakers, which combine small size with exceptional bass performance. Several surround sound amplifiers, notably from Pioneer and NEC, were also on display, and continue to impress. A new type of Jamo speaker from Scan Audio, with internally resonant bass drivers, sounds very pleasant, and as usual, Bose wins the prize for marketing with its pneumatically driven show for the System X. More maintenance would be a help though.

It's obvious that, whatever the gloom merchants might be saying, there is still plenty of room for selling toys to the boys. Also, it will be a while before anyone else can stage a show like the Perth Electronics Show.

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