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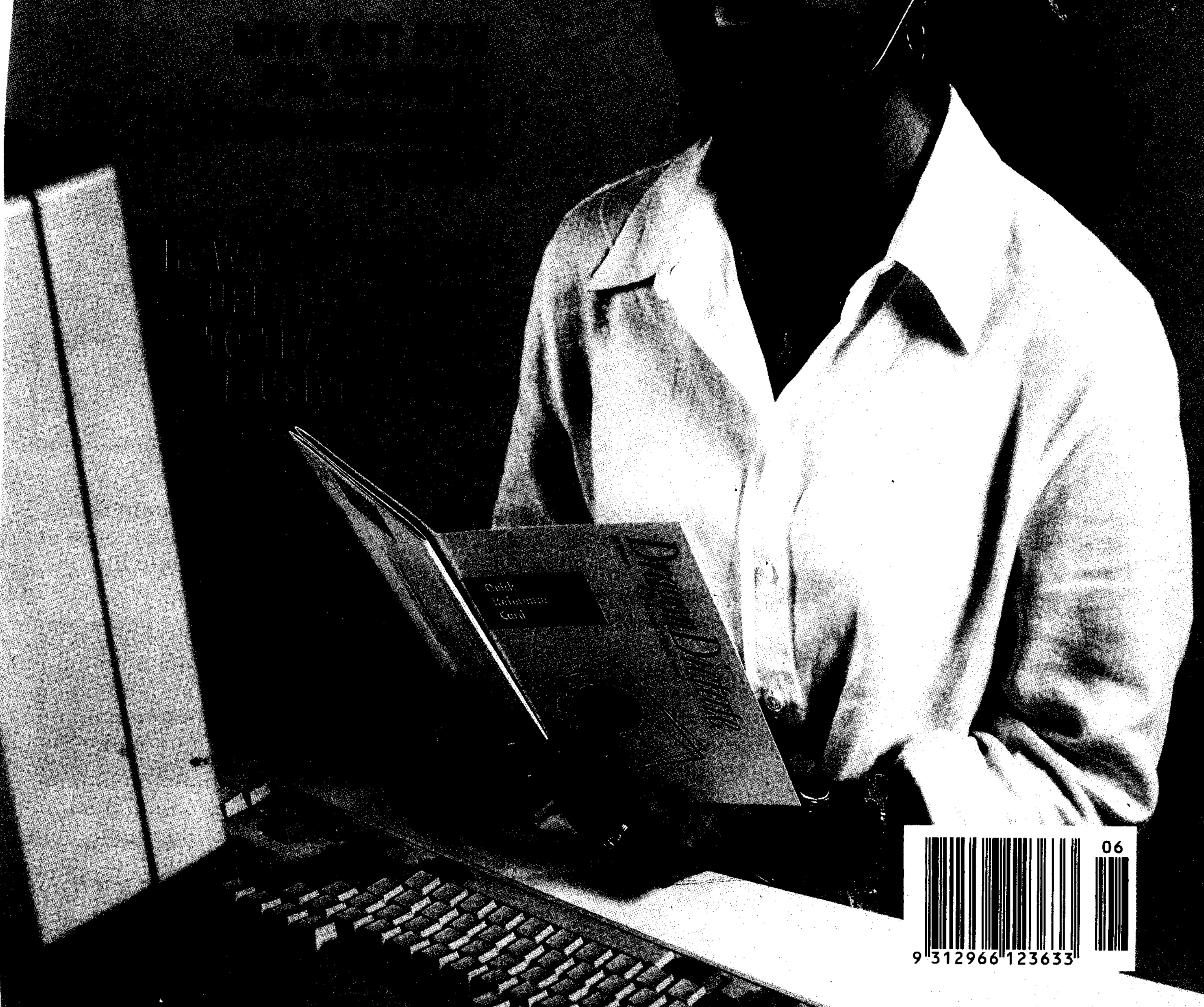

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Electronics AUSTRALIA Professional Electronics & ETI

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

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See in the (almost) dark!

Graham Cattley has been evaluating the new Apple Nighteyes night viewer, which uses 'starlight' technology. His review starts on page 16. You also have the chance to win one for yourself — for details see page 19.

Building our RF oscillator

As well as being low in cost, our new RF Test Oscillator is particularly easy to build as virtually all of the internal wiring is performed by two PCBs which connect directly together via terminal pins. Full details on its construction and setting up are in the article starting on page 60...

On the cover

Federal advertising production coordinator Magdaline Youssef tries out the new DragonDictate for Windows Version 2.0, which allows PC users to dictate and control Windows applications — using very close to normal continuous speech. It's reviewed this month, starting on page 116.
(Photo by Phil Aynsley.)

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LETTERS TO THE EDITOR

Software, or data?

Please excuse me for being pedantic but as a reader of EA for some years now, I can no longer resist...

A number of your excellent contributors on audio gear, most prominently Louis Challis, refer to the contents of their audio CDs, digital audio tapes etc., as 'software'. Surely it is *data*?

I think the term software is more appropriately used for the algorithms and code that process raw data, to produce desired outputs. I would liken the contents of an audio CD to a text document, with the CD player being the 'word processor' which manipulates and 'displays' the CD contents. In this analogy, most people would agree the text document is data and the word processor is the software.

By the way, I don't intend this as a significant criticism of Mr Challis or others. The content of their columns is generally very interesting reading and first class.

Glenn Pure,
Kambah, ACT

Point taken, Glenn. Strictly speaking I'm sure you're right, although the term 'software' seems to have acquired a broader meaning, to include data as well as programs. I guess that's because inside the systems concerned, both are simply patterns of bits. It's all a matter of how they're interpreted and used, isn't it?

Cache checker update

Following your editorial Jan 96 regarding the cache ram scare, I downloaded the CACHCHK2.ZIP program from your BBS as you suggested. However on running the program I got results I didn't really believe.

I sent Mr van Tassle a copy of the program output and the information I had about my motherboard, a Micronics Pentium 75MHz unit in an Osborne computer. He has now replied, basically advising that CACHCHK2.ZIP has bugs in it. He suggested that I download CACHCHK4.ZIP and the problems should be solved.

I am writing this letter to you because on April 4, your BBS still had CACHCHK2.ZIP in its download file directory. The problem free version CACHCHK4.ZIP is available from the Internet at the following address, using file transfer protocol:

ftp://ftp.coast.net/SimTel/msdos/sysinfo/cachchk4.zip

I am sure I am not the only person that would have encountered problems with version 2, so you may consider replacing the version on your BBS with the new version.

Many thanks for all the effort in producing *EA*. I am a long time purchaser and in the recent years, a subscriber to this informative mag.

Barry O'Connor,
Ballina, NSW

Thanks for the update, Barry. As soon as your message arrived, we obtained a copy of the revised version of Mr van Tassle's program from the ftp address you supplied, and it's already on our BBS instead of the earlier version.

Dr Ernest Benson

Having recently read the very fine articles on Dr Ernest Benson in the January and February issues of your magazine, I felt the urge to write one or two comments.

Firstly, I found them very enjoyable as I knew Ernie for quite a few years. One of our highlights was the system in the old Music Hall Restaurant. The owner, George Miller, talked me into 'building an amplifier" for him as previous systems were not satisfactory. Ernie and I designed the new system using three five-foot tapered columns plus woofers, for a three-channel stereo set up.

I made five amplifiers rather than one, and sub-contracted AWA to make the control console and power supply. (John Hooke had been a student of mine). All in three weeks!

Proscenium shotgun microphones plus foot-light short ones were used. On opening night of *The Specter Of Wickham Manor*, some of the media guests asked George "We noticed the tip of a few microphones — when do you use them?" I think we had only 2 or 3dB variation over the whole theatre and excellent directivity.

However, a couple of points in the second article are not correct. The sound system in St Andrews cathedral was done by Ernie and myself, as was the Bondi Church In The Market Place; AWA had nothing to do with it. Also, after retiring from Sydney University I, plus manager wife formed Murray Amplifiers P/L and we won the contract for the new Parliament House. Again AWA had no part in the audio.

I sub-contracted Ernie for help with the speaker design and placement. (If one includes the rear connector units there were five and half thousand items.)

As a point of interest, when finalising column design we sat facing the column about three metres away and if we could hear the speaker it was not passed.

It would be very good if the record on Ernie could be put straight.

Cyril Murray,
Ninderry, Qld.

RF radiation concerns

I was recently given a copy of *Electronics Australia* (Sept 1995) and may I say how refreshing it was to read your editorial on the radio frequency radiation health issue highlighted in the ABC *Four Corners* programme.

Our Electromagnetic Field Radiation (EMF) Committee members are concerned and committed people endeavouring to make available to the public information on the issue of electromagnetic field (EMF) exposure and health. Given the state of the scientific research we see the EMF health issue as yet another environmental factor demanding serious attention, long overdue.

There are an increasing number of people reporting that continuous or repeated experience from exposure to EMFs has convinced them that their health and wellbeing is compromised by such exposure. Often anecdotal evidence correlates with scientific research findings, again reinforcing the conviction that artificial EMFs from all sources are biological stressors. The trite remark of 'not proven' made by authorities and those with vested interests regarding EMF causing adverse health effects, give no comfort at all.

One prominent researcher in the USA, Dr William Ross Adey, has strongly criticised Governments and industry for the lack of attention to the EMF health issue. We are in complete agreement with his criticism.

Thank you for your intelligent and thoughtful comment. We believe readers will be the richer for the editorial.

Betty Venables, Research Officer
(Coordinator EMF Committee)
Sutherland Shire Environment Centre
Sutherland, NSW. ❖

EDITORIAL VIEWPOINT

The importance of servicing information for EM compatibility

As we reported in the October 1995 issue, Australia's Spectrum Management Authority last year set up the EMC Framework, a system of regulations designed to begin managing the growing problems of electromagnetic compatibility. This is in line with similar moves in many other countries.

The basic idea of the EMC Framework is that firms marketing new electrical and electronic products are being required to have them tested for compliance with various standards for both EMI radiation and susceptibility to interference from radiation, before being offered for sale. And this is fine, as far as it goes — but of course it doesn't address the matter of compliance during the working life of the products...

With this in mind I was very interested to see a copy of a letter sent recently to the SMA, commenting on the EMC Framework, by Jim Lawler. Many readers of *EA* would know Mr Lawler as a regular contributor to the magazine; however currently he's also Federal President of TETIA, The Electronic Technicians' Institute of Australia, and his letter was written in this capacity.

In the letter, Mr Lawler generally supported the EMC Framework. However he also pointed out the need to ensure that equipment was maintained properly during its working life, so that it *continued* to conform to the required level of electromagnetic compatibility. And he drew the SMA's attention to an ongoing obstacle in this regard: the restricted availability (or at times non-availability) of adequate servicing information, from many manufacturers and distributors.

This is a situation that I've complained about myself, on various occasions. Quite a few manufacturers and importers either refuse to provide service manuals, circuit diagrams, adjustment information (and sometimes even the correct replacement parts) to anyone other than their own appointed 'service agents'; others set arbitrary price levels, below which products are deemed 'disposable' and not worth servicing — so they refuse to make service information available at all. Clearly these sorts of policies not only make it much harder than it should be for the customer to keep the equipment working at all, but as Jim Lawler points out they are also going to make it even harder to ensure that it continues to comply with the EMC Framework...

I know I've been at odds with TETIA at various times in the past, but this is one area where I believe they're quite right. If you think so too, can I suggest that you help both them and yourself (in the long run) by writing a letter supporting the need for adequate servicing information, to the Manager, Radiocommunications Standards, Spectrum Management Authority, PO Box 78, Belconnen ACT 2616.

By the way, during a phone discussion with Jim Lawler I gather that TETIA is attempting to gather documentary evidence on some of the above restrictive practices by manufacturers and distributors, regarding servicing information, to submit to the SMA. So if you have such evidence, please send it to TETIA's Tasmanian Division, at 16 Adina Street, Geilston Bay 7015.

Jim Rowe

BATTERY BLUES, & NEW TECHNOLOGY

Louis Challis decided to devote this month's column to a review of new battery technology, and initially it was going to be based on information he found at the recent Las Vegas Consumer Electronics Show. However then he had a very embarrassing experience when some nickel-cadmium batteries let him down during a critical recording session — providing a much more practical way to introduce this topic. As most of us are using more batteries than ever, nowadays, it makes very relevant reading...

Two weeks ago, I was invited to produce an archival recording of the Australian Brandenburg Orchestra's 'Archibald Concert' at the Art Gallery of NSW. On the opening night I had been entranced by the 'Musical Portraits from the Baroque' which coincided with the Archibald Prize Exhibition.

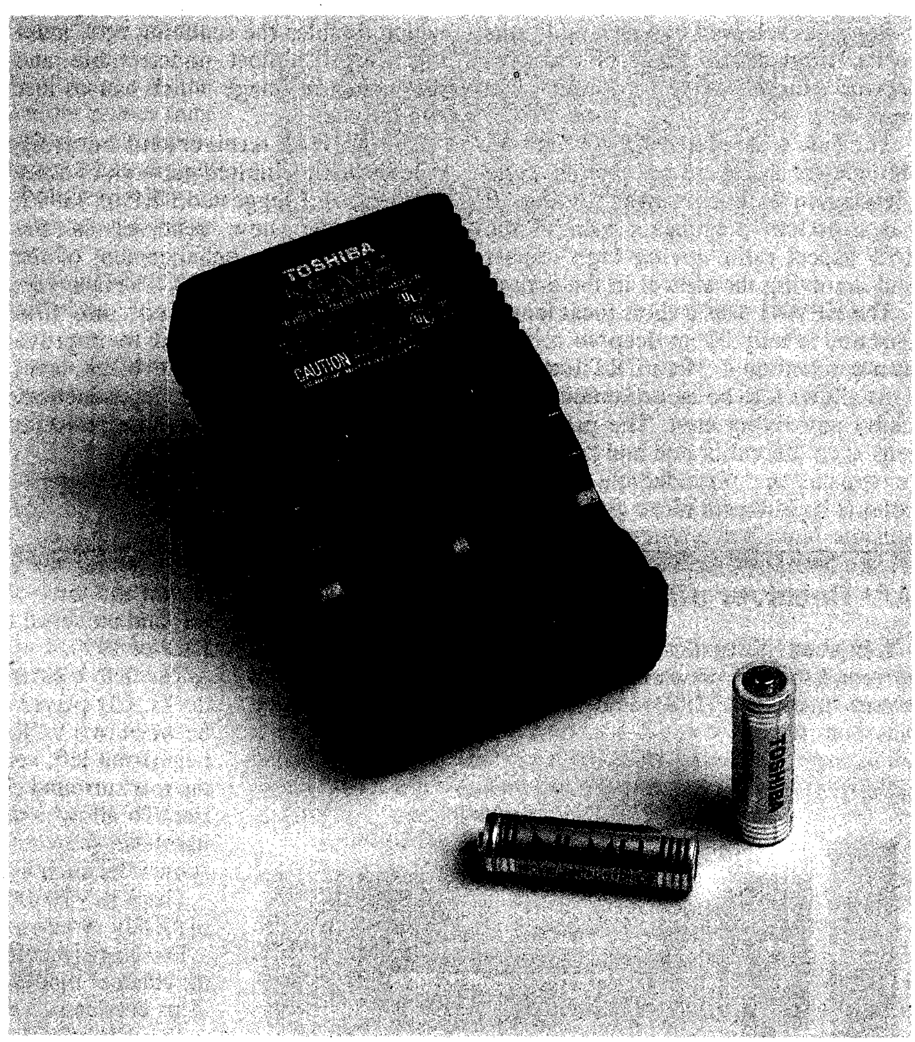
Before the audience arrived, I quietly set up two laboratory microphones on stands, supplemented by a new pair of battery operated microphone preamplifier power supplies. I decided to use my Sony PCM 2000 two channel DAT recorder, as it provides exceptional linearity over the frequency range 2Hz to 22kHz. I had already convinced myself that battery power would be preferable to an external mains supply, as that would preclude earth loop problems. I had already charged up three nickel-cadmium batteries (Sony type NP-1As), in the belief that it would only be necessary to change one battery at the interval.

On the basis of my memories of the first concert I attended, I estimated that the typical average sound pressure level would be close to 94dB at the two microphone positions. With clear memories of how loud the trumpet had been on the first night, I felt that I would need at least 16dB of 'headroom' to accommodate the trumpeter's peaks. Accordingly, I adjusted the OdB peak recording level to conform to a level of 118dB, and patiently waited for the concert to start.

Now the concert was truly outstanding. The acoustical characteristics of the gallery were equally outstanding, and I was gratified to find that the average peak levels during the first half of the concert were 2dB less than I had estimated. Everything appeared to be conforming to plan and with the rest of the audience, I was quietly enjoying the performance.

The interval came and went, and a few minutes into the second half of the concert, I watched in utter disbelief as the low battery warning signal suddenly appeared on the DAT's LCD display. Before I even had time to respond, the recorder had stopped DEAD!

With my heart in my mouth, I quickly changed the battery. But at least 40 seconds of critical recording was lost, and



In the USA, Toshiba has released this 10-hour charger to suit its new AA size nickel-metal hydride batteries. With an internal microcontroller, the charger plugs straight into a wall socket.

my 'archival tape recording' had suffered an embarrassing and irretrievable loss of material.

As the concert continued I sat there with a red face. I too had been caught out by one of the nasty scourges of modern electronics. Yes, I was smarting from a severe case of what I call the 'battery blues'.

As it happens, planning for this article was well in advance at that time. But I had planned an entirely different start, intending to describe the Energiser PR release at the recent Winter CES in Las Vegas. But heck! — *they* didn't even answer my last two faxes, so I'll ignore the new Energiser batteries and their battery packs and look instead at the firms who are prepared to do something constructive, in solving battery problems.

Batteries crucial

Virtually everybody I know now uses one or more forms of batteries on a day by day basis. But most users give scant thought to what they are, how they work or the crucial nature of their functionality and performance.

The batteries most commonly found in your house are likely to be zinc-carbon batteries. They are slowly, but systematically, being replaced by manganese-alkaline batteries in torches, toys and in remote controls for TV sets, VCRs and hi-fi's. Both of those batteries are described as 'primary batteries', because they are not rechargeable. Rechargeable batteries are in contrast described as 'secondary batteries', the most common examples of which have long been nickel-cadmium batteries.

Now nickel-cadmium (NiCad) batteries were originally developed as traction batteries, more than 50 years ago. During the latter part of this century they became the preferred secondary battery for most portable electronic applications. NiCad batteries have some very pertinent attributes, the most significant of which is their ability to provide high discharge current capacity, coupled with a relatively constant output supply voltage.

Now in most applications, NiCad cells hold an almost constant voltage throughout most of the discharge period. As a result, they are used in such diverse applications as portable electric drills of the kind commonly used on building sites, as well as for powering most portable music systems.

A well made nickel-cadmium battery has low internal resistance, and is thus well suited to high current or pulse current discharges. Under controlled conditions they are also capable of being recharged at high rates, and they are designed to operate over a very wide temperature range. They can be overcharged at recommended rates, but only under tightly controlled conditions.

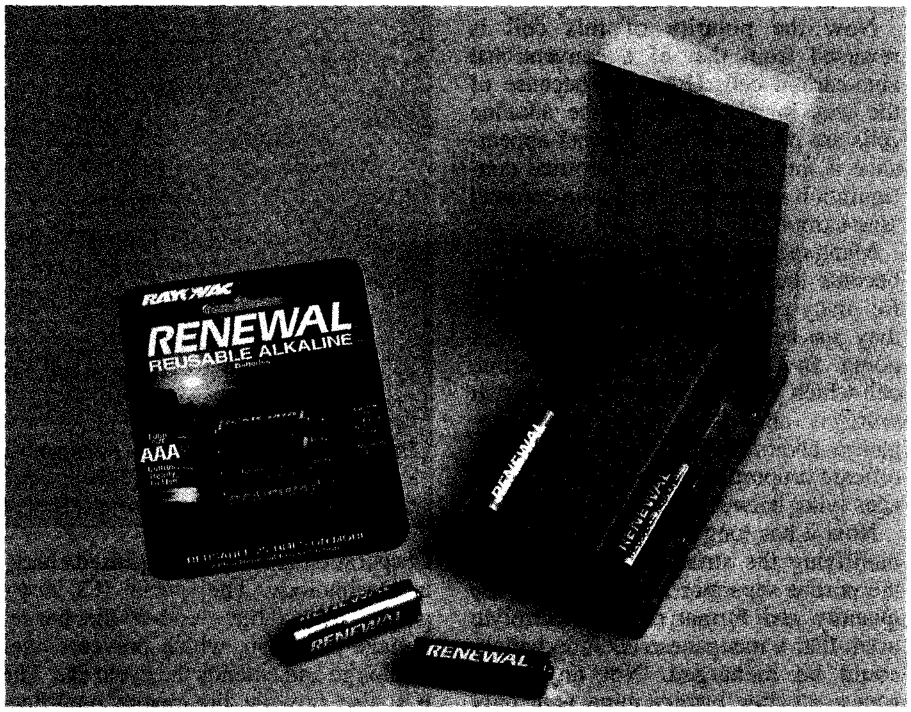
The one design aspect that many manufacturers fail to warn you about is their **memory effect**. If a nickel-cadmium battery is recharged from a partially discharged condition, the battery may 'remember' the last discharge level and will then only accept part of the intended charge. On discharge, such a recalcitrant nickel-cadmium battery will only deliver a reduced charge, as the recharging process leads to electrode crystallisation in the charged cell. When that happens the battery is incapable of accumulating a full charge.

Some manufacturers recommend that any such batteries should be deeply discharged and then recharged, a number of times. Now that may work well with some batteries — but as I have discovered, not with all.

Some models, or more pointedly, some *brands* of nickel-cadmium batteries seem to be less prone to problems than others. Frankly, I have now formed the view that some manufacturers of these batteries (in particular Matsushita in Japan) have spent more time and effort in resolving this problem than many of their competitors. Based on my observations, Matsushita's NiCad designs are less prone to memory effects, as a result of what appears to be superior manufacturing technology.

New technologies

Over the last decade, the major consumer electronics firms in the USA, Europe and Japan have directed their research teams to the development of new and superior batteries. Their goal has been development of secondary batteries with higher energy density, lower weight, and where possible, flat profiles so that they would be suitable for computers. They have also aimed to achieve minimal (or no) risk of causing explosions, and a positive freedom from any trace of 'memory effect'.



Wisconsin-based Rayovac is marketing its new 'Renewal' rechargeable alkaline cells. The matching recharger uses a special IC developed by Benchmarq, which uses a pulse charging technique.

Now that composite quest may sound a trifle optimistic, but as you read on you will find that there have been some outstanding developments. If you're not already aware of these, it's probably high time you were.

But before examining those developments, it is appropriate that we examine some of the basics on which the new battery technology has been based.

Manganese-alkalines

Manganese-alkaline or 'alkaline' batteries are currently one of the most attractive sources of energy for portable equipment. They offer about three times the energy density of nickel-cadmium batteries, but as normally constructed are useable once only.

Alkaline batteries use a cylindrical depolariser, in contact with a cell container of nickel plated steel. Because of the passivity of the steel, when used in an alkaline electrolyte, there is no chemical reaction between the depolariser and the steel. The depolariser surrounds a cylindrical, granular zinc anode, with the two electrochemical components separated by a porous material.

Now the polarity of this cell is reversed from that of a conventional zinc-carbon cell. However, because of the way in which manganese alkaline cells are packaged, the external appearance is the same and the terminal configuration is the same as a conventional zinc-carbon cell.

Manganese-alkaline cells have become the preferred primary batteries for many portable applications because they just keep on going, and going and going. In fact, unlike the zinc-carbon cell which provides most of its output at voltages above 1.2 volts, the manganese-alkaline battery provides a significant proportion of its output for voltages lying between 0.9 and 1.1 volts.

Now it has long been realised that by modifying the structure and details of the porous separator and modifying the quantity and format of the electrolyte used, that a manganese-alkaline battery could be recharged. Not any manganese-alkaline battery mind you; only those which have been specially designed and constructed to cope with the rigours of a recharging process. However, without an appropriate charger, the recharging operation was potentially dicey — very dicey.

Now at least two manufacturers have released rechargeable manganese-alkaline batteries. The first is the Rayovac Corporation of Madison, Wisconsin, who are marketing the 'Renewal' brand in the USA. The second is the 'Pure Energy' Company in Canada. Both manufacturers claim that their batteries are rechargeable at least 25 times from the fully discharged state, or more than 100 times if recharged after each partial discharge.

A fundamental requirement for both manufacturers' products is their provision of a special recharger, which is purchased separately. Both firms market rechargers incorporating a purpose-designed 'Rechargeable Alkaline Charger Integrated Circuit'. The recharger ICs used by Rayovac were developed by the Benchmarq Corporation and employ a pulsed charging technology. The special ICs incorporate selectable 'end-of-discharge' voltage detection, which prevents over discharge and extends the cycle life. The ICs also provide pre-charge qualification to identify fault conditions and provide dedicated outputs to individual LEDs, which indicate charge status of each of the four cells in the charger.

Parameter	Test Conditions	Results
Short Circuit	Short Circuit at 20°C	Cell temperature reached 120°C. No fire, no explosion.
Repetitive Over-Charge & forced discharge	Repeated 150% overcharge and overcharge	Cell failed by first over discharge. No fire. No explosion.
High temperature Storage	Storage at 75°C for 48 hours	No leakage. No explosion. No abnormal weight loss.
Overheating	Conducted at 200°C on hot plate.	Venting, releasing of electrolyte & gas above 140°C. No flame and no explosion under 200°C.
Vibration	0.15mm amplitude. Swept from 10-55 Hz over swept @ speed of 1Hz/minute.	No leakage. No explosion. Cell voltages remained stable.
Mechanical Shock	Average acceleration 75 G. Peak acceleration 125-175 G.	No leakage. No explosion. No damage in cell.
Crush Test	4,000 kg. force between steel plates covered with plastic using hydraulic press	Cell temperature increased to 100°C. Leakage of electrolyte, but no fire
Penetration Test	Sharp metal spike of 4mm diameter & 35 mm long	Cell temperature increased to 95°C. Leakage of electrolyte. No fire.

Table 1: An extract of key information on Sony's US-61 rechargeable lithium-ion cells. Both Sony and Toshiba have received exemptions from dangerous goods transport regulations, for their lithium-ion cells.

Now rechargeable manganese-alkaline batteries cost approximately 50% more than the normal primary variety. The chargers, which sell for around $14, plug straight into a power point and accept 1 - 4 batteries at the same time. Whilst a conventional premium AA size manganese-alkaline battery provide a 2300mA/hour charge capacity, the rechargeable version only provide 1400mA/hour capacity.

As the number of recharges increases, this initial capacity is further degraded. After 25 full discharges, the typical capacity drops further to around 600mA/hour, which is on a par with most NiCad batteries.

The most positive attribute of the rechargeable manganese-alkaline battery is that its charge retention is excellent, as it loses less than 20% of its charge after one year's storage. By contrast, a NiCad battery would be 'dead' in less than half that time.

Nickel-metal hydrides

Whilst major American and Canadian battery manufacturers are busy developing rechargeable manganese-alkaline batteries, other manufacturers have been more interested in researching alternative battery technology. The market now demands batteries that can be recharged 300 times and preferably more, without displaying memory problems.

One of the more interesting recent developments is the nickel-metal hydride (NiMH) battery. Initially developed for handicams (handheld video cameras), they soon started replacing NiCad batteries in mobile telephones, as they offered an energy density 50% better than NiCad batteries.

With nominally the same output of 1.2 volts, reasonable compatibility with existing NiCad chargers, a life in excess of 500 recharges and only minimal memory effects, NiMH batteries have revitalised the mobile telephone replacement battery market. The most significant limitation that they exhibit is a relatively rapid self-discharge characteristic, losing approximately half charge in less than a month. They also cost more than NiCad batteries although their selling prices are currently dropping.

Still, when their performance and user-friendly characteristics are compared with those of NiCad batteries, few users would be willing to accept a NiCad in their place. Conventional sized NiMH batteries (AA, C and D) are now being trial marketed by Toshiba in the USA. They are being sold in combination with intelligent microprocessor-based chargers that plug straight into the wall outlets and safely (slowly) recharge a set of batteries in approximately 10 hours.

Whilst I have enjoyed the advantages of NiMH batteries in my cellular telephone for more than two years, I was not oblivious of other exciting research which has aimed at developing superior and safer batteries. Why *safer*, you asked? Well if you accidentally short circuit the terminals of a NiMH battery, the results could range from rather disturbing, to extremely dangerous — so BEWARE!

Lithium-ion batteries

But the most exciting, new and practical battery developments are the lithium-ion batteries, initially developed by Sony.

Sony Energytec, Inc started its research more than 10 years ago, and offered us some pre-production samples around six years ago. I believed their initial PR releases, concerning the imminent availability of their product, and foolishly specified lithium-ion batteries for a new portable vibration monitor which we were then designing. Alas, they couldn't deliver and I found myself in a very embarrassing situation. Six years were to pass before I saw the first Sony 'lithium-ion powered' consumer equipment.

Now there were numerous tricky issues to be resolved during the design and development of the lithium-ion battery. One of the most important considerations was the environmental concern.

When a battery no longer holds its charge, it has to be replaced. Other rechargeable batteries containing lead, mercury or cadmium proved to be extremely toxic. They posed serious and very real dangers to our environment, if not disposed of correctly. If thoughtlessly dumped in land fill, they can lead to rapid toxic contamination of ground water, which would ultimately pollute our water supplies. Even the newer NiMH batteries pose significant dangers in this regard.

As my research revealed, there are two different types of lithium-ion batteries now available. The first was the battery developed by Sony, which uses an anode of lithium-cobalt oxide whilst a carbon based structure is used for the cathode. In contrast Toshiba's lithium-ion battery uses a slightly different lithium oxide design for the anode, but maintains a similar carbon-based structure for the cathode (the negative electrode).

Both manufacturers' batteries interpose an organic liquid electrolyte which contains lithium ions. Sony apparently uses a lithium fluoride, dissolved in propylene carbonate for its electrolyte. Both the electrolyte and the electrodes are thin and extremely light. As a result, lithium-ion batteries are considerably lighter than conventional NiCad or NiMH batteries. This is a critical attribute, as it ensures that they are the preferred batteries in any new application which calls for either low weight or for a dramatic reduction in weight.

Whilst NiCad and NiMH batteries have a 1.2 volt nominal potential per cell, the open circuit voltage of a lithium-ion battery is nominally 3.6V, or as high as 4.1V immediately after recharging. With a terminal voltage as high as that, many simple applications require only 1 or 2 cells. If 12V is nominally required, then four cells would be used.

The energy density of a lithium-ion battery is about twice that of a comparably sized NiCad battery, and is only 12 to 15% less than that of a premium manganese-alkaline battery. With a capacity as high as that, portable laptop computers weighing less than 2kg and miniature video or audio recorders with long life rechargeable batteries become a practical reality. More significantly, with no adverse memory effect and with the promise of up to 1000 life cycles, the initial higher cost is no longer as daunting to either the designer or the purchaser.

Lithium-ion batteries have other more critical attributes, when compared with their competitors. The issue that has captured the imagination, hearts and minds of the powers that be in the USA is the **safety issue**.

Table 1 shows an extract of information on Sony's US-61 lithium-ion rechargeable cells. It appears that Toshiba's newly developed lithium-ion cells, although slightly different, are equally safe. Both manufacturers have confirmed that the US Department of Transport has issued a formal exemption from the dangerous materials regulation affecting the use of lithium-ion batteries in the transportation area (i.e., on aircraft, ships and trains). That exemption was followed by a similar ruling of the International Air Transport Association (IATA), that the lithium-ion batteries would not be classified as dangerous goods.

Whilst Sony, Toshiba, Duracell and Varta are all producing lithium-ion batteries, their use is still currently restricted to new equipment for whose use they have been purpose-designed. However Sony Energytec is about to release a range of single cells which will cater for

(Continued on page 35)

	NOMINAL VOLTAGE	PEAK POWER	RE-CHARGE CYCLES	SELF DIS-CHARGE	CAPACITY (AA SIZE) mAh	ENERGY WH/Kg	DENSITY WH/L
Nickel Cadmium	1.2	High	>200	1%/day	800	55	130
Lead-Acid	2.0	Moderate	200	Moderate	N/A	35	90
Nickel Metal-Hydride	1.2	Moderate	500	4%/day	1,150	70	175
Lithium Ion (C-Li or Li_xCoO_2)	3.6	Low-moderate	>1000	Moderate not stated	380	115	250
Alkaline (Zinc-MNO_2)	1.5	Low-moderate	N/A	0.01%/day	2,300	130	300
Rechargeable manganese alkaline	1.5	Low-moderate	>25	0.01%/day	1400	80	220

Comparing power packages

One way of comparing old and new battery technology is on the basis of their energy densities, on the basis of either weight (watt-hours per kg) or volume (watt-hours per litre). As all of these batteries are currently available in AA size, the accompanying chart compares their energy capacities — i.e., how long a given current can be generated before the cell is effectively dead. This is expressed in milliampere-hours (mAh). Nominal voltages are also listed for the five rechargeable (secondary) batteries and for one primary (single use) battery.

Hands-on Review of the

APPLE NIGHTEYES NIGHT VISION SCOPE

The Apple Nighteyes, recently released by Dick Smith Electronics, is perhaps the first professional night vision imaging system made available to the Australian public. Taking advantage of 'starlight technology', this compact device has many applications, including bird and wildlife watching, security, astronomy, etc. Manufactured in Russia by Zenit, who are renowned for their high quality photographic lenses, the Nighteyes ranks as an instrument of superior quality and construction.

by GRAHAM CATTLEY

Go outside on a dark and moonless night, and you'll soon see the benefits of being able to see in the dark. The use of a torch to find your way around is all very well, but the bright light tends to dazzle you and scare off any wildlife or nefarious humans....

The Nighteyes night vision scope changes all that with its ability to amplify light by a factor of over 10,000. Most night vision scopes with this sort of sensitivity employ what is known as 'starlight technology', and can often detect objects with light intensities of as little as 0.001 lux. Compare this with direct sunlight, at over 100,000 lux, and you can appreciate the sort of light levels that we are talking about.

(The SI unit of light intensity is the lux, which is equal to one lumen per square metre, and a lumen is equal to the intensity of one candela at one metre...)

Compact, but solid

Measuring a slim 225 x 95 x 80mm, the Apple Nighteyes looks very much like a small camcorder, and the first thing you notice about it is its weight. At a tad over 1.3kg, the Nighteyes has the reassuring heft of a high quality optical instrument.

About a third of this weight is in the 100mm f/1.5 lens mounted on the front of the unit, giving a narrow angular field of view of a quoted 9.7°, and a magnification of 3.8 times. The lens has the usual aperture and focus adjustments, while an adjustable +/-4 dioptre eyepiece allows you to focus clearly on the displayed image.

Easily held with one hand, the Nighteyes' outer case has only one control — the power switch — and is contoured to fit either hand, making it very easy to pick up and use. The unit is supplied in a handy padded nylon carry case, and comes complete with a clip-on IR illuminator, lens caps and even batteries.

See in the dark!

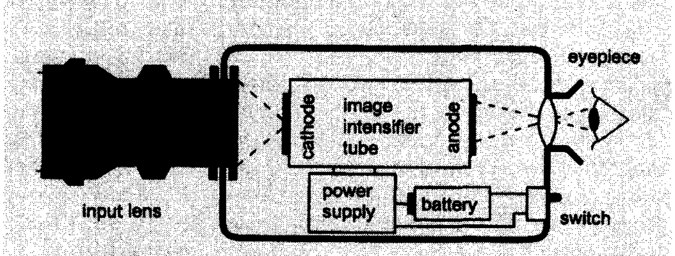
Using the Nighteyes is as simple as picking it up and pressing the small rubber on/off switch conveniently positioned next to the eyepiece. One important note that is mentioned in the Nighteyes' instruction booklet is that the device can be damaged if operated in daylight, as the image intensifier tube can be overloaded if exposed in even a normally lighted room. It is for this reason that a slightly modified lens cap is supplied by Dick Smith Electronics.

This cap has a small 3mm hole drilled in the centre of it, and it can be used to restrict the amount of light entering the scope. With this cap in place, it is possible to run the Nighteyes in normal room lighting without fear of damaging anything. In the dark, however, the cap can be removed, allowing you to 'turn night into day'.

Looking through the eyepiece reveals the world in a somewhat eerie green glow, due to the type of phosphor used in the imaging tube itself — human eyes are most sensitive to light in the green part of the spectrum, so a phosphor of this colour is most suited to this type of application.

Using the Nighteyes to look around a darkened room, I found that I could see quite clearly, although the lens supplied was only designed to focus to a minimum of about three metres away. As the Nighteyes accepts standard camera lenses, the existing lens assembly could easily be replaced if there were a need for any close work.

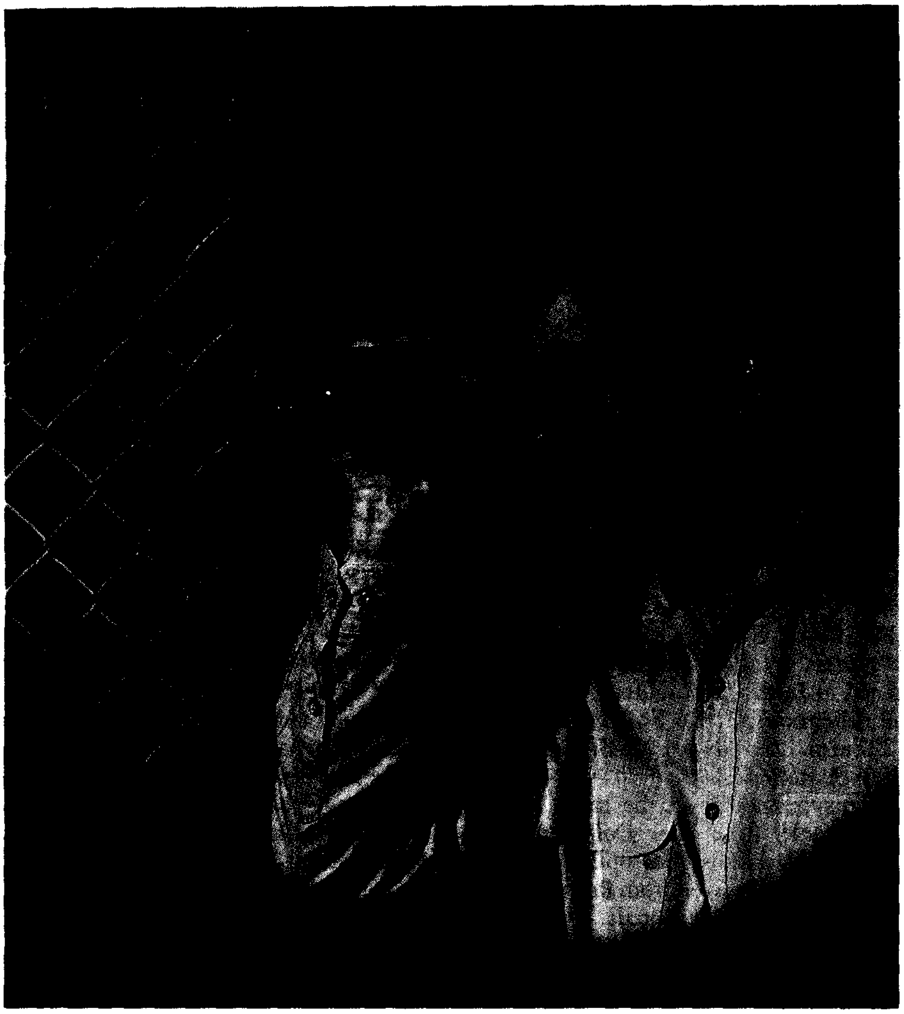
After a while of looking around through the scope, I found that although I could see objects clearly through the Nighteyes, my own eyes had adapted to the low light level in the room and I could see everything almost as well without using the device. Obviously the Nighteyes was designed for use in darker places than could be obtained in the somewhat urban environment I was in.



This diagram shows the internal components of a night viewer.

Borrowing the Nighteyes for a weekend, I decided to take it with me to a relative's house down on the south coast. This was a good place to try it out, because at night the area gets *really* dark. Being so far away from city lights meant that the only light around was that from the new Moon and the usual sea of stars.

This was obviously the ideal environ-



ment for the Nighteyes. When I tried it outside that night, I found that the vague shadowy forms of shrubs and trees sprang into life, giving me a whole new world to explore. (In green.)

Venturing out a bit further, I discovered that the main advantage of using the Nighteyes to navigate — over using a torch to light the way — was that my eyes remained dark-adapted and it was practical to change from the Nighteyes to unassisted normal vision in the brighter areas. A slight problem here was that I couldn't use the Nighteyes while walking around, due to its narrow field of view; a little like using a pair of binoculars. This could, of course, be remedied by substituting a standard wide angle lens.

One interesting thing about using Nighteyes was that while pressing the on/off button caused the imaging tube viewing screen to light up as expected, releasing the button didn't seem to turn it off. It seems that pressing the button starts a DC-DC voltage converter, charging a high voltage capacitor within the viewer itself. This in turn powers the imaging tube, which requires approximately 15kV at only a few microamps.

As the tube draws so little current, the stored charge in the capacitor is enough to run the viewer for a good two minutes or so, adding to the expected life of the two penlight batteries that power the device. The user manual quotes a battery life of around eight hours for continuous use, but if you only use the on button to top up the storage capacitor every now and then, you can expect a much longer battery life from the Nighteyes.

How does it work?

All night vision scopes — including the Nighteyes — work on the principle of light amplification. This is usually performed by focusing the weak image to be amplified onto the photocathode on the 'front end' of the image intensifying tube. This end is a thin glass plate, coated on the inside with a chemical film that emits electrons in response to photons hitting it.

Using a high voltage electric field, these electrons are accelerated through a bundle of thousands of parallel microscopic glass tubes, known as a *microchannel plate*, which extends from the cathode to the anode within the tube. Presumably there is a small quantity of a suitable gas in the tubes of the microchannel plate, to allow an avalanching action and consequent electron multiplication.

The end result is that when a resulting larger number of electrons emerge from the ends of each tube to bombard the phosphor coated anode, they produce a pixelated and much brighter view of the original image.

IR illuminator

Of course no night vision imaging system can operate if there is *no* light to amplify, and the Nighteyes is no exception. As the ambient light level falls, so the definition of the imaging tube falls, with the result that the picture gets darker and fuzzier.

Using the Nighteyes in almost total darkness (a closed off windowless room, with the only light entering through a crack under the door), I found that I could make out only the larger more reflective objects in the room, while everything else tended to get lost in the murk. It is in this sort of situation that the semiconductor diode IR illuminator (supplied with the Nighteyes and loosely called a 'laser illuminator') comes in very handy indeed.

Fitting into a standard sized flash shoe on the side of the Nighteyes, the illuminator unit measures only 20 x 80 x 60mm and draws its power directly from the viewer. Powered only when the Nighteyes is switched on, it produces a broad and bright infrared beam that lights up the scene in front of the viewer, giving more than adequate light for clear vision, even in total visual darkness.

Not that you can see the IR light that's produced with the naked eye, of course, as it is too low in the electromagnetic spectrum for human eyes to detect. All that is visible is a dull red glow from the end of the illuminator.

Conclusion

The Apple Nighteyes certainly rates as a professional night vision imaging system, and its quoted retail price of $999 would seem to indicate that the system is aimed more at the professional market, rather than home use. Obviously if you have a need for such a device, you can't go past it in terms of quality, performance and presentation.

Available only from Dick Smith Electronics, the Apple Nighteyes retails for $999 including IR illuminator, and comes with a 12 month full replacement warranty. ❖

NEW BOOKS

Cyberspace re-examined

SILICON SNAKE OIL: Second Thoughts on the Information Highway, by Clifford Stoll. Published by Pan Books (Macmillan), 1996. Soft covers, 198 x 131mm, 247 pages. ISBN 0-330-34442-0. RRP $16.95.

The Internet and World Wide Web are now flavour of the decade, with just about every newspaper and magazine constantly running features on how to 'surf' them. Everyone and their dog is being encouraged to go 'on line', or risk being left behind. But what's the *reality* behind this barrage of hype? Is there no down side to the Net? Do you have to either accept it all without criticism, or eschew it totally and join the neo-Luddite basket weavers? These are the ideas that Cliff Stoll seeks to explore in this very timely new book.

Stoll is an astronomer at the University of Berkeley in California, and like many people in science and engineering he's been using computers and the Net for many years — so he's no Luddite. However he does have serious reservations about some of the less attractive aspects of the multimedia era. Like the way our kids are coming to regard conventional books as 'boring', because they don't provide an 'all singing, all dancing' interactive audiovisual presentation. Or the way people are coming to regard the Net as the fount of all knowledge worth having, when so much of what's there is really very superficial and little more than 'CB via modems'. Or the way our schools and libraries are having to use more and more of their budgets to buy computers and on-line access time, to the detriment of their core activities.

In short, he's become what he describes as 'deeply ambivalent' about many of these developments, and has written this book in an effort to get people thinking seriously about the potential problems.

I found it both absorbing and thought provoking. Mr Stoll writes in a friendly, accessible way, too. I can warmly recommend it, if you're at all interested in considering just where the information highway may be leading us. (J.R.)

Digital primer

DIGITAL CIRCUITS: An Advanced Primer, by P.J. Lesniewski and Dr L.C. Jain. Published by BPB Publications, 1993. Soft cover, 180 x 232mm, 218 pages. ISBN 81-7029-416-9. RRP $22.95.

This is another in the range of low cost books from New Delhi publisher BPB Publications. But unlike previous books I've reviewed from this publisher, the authors are locals, from the University of South Australia.

First up, it's not a book for beginners as, according to the back cover, it has no 'standard fundamental material'. It is described as avoiding excessive repetition and over simplification. The writing style and presentation is clearly aimed at those studying an undergraduate course in Electronics Engineering.

Despite this, its contents appear to be typical of those of a general digital textbook. There are nine chapters in all, beginning with number systems and ending up with memory ICs, A/D and D/A converters. But the text of many chapters is very brief, compressing a lot of concepts into a very small number of pages — often as few as ten.

The main feature of the book is the copious IC data, but its brevity and lack of fundamentals will probably make it unsuitable as a general digital textbook. Certainly it will be useful as a low cost reference, and it presumably suits courses run at the Uni of South Australia.

The review copy came from Jaycar Electronics, and is available from Jaycar stores as Cat. No. BM2491. (P.P.)

SPICE models

SPICE: PRACTICAL DEVICE MODELLING, by Ron Kielkowski. McGraw-Hill Books, 1995. Hard covers, 237 x 158mm, 260 pages, with 3.5" floppy disk. ISBN 0-07-911524-1. RRP $140 (NZ$181.95).

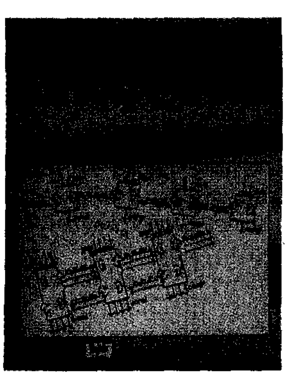
Murphy's law seems to ensure that you don't have the correct model for some key device or component used in the circuit you want to simulate. Some simulators, like Intusoft's IsSpice, come with a set of utilities to help you come up with models for components not in their libraries, using manufacturer's data sheets. There have also been quite a few books on the subject, although most have been so laced with device theory and maths that they've been of use mainly to those with a PhD in solid state physics. This book is designed to be of more practical help to the rest of us...

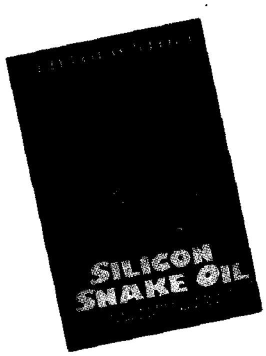
Mr Kielkowski has already produced one very helpful book on simulation, *Inside SPICE: Overcoming the Obstacles of Circuit Simulation*, which I reviewed in our February 1995 issue. This new book certainly seems to continue in the same down-to-earth vein, with the emphasis on developing *practical* component models quickly.

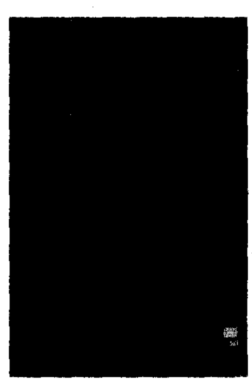
After an initial and very helpful introductory chapter, there are chapters on modelling passive components, diodes and zeners, bipolar transistors, JFETs and power MOSFETs. A set of data appendices explain how to use a collection of modelling utilities provided on an accompanying floppy disk, which also contains RSPICE (a PC-based version of SPICE 2G.6) and RGRAPH (a matching graphical post-processor).

Like Mr Kielkowski's previous book, I can recommend it to anyone who needs to use simulation 'in anger'.

The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (J.R.) ❖







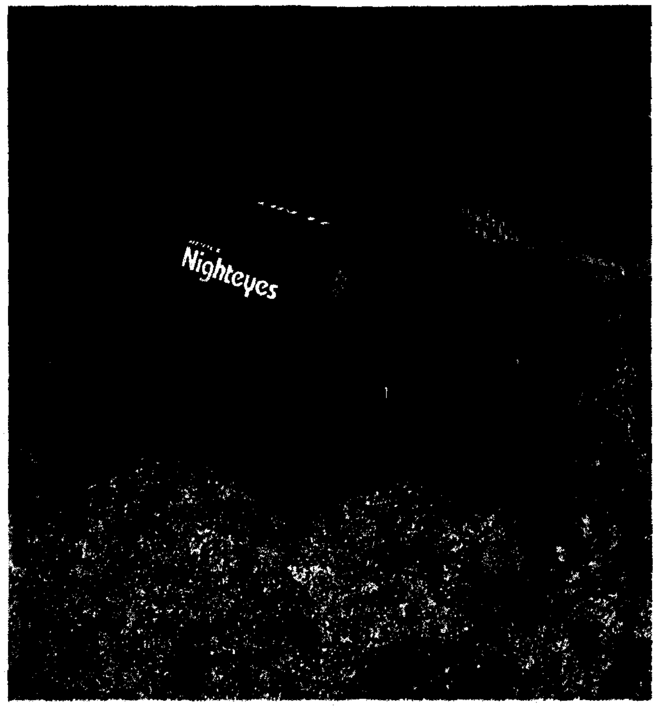
Win an Apple Nighteyes hi-tech night viewer valued at $999!

As a special offer to *Electronics Australia* readers, and to promote interest in the Apple Nighteyes night viewer, Dick Smith Electronics has generously provided us with a unit — worth $999 — to give away as a prize. So here's YOUR chance to win one of these fascinating high tech devices!

All you have to do is demonstrate your understanding of the way a night viewer device works, by adding the missing words in the brief explanation given below, in the entry coupon. Then add your name and address, and send in the coupon (or a facsimile/photocopy of it) to reach the *EA* office by June 28, 1996.

During the first week of July, we'll check all eligible entries and decide the neatest correct entry. The entrant responsible will then receive the Apple Nighteyes viewer — it's that simple!

Send your entry to the Electronics Australia/Dick Smith Electronics 'Win an Apple Nighteyes Night Viewer Competition', PO Box 199, Alexandria 2015, or if you prefer fax it to (02) 353 0613.



The Apple Nighteyes viewer: very compact, it can amplify the light from a scene by up to 10,000 times — allowing clear vision in almost complete darkness!

ELECTRONICS AUSTRALIA/DICK SMITH ELECTRONICS 'WIN AN APPLE NIGHTEYES' NIGHT VIEWER COMPETITION

ENTRY FORM:

Name: ....

Address: ....

.... Postcode: ....

Night viewers like the Apple Nighteyes work by focussing the light .... from the scene being viewed onto a photocathode, to produce .... These are then amplified, and used to excite the molecules of a .... screen, to produce a much brighter light image.

This competition is only open to Australian residents. Entries received after the closing date will not be included. Employees of the Hannan Group or Dick Smith Electronics, their subsidiaries and families are not eligible to enter. Prizes are not transferable or exchangeable, and may not be converted into cash. The judges' decision is final, and no correspondence will be entered into. Description of the competition forms a part of the competition. The competition commences on 29.5.96 and closes last mail 28.6.96. The judging will take place in Sydney on 3.7.96 at 11am and the winner will be notified by mail and also announced in a later edition of Electronics Australia. The prize is an Apple Nighteyes night viewer valued at $999. Total prize value $999.

Up until his death, he lived in the same house he bought in the mid 1950s overlooking Palo Alto and the San Francisco Bay. He was a great outdoorsman, with

career into a lifelong campaign to improve the lives of children, support research in science and engineering, protect and conserve nature and promote

Terman, the famous university dean of engineering who would later encourage a generation of Stanford graduates, including Packard and Hewlett, to stay

THE END OF AN ERA

David Packard

er to think and talk about their patriarch. In cafeterias and in cubicles, many workers broke down and cried or stood still in disbelief.

Unlike most large companies, where the top brass is rarely seen by the vast majority of workers, there are few H-P employees without a story to tell about David Packard or Bill Hewlett. The two maintained a passionate regard for their employees at all levels. It was they who created the term 'management by walking around' (MBWA), as the two literally spent many hours a week visiting different departments to talk shop with just about anyone that crossed their path.

Packard, especially, was the company's father figure, prowling the hallways and chatting with just about anyone who approached him. He downplayed his status as the chief executive who was worth billions of dollars. Packard regularly went down to the company cafeteria and sat down randomly with employees to eat lunch and discuss business and personal matters.

The day after his death, the flags flew at half-mast on H-P's many campuses in Silicon Valley and around the world.

"You could see a sparkle in his eye when he said hello to you", said Rhonda Kirk, a graphic designer at H-P Labs in Palo Alto. "He was so approachable."

Jeff Bardin, an air conditioning contractor at H-P's Palo Alto site, said he truly felt as if he had lost a member of his family. His grandfather worked at H-P for 30 years, his father for 15 years, and he, too, has worked there for 15 years. "At a company picnic, he held me in his arms when I was a baby, My whole family was raised on H-P. I've heard people ask what the H-P Way is. It's what Bill and Dave did."

However close Packard was to his employees, he always kept his mind focused on the business at hand, and would not hesitate to reprimand those who were taking their job and the company's success for granted.

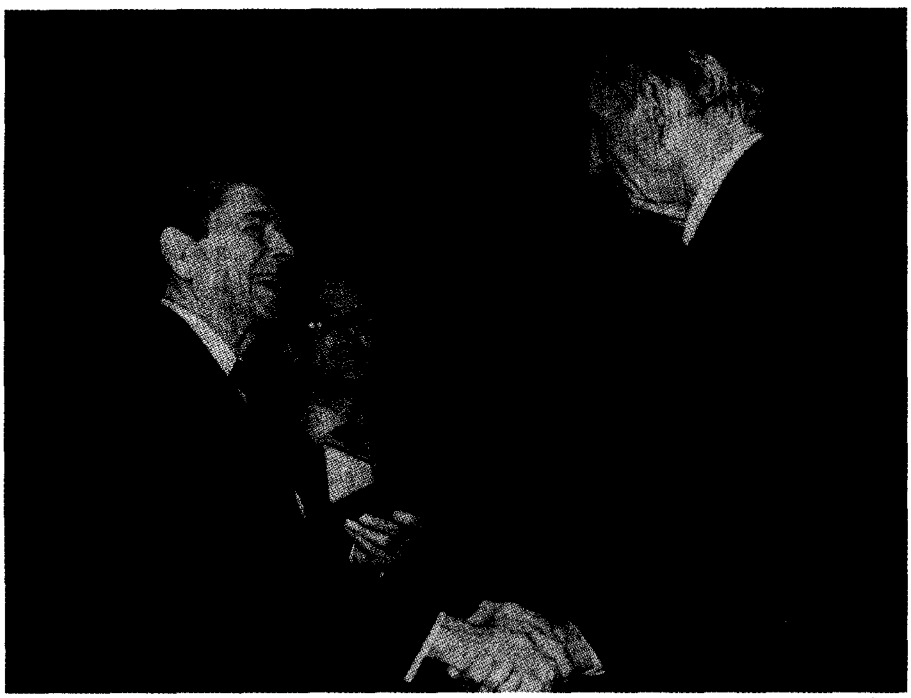
When H-P hit the US$10 billion sales mark in the mid-1980s, Packard had long since retired from day-to-day operations, but he was never far from it.

At the time, the company was in the midst of an earnings slump despite rapidly rising sales. Still, the sales organization felt reason to celebrate the revenue milestone and loaded up several planes with sales reps and managers, with course set for Hawaii. There, they were greeted at the gate by — a very annoyed David Packard, who told them in no uncertain terms that he had very little use for a $10 billion company that didn't make any money. Obviously the mood was less than festive from there on...

Even in 1991, when H-P last experienced a financial stumble and the H-P Way appeared to become a thing of the past, Packard jumped back into the saddle and helped put the company back on a solid financial track — re-instilling the virtues of the H-P Way as the key to the company's long-term success.

There's no doubt that the heart of 'the H-P Way' is the character of its founders, Bill Hewlett and Dave Packard. Their philosophy of high ethics, committment to excellence and willingness to listen to and to act upon new ideas, became a model not only in technology but for well-run companies everywhere.

Perhaps uniquely, Hewlett-Packard's 'culture' and resultant great success are continuing even after the founders are no longer at the helm. ❖



President Ronald Reagan presents the National Medal of Technology to David Packard (R) in July 1988, at the White House.

program for young scientists and engineers and a $10 million series of grants for black colleges.

The themes of the foundation's grants are science, children, population, education and land conservation — all reflecting the personal interests of Packard, who had been the driving force at the foundation since founding it in 1962.

Public service

Packard was also generous with his time, taking a number of public service positions. He served under President Nixon as US deputy Secretary of Defense from January 1969 until December 1971, resigning from the post in frustration over Washington politics and the almost complete lack of basic business principles by which the US Defense organisation operated.

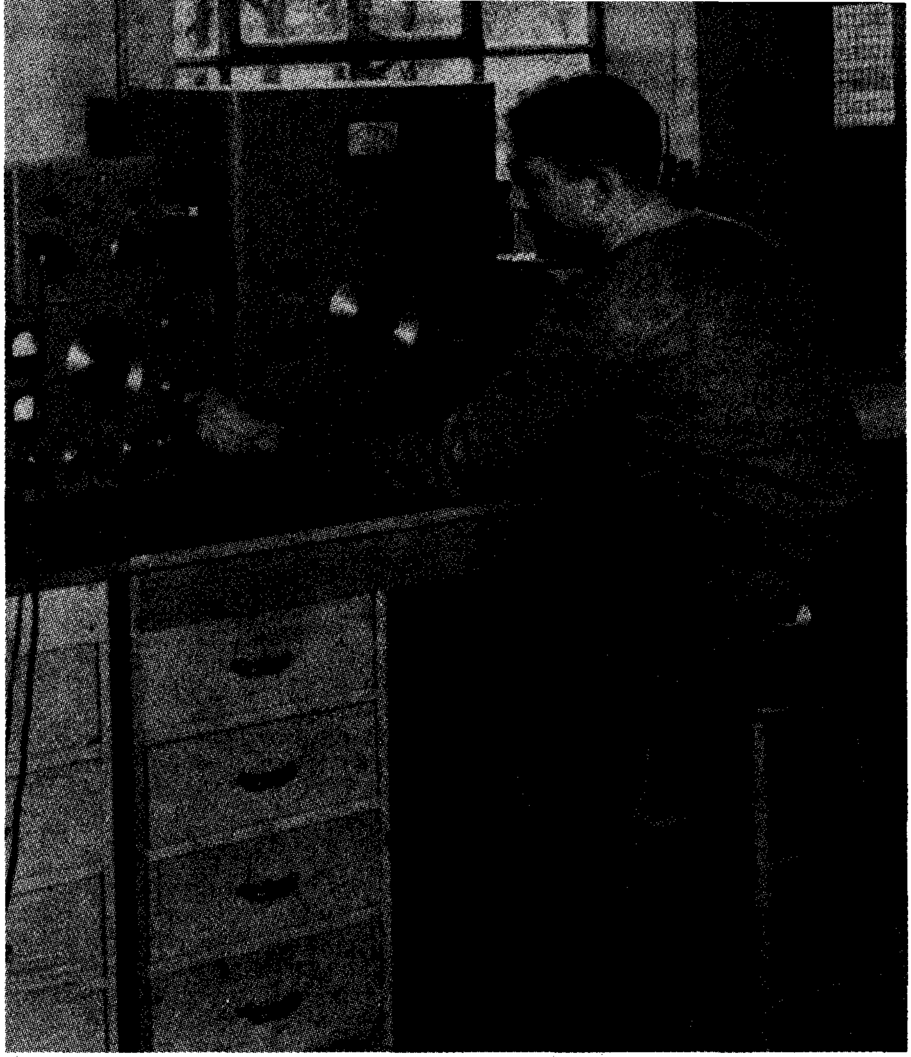
Fourteen years later, he also chaired President Reagan's Commission on Defense Management, which produced a scathing assessment of the nation's defence spending practices. Packard told a congressional committee that the Pentagon would do just as well in its weapons systems if it eliminated its procurement bureaucracy and "simply picked names from a hat"...

"I am deeply saddened by the death of David Packard, who was a friend and mentor to me for many years", commented US Defense Secretary William Perry. "As deputy secretary of defense under Secretary Melvin Laird, Mr Packard served in one of the strongest teams ever to run the Defense Department. Their leadership is still a model for enlightened civilian management of the military."

"A decade ago, he made another huge and enduring contribution to good government. He chaired the Packard Commission, which recommended a revolution in defense procurement through the application of standard business practices. His recommendations are still being implemented today. They are enabling the military to modernise more quickly at lower cost. In everything he undertook, Dave Packard helped change the world for the better."

Kept it simple

While one of the world's richest men, Packard disdained luxury and maintained a casual California lifestyle. Until recently, he drove himself to and from the office in a weathered station wagon. Up until his death, he lived in the same house he bought in the mid 1950s overlooking Palo Alto and the San Francisco Bay. He was a great outdoorsman, with an exceptional love for fly fishing.



David Packard shown using a signal generator and harmonic analyser at H-P's lab bench in 1940. By then the company had moved from garage to 'Tinker' Bell's building.

"After leading the company for over 50 years, Dave's death is a loss to the company and to the country that he loved so well", said his friend and partner Bill Hewlett. "David was a brilliant scientist, an innovative businessman and an incredibly generous and tolerant human being. One of the greatest things that he leaves behind him is a code of ethics known as the 'H-P Way', that will serve to guide the company in the years to come."

Added Lewis Platt, current chairman and CEO of Hewlett-Packard: "A modest man from Colorado — with his best friend — built a world-class company that employs 105,000 people. He turned the blessings of a successful business career into a lifelong campaign to improve the lives of children, support research in science and engineering, protect and conserve nature and promote the arts. We've lost a friend and a great leader, who will be missed immensely. But with our eye to the future, we'll do what Dave would want us to do — to build on what he and Bill Hewlett began in 1939."

From tinkerer to engineer

David Packard was born on September 7, 1912 in Pueblo, Colorado. His father was a lawyer, while his mother was a high school teacher. He was a tinkerer for most of his youth, a skill which served him well when he went to California to study engineering at Stanford, from which he graduated in 1934.

At Stanford he befriended Bill Hewlett and Frederick Emmons Terman, the famous university dean of engineering who would later encourage a generation of Stanford graduates, including Packard and Hewlett, to stay

schedule until 5 October: 1650-1952 on 6145kHz; 1953-2206 on 9810kHz; 2207-0106 on 11,735kHz; 0107-0458 on 15,115kHz; 0459-0715 on 9570kHz; and 0717-1206 on 6100kHz.

WWCR Nashville has opened its fourth 100kW transmitter and is operating 1800-2200 on 9400kHz and 2200-0600UTC on 7435kHz. WWCR also plans to use the low frequency of 2460kHz.

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and short-wave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind New Zealand Standard Time.

er to think and talk about their patriarch. In cafeterias and in cubicles, many workers broke down and cried or stood still in disbelief.

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played his status as the chief executive who was worth billions of dollars. Packard regularly went down to the company cafeteria and sat down randomly with employees to eat lunch and

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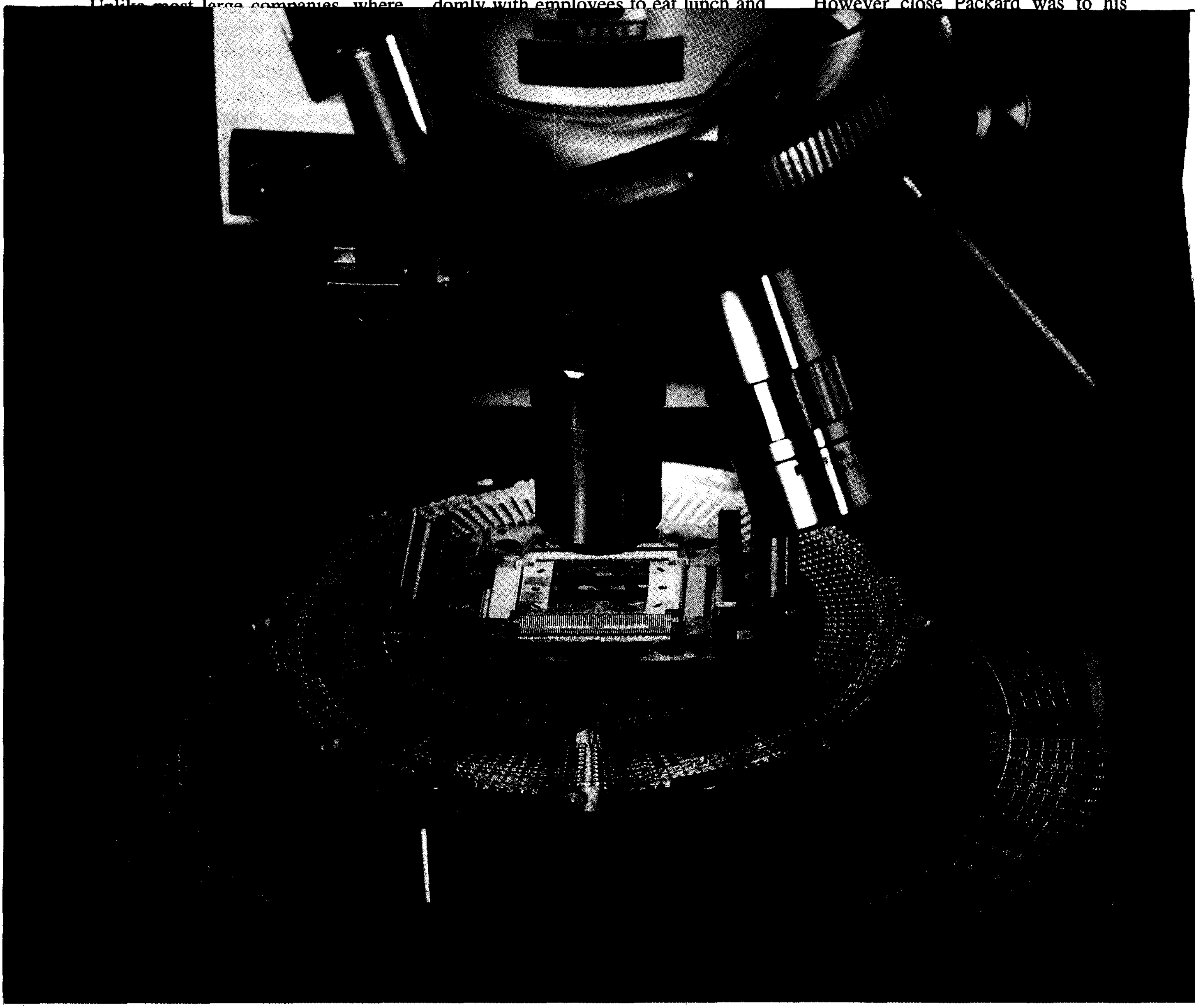
However close Packard was to his



HARNESSING THE FAINT LIGHT FROM CHIP DEFECTS

As integrated circuit chips have become more and more complex, it has become harder and harder to track down design and manufacturing faults. However in the last few years the job of locating chip faults has been made vastly easier by a technique known as emission microscopy — developed by Neeraj Khurana, founder of Californian firm Hypervision. Here's how it works.

by TOM ADAMS

Back in the 1950s, when early semiconductor devices were being designed, a peculiar phenomenon was noticed. If one of these large, clunky devices harboured a defect, it would often give off a faint glow. If the device were energised and the room lights turned off, the glow would be visible from across the room. Researchers thus had a primitive 'darkened room' test for confirming the presence of defects.

At the time, no one foresaw placing 400,000 or more transistors onto a minuscule slice of silicon. The knowledge that many types of circuit defects emitted light remained a sort of curiosity, although it was the sort of neat trick that a researcher (using a light microscope as the devices began to shrink) could pull off dramatically now and then.

The quest for higher speed and greater capacity led, of course, to continually smaller circuit elements. And as chips became smaller and more complex, a bothersome problem began to appear: it was hard to find the location of a single defect on a crowded chip. A chip with 400,000 transistors, for example, may have a single defective transistor whose behaviour shows up in electrical tests. That single transistor may be defective because of a design problem, or because of a processing error; either way, its behaviour must be analyzed. First, though, you have to *find* the transistor among its 399,999 neighbours...

Looking at a chip with 400,000 transistors is a bit like studying a city of 400,000 buildings from the air. Only one of the buildings contains the elusive culprit you are seeking — but *which* building? If you could only make a beacon light up on the house the culprit is in!

Began in 1987

"A beacon in the night" were the words one failure analyst actually used, to describe the performance of his new emission microscope. Emission microscopy — the business of using high optical magnification to see the exceedingly faint light given off by today's chip defects — had its beginnings in 1987, when Neeraj Khurana began to design and market the world's first emission microscopes. Khurana coined the term 'emission microscopy', wrote the basic patent for the emission microscope, and founded Hypervision, today the leading innovator in the field.

How far the science of electronics has come from the 1950s can be judged by the sensitivity needed by emission microscopes today. Suppose the operator of the microscope (usually a failure analyst working for a chip maker) receives a 'field return' — a plastic-packaged chip retrieved from a system such as a computer or fax machine which failed while being used by a customer. (Perhaps you wondered what became of those chips which the dealer replaced in your home computer.)

The failure analyst will first dissolve away the plastic outer package with hot nitric acid, to reveal the chip. Next, he'll bias (energize) the chip to make defective areas emit light. Light emissions occur when damaged semiconductors draw excess current. This process creates multiplication of electron and hole pairs recombining and relaxing, which in turn results in the emission of photons. The term for the process is *recombinant radiation.*

Most, but not all, chip-level defects emit light. Wavelengths of the emissions are from 550 to 1100nm.

The light from a chip defect, though, is less than one *millionth* the intensity you would be able to see with the naked eye. Simply plunking an optical microscope over the biased chip won't show anything — and even if you could see a light emission, you would have to start imaging at a very low power to see enough of the chip to locate the source properly.

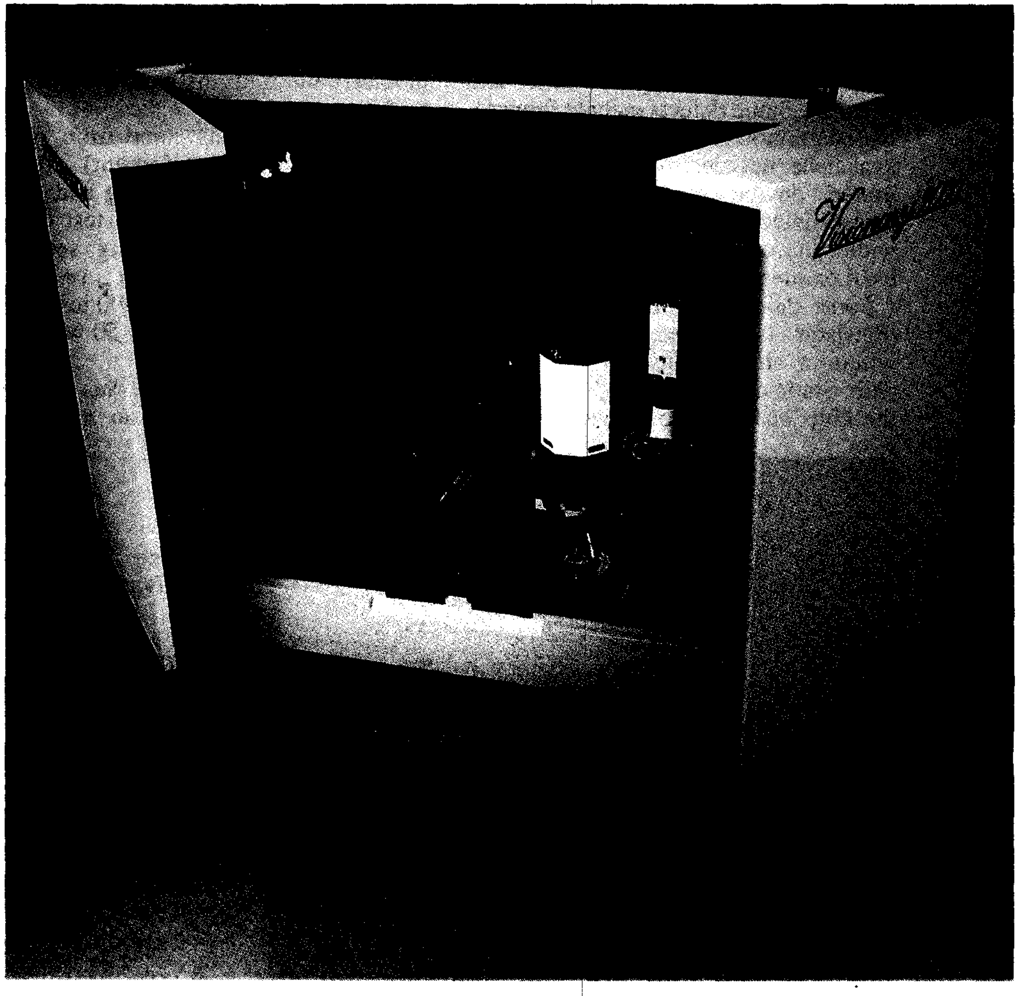
Image intensifier

To boost the intensity of emissions from defects, the emission microscope's camera system contains an image intensifier, which collects photons from the defect and multiplies them lavishly.

First, photons from the defect pass through the objective lens of the microscope. Then they strike a photocathode, which converts them to electrons which are amplified by a microchannel plate. Further along, the electrons strike a bed of phosphors which converts each electron back into a large number of photons. A single initial emitted photon can be amplified as much as 11,000,000 times by this method.

The resulting image, though, shows *only* the defect; it doesn't show the details of the rest of the chip, so you can't tell from the emission image alone where the defect is — just that it exists. To show the location, the microscope uses its own light source to make an illuminated image showing chip details. The final output is an overlay of these two images, showing the light from the defect (generally a red pinpoint) in its exact location on the chip.

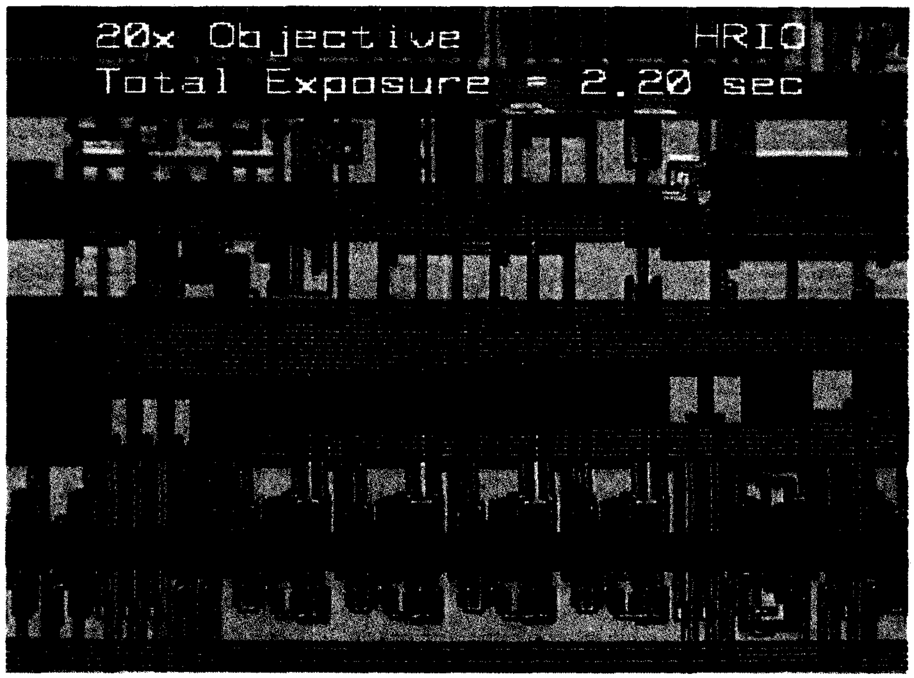
Ideally, one would want to look at the whole chip in one view, and still be able to see defect emissions. For this reason Hypervision developed a low power, wide-angle objective lens called the HyperLens. Its magnification is 0.8x; for larger chips, a 0.5x version is available. For all but the largest chips, you



Emission microscopes emulate 'darkened rooms' in order to pick up the extremely faint light emissions from chip defects. The emissions are then intensified for imaging. To locate elusive functional defects, the chip must be 'exercised' by test vectors sent from automated test equipment (ATE). The picture on the facing page shows an ATE test head docked to the emission microscope, to pinpoint functional defects. (Courtesy Hypervision, Inc.)

Emission Microscopy finds chip defects...

can see all of the 'real estate' plus the light-emitting defect.



Emission images are actually a composite, with the emitted light overlaid with an illuminated view of the chip structure. The coloured areas at the upper right of this emission image show defect sites.

The implications

What has this meant to failure analysts? The old method of finding defects is by mounting the offending chip in a socket and flipping switches (either manually or via a computer) until the precise combination of inputs is accidentally found which causes the failure; the addresses of the inputs will pinpoint the defect site. For a modestly complex chip, and with average luck, this can take about a week; for some chips it can take a month. Meanwhile, the cause of the defect (a design flaw? a processing error?) goes undetected and uncorrected...

This is why failure analysts like emission microscopes. Preparing the chip (which may mean etching away the plastic package) and making the emission image takes an hour or so. The job of the emission microscope is only to locate the defect; the next step is usually close scrutiny of the defect with a scanning electron microscope (SEM), which can show details of the defect and help to reveal its cause.

Overall, defects at the chip level are divided into two types, static and dynamic. Static defects include forward-biased emissions (also called latch-up), avalanche, hot electron effects, and saturated device emissions. Forward-biased defects emit in a narrow bandwidth; the other three types are broadband emitters.

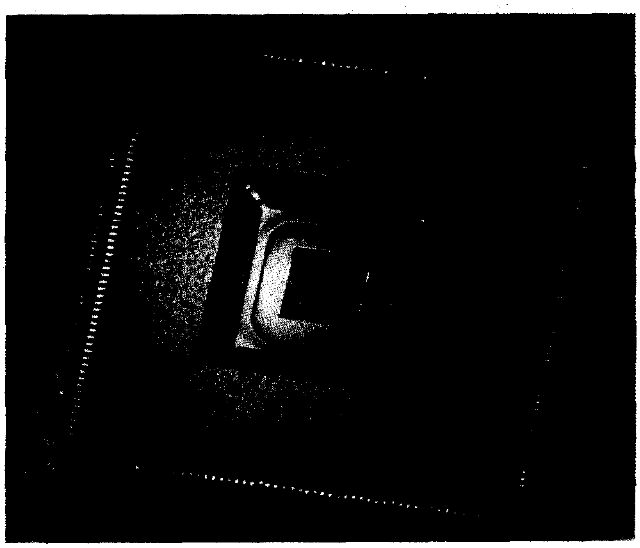
Some defects involve only a single transistor — or even asingle junction within a single transistor — on the chip. Static defects emit light as long as the chip is biased, but dynamic (also called functional) defects are much more elusive; they emit light only when precisely the right instructions are sent to the chip.

Those instructions come from ATE (automated test equipment) units, which are basically very big and very expensive computers which test chips by running extremely long sets of instructions (called *test vectors*) through them. Out of 100,000 test vectors, a sequence of perhaps 50 will initiate a functional failure.

Previously, though, there was no way to connect an ATE to an emission microscope, except by using long cable sets, which worked only with low-speed chips and which were fiendishly difficult to keep in repair. For the higher speed chips which everyone was designing, you could tell that a functional failure existed, but because of its evanescent nature you couldn't tell where it was.

Hypervision solved this problem by making a 'docking' emission microscope, in which the large circular test head of the ATE system docks right into the microscope, to place the device under test (DUT — the chip) right under the microscope's objective lenses.

The test vectors are sent through the chip from the ATE. When the site of the functional defect on the chip lights up, the test vectors trigger the microscope's camera. Once the chip is mounted on the ATE test head and the test head docked with the microscope, finding the precise location of the functional failure takes about five minutes.



Because of heavy metallisation, some new high-speed chips are imaged from the back side. A square window has been cut into the back side of this QFP (quad flat pack), to within 50 microns of the circuitry, to permit backside emission imaging.

New problems

The first docking emission microscope was built and sold by Hypervision in 1993. At about the same time, the semiconductor industry was reaching new heights of both chip density and device speed. Along with these new performance levels came new and formidable inspection problems.

programs are a $70 million fellowship program for young scientists and engineers and a $10 million series of grants for black colleges.

The themes of the foundation's grants are science, children, population, education and land conservation — all reflecting the personal interests of Packard, who had been the driving force at the foundation since founding it in 1962.

Public service

Packard was also generous with his time, taking a number of public service positions. He served under President Nixon as US deputy Secretary of Defense from January 1969 until December 1971, resigning from the post in frustration over Washington politics and the almost complete lack of basic business principles by which the US Defense organisation operated.

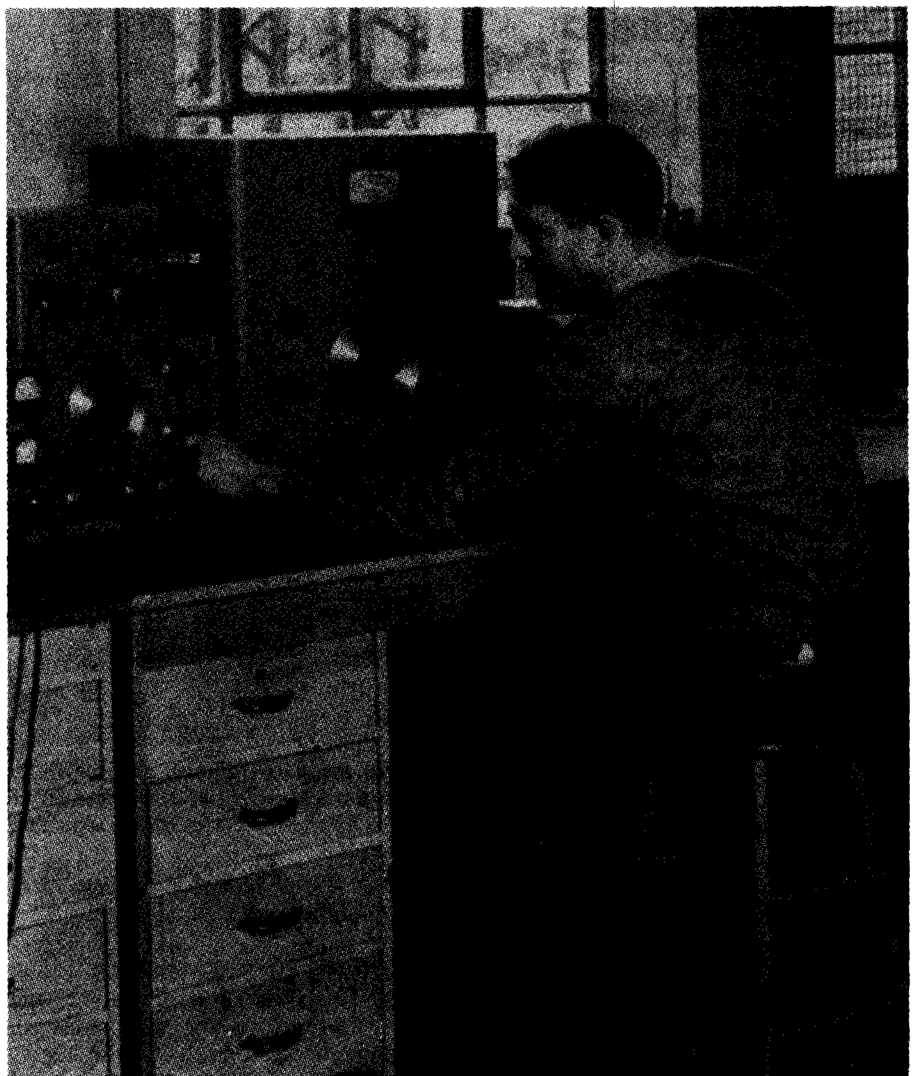
Fourteen years later, he also chaired President Reagan's Commission on Defense Management, which produced a scathing assessment of the nation's defence spending practices. Packard told a congressional committee that the Pentagon would do just as well in its weapons systems if it eliminated its procurement bureaucracy and "simply picked names from a hat"...

"I am deeply saddened by the death of David Packard, who was a friend and mentor to me for many years", commented US Defense Secretary William Perry. "As deputy secretary of defense under Secretary Melvin Laird, Mr Packard served in one of the strongest teams ever to run the Defense Department. Their leadership is still a model for enlightened civilian management of the military."

"A decade ago, he made another huge and enduring contribution to good government. He chaired the Packard Commission, which recommended a revolution in defense procurement through the application of standard business practices. His recommendations are still being implemented today. They are enabling the military to modernise more quickly at lower cost. In everything he undertook, Dave Packard helped change the world for the better."

Kept it simple

While one of the world's richest men, Packard disdained luxury and maintained a casual California lifestyle. Until recently, he drove himself to and from the office in a weathered station wagon. Up until his death, he lived in the same house he bought in the mid 1950s overlooking Palo Alto and the San Francisco Bay. He was a great outdoorsman, with an exceptional love for fly fishing.



David Packard shown using a signal generator and harmonic analyser at H-P's lab bench in 1940. By then the company had moved from garage to 'Tinker' Bell's building.

"After leading the company for over 50 years, Dave's death is a loss to the company and to the country that he loved so well", said his friend and partner Bill Hewlett. "David was a brilliant scientist, an innovative businessman and an incredibly generous and tolerant human being. One of the greatest things that he leaves behind him is a code of ethics known as the 'H-P Way', that will serve to guide the company in the years to come."

Added Lewis Platt, current chairman and CEO of Hewlett-Packard: "A modest man from Colorado — with his best friend — built a world-class company that employs 105,000 people. He turned the blessings of a successful business career into a lifelong campaign to improve the lives of children, support research in science and engineering, protect and conserve nature and promote the arts. We've lost a friend and a great leader, who will be missed immensely. But with our eye to the future, we'll do what Dave would want us to do — to build on what he and Bill Hewlett began in 1939."

From tinkerer to engineer

David Packard was born on September 7, 1912 in Pueblo, Colorado. His father was a lawyer, while his mother was a high school teacher. He was a tinkerer for most of his youth, a skill which served him well when he went to California to study engineering at Stanford, from which he graduated in 1934.

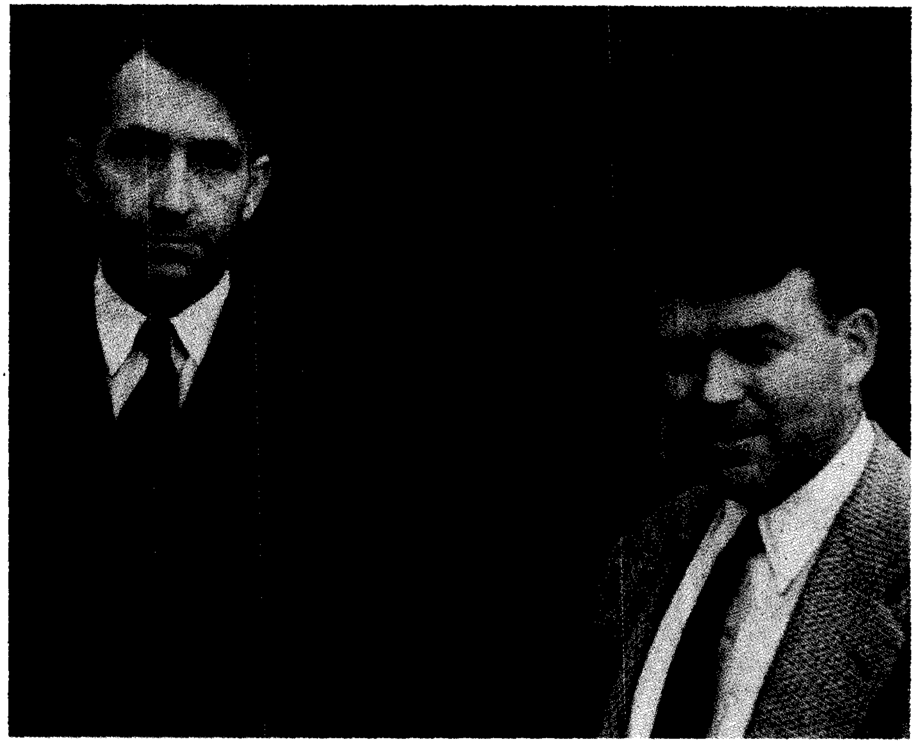
At Stanford he befriended Bill Hewlett and Frederick Emmons Terman, the famous university dean of engineering who would later encourage a generation of Stanford graduates, including Packard and Hewlett, to stay

David Packard

in the Bay Area and put their knowledge to practical, entrepreneurial use.

Hewlett-Packard was formally incorporated in 1947 and went public in 1957 at $16 a share. Each of those shares today is worth an incredible $8988.

As a measure of their friendship, Packard and Hewlett settled the question of whose name would go first in the name of their company to the chance of a coin toss. For all of their many years as business partners, there was never any argument over management issues. Packard maintained general control over the overall organisation, while Hewlett drove H-P's exceptional engineering efforts.



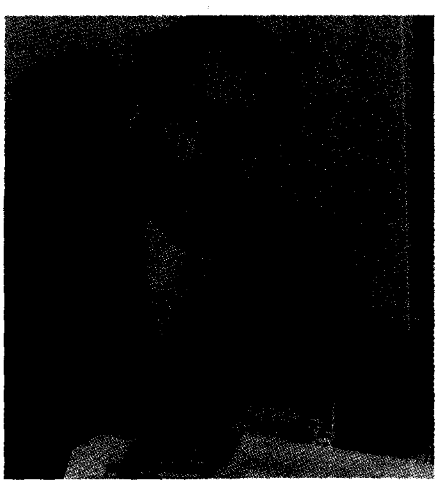
David Packard (L) and Bill Hewlett pictured in the mid 1940s in front of the Redwood building at 395 Page Mill Road, Palo Alto. The first facility built and owned by H-P, it had 10,000 square feet of office, lab and factory space.

Grew much wider

Until the mid-1980s, most of H-P's revenues were derived from highly specialised electronics instrumentation, such as test and measurement tools, and medical equipment. In the late 1970s, the company moved into business and consumer-related markets such as business computers, calculators, computers and peripherals such as laser printers.

In addition to the success of the products their company put out, Packard and Hewlett will be long remembered for their unique management style and the corporate culture they created. Generally known as 'the H-P Way', it has been widely copied and is how most of the top-tier companies in Silicon Valley operate.

It is a non-hierarchical structure, that values the contributions of all employees; engineers thought nothing of arguing with their bosses. Workers were treated well; even today, the H-P workforce generally does not suffer the day-to-day fear about job loss that seems a fact of life in much of the rest of the white-collar world.



David Packard pictured at his office desk in 1942.

Modest, but generous

Packard was an unpretentious man who loved to potter with tools and machinery, and with Hewlett he shared a love of the outdoors. They co-owned two ranches. Vacations usually meant hunting, fishing or horseback riding, albeit often with a stop to chat with shopkeepers about inventories and sales trends.

Packard's close friends say he lost much of his spirit after Lucile, his wife of 49 years, died in May 1987. In January 1989, Packard created the David and Lucile Packard Center for the Future of Children at his charitable foundation in Los Altos.

Funded initially at $5 million a year, the center targets the health and social problems of minority children younger than seven years old."It could be one of the most important things this foundation does", Packard said when he announced the formation of the centre. "You have tremendous leverage if you can do things (with children) early on."

Packard is survived by his four children, David Woodley Packard, Nancy Ann Packard Burnett, Susan Packard Orr and Julie Elizabeth Packard.

All were at his bedside when he died. There are also nine grandchildren.

Valley remembers...

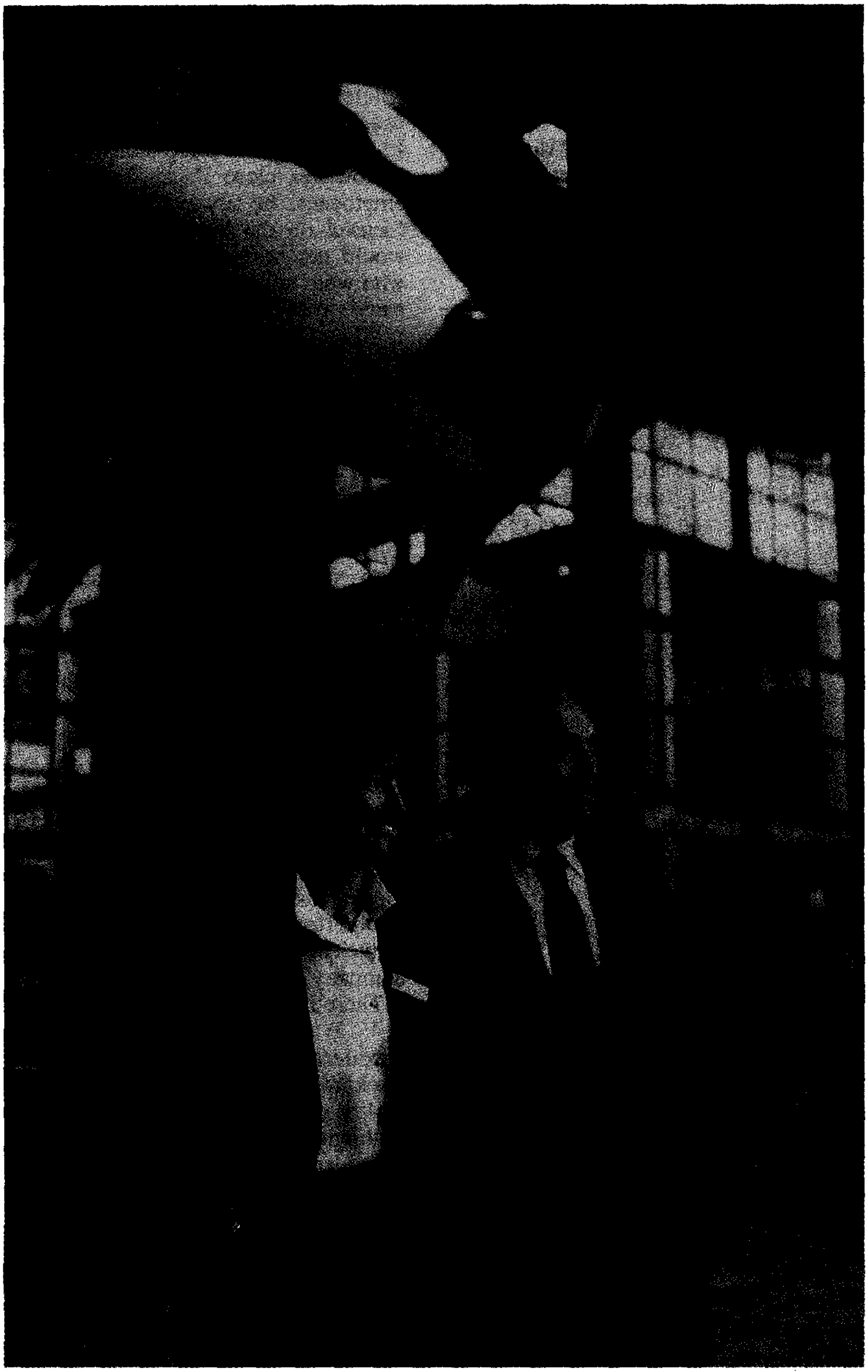
"David Packard created a whole new way of conducting business", said William Krause, a 13-year H-P veteran who became chairman and chief executive of 3Com Inc. of Santa Clara, and a chairman of the American Electronics Association. "In one way or another, many companies around here are really little H-Ps. A piece of Hewlett-Packard is embedded in many of their corporate cultures."

Tandem Computers founder James Treybig is another H-P veteran, and added "H-P is an example of what, unfortunately, does not often happen in the rest of country. It's not the kind of company that tries to grow 100% a year, and which hires 1000 people one year and then fires them the next."

"That's because of Packard's legacy: extreme devotion to people, to technology and to sound business practices. Which explains why H-P is the success it is. Packard didn't try to make a dollar too fast, but he also didn't forget that his job was to make a dollar."

Some of the other Valley leaders who have fond memories of David Packard commented:

W.J. 'Jerry' Sanders III, CEO Advanced Micro Devices: "I remember a dinner when David Packard was serving as deputy secretary of defense. It



David Packard pictured at the opening of the Monterey Bay Aquarium in 1984, with his daughter Julie (Aquarium's Director). A US$49 million philanthropic project by the Packard family, the aquarium has attracted millions of visitors.

was scheduled for Rickey's in Palo Alto. Some anti-war protesters were going to picket it, so people wondered whether the dinner should be moved. Packard wouldn't move the speech. He had a lot of courage. He was the dean of Silicon Valley. The idea of Silicon Valley wouldn't be around without him. We would not be who we are today, if it weren't for David Packard."

Gordon Moore, chairman, Intel: "Dave represented the best of the best of Silicon Valley. He and the company he co-founded with Bill Hewlett gave us all something to look up to. His example as a businessman, leader, philanthropist and human being will be sorely missed."

Douglas Chance, president and CEO of Wyse Technology: "David Packard was one of the most 'hands-on' and 'down-to-earth' people I have ever met. I remember travelling with him to an H-P corporate function and noticing that he was rubbing his hands, which were all red, swollen and scratched. He had black dirt under broken fingernails. When I inquired as to what he had done to his hands, his eyes lit up and he talked for half an hour about how he had spent the weekend installing a sprinkler system at his new retreat in Big Sur. He had dug all the trenches and designed a reservoir to capture the water from a spring 150 yards up from the house. He even had plans for a small hydroelectric generator to supply power to the home."

Fred Gibbons, chairman, Software Publishing: "There are those who really know him, like John Young, Paul Ely and Ed McCracken. And there are those of us who mainly heard the stories and, if lucky, shook his enormous paw at a new-employee lunch. We are the third generation of H-P employees. We were trained in the H-P Way by those whom he had taught directly... Bill and Dave's philosophy was not lost in the transition. These seeds have been scattered everywhere in Silicon Valley, and a thousand companies have bloomed."

Peter Giles, president and CEO, Technology Museum of Innovation of San Jose: "I used to host affairs for leaders, and I remember one seminar. I was putting away chairs, and David Packard was saying good-bye to the dignitaries. Then he came over and helped me put away chairs. He was holding three in each hand and carrying them down to the basement. I stopped and thought — this is a man who leads by example. No work was below him. I think of him as the rock of leadership. You drop it into the lake, and the ripples touch all the shores of the lake. I think his influence is so widespread that, even now after he has passed away, his influence upon our region will only grow."

Sandra Kurtzig, founder and retired chairman/CEO of Ask Computer Systems: "David Packard had a way of listening to you with undivided attention, as if you were simply the most important person in the world. He was an imposing and generous man, and his company lives on as testimony to his particular genius."

H-P staff, too

At lunchtime on Tuesday March 26, H-P workers first learned about the death of their company's co-founder, as company chairman Lewis Platt broke the news of David Packard's passing over the company's intercom system. Platt said the company would carry on in Packard's memory, and encouraged employees to take time alone or together to think and talk about their patriarch. In cafeterias and in cubicles, many workers broke down and cried or stood still in disbelief.

Unlike most large companies, where the top brass is rarely seen by the vast majority of workers, there are few H-P employees without a story to tell about David Packard or Bill Hewlett. The two maintained a passionate regard for their employees at all levels. It was they who created the term 'management by walking around' (MBWA), as the two literally spent many hours a week visiting different departments to talk shop with just about anyone that crossed their path.

Packard, especially, was the company's father figure, prowling the hallways and chatting with just about anyone who approached him. He downplayed his status as the chief executive who was worth billions of dollars. Packard regularly went down to the company cafeteria and sat down randomly with employees to eat lunch and discuss business and personal matters.

The day after his death, the flags flew at half-mast on H-P's many campuses in Silicon Valley and around the world.

"You could see a sparkle in his eye when he said hello to you", said Rhonda Kirk, a graphic designer at H-P Labs in Palo Alto. "He was so approachable."

Jeff Bardin, an air conditioning contractor at H-P's Palo Alto site, said he truly felt as if he had lost a member of his family. His grandfather worked at H-P for 30 years, his father for 15 years, and he, too, has worked there for 15 years. "At a company picnic, he held me in his arms when I was a baby, My whole family was raised on H-P. I've heard people ask what the H-P Way is. It's what Bill and Dave did."

President Ronald Reagan presents the National Medal of Technology to David Packard (R) in July 1988, at the White House.

However close Packard was to his employees, he always kept his mind focused on the business at hand, and would not hesitate to reprimand those who were taking their job and the company's success for granted.

When H-P hit the US$10 billion sales mark in the mid-1980s, Packard had long since retired from day-to-day operations, but he was never far from it.

At the time, the company was in the midst of an earnings slump despite rapidly rising sales. Still, the sales organization felt reason to celebrate the revenue milestone and loaded up several planes with sales reps and managers, with course set for Hawaii. There, they were greeted at the gate by — a very annoyed David Packard, who told them in no uncertain terms that he had very little use for a $10 billion company that didn't make any money. Obviously the mood was less than festive from there on...

Even in 1991, when H-P last experienced a financial stumble and the H-P Way appeared to become a thing of the past, Packard jumped back into the saddle and helped put the company back on a solid financial track — re-instilling the virtues of the H-P Way as the key to the company's long-term success.

There's no doubt that the heart of 'the H-P Way' is the character of its founders, Bill Hewlett and Dave Packard. Their philosophy of high ethics, committment to excellence and willingness to listen to and to act upon new ideas, became a model not only in technology but for well-run companies everywhere.

Perhaps uniquely, Hewlett-Packard's 'culture' and resultant great success are continuing even after the founders are no longer at the helm. ❖

SHORTWAVE LISTENING

with Arthur Cushen, MBE

Bougainville radio war continues

It is some four years since the breakaway group on Bougainville declared independence, and over that time broadcasting in the area has been from two different points of view.

Bougainville, which is in the Northern Solomons but now officially part of Papua New Guinea, commenced operating as Radio Free Bougainville in January 1992 and was officially opened by the Prime Minister of the Republic of Bougainville on January 21, 1992. The station operated on 3890kHz, later 3850kHz. The transmitter was supplied by the International Amateur Radio Network, and although low in power was heard throughout the South Pacific. It operated under very sparse conditions, and even today news reports from the Solomons indicate that the station still operates; but its reception has not been possible over recent weeks.

To counter the broadcasts of Radio Free Bougainville, a station has been set up on Buka known as Radio United Bougainville, which is the Voice of Peace and Unity in the area. It is not directly operated by Papua New Guinea's NBC network but is an independent station. Although mail service is difficult, a verification received gave interesting details on the establishment and operation of this broadcaster located in the Northern Solomons.

Buka was to be the site of a new 10kW transmitter, but this proposal has not proceeded and in fact, in recent weeks a high powered transmitter has been heard on 3325kHz — which is the new Radio Northern Solomons, operating from the Rabaul area.

The details concerning Radio United Bougainville are that the power is only 70W. Daytime transmissions are on 6010kHz and night-time on 3875kHz and signals have been heard here to closing at 1300UTC. The station also has an FM service on 89.9MHz which has a power of 20W.

According to the Controller of Radio United Bougainville, which has the address of PO Box 268, Buka, the role of the station is to disseminate relevant Government information, comprehensively counteract on the BRA rebels' political propaganda and at the same time provide musical entertainment to the listeners in the area. In his letter the Controller, Emilouyse Tenoa apologised for the delay in replying to my report due to the very poor mail service and indicated that he was the announcer that I heard when I had listened to the broadcast — in September 1994.

Attempts to settle the dispute on Bougainville have been under way for some months, with Australia acting as the peacemaker and it is hoped that some settlement of this dispute will take place in the near future.

With reference to the signal heard on 3325kHz, this is Radio Northern Solomons and the transmitter is located at Rabaul. In a telephone conversation with the Controller at Port Moresby, he indicated the power was 10kW and the transmitter was located with the other two NBC stations at Rabaul on mediumwave and shortwave. The studios of the new station are on Buka and programmes are taken off air from the Port Moresby shortwave signal on 4890kHz.

The Buka studios have some programmes of their own but mainly relay the Port Moresby service and have been heard closing at 1200UTC when they will relay the signal from the key station. Sign on is announced at 1930UTC.

The transmitters at Rabaul were destroyed by the volcano and new equipment is gradually being installed. This is the third one to be put into the NBC transmitting site. Signals have been heard very early in the South Pacific due to the closeness of the site, and the programme service includes news in English at 0900UTC.

Jakarta well received

Excellent reception of Radio Republic Indonesia, Jakarta is being received, from three transmitters. Two of these carry the Indonesian National Programme and the other the Foreign Programme. The National Programme is now heard on 9680kHz and 15,130kHz around 1000UTC, while the Foreign Programme has English 0800-0900 and 2100-2200UTC on 9525kHz.

The Republic of Indonesia recently signed a contract with GEC-Marconi Communications Limited for the supply and installation of three Marconi 250kW shortwave transmitters, which are now in operation, plus five curtain antennas, satellite programme links and ancillary equipment.

The contract, worth over £12 million, gives enhanced coverage of the Voice of Indonesia to Malaysia, China, Japan, Australia, Papua New Guinea, Europe and the Middle East. ❖

AROUND THE WORLD

GREECE: Athens has been heard in English at 1445UTC on the new channel of 9915kHz, also on 9420 and 15,650kHz.

GUAM: KSDA has a completely new schedule up to 27 October, with English broadcasts at 1000UTC on 9370kHz; 1030 on 9530kHz; 1330-1400 on 9650kHz; 1600-1700 on 7395kHz; 1730-1800 on 9370kHz; 2130-2200 on 15,310kHz; and 2300-2330 on 11,775kHz.

JAPAN: Radio Japan is using BBC's Kranji transmitter to Oceania from 0500-0900 on 11,920kHz and 1900-2100 on 6035kHz. This will be additional coverage to the South Pacific area.

MONACCO: TWR, Monte Carlo has English broadcasts daily 0655-0800, and on Saturday and Sunday opens at 0645 and closes at 0820 on 7115kHz.

NEW ZEALAND: Radio New Zealand International has an amended schedule until 5 October: 1650-1952 on 6145kHz; 1953-2206 on 9810kHz; 2207-0106 on 11,735kHz; 0107-0458 on 15,115kHz; 0459-0715 on 9570kHz; and 0717-1206 on 6100kHz.

SAIPAN: KHBI's schedule in English until September 2nd, to this area is: 0800 on 9425kHz; 0900 on 13,615kHz; 1000 on 13,840kHz; 1100 and 1200 on 9430kHz; 1300 on 13,840kHz; 2000 on 9570kHz; 2100 on 13,840kHz; and 2300UTC on 13,625kHz.

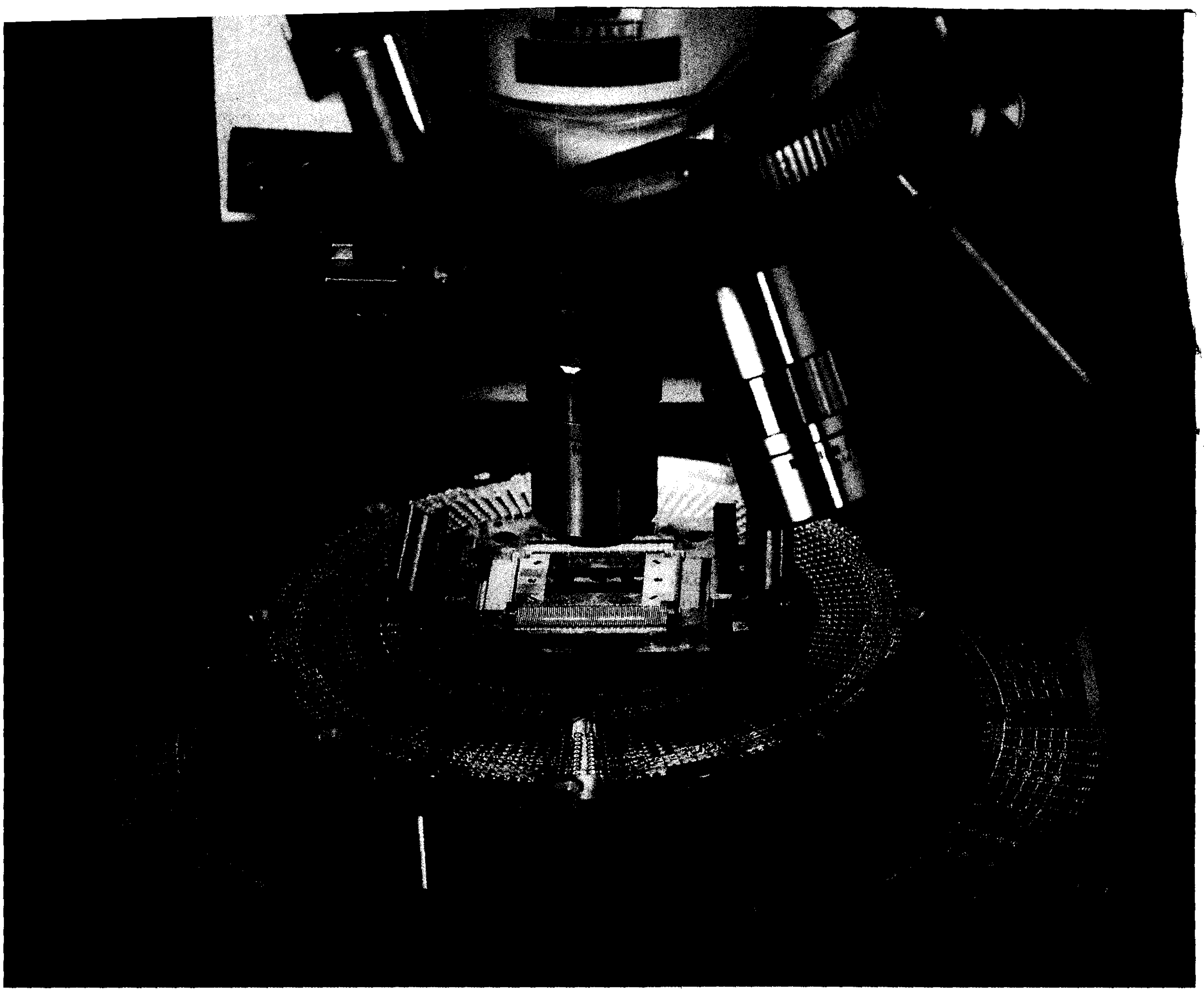
SRI LANKA: Colombo on 4902kHz has been heard at excellent strength at 1700UTC. Sign off is around 1730 with local Sinhala programmes.

USA: Radio Marte, which broadcasts special programmes to Cuba, has increased its output and is using the transmitter at Delano, California. All broadcasts are in Spanish and the operation is from 1000-1200UTC on 5890kHz; 1200-1400 on 7405kHz; and 1800-2300 on 13,665kHz.

WYFR Family Radio, Okeechobee, Florida has leased time to the BBC World Service and is broadcasting to the Americas 1300-1600 on 9590kHz.

WWCR Nashville has opened its fourth 100kW transmitter and is operating 1800-2200 on 9400kHz and 2200-0600UTC on 7435kHz. WWCR also plans to use the low frequency of 2460kHz.

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind New Zealand Standard Time.



HARNESSING THE FAINT LIGHT FROM CHIP DEFECTS

As integrated circuit chips have become more and more complex, it has become harder and harder to track down design and manufacturing faults. However in the last few years the job of locating chip faults has been made vastly easier by a technique known as emission microscopy — developed by Neeraj Khurana, founder of Californian firm Hypervision. Here's how it works.

by TOM ADAMS

Back in the 1950s, when early semiconductor devices were being designed, a peculiar phenomenon was noticed. If one of these large, clunky devices harboured a defect, it would often give off a faint glow. If the device were energised and the room lights turned off, the glow would be visible from across the room. Researchers thus had a primitive 'darkened room' test for confirming the presence of defects.

At the time, no one foresaw placing 400,000 or more transistors onto a minuscule slice of silicon. The knowledge that many types of circuit defects emitted light remained a sort of curiosity, although it was the sort of neat trick that a researcher (using a light microscope as the devices began to shrink) could pull off dramatically now and then.

The quest for higher speed and greater capacity led, of course, to continually smaller circuit elements. And as chips became smaller and more complex, a bothersome problem began to appear: it was hard to find the location of a single defect on a crowded chip. A chip with 400,000 transistors, for example, may have a single defective transistor whose behaviour shows up in electrical tests. That single transistor may be defective because of a design problem, or because of a processing error; either way, its behaviour must be analyzed. First, though, you have to *find* the transistor among its 399,999 neighbours...

Looking at a chip with 400,000 transistors is a bit like studying a city of 400,000 buildings from the air. Only one of the buildings contains the elusive culprit you are seeking — but *which* building? If you could only make a beacon light up on the house the culprit is in!

Began in 1987

"A beacon in the night" were the words one failure analyst actually used, to describe the performance of his new emission microscope. Emission microscopy — the business of using high optical magnification to see the exceedingly faint light given off by today's chip defects — had its beginnings in 1987, when Neeraj Khurana began to design and market the world's first emission microscopes. Khurana coined the term 'emission microscopy', wrote the basic patent for the emission microscope, and founded Hypervision, today the leading innovator in the field.

How far the science of electronics has come from the 1950s can be judged by the sensitivity needed by emission microscopes today. Suppose the operator of the microscope (usually a failure analyst working for a chip maker) receives a 'field return' — a plastic-packaged chip retrieved from a system such as a computer or fax machine which failed while being used by a customer. (Perhaps you wondered what became of those chips which the dealer replaced in your home computer.)

The failure analyst will first dissolve away the plastic outer package with hot nitric acid, to reveal the chip. Next, he'll bias (energize) the chip to make defective areas emit light. Light emissions occur when damaged semiconductors draw excess current. This process creates multiplication of electron and hole pairs recombining and relaxing, which in turn results in the emission of photons. The term for the process is *recombinant radiation.*

Most, but not all, chip-level defects emit light. Wavelengths of the emissions are from 550 to 1100nm.

The light from a chip defect, though, is less than one *millionth* the intensity you would be able to see with the naked eye. Simply plunking an optical microscope over the biased chip won't show anything — and even if you could see a light emission, you would have to start imaging at a very low power to see enough of the chip to locate the source properly.

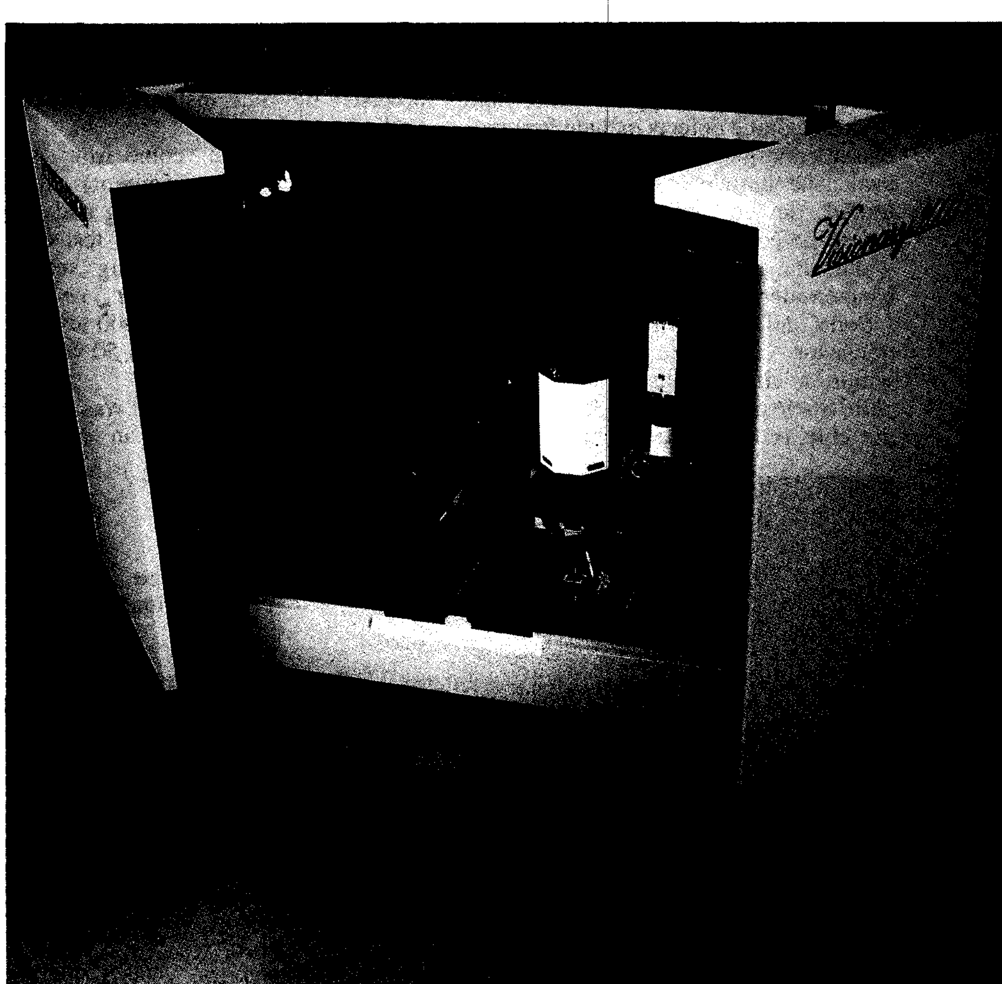
Image intensifier

To boost the intensity of emissions from defects, the emission microscope's camera system contains an image intensifier, which collects photons from the defect and multiplies them lavishly.

First, photons from the defect pass through the objective lens of the microscope. Then they strike a photocathode, which converts them to electrons which are amplified by a microchannel plate. Further along, the electrons strike a bed of phosphors which converts each electron back into a large number of photons. A single initial emitted photon can be amplified as much as 11,000,000 times by this method.

The resulting image, though, shows *only* the defect; it doesn't show the details of the rest of the chip, so you can't tell from the emission image alone where the defect is — just that it exists. To show the location, the microscope uses its own light source to make an illuminated image showing chip details. The final output is an overlay of these two images, showing the light from the defect (generally a red pinpoint) in its exact location on the chip.

Ideally, one would want to look at the whole chip in one view, and still be able to see defect emissions. For this reason Hypervision developed a low power, wide-angle objective lens called the HyperLens. Its magnification is 0.8x; for larger chips, a 0.5x version is available. For all but the largest chips, you



Emission microscopes emulate 'darkened rooms' in order to pick up the extremely faint light emissions from chip defects. The emissions are then intensified for imaging. To locate elusive functional defects, the chip must be 'exercised' by test vectors sent from automated test equipment (ATE). The picture on the facing page shows an ATE test head docked to the emission microscope, to pinpoint functional defects.
(Courtesy Hypervision, Inc.)

Emission Microscopy finds chip defects...

can see all of the 'real estate' plus the light-emitting defect.

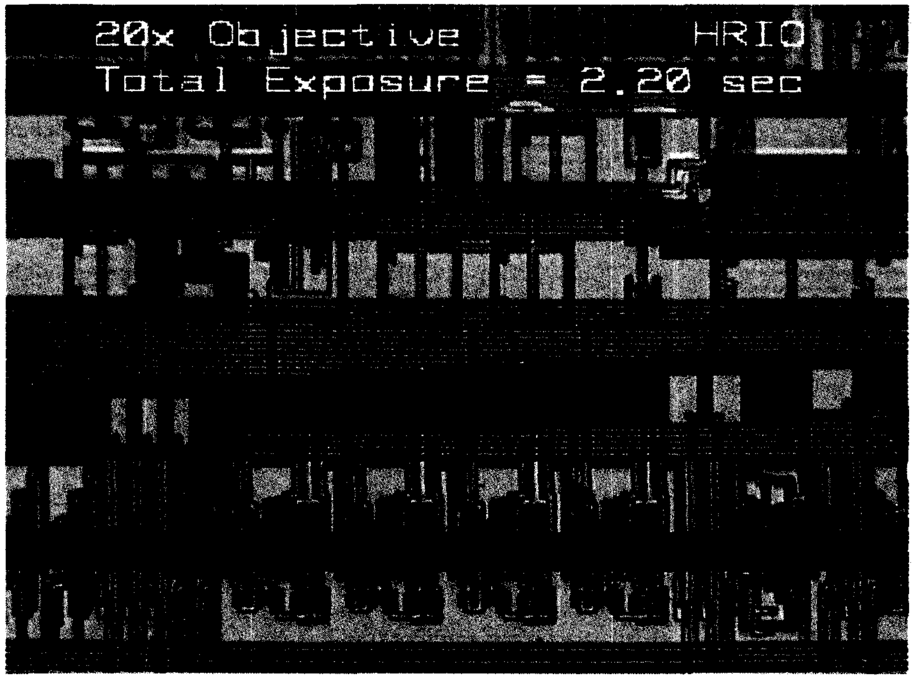
The implications

What has this meant to failure analysts? The old method of finding defects is by mounting the offending chip in a socket and flipping switches (either manually or via a computer) until the precise combination of inputs is accidentally found which causes the failure; the addresses of the inputs will pinpoint the defect site. For a modestly complex chip, and with average luck, this can take about a week; for some chips it can take a month. Meanwhile, the cause of the defect (a design flaw? a processing error?) goes undetected and uncorrected...

This is why failure analysts like emission microscopes. Preparing the chip (which may mean etching away the plastic package) and making the emission image takes an hour or so. The job of the emission microscope is only to locate the defect; the next step is usually close scrutiny of the defect with a scanning electron microscope (SEM), which can show details of the defect and help to reveal its cause.

Overall, defects at the chip level are divided into two types, static and dynamic. Static defects include forward-biased emissions (also called latch-up), avalanche, hot electron effects, and saturated device emissions. Forward-biased defects emit in a narrow bandwidth; the other three types are broadband emitters.

Some defects involve only a single transistor — or even asingle junction within a single transistor — on the chip. Static defects emit light as long as the chip is biased, but dynamic (also called functional) defects are much more elusive; they emit light only when precisely the right instructions are sent to the chip.



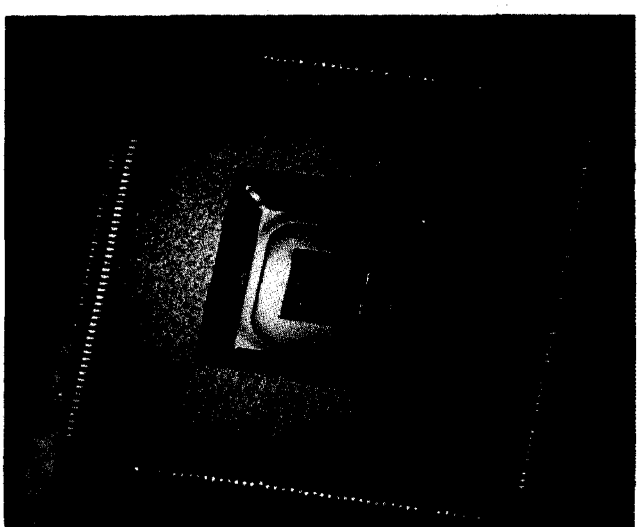
Emission images are actually a composite, with the emitted light overlaid with an illuminated view of the chip structure. The coloured areas at the upper right of this emission image show defect sites.

Those instructions come from ATE (automated test equipment) units, which are basically very big and very expensive computers which test chips by running extremely long sets of instructions (called *test vectors*) through them. Out of 100,000 test vectors, a sequence of perhaps 50 will initiate a functional failure.

Previously, though, there was no way to connect an ATE to an emission microscope, except by using long cable sets, which worked only with low-speed chips and which were fiendishly difficult to keep in repair. For the higher speed chips which everyone was designing, you could tell that a functional failure existed, but because of its evanescent nature you couldn't tell where it was.

Hypervision solved this problem by making a 'docking' emission microscope, in which the large circular test head of the ATE system docks right into the microscope, to place the device under test (DUT — the chip) right under the microscope's objective lenses.

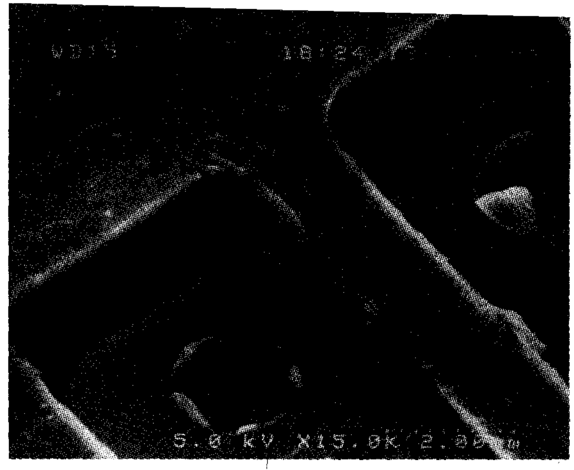
The test vectors are sent through the chip from the ATE. When the site of the functional defect on the chip lights up, the test vectors trigger the microscope's camera. Once the chip is mounted on the ATE test head and the test head docked with the microscope, finding the precise location of the functional failure takes about five minutes.



Because of heavy metallisation, some new high-speed chips are imaged from the back side. A square window has been cut into the back side of this QFP (quad flat pack), to within 50 microns of the circuitry, to permit backside emission imaging.

New problems

The first docking emission microscope was built and sold by Hypervision in 1993. At about the same time, the semiconductor industry was reaching new heights of both chip density and device speed. Along with these new performance levels came new and formidable inspection problems.



Once the location of a defect has been pinpointed by the emission microscope, the defect can be studied in greater detail by a scanning electron microscope (SEM). This 15,000x SEM image shows melting of polysilicon at a chip defect site.

Even modest chips often have lines of metallisation on the surface. The low-power HyperLens has a wide-angle aperture because of the metallisation: defects are often located *under* the metallisation, and the light from the defects bounces between the metallisation and the chip to escape at an angle. The wide-angle lens can capture these low-angle emissions.

As the speed of chips grew, metallisation on chips increased until some chips had four or five layers of metallisation, or unbroken ground planes. Increasing layers of metallisation improve speed, eliminate cross-talk, and avoid distortion. But the same metallisation meant the light from defect sites could no longer escape upward at all.

An unsolvable problem? Not at all. Light-emitting defects emit light in *all* directions, not just toward the top of the chip. One of those directions is toward the back of the chip, and fortunately, silicon is somewhat transparent to the wavelengths involved.

The solution which Hypervision devised was a precise and careful — but reasonably fast — technique (a patent is pending) to remove nearly everything behind the active circuit layers. A cutting/grinding tool removes a window through the plastic package, through the metal lead frame to which the chip is attached, and then through most of the silicon of the chip itself.

Today's chips are usually around 750 microns (0.75mm) thick; the Hypervision method removes about 700 microns of this silicon and leaves about 50um — a nice window thin enough for the light emitted by defects to shine through. The silicon window is also thin enough to transmit incident light, to produce the illuminated image showing the details of the chip. The process is so precise that it can even produce windows through the 'backside' of chips in uncut wafers. Through this window the emission microscope can produce emission and illuminated images just as sharp as frontside images.

For consumers, the benefit of finding light-emitting defect sites is direct and simple: fax machines, computers and all sorts of other systems — which might otherwise fail because of undiscovered chip defects — keep right on running.

Further information on Hypervision and its range of emission microscopes and associated systems is available from Hypervision Inc., 46560 Fremont Boulevard, Suite 415, Fremont, California USA 94538; phone (510) 651-7768 or fax (510) 651-1415. ❖

READER INFO NO. 44

By the way a 'brief' WeatherVox report includes time; current outdoor temperature; overnight low tempera-

ranging from $401.38 for the Ultimeter II to $767.38 for the Ultimeter 2000.
Sphere can also supply a wide range of

LOCAL FIRM DEVELOPS

DART: USING ISDN TO DELIVER RADIO ADS

A Sydney-based audio production studio has begun delivering commercials to radio stations around the country in digital form, via ISDN. The advertisers are delighted, and the stations are happy — they get the ads faster, and in high quality form; but claims of 'unfair competition' are coming from production firms still using older analog technology...

by BARRIE SMITH

Radio commercials — you either love 'em or hate 'em. But unless you Araldite your radio dial to an ABC or ad-free community station, you can't avoid them.

In this country we have one of the most advanced and balanced radio broadcasting systems — in terms of both content and technology. But there is one side of it which has been left to wallow in its own hash... the handling of the very ads which bankroll the whole commercial panoply.

In our major capital cities, there are now audio production studios which are equipped to deliver — and do deliver — an output equal to the world's best. One Sydney studio which is a leader in its field is Stellar Sound Studios, based in Glebe.

Stellar is managed by radio veteran Rob Lynch, employs 22 people and houses three voice studios and an unusual section which produces in-flight audio programming for 14 world airlines. Most times these operations run smoothly, profitably and with little headache. But a new area for the company, which kicked off on February 12 last, has caused an unexpected furore from the industry itself.

The new development is DART — Digital Audio Rapid Transfer — a new way to deliver radio ad spots to stations across the country. In a nutshell DART involves sending the ads in digital form, via ISDN (the Integrated Services Digital Network).

When Rob Lynch began as an on-air announcer back in the 60's, ads were replayed from 45rpm vinyl platters: "If you were doing a breakfast show, you'd have chaos in the studio. You'd have your three turntables constantly running. You never turned them off. You just put the next disc on, cued them up and played ad after ad."

That method had lasted about two decades, and was followed by delivery on 1/4" tape reels which went on for 23 years. In recent years most stations dubbed the supplied tracks onto tape cartridges, which at least delivered some form of on-air mechanisation. However the quality of commercials always suffered.

While FM brought benefits from a live voice content and CD quality music, the ads — which really paid for the whole show — often went to air from players stacked with cartridges which had probably seen two to three hundred passes.

Lynch: "The stations had gone digital. But the only thing analog on air were the commercials, the lifeblood. Everything around them was digital and the commercials were analog. Then they (the ad agencies) wanted them brighter, so they'd equalise them to be brighter until they broke up at the top end. This wasn't the solution at all."

In Lynch's view, it was obvious the agencies weren't going to do anything about it, nor were the radio stations: "And then you had the production studios, the third element of it. The studios were making a profit out of sending dubs, and they weren't going to help an end to that monopoly."

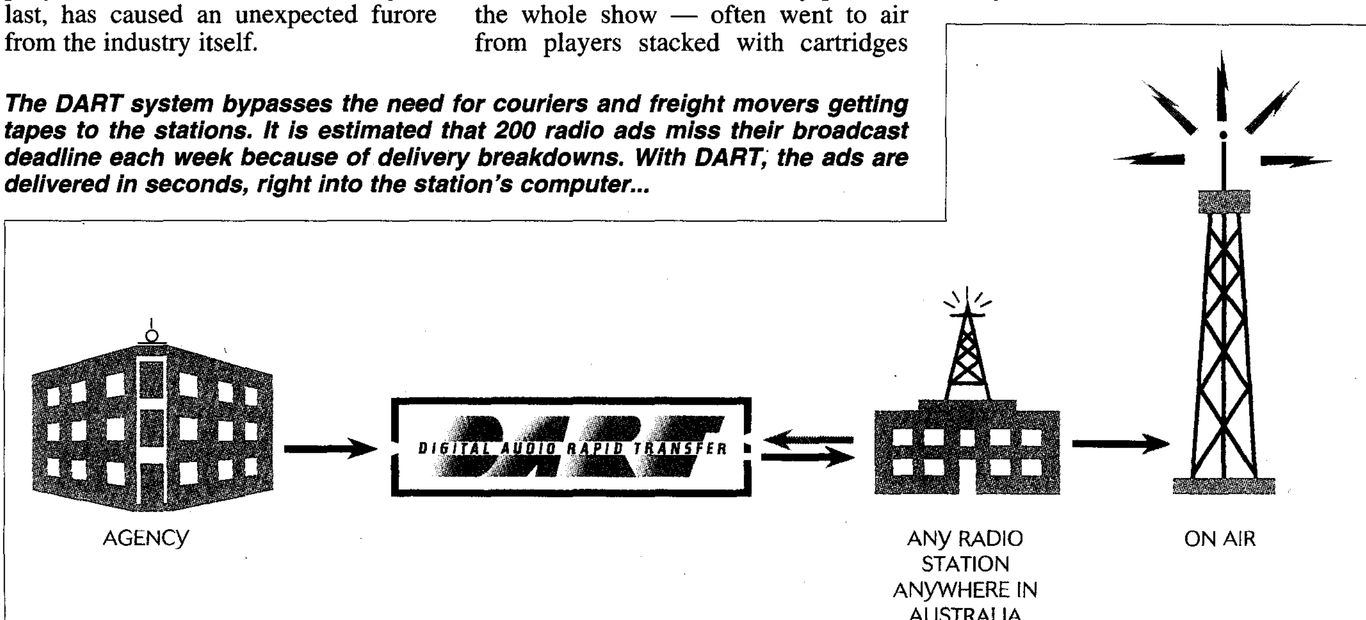
But Lynch decided to make it his problem — and to find a solution.

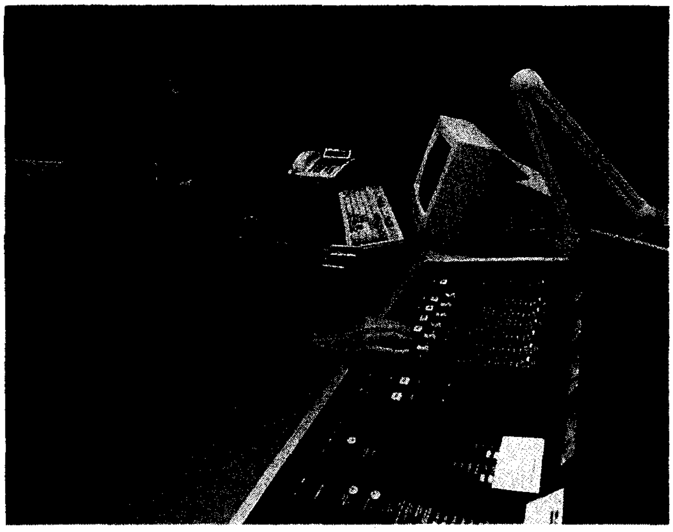
Enter DART

I visited Stellar's DART operation in William Street, Kings Cross and spoke to GM Linda Christian.

Ms Christian: "We've installed in every (commercial) radio station in the

The DART system bypasses the need for couriers and freight movers getting tapes to the stations. It is estimated that 200 radio ads miss their broadcast deadline each week because of delivery breakdowns. With DART, the ads are delivered in seconds, right into the station's computer...





At left, DART general manager Linda Christian monitors a radio advertisement prior to 'sending it down the line'. At her left hand is the master replay DAT machine — a Fostex unit. At right, Ms Christian at the keyboard of a 286-based PC, about to begin delivery of some audio tracks to a radio station via an ISDN link.

country computers and software so that we can send commercials by ISDN. We can have a 30-second commercial anywhere in the country in 45 seconds. All the hardware and management software is run from here."

A DAT cassette, 1/4" tape or ISDN feed is taken from a studio or an agency, traffic instructions are added and the tracks copied to a DAT machine in the main control room, controlled by a bank of PCs. Explains Christian: "It's really just a despatching system. Almost like a digital courier."

The DART setup operates at no cost to the stations, being financed by a transmission cost to the advertiser of $40 per 'send'. This transmission may contain a number of different spots. The conventional method of making tape dubs can equal this figure and more, when courier and freight costs are added.

Linda Christian: "The radio stations think it's just marvellous."

The advertisers also benefit, from the rapidity of delivery and ability to alter the playout schedule quickly. It is feasible for a spot to be written, recorded and transmitted by DART to any station in the country within the space of half a working day.

As the setup operates 24 hours a day, every day, an advertiser can instruct that the ad be transmitted at any time or even withheld until a specified release time.

Each radio station in the scheme (currently 123 out of a total of 161) has a PC linked to Kings Cross by ISDN and the spots are received and downloaded to whatever machine they deploy — be it DAT, CART or whatever — along with instructions for its correct scheduling.

The system is two-way in one sense: if an out-of-Sydney advertiser wishes to distribute material nationally, the tapes are given to a DART distribution point in each state capital to relay to Sydney for dissemination.

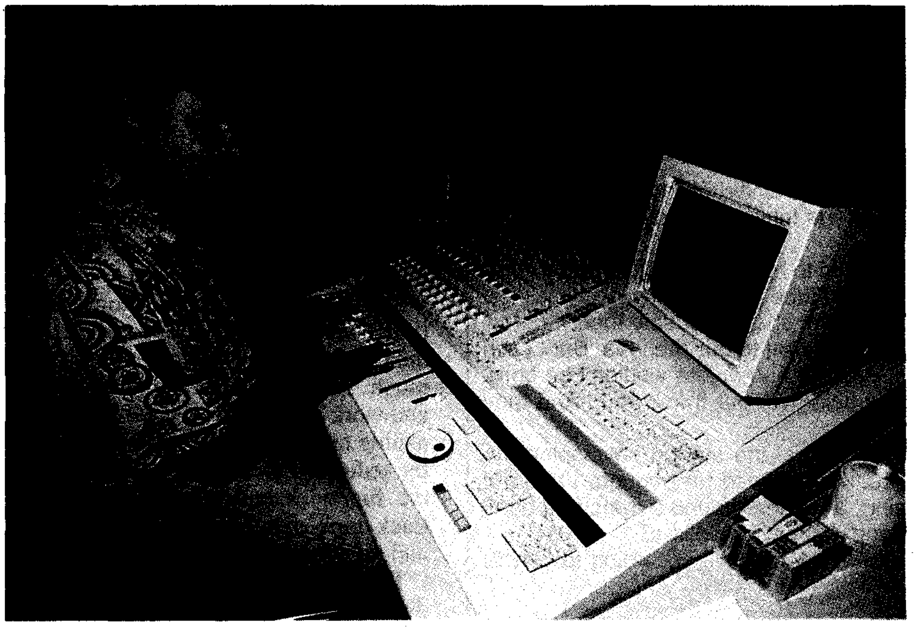
The quality is basically that of a CD. Transmission takes place after processing, via rack mounted file servers, linked directly into Telstra's ISDN system. The output to ISDN is 18-bit, 64x oversampled at a user variable 32kHz, 44.1kHz or 48kHz sampling rate. At both ends a 486DX4/100MHz PC is used, each using 8MB of RAM and a 540MB hard drive.

As mentioned, the entire cost of installation at the station end was born by DART. In some cases, the spots arrive and are integrated directly into the station's computer traffic/scheduling system, ready for broadcasting.

Significant outlay

Rob Lynch admits, in the start up phase "there were two schools of thought" on who would bear the cost of the installation:

"I went for what people do in their houses; the phone is put in for nothing, then they're charged to use it. I knew radio stations wouldn't even pay a con-



Recording engineer Brad Power driving one of Stellar's Lexicon Opus digital mixing consoles. The jog shuttle control at lower centre of the picture allows precise inching of any track on the system.

nection fee. But they wanted it and they were excited about it."

"The tenet of this whole idea is that it costs the radio stations nothing. So we stuck with that. I had a few heavy fights because that's where a lot of money went, obviously — about $1.4 million has gone into just the radio station installations."

The period from mid February to March was used to bed in the software and smoke out the bugs.

Pluses and minuses

Obviously, Telstra will gain from the ISDN revenue. Stellar (as a sound company) will lose all their dub revenue — as will other production studios.

Some other studios have revolted against DART, claiming it was a restrictive trade practice and ignoring the quantum leap in technology it offered. One group, 2UE/4BC already use satellite distribution for live programme output. They are opposed to DART.

What DART does is free up studios to maximise their creative input in recording, especially helping the smaller units who use outside dubbing facilities.

As Lynch says, people are still free to send dubs by satellite or any other way — "It's not a monopoly".

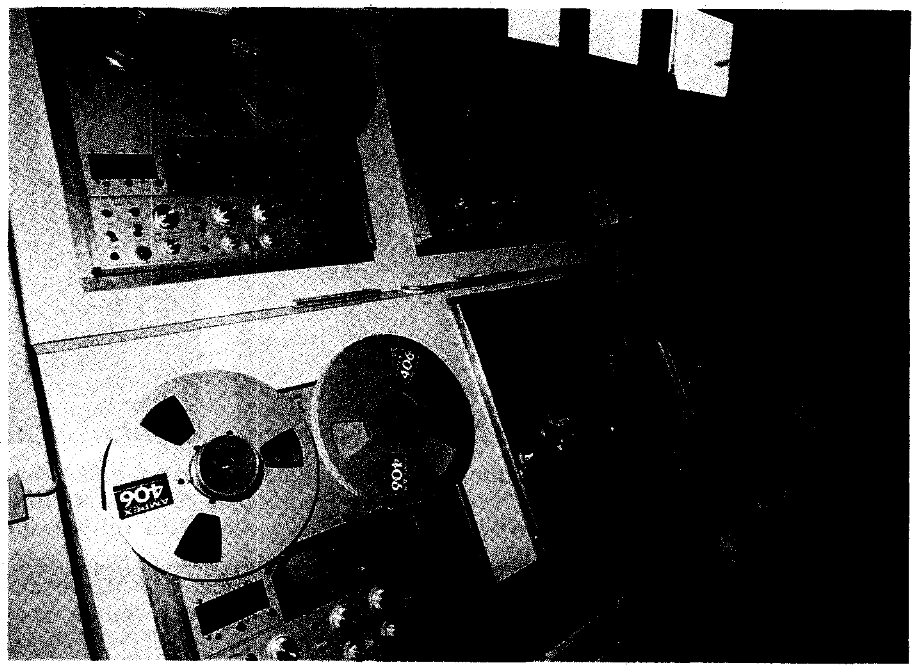
Stellar in the air

Well before DART was a twinkle in Rob Lynch's eye, a great deal of attention was paid by the company to its in-flight services. Running now for 22 years, 14 airlines take the service — from Qantas to Malaysian Airlines to Air Namibia. Lynch's company is in fact "the longest established producer of in-flight audio in the world".

Four full time producers make audio programmes for the airline clients. This includes original voicing and mixing with CD tracks, right down to the supply of the aircraft's cassettes.

When, say a classical programme for Malaysian Airlines is required, the producer employs custom computer software to devise a suitable programme, based on desirable parameters. At this point the computer assembles all the components, determines intros, mix and fade points, then goes on to produce the copyright reports.

Compact cassettes are used for output at the moment, but it is expected that Stellar's in-flight programmes will be on CD in the near future.



As DART takes over, so does the old guard of six Studer 1/4" dubbing recorders go out. Any offers?

Where did it go?

On the day of my visit, a crew was busy decommissioning rows of Studer 1/4" dubbers and an Atari 16-track studio recorder — victims of the relentless DART juggernaut...

Having spent many hours over the years in audio studios in various parts of the world, I was always impressed by the massive mixing desk — but less by the rack mounted analog recorders, continuously demanding of the operator's attention, sometimes to the detriment of the EQ and mix process.

Walk into a Stellar studio and you wonder where it all went. It fell, according to studio manager Brad Power, under the wake of Opus: a $300,000 digital mixing and editing system. Opus is essentially a digital audio workstation.

This tapeless digital recording system is fully integrated, offering random access and is controlled from a single mixing console.

Storing and editing audio on conventional magnetic tape always required management of sequential events, with much spooling back and forth to find and work on selected segments; melding analog and digital formats also added to the tedium. The Opus approach delivers the functions and controls of a multitrack tape machine, a mixing console and an editing system.

The audio material is recorded on hard disk drives. All audio inputs and outputs

How the DART idea was born, in Monaco...

It was mid 1994, and Rob Lynch was on a recuperative holiday with his wife in Europe: "I had been to an Edward de Bono lateral thinking course before I left. I was quite interested in ideas."

As he drove along in the south of France he said to his wife: "I've just had a good idea." He told her, and she replied "That's a good idea."

Lynch notes that it was "The first time in 30 years she's ever said that!"

Back in Australia Lynch met with Telstra, who offered to buy the idea. But Lynch said no: "If I'd sold it to them, it wouldn't go anywhere; the idea wouldn't be born. I know how those corporations operate. So I said 'No, but thank you'. And they came in as a sponsor. And they still are."

"After that I contacted software writers and others and started developing the idea. It then got to the point where it had been developed far enough. I had put about 100 grand into it. It was up and running, and then I found a merchant bank to finance the idea, because it has cost a couple of million dollars."

The DART system may well be suitable for video as well, according to Lynch: "We'd also like to take it offshore".

of the mixer can be 'soft-assigned' to either analog or digital input/outputs. Twelve channels of four section digital EQ (equalisation) is provided, able to sweep the entire 20-20kHz spectrum. There is also a DC blocking filter on each channel.

In operation, changes can be made to any element without altering the original material. To perform an edit the in/out points are determined and marked by rocking the audio back and forth, or by entering the time code address on a keypad.

A video display is used to confirm the machine's status and configuration, but many operators find no need for a visual reference.

One freestanding, remotely located cabinet stores the CPU and sufficient hard drive storage to hold over 14 hours of audio sampled at 48kHz. Four disks can amount to a 4.8GB capacity.

How about backup? Small, efficient and low cost Sony format 8mm tapes are used; each can hold 2.3GB or 360 track-minutes of audio.

The Boston-based Lexicon company behind Opus maintains remote diagnostic support and allows for software upgrades via an integral 2400 baud modem. At present there are two companies each in Sydney and Melbourne using the $300,000 Opus system.

It all makes reel to reel or tape cartridges look quite ancient! ❖

NOTES & ERRATA

240V Power Relay (January 1992): When using this unit with a 'master' appliance that draws a small standby current, the circuit can be turned partially on if sensitivity resistor R2 is of an unsuitable value — as detailed in the March '92 errata. If this is the case, the 'slave' 240V outlet may produce a *chopped* waveform much like that from a conventional light dimmer when adjusted to a low setting, which in turn can distress and even damage some appliance power transformers.

In the light of this potential for damage, we unfortunately must recommend that constructors do not build or use this project.

Subwoofer/Bridge Adaptor for 12V (March 1996): Electrolytic capacitors C7 and C9 are shown with the wrong orientation on the component overlay diagram on page 76. When correctly installed, the positive lead of C9 should connect to pin 9 of IC2, while that of C7 must be connected to pin 8 of IC2.

Also, 12V DC input leads are transposed in the overlay. The negative connection is towards the top of the diagram, while the positive lead is the lower of the two, as indicated by the '+' marking on the copper side of the PCB.

PC-Driven PIC Programmer (April 1996): Contributing author Charles Manning has advised of a minor design error in this project, and its remedy:

Although many prototypes have worked well for over a year now, I have discovered a slight design error. One of the purposes of U4, the 74LS05, is to drive the 13V Vpp switching transistor. When the transistor is off, the output voltage on U4 will be 13V, which is higher than the specified output voltage for these parts even though the circuit still functioned perfectly with a National Semiconductor part.

As reliability was a key goal in the design of the programmer, I decided to effect a last minute change. The 74LS05 was changed to a 7407. These parts are pin compatible, but the 7407 is capable of tolerating higher output voltages. Unfortunately these parts are non-inverting, so the control software had to be modified slightly. Since the 7407 is quite difficult to source, I am providing a 7407 with all sofware of full kit orders. So even if you buy only the software set, you will still receive a 7407.

My apologies to anybody who has been inconvenienced, especially the first few people to order kits; a delay in sourcing 7407s meant that they had to wait a few extra days for the kits to be shipped. ❖

The Challis Report

(Continued from page 13)

old as well as new uses.

Other developments

There are of course other new types of batteries currently under development. Some of the most exciting make use of polymer electrolytes in the form of ultra-thin laminates, with foil anodes and cathodes. One potential application of such technology would be to provide cost-effective and range-effective battery-operated cars. General Motors in America has been a serious researcher in this field for more than a decade.

Whilst it appears that the basic technology may be close at hand, a variety of practical problems has placed embarrassing pitfalls in its path. Possibly the most vexing of those problems is the need to assure that each cell in a stack is correctly charged. If not, then over-charging imbalances are likely to occur. Should that occur, then there is the risk of cell damage, or conversely inadequate stack voltage output.

With only four cells to charge in a stack, the task is relatively easy, but when the stack contains as many as 100 or more cells then the issue assumes critical importance. It appears that this problem has not yet been satisfactorily (economically) resolved.

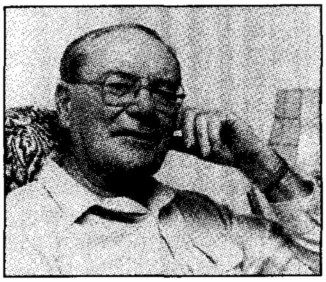
An equally vexing problem facing designers in USA and Canada is the impact of low temperature on battery performance. If a battery doesn't work at -20°C, which is a common winter temperature in most mid-western and northern states, then their problem becomes quite serious. Now lithium-ion batteries fortunately still provide at least 60% of their rated capacity at -20°C. As a result, they still have considerable appeal in many new designs for equipment that is likely to be operated out of doors.

It is my understanding that multicell lithium-ion batteries have been developed for automotive use, but at this stage there are still problems which have yet to be resolved.

With most manufacturers keeping quiet about their new developments until after their public debut, it's difficult to know what's really happening. As I discovered during my most recent trip to America, there are still many manufacturers who believe that their existing technology can be retained and markedly improved. It thus appears that the ubiquitous nickel-cadmium battery is by no means *passe*!

There are still more than one hundred million NiCad batteries being produced world-wide each year. That market appears to be strong and vibrant. Many of the major manufacturers are now developing 'memory resistant' batteries, as they face the competition from new contenders.

It looks like we'll have more batteries to choose from, but many users may still suffer from those vexing 'battery blues'. ❖



When I Think Back...

by Neville Williams

Arthur David Spring - 1: A true 'hands on' electronics engineer

After compiling 99 previous instalments of 'When I Think Back', it still came as a surprise to find myself writing this 100th column on the life story of a friend whom I thought I knew — until I set about preparing it for publication. Fortunately, I managed to persuade him to interrupt his still busy life to spell out his memories of other days onto tape cassettes, to augment a recording he made for the 'Bright Sparks' series on ABC Radio.

Family records attest to the fact that Arthur Spring was born at Wellington in the NSW midwest, in July 1918. His father worked on the railways, which were at the time central to the existence of many such country towns.

On the job, his father had spent many hours in the company of Ben Chifley, who was later to become Prime Minister of Australia. That, and the impact of the bitter railway strike of 1918, probably generated in the Spring family an attitude often described as 'left of centre'.

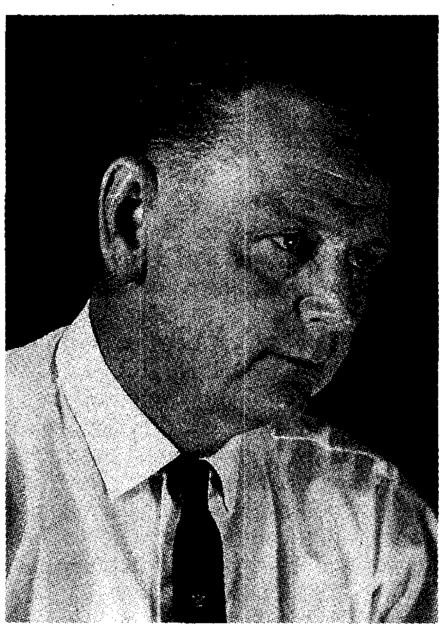
In his spare time his father busied himself with lodge activities and became an alderman on the Wellington council, where he sponsored the installation of the Wellington Park and a swimming pool to Olympic standards.

In this same time period, Spring Senior took up share-cropping at Mumbil — which I had never heard of until its mention in Arthur's tapes. (It must be close by, having the same postcode as Wellington.) While there, he introduced the Fordson tractor to the area. That phase lasted until 1925, when his father took the family to Sydney to become a Manager in a firm of funeral directors.

So it was that Spring Snr, his wife (a girl from Orange), young Arthur and a brother two years his junior ended up at Petersham, then at Five Dock, where a third son was added to the family.

Being of school age, young Arthur began to absorb the three R's, mainly at Five Dock public and later at Stanmore Commercial School. This last was at the insistence of his father, who tried to impress upon him that there was good reason to study book-keeping and other 'commercial' subjects, in addition to acquiring manual skills. In the taped interview with Stephen Rapley of the ABC, Arthur confesses that he found school utterly boring because it seemed so irrelevant to his real interest, which was in things practical and technical.

More to the point, in 1930 at age 12, he appears to have been bitten by the 'wireless bug' as evidenced by the fact that he built his first shortwave radio. How this came about is lost in the mists of time, although he does recall having enjoyed reading the biography of Thomas Edison. He also remembers that his father had put together a couple of crystal sets; his contribution to the exercise had been to heat the soldering iron on a gas flame — without burning off the 'tinning'. Yes, he would have heard 2FC on a crystal set, but he couldn't recall any special reaction to the experience.



Arthur Spring in his prime, in 1965. Building on his early practical experience, he had become Chief Engineer of A.W. Jackson Industries, and had designed and produced the very successful 'Precedent' range of B&W TV receivers.

He did however recall a couple of boyhood friends who were interested in wireless, and he did scavenge wireless parts from old battery sets — sufficient to warrant a direction from his mother to 'clean up your room'.

The radio 'bug' bites

From that collection of oddments came the wherewithal to build a two-valve shortwave set, powered from batteries and driving an old cone type loudspeaker. Perhaps the wireless craze was born on the day that he picked up a signal direct from Germany and yelled for his parents to "come and listen to this"!

From overseas stations, young Arthur Spring's interest turned to amateur signals and the informal chatter that went on between the operators. This prompted the construction of a receiver for the five-metre (60MHz) band — in the days when transmitters were self-excited oscillators and the receivers superregenerative detectors. Arthur was very proud when he logged an amateur direct from Newcastle.

Back to the HF bands, Arthur and a mate thought it might be interesting to have 'mobile' equipment, and accordingly loaded their gear into their respective billy carts. Arthur had the receiver in his; in his mate's cart was a car battery, an old Ford spark coil and a modified Emmco B-eliminator which rectified and filtered an HT supply for the set — involving a cable between the carts.

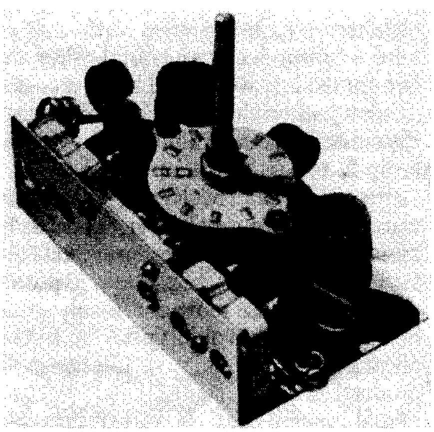
Such was their enthusiasm, they trundled this unlikely outfit all the way to an amateur station in nearby Ashfield.

'Pirate' amateur

Inevitably, perhaps, Arthur was caught up by the urge to be a part of amateur radio, and the result was a simple HF transmitter with which he was able to join in the conversations — as a 'pirate', using the callsign VK2BB.

His father in particular was critical of such activities, mainly on the basis that he was spending half the night playing with 'that thing' when he should have been doing his school work.

All went smoothly enough until he responded to a 'CQ' from VK2AA, who casually inquired about the area where he lived. Arthur discretely omitted to answer the question, but minutes later the phone rang to the sound of a friend's



The first identifiable engineering product designed by Arthur Spring: the Crown model ID-2 dual wave coil bracket, as advertised in 1937.

voice: "That's the Radio Inspector you're talking to!"

Panic reigned, his parents were dismayed, and within record time, all trace of a transmitter had disappeared from the premises. Nothing more was heard of the incident, but VK2BB had been effectively silenced.

By age 15, Arthur had passed all subjects in his curriculum, but at different times. "I didn't officially leave school", said Arthur, "I just lost interest in formal education!"

Meanwhile, Australia was in the grip of the Great Depression, as Arthur discovered when he started looking seriously for a job. He spent endless hours stand-

The Crown Radio building as pictured on the cover of their 1937 catalogue. By stacking all and sundry employees into the various departments, the interior photos suggest a staff complement of an improbable hundred or so!

ing in queues, extending 'down the street and round the corner', only to miss out. But he did have one advantage that was to stand him in good stead: he was interested in radio, he had built his own shortwave set and he could solder.

That finally commended him to Radiokes, at the time a prominent manufacturer and supplier of radio components to hobbyists and small receiver manufacturers. They offered him a job in 1935 at 13/6 ($1.35) per week, working with other juniors, male and female. He recalls that he and a Colin Sanderson shared a bench with two girls, assembling small components for the market.

Assembling radio 'bits'

In the 'Lab' were Max Laurey and Harold O'Shea, who 'designed' the components and kept a check on production quality.

In 1936, says Arthur, Harold O'Shea accepted a job in a rival company, Crown Radio, in Crown Street (Sydney) and he in turn proceeded to surreptitously 'poach' Arthur Spring. Arthur didn't mind in the least, because he was being offered 22 shillings ($2.20) per week.

That's how Arthur tells it, but subsequent events have suggested that the rivalry between Radiokes, Crown and RCS was largely posturing. Behind the scenes, it was convenient for all three to exchange information and facilities to their mutual advantage.

Crown Radio at the time was in incredibly 'pokey' premises towards the Wooloomooloo end of Crown Street, and the walk to work each morning took him past apartments occupied by sundry 'ladies of the night' who often made interesting suggestions to the 'callow youths' passing by...

Shortly afterwards, Crown moved to much larger premises at Pyrmont, with more air, more light and enough room to spread the acvities into separate 'departments' — including a quite respectable laboratory. Arthur recalls that, for the preparation of 'new look' literature (The *Crown 1937 Catalogue*) a photographer took shots of the various sections — but only after all and sundry had been shuffled to strategic positions to make the place look fully occupied!

Questioned about the role of unions at the time, Arthur said that for all practical purposes in small radio factories, their role was nil.

Employers paid what they had to, and hired and fired at will, depending on the supply of materials and the state of the Order Book. Work was seasonal: busy in winter, slack in summer and "at its worst in the Ides of March".

'Hands-on' tuition

Be that as it may, young Arthur refined a range of production skills at Crown, including the correct tinning and termination of multi-strand 'Litz' (Litzendraht) wire, observing the critical effect it had on the 'Q', gain and selectivity of tuning coils and IF transformers.

In the same context, he was made aware of the need for operator precision and hygiene in handling fine wire and the ruby mica dielectric in compression trimmmers. (Perspiration from female operatives during their monthly periods presented a subtle hazard.)

He spent time in the laboratory, and contributed to the design of Crown prefabricated dual-wave coil brackets which were used by hobbyists and small manufacturers.

By 1937, he had absorbed sufficient practical know-how about wireless workshop practice to compete for a job in his own right — which is how he ended up at the then-nearby Breville

Radio, again on the heels of Harold O'Shea. There he found himself involved in the production of receiver components, much as in Radiokes and Crown, except that Breville was making them for use in its own receivers.

As one assignment, he was directed to study the design and layout of a new battery powered receiver that was being readied for production and release. His commission was to prepare a set of wiring guides in full colour which could be used on an assembly line. As the chasses were moved along, each operator would instal the particular leads and components shown on their individual display board.

It so happened that Arthur found one of the female coil winders, Myrtle by name, particulalry attractive. In due course, after all the usual preliminaries, they were married in 1942 and set up home at the same street address in Henley where Arthur still lives. It was a happy marriage, and Arthur adds that he was 'devastated' in 1964 when his wife died quite suddenly of a heart attack.

In terms of his career, Breville Radio provided a more purposeful engineering environment than in Arthur's earlier years. It was headed up by none other than Noel Smith who, in evening hours, was final-year lecturer to the first generation of radio graduates coming through the Sydney Technical College — now the University of Technology.

Learning by doing

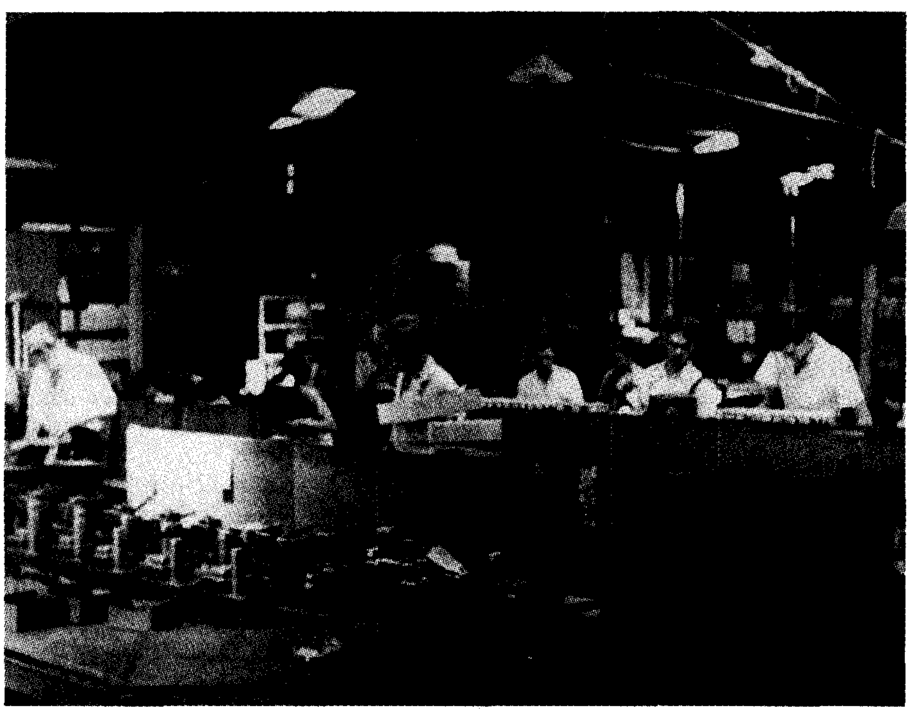
It was about this time that a maturing Arthur Spring realised that he didn't have a head for routine 'book learning'. I quote: "The shutters went up. I came to grip with theory by actually doing things, and working out why they were so in the hands-on context."

If he was going to get anywhere in life, his best prospect would be to apply himself seriously to the subject they were describing as 'electronics' and seek to become really good at it. Success would be consummated by becoming a chief engineer, a manager or running a company of his own.

For the present, he was warned by Breville management to get more rest instead of staying up into the small hours merely fiddling with radio. Under pain of 'the sack' he simply must turn up for work on time and alert!

He recalls how he once asked Noel Smith: "Should I enroll at tech"?

"No", said Noel; "Do what you're doing now — but keep your mind on the job!" "The important thing is not to carry all the facts in your head, but to know where to find them when you need them!" For him, Arthur reckons, it was timely advice...



An inside shot of the Breville factory in 1938. An unusual fact Arthur remembers was that the operatives were not issued with stools. They were expected to work standing up, behind high benches!

Breville Radio moved to Missenden Road, Camperdown (Sydney) in early 1937, poised to become a major manufacturer of domestic radios and other retail products under the Breville Radio banner. Painted on the building for all to see was the motto favoured by the proprietor, Bill O'Brien: 'Eventually — Why Not Now?'

Typical of an expanding enterprise, it had a machine shop on the ground floor, radio assembly facilities on the floor above and a laboratory in a first floor extension 'out the back'. In summer, Arthur recalls that the lab was "as hot as Hades", trapped as it was between a galvanised iron roof above and coke ovens below operated by the manufacturer of 'Bonzer' automobile leaf springs.

Arthur knew about the annexe, because he would seem to have become a kind of technical 'handyman', poised somewhere between the lab staff and production.

The problems were gradually sorted out, however, and five test booths were installed, double screened with chicken wire — three for production testing and two for the lab, which had been relocated in what had originally been a showroom.

Reminiscing about traditional Australian radio factories, Arthur observed:

"Blokes like Alan McKeown in the final test rooms were usually very good technicians, not necessarily certificated but very experienced. Arguments between them and the lab most commonly arose because designers didn't make sufficient allowance for cumulative tolerances in production components."

"Final testers had to sort things out when particular chasses tended to come off the line unstable, because factors enhancing the gain met up with unduly low tolerance bypass capacitors."

"The testers tended to complain that 'It's one thing for you blokes to build up a couple of prototypes — it's quite another when we have to mass-produce hundreds of them'!"

That's what Arthur Spring was about when war broke out in 1939. Along with many other manufacturers, Breville was informed that their expertise and facilities would have to be re-directed to meet defence needs, and that their key employees would be provisionally classified as: 'in a Reserved occupation'.

At a purely personal level, this suited Arthur Spring. In personal conversation he told me that he had never been interested in subjects like astrology or religion — being, in fact, an atheist. He was also a pacifist at heart and could generate no enthusiasm for a 'foreign' war. This, despite the fact one of his brothers was an Army officer. Defence of one's country was one thing; a shooting war about European politics was quite another!

At Breville he was in a reserved occupation. Better still, he became involved in a group required to develop and produce mine detectors for the Australian Forces. For him, any personal conflict had been resolved; he was helping the war effort, not by destroying people but by decreasing their chances of being maimed or killed. He was also engaged in practical technical research. More about that later.

Radio production under wartime conditions posed some weird problems, particularly when they were called upon to produce a quota of civilian and/or welfare receivers without absorbing scarce raw materials. Ganged tuning capacitors were a case in point, where they had to stamp the plates from zinc rather than fine gauge aluminium. The increase in mass was such that they would tend, in the presence of vibration, to rotate heavy section down — thereby re-tuning themselves towards the low frequency end of the band!

Spring's electric car

Arthur's interest in technical projects was underscored in 1942 by his decision to build himself an electric car, (a) to discover whether it was practical and (b) to sidestep civilian petrol rationing. His starting point was an old Fiat, the likes of which I well remember from my own youthful past.

Arthur replaced the petrol engine, gearbox and radiator with a specially wound six horsepower electric motor, driving the layshaft by cogs and chain. Reversing was achieved by switching the polarity of the motor feed.

He stripped off most of the bodywork to save weight, and rearranged things to accommodate an array of lead-acid accumulators. How many and how he came by them is not part of the story, but he did reach one important decision.

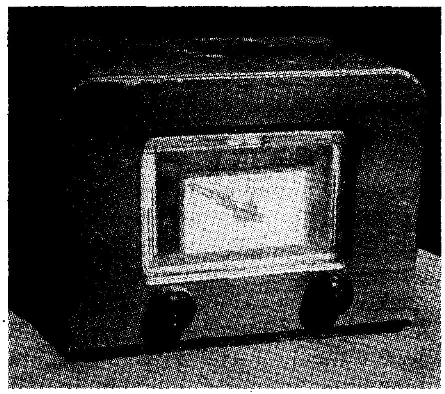
He could have connected them in series-parallel to provide a low voltage (e.g., 48V) high current supply, but the efficiency of the system would have been compromised by resistive losses in the cables, the connections and switching.

So he decided on a series connection, giving him a high voltage (nominally 200V) lower current system, with a motor to suit. A further consideration, I gather, was that, with care, a high voltage battery bank would be easier to charge from the AC mains that one demanding a massive step-down transformer and rectifier...

Put to the test on a (then) gravel road between Five Dock and nearby Haberfield, the electrified Fiat whipped up to around 60mph in no time flat — being faster off the mark than his father's V8 Ford!

Having spent some of my own youth riding around in 501 and 509 Fiats, I can assert that the only way they would normally ever reach such a speed would be downhill with a tail wind! What's more, such were their sluggish cable brakes, that the driver might then have needed uphill and a headwind to stop within a respectable distance!

Arthur had known beforehand that back EMF could pose a problem, especially at the instant when, at speed, the motor was disconnected from the batteries. With no batteries to peg down the voltage, residually energised fields and the



An obvious indication of the enthusiast element in the Breville lab — an FM tuner based on the American 'Pilot' design, but intended for use on the ABC's 'experimental' FM channel.

rotor spinning at speed, the back EMF — in Arthur's words — could build up to "thousands of volts".

On one memorable evening, Arthur was doing his thing on the gravel track when the copper stop-go switch that served as an accelerator arced across the gap and welded itself 'on'. The 'flying bedstead' was out of control, drawing 36A and hitting 58mph without effective brakes!

Arthur had provided for just such an emergency with a knife switch on the facia. The trouble was that when he reached across to 'save his neck', the resulting arc fried his fingers...

He subsequently tried various tricks with carbon block make-before-break contactors, but in the evening shadows, the 'naked' electric Fiat's progress through the streets of Five Dock was still marked by "more sparks and arcs than a Bondi tram".

The motor didn't like the peak currents, either, and he tired of having to repair it. All told, at that point in time, an electric car was judged not to be an attractive proposition, so he settled for a Morris Minor and a motor bike running on whatever petrol he could get.

Whatever else he learned from the experience, Arthur didn't need any formal lessons about the reality of the back-EMF effect, no matter what the academics might say about the terminology.

Mine detectors

Back at Breville, Arthur remembers the day when a rather talkative man made his appearance with "an idea that might be of interest to the Armed Forces". At the time, Rommel was trying to battle his way into Egypt, while the Allied Forces were just as keen to push him back the way he had come.

Both sides had planted landmines in the desert, with the result that it had become a very dangerous place to venture. Invisible under a few inches of sand, the mines were a major hazard to vehicles, animals and foot soldiers alike.

The talkative one had worked out that it might be possible to detect the mines with the aid of an electronic search coil that would react to the presence of a metallic object under the sandy surface. It would alert the operator by changing the pitch of an oscillatory tone or a heterodyne whistle.

Army officers he had spoken to were interested, but not to the point where they were prepared to put the proposition to the Department of Supply. Perhaps Breville could have a look at the idea 'unofficially' and see whether it might be practical. Why not? So the idea was referred to 'the blokes in the lab'. Initially that boiled down to a certain non-academic but inveterate fiddler and experimenter: young Arthur Spring.

The talkative one had put together a prototype, using batteries and battery type valves which were accommodated in a pack meant to be strapped to the operator's back. The search coil was mounted on a separate wand with a lead plugged into the equipment, along with conventional pair of headphones worn over the ears.

It worked in a fashion, reacting to steel whatnots buried under the turf, but it was obvious to Arthur that a desert soldier might not want to walk around fully erect carrying a cumbersome back pack and manipulating a wand carrying a search coil. If shooting started, he would need to make himself as inconspicuous as quickly as possible — face down, flat on the sand!

In short order, mine detectors became

the subject of much discussion within the Company and with representatives of the armed forces both here and overseas.

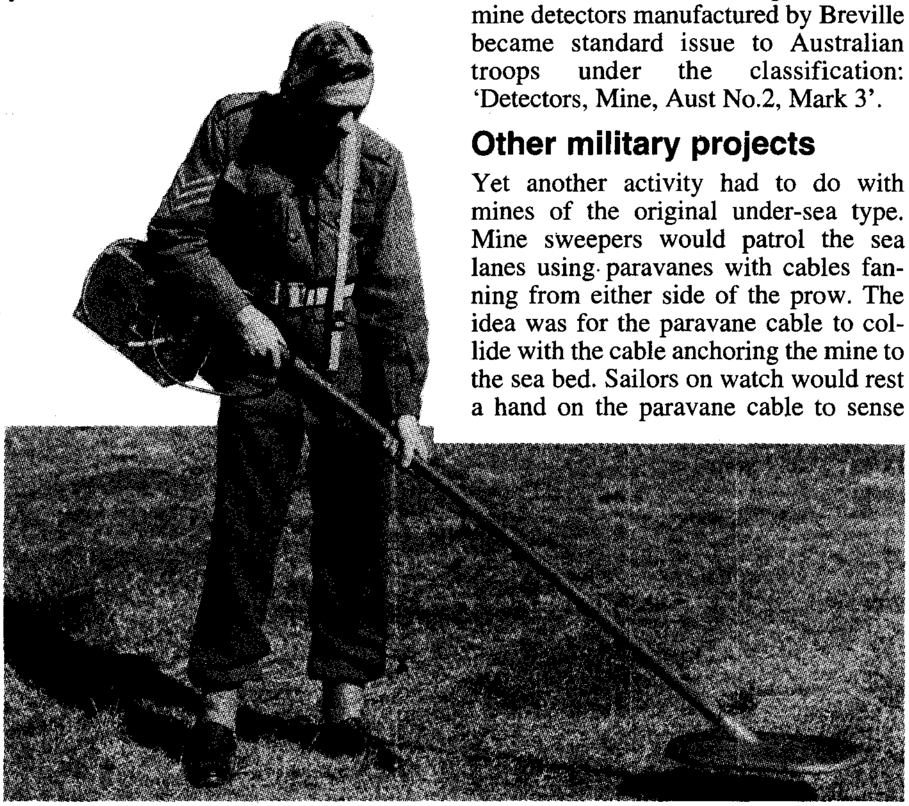
Breville's prototype

In the ultimate, when Arthur assembled the Breville prototype, the probe coil and electronics were concentrated at one end of a stout telescopic rod and the batteries at the other. The weight was balanced so that the rod could be slung from a strap over either shoulder and manipulated with one hand or both. It could be dropped easily onto the sand and nudged along with the operator lying prone.

Arthur recalls that he became so involved in the project that he worked alone in the factory for 36 hours straight, over one weekend, interrupted only when the boss turned up with a bowl of hot soup!

Breville finally made up an experimental batch, which was despatched to North Africa by military air transport — a memorable occasion when the heavily loaded plane barely lifted off the end of the runway. ("Phew!")

Fortunately the prototypes made it to their destination and proved to be a practical proposition, well worth pursuing. Indeed, mine detectors were to feature prominently in Breville's future activities, and Arthur tended to specialise in them.



The Breville Mine Detector, largely the work of Arthur Spring, being demonstrated by his brother in Army uniform.

When the emphasis shifted from the Sahara Desert to islands in the Pacific Ocean, conventional landmines were replaced by Japanese anti-personnel mines. About the size and shape of a 'stubby', they were buried upright as often as not, under black wet magnetic sand which shrouded them from magnetic sensing. When triggered, they would jump up about a metre and explode, smashing ceramic marbles into a soldier in a body area where a man is particularly vulnerable!

Detectors had to be devised with a two-way switch for (a) magnetic sensing and (b) eddy current, phase shift effects caused by non-ferrous metal components. Assembled on a long telescopic rod, they were too heavy and awkward to be handled gently during a beach landing but were simply tossed over the side of the landing craft, then recovered and carried through the surf onto the beach, where they were pushed up the slope ahead of operators lying prone on the sand.

At the factory, the electronic unit was final-tested by being placed in a tub of water about four feet (1.3m) deep for a specified time. Any suggestion of bubbles would be interpreted as a leak and a need to re-check the sealing. Personnel mine detectors manufactured by Breville became standard issue to Australian troops under the classification: 'Detectors, Mine, Aust No.2, Mark 3'.

Other military projects

Yet another activity had to do with mines of the original under-sea type. Mine sweepers would patrol the sea lanes using paravanes with cables fanning from either side of the prow. The idea was for the paravane cable to collide with the cable anchoring the mine to the sea bed. Sailors on watch would rest a hand on the paravane cable to sense any such encounter.

It was a tedious job which demanded constant alertness and at Breville, Arthur was able to come up with a clamp-on magnetostriction microphone and amplifier system, which could 'listen' for scraping noises on the paravane cable and sound an alarm.

Amongst the other wartime projects at Breville which Arthur recalls was a general purpose multiband receiver ostensibly for use in Bren Gun carriers. Arthur was involved because of his background in shortwave communication, but during the course of its development, the emphasis shifted progressively to a general purpose role. The specification, however, still required that prototypes be suitable for installation in a Bren Gun carrier.

Arthur says that he can still remember the official visit to the specified Army Base in the quiet comfort of Bill O'Brien's Studebaker. The Bren Gun carrier would be waiting, antenna fitted and crew on standby.

On arrival, the receiver was bolted into place and connected to the antenna — a stout telescopic rod, nominally vertical but free to flex any-which-way by reason of a rubber joint part way up from the bottom.

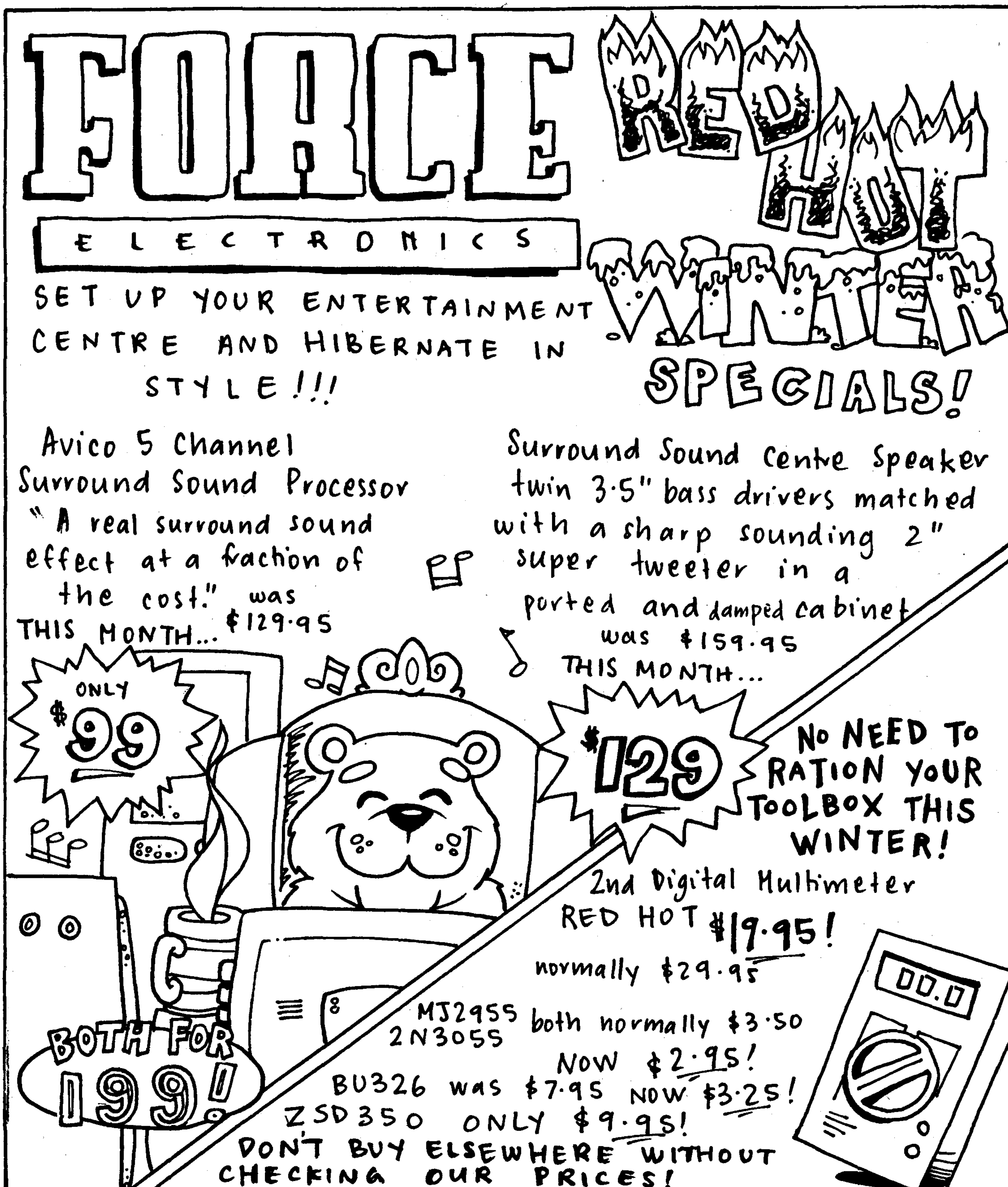
The route and terrain negotiated for the test run had to be experienced to believe. The Breville personnel had to hang on for dear life, and all the while the rubber-jointed antenna was whipping around their ears like a 'stockwhip from Hell'.

The receiver didn't fall to pieces, but that's about as far as it went. The Army covered the development costs, paid for the prototype and that was that!

They also expressed an interest in a multiband UHF receiver. Breville's Lab did the necessary development work at the Army's expense, but when the time came to place a bulk order, they decided not to go ahead with it. The reason, it seems, was that American radio equipment was appearing on the scene, inhibiting local military planning.

Along similar lines, Breville was requested to quote for equipment to monitor the landing beams serving Mascot Airport. If these were interrupted for any reason, the military wanted to know, without waiting to be told. This option, too, was not taken up.

By way of compensation, however, orders were placed by the US Armed Forces as, for example, timing equipment based on transmissions from WWVH in Hawaii. (*To be continued*) ❖



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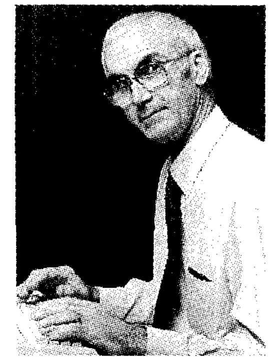


Should electronics technicians be paid more than street sweepers?

As promised last month, I still have a couple of reader responses on the subject of microcontroller-based projects, and I'm presenting them here. There are also some letters following up on other recent topics. But there's been a particularly sobering letter in response to my editorial in the February issue, on the subject of career opportunities in the Australian electronics industry, and because it raises an aspect that tends to affect just about all of us — wage and salary levels — I've decided to give it first kick.

In my February editorial, you may recall, I talked about the current and rather worrying trend in many firms away from permanent employment, on-the-job training and offering true 'career' opportunities. I suggested that this not only discouraged young people, but would turn out in the long run to lead to disaster for both the firms concerned and for Australia as a whole.

I went on to note that luckily there were still some firms, like advertiser Dick Smith Electronics, who *are* still committed to providing permanent employment, on-the-job training and true career opportunities. I felt this was worth mentioning, because at first sight many young people might not think that a distribution and retailing firm like DSE would offer many career opportunities for young people interested in the technical side of electronics — when in fact they do.

Anyway, it seems that this particular editorial managed to hit a raw spot with at least one reader, who sent in the following rather sobering and thought-provoking letter. The reader concerned has supplied their full name and address, as a sign of good faith, but in view of the comments made have asked that I refer to them merely as 'P.R. of Crows Nest, NSW'.

Without further preamble, then, here's what P.R. has to say:

I read with interest your February editorial suggesting young electronics technicians consider a career with Dick Smith Electronics. Certainly I have found most of the staff at DSE and Jaycar, to name just two, friendly and often surprisingly well informed. It does appear a good career start.

However, your editorial touched a tender nerve. I have reached the stage of not recommending electronics as a career to anyone who intends living in Australia, unless they have firm plans of running their own business. The reason is simple. There's just no money in it!

Having recently returned to Australia after many years abroad, I am shocked, surprised, and quite angry at the pathetic wages offered to electronics personnel, whether as technicians or qualified engineers. During my time overseas, I worked in no less than ten foreign countries as basically an electronics technician. In all these areas I earned a very reasonable living — not rich, but well off.

But upon returning to Australia, I find wages for technicians and engineers have remained at a stagnant level for seemingly the last ten years, whilst the wages of most other types of career have risen somewhat with the cost of living.

Here I found it hard to get any sort of electronics work at over about $30k per year. This is poverty level in Australia, and most especially so in Sydney where rents are high and everything is more expensive. Here I see examples of our finest engineers and technical staff, the CSIRO for example, and other research establishments, getting a pittance compared to their colleagues overseas.

I think we have a compound problem in Australia, concerning all types of engineering personnel, electronics and other. For a start we have a 'cultural cringe' regarding our abilities. Despite being hailed, and justly so, as an inventive country, we maintain the attitude in Australia that anything invented overseas must be better. We are constantly bringing in overseas 'experts' to do the 'difficult' jobs for us, when there are plenty of Australians far better trained, and with far more knowledge, right here. Bringing in American 'oil experts' to Bass Strait is a typical example.

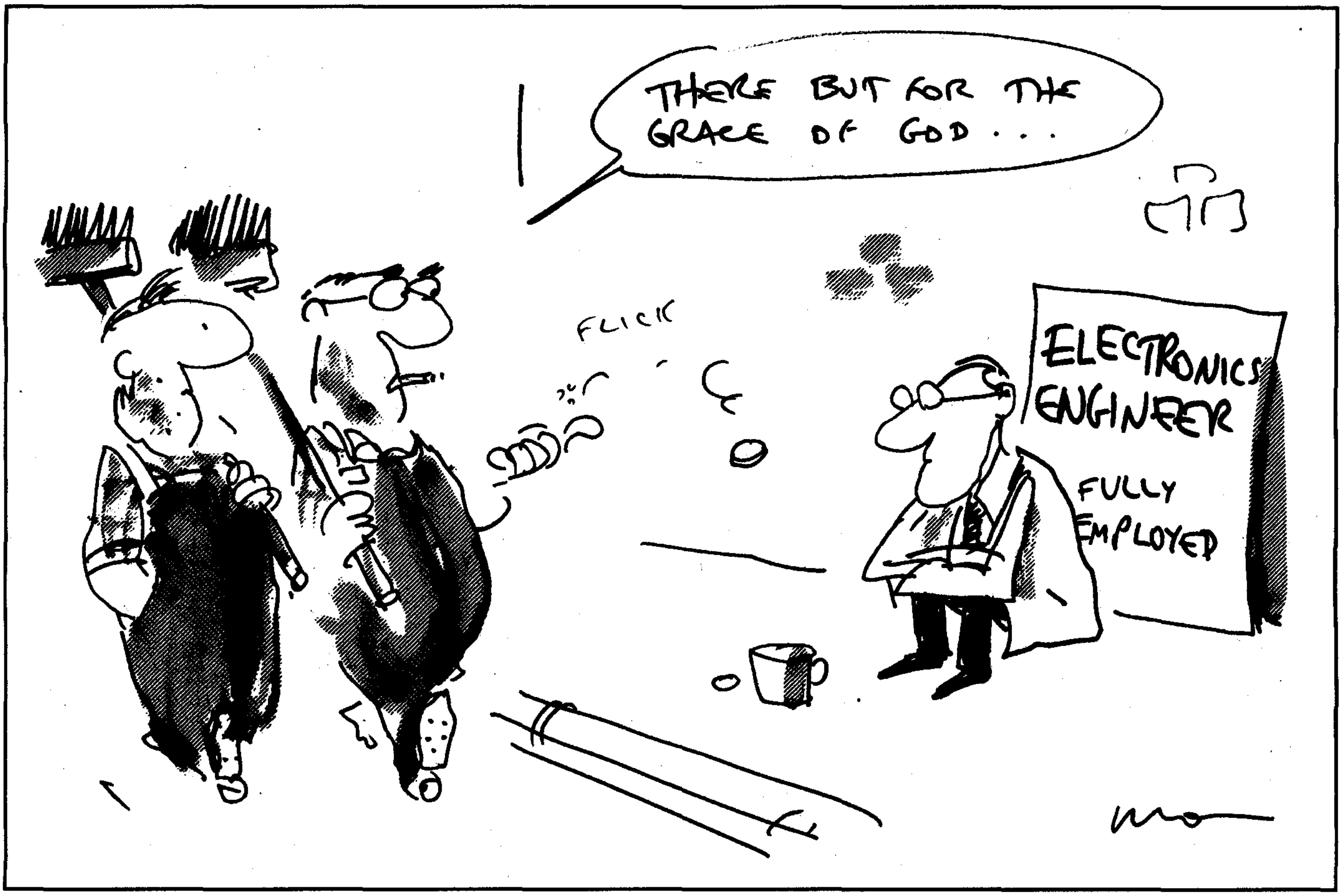
We also have a severe problem of 'image'. Hollywood movies are much to blame for this, stereotyping engineers and technicians in movies such as James Bond. Technical personnel in 'weapons research' laboratories are portrayed as eccentric bumbling buffoons, brilliant scientifically but devoid of any social graces, inept in speech, dress and manner, prone to dribble...! We've all seen the 'mad professor' image, the goofy-like technical assistant.

Technician = 'Mr Fixit'?

On the other end of the scale, many in the public indentify 'technician' with 'toaster repair man' — the poorly educated 'Mr Fix-it', who puts plugs on lamp cords, or at best is good at cleaning telephones. Who amongst us hasn't had a faulty transistor radio or fax machine thrust upon us by the dreaded relatives, or a neighbour, when you actually work in Nuclear Science?

A further problem exists, due to our mostly British origins. Not so easily detected perhaps, but there nevertheless. It stems from the English upper class attitudes prior to WWII, that people in 'trade', or engineering people, were not really 'sociably acceptable'. Shakespeare even used the phrase — 'the crude mechanical'. Engineers were nasty messy people who were always covered in dirty grease and oil from their infernal machinery.

Certainly whilst I was at Sydney University in the '60s, engineering students were regarded as 'lacking' in social status. I believe the popular



term now is 'Nerd' — yet another stereotype image, destined for people who like computers.

Well, having worked in all sorts of engineering fields, including research laboratories, I can vouch that these images of technical people are wholly unjust. In the main I see people so dedicated to their work, with a love of electronics and science, that if there is any complaint to be leveled, it's just that they are often too busy to worry much about money. Most know that unfair advantage is being taken of them, but we've never been an aggressive bunch and tend to avoid conflicts about wages.

As a result, we've been left far behind in wages upgrading. I believe, and I hope, that will change in the near future. Already our universities and colleges are noticing a severe downward trend in applications for technical courses. It will be a great loss to Australia if we lose any more of our engineering and technical skills.

What a society! We'll pay our most looney politicians well over $100k+++ per year, local GP's (doctors) are getting depressed at a miserly $80k, yet we begrudge a research scientist, working on increasing world food production or developing amazing communications technology, or yet another wonderful medical technology breakthrough, a mere $40k and often lower wages.

All of those who don't agree with the above can immediately throw away that mobile phone, Walkman, CD player and hi-fi, the TV and VCR, your hearing aids, pacemakers, bone growth stimulators, marine radios, communications systems, satellite links and computerised motor controls for you car. Who do you think invented them?

By all means choose an electronics/scientific career if you must. But besides four to five years of hard study to become either a technician or engineer, it will take up a great deal of your time in constantly upgrading your knowledge, taking further education courses, and lots of home study, just to keep abreast of technology. And you may end up being paid peanuts for your pains.

As a final word, I suggest a study of the popular newspaper job advertisments over the coming weekends. I almost gave up looking for electronic work when I came across an advertisement for a 'Labourer/Street Sweeper', that offered better wages than many of the electronics positions.

Well, there you are: a cry from the heart, if ever there was one. Thanks for your letter, 'P.R.', and you certainly raise some very pertinent questions — not just about the salaries and wages of technical people working in the Australian electronics industry, but about the low status and recognition afforded to a great many of our scientists, engineers and technicians in general.

I don't think anyone would argue that this lamentable situation exists, or that in the long run it's going to prove a serious problem for our country. The real question, I think, is what on earth we can *do* about solving the problem...

I'm aware, for example, that virtually the same situation applies regarding our teachers, and also our nurses. Both of these professions have a high percentage of truly dedicated individuals, who gain a great deal of personal satisfaction from doing their job really well — but in both cases their modest status and meagre salary levels are far below what would be appropriate and just, in view of their true importance to our society.

How have *these* professions tackled the problem P.R. raises? As far as I can see, only by raising public awareness of the iniquity of their position, and also by being prepared to take industrial action, if necessary, to gain improvements in salary levels. Unfortunately industrial action also tends to detract from their 'professional' image in the public eye, but this is perhaps a tradeoff that must be made, at times...

Mind you, it seems to me that even taking these steps, these professions have actually made very little real headway — either in terms of improving their status or in raising their salary levels to a just level. So perhaps these tactics aren't likely to achieve a great deal for scientists and electronics people, either. Still, if anyone has discovered a better way to raise the status and salary levels of all of these vocations, I'm sure we'd all hear it.

I certainly agree with P.R. that it seems crazy, and a potential disaster for the future of Australia, when higher salary levels are being offered for labourer/street sweeper positions than for electronics technicians.

CD compatibility

Important though this subject is, though, let's leave it for the present and turn to another letter that came from Mr Peter Hanicek, of Brisbane in Queensland. Mr Hanicek is adding to the discussion of compact disc/CD player compatibility problems and their causes, first raised by Gerard Lawrence in the December 1994 issue and since then addressed by others in the March, July and December 1995 issues, and more recently in the March column by Keith Walters.

Mr Hanicek adds another possible cause to the problem of CD players that won't play some discs, based on his direct experience:

Regarding CD players and a possible cause of disc incompatibility due to TOC (Table Of Contents) loading problems, my specific fix for this fault with my own CD player hasn't been mentioned yet, so I've decided to write, for your interest if anything.

I had a problem with my Technics SL-P2 CD player purchased new back in 1986. This player would not load half of my CD's — i.e., it failed to recognise the CD at all and had been written off by the company's servicing centre. As a technician of sorts, I decided to have a look myself.

In this player the laser servo head assembly is driven along two rails by a belt driven motor. At either end of these rails is a leaf-spring type make contact switch, which tells the electronics that the laser head has reached the end of the rail. What I found was the switch at the spindle end of the rail was incorrectly adjusted and this was preventing the laser head from getting sufficiently close to read the innermost tracks. This wasn't visibly obvious.

The adjustment was simple and to date the player has never faulted since, with any CD purchased.

Thanks for your contribution, Mr Hanicek. I for one found it particularly interesting, because it was exactly this kind of fault that I originally suspected might be responsible for those mysterious compatibility problems. I wonder how many of the problems are due to similar 'misadjustments' in other players?

Fax modem compatibility

Moving on again, though, another reader has sent in a contribution to the topic that Tom Moffat first raised in his article 'Formulas for Fantastic Faxing' in the September 1995 issue, regarding the performance of computer fax modems in comparison with dedicated fax machines. You may recall that a reader commented on this in the March column, and was very critical of the simplified line interface and lack of adjustable equalisation used in many fax modems.

The new response has come from Mr H. Jansons, of Wynnum West in Queensland. Mr Jansons works for Telstra, and as you can see he basically seems to support the points made by our first correspondent:

I have just been reading the item 'Fax modem performance' in the Forum section of the March 1996 edition.

I am employed with Telstra. A few years ago I was involved with a Section which investigated technical problems associated with customer complaints and, amongst the many problems investigated, fax problems had their fair share of complaints. This Section had Groups in each of the States and a number of these became specialist in a particular field — with the Sydney group, along with its specialist equipment, becoming renowned for being in the forefront of fax operations and knowledge.

Of the many fax complaints the Telstra troubleshooting Group investigated, the majority was due to exactly the symptoms that your correspondent from South Australia stated — poor equalisation to the cable, incorrect signal levels, mismatched impedances, etc. All led to signal distortion and hence corrupt data, with the result being poor quality faxes. All major fax equipment suppliers eventually realised, just like your correspondent's company, the importance of correct setup. Now they provide a setup service as part of the purchase of a fax machine.

Granted there were pockets of poor telecom cable. However, most of this has now disappeared with the modernisation of the network, upgrade of customer cables, customers being more discerning about their telecommunication needs, and Telstra being more customer responsive.

This leads back to Tom Moffat's article 'Formulas for Fantastic Faxes'. What type of subscriber network have the fax/modems been designed for? (The cable impedance is more complex than just 600 ohms.) Can these modems be better matched to the cable, and how can this be done without the need for sophisticated test equipment?

Maybe you can arrange to discuss this matter with one of the major modem producing companies.

Thanks for those comments too, Mr Jansons, and it's interesting that the findings of the Telstra group agree so well with the points made by our first correspondent. There doesn't seem much doubt that some of the fax modems are either incorrectly adjusted, or incapable of being either properly matched to, and/or equalised for the telecomm line.

I suspect that by now it should be possible to make modems that are capable of performing their own automatic setup, to achieve optimum operation on a given line. I'll try to find out whether this is the case, with some of the newer models.

More on micros

For now, though, let's return again to that topic which has obviously proved so thought provoking — whether or not magazines like *EA* should describe more microcontroller-based projects, and whether we should provide full source code listings when we do. This was launched in the January column, you might recall, and we've published quite a few responses since then. But as I mentioned last month there are still a couple to show you, and their time has finally arrived. Sorry for the delay!

The first comes from Mr Mark van der Eynden, of Ferntree in Victoria. Here's what Mr van der Eynden has to say:

Please allow me to respond to your December '95 EA Forum 'Why Doesn't EA publish more micro-based projects — with full source code'.

I tend to agree with much of what is said by both parties, but I can not agree *with the kit supplier viewpoint. Surely stocking a preprogrammed chip is the same as stocking an XYZ special function chip as used in the ABC project. It could even be more effective for the kit supplier to stock the blank chips, arrange with the author to pay as they copy them, and then produce the ABC and DEF programmed chips as demand dictates...*

Now for my main point. I feel a circuit diagram is analogous to a firmware listing and a circuit description is akin to a firmware description. Therefore publishing a 'programmed chip' article without a firmware listing is the same as producing a new 40+40W amplifier design in which you only get the circuit diagram for board A, the main amplifier. For board B, the preamplifier, you send away $$$ to the author, who returns to you an epoxy'd black box with a 10-pin edge connector to plug into board A. Now where is the fun in that?!

It is as interesting to see how and why a piece of code causes a relay to fire, as it is to trace a circuit for the same reason, and I feel it would be advantageous for EA to publish and describe the function of both. I hope I can describe a method whereby everybody can be happy.

There seems to be some misconception as to what happens to copyright when firmware is published. Many seem to think that the copyright then becomes non existent. This is not so; the writer may release all copyright restrictions, but then again they may retain all copyright and/or apply a caveat to the use of the published material.

I would suggest that the firmware is printed with a caveat along the lines of the following: 'This firmware listing is published for the purpose of allowing home constructors to better understand the function of the project. If the home constructor wishes to create his own EPROM from this listing, they must retype the listing (i.e., no scanning) and produce only one EPROM from each typed copy.' The listing should not be available on the Bulletin board and EA may half-tone or shadow the listing in such a way that it cannot be scanned.

Home constructors will have their listing and they will probably decide that the $20 (say) premium they are paying for the pre-programmed chip is money well spent. This will not stop the illegal mass copying of the firmware, but nothing will. If you want to mass copy the firmware, you can always buy one chip from the author and start from there. I know there are copy protected chips around, but that seems the same as making epoxy'd black boards to me. If you can't guarantee replacement chips will be available for the life of the product, you are being quite unscrupulous.

As for publishing the listings, you could get about 400 lines per page using the smallest font you currently use. I'm sure the average reader will not mind if you use an even smaller font that may require a magnifying lens to read easily. The author, of course, should be entitled to a payment for the publication, at a rate lower than the article's word rate.

Thanks for your comments, Mark, and your approach is an interesting one. I see your point about a firmware listing being analogous to the schematic diagram for a hardware circuit, and it seems pretty valid. However I'm not sure how many readers would be happy with listings in a font and point size that let us squeeze 400 lines of listing into a page. Those that were interested would probably complain that it was too small to work from, while the rest would probably think it was still taking up too much space!

And finally, but by no means least, here are the comments that arrived from Mr Dennis Chuah of Riccarton, in Christchurch NZ:

I am writing in reply to your comments in the Forum column in the January 1996 issue. I agree with Mr Olsen that micro based design is becoming more important in electronics design. In fact, I would go one step further and suggest that most modern electronics designs involve the use of at least one micro, from washing machines to Walkmans. The reality is these designs provide better maintenance, more reliability and more flexibility (only firmware needs to be changed instead of hardware).

Take for example, modems. Most 9.6kb/s modems can be upgraded to run at 14.4 or 28.8kb/s just by upgrading the firmware. In fact, electrically, a 9.6kb/s modem is actually a 2.4k baud modem. The only difference is in the firmware. The faster modems employ a stellar I-Q encoding.

It is also easier to 'shrink' a micro based design than one using conventional logic.

I am a regular reader of your magazine (though not a subscriber yet). As such I am on the side of the argument that your magazine should provide more micro based projects. I feel there should be fewer or none of the projects that require specialist parts. Microcontrollers are readily available, and very

(Continued on page 67)

THE SERVICEMAN

The serviceman who made a temporary repair — to one of a set's integrated circuits!

In the days of valves, and even discrete transistors, it was often possible to make 'temporary' repairs to equipment when the correct replacement parts were not available, to keep it going until the correct parts could be obtained. In most cases such repairs are well-nigh impossible, in these days of large-scale IC's; but one of our stories this month concerns an unknown serviceman who managed to make a temporary 'repair' to an IC — and in a novel way...

The first story for this month comes from one of our long-time contributors who wishes to remain anonymous. It's from L.K., formerly of Daintree in the far north of Queensland but lately of Mudgeeraba, also in Queensland but far less north.

In his covering note L.K. comments that he has now reached retiring age and that this is likely to be his last contribution for some considerable time — if not the last for all time. Which saddens me, because L.K. has been one contributor who could be relied on for a good yarn, consistently well told.

As well, most of his stories contained a hearty chuckle, such was his great sense of humour. We are going to miss L.K. — but then, as he says, old servicemen don't die, they just lose their scope!

Read this story, then, and see what you think of L.K.'s scope:

It is the unusual that makes a story, and this one originated with a tourist requesting service on his NEC portable, an N1423 which has suffered vertical failure. My customer explained that the set had, as he put it, 'done this' a couple of months earlier.

A serviceman he had consulted earlier in his trip had examined the set and advised the owner that an IC needed replacing — which he would have to order in, as this make was not one for which he carried spares.

This arrangement apparently didn't suit the owner, who expressed a wish to keep moving. A discussion ensued, ending with the said serviceman suggesting he might effect a temporary repair but could not guarantee how long it would last.

This was accepted and the TV had been more or less satisfactory until now. He believed that this original fiddle must have finally failed as the set was again exhibiting the same symptoms.

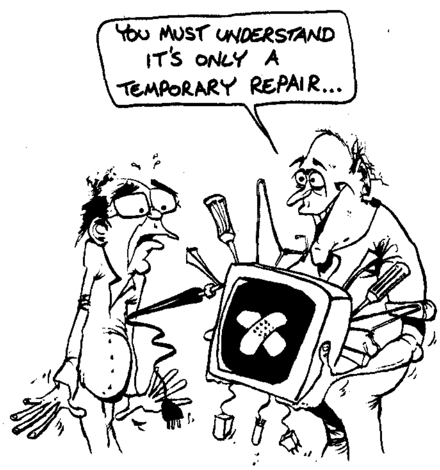
When he departed, I returned to my coffee to ponder just what sort of a temporary repair might have been carried out to an IC, especially in a hurry. As they say, the mind boggled!

I popped the set on the bench, removed the back and this being a live chassis, plugged into the isolation transformer. The owner's description proved correct — not a sign of any vertical movement.

As the oscilloscope was handy, I flipped the switch and began looking for some useful spot to prod with the probe. The yoke socket caught my eye and investigation here showed plenty of signal. The outlook was not so sunny. If this point was OK, it didn't leave much to be faulty but the yoke itself.

Disconnecting the plug, I attached a multimeter directly across the vertical terminations. It was as open as a mouth at the dentist! If this had been the site of that temporary repair, the owner must have got his terminology awry. That's not uncommon and sometimes entertaining.

Further inspection revealed a break in one of the wires where it emerged



from the lower winding; a casualty no doubt of the constant vibration. Fortunately, there remained about 10mm of wire for me to accomplish a repair — although being at the bottom between the tube neck and the chassis left me little room to manoeuvre.

After this, the remaining leads were checked for signs of future trouble before putting a dollop of silastic on the joint to hold it firm against the windings. What lingered was an uneasy feeling when I could find no indication of any previous work in this area.

Plugging the TV back into the isolation transformer, I nevertheless expected to see a successful result. But it was not to be — there was still no vertical action.

By this time the CRO had been shifted

to another part of the workshop to monitor an intermittent problem and there was some delay in bringing it back to bear on the job in hand. Just as things got organised, a picture appeared, rolled a few times then locked solid — as good as anyone could wish for.

At this point I erred in a direction which would cost me a lot of time. Still suspecting a yoke problem, I decided to let the beast cool down but keep the scope running and connected to the output stage, so when the set was powered up, I could check immediately for drive.

Unfortunately, each time I pressed the button the set started without hesitation. Since it had now passed closing time, I elected to call a halt until the morrow.

Now we come to the first turn-on next morning, and there it was — no scan. A few moments probing established that there was no signal either, into or out of the final transistor pair. But before I could work my way back to the oscillator chip, it was up and away!

Again I shut it off, then set about locating the right IC, to be on the spot when next it chose to have a rest. And it was here that I met up with that elusive 'temporary repair'.

The oscillator turned out to be part of C701, a 48-pin multifunction gadget. At first sight it appeared to have a hornet's nest on the upper surface, but a closer look revealed something more akin to automotive body filler.

What made it even more interesting were the wires which emerged from either end and meandered over to the HOT side of the AC power switch! Whatever this nest was, it was connected directly across the mains. Not an NEC original, and definitely not an official mod...

The substance proved to be quite hard, preventing easy investigation of the innards. However, a check with the ohmmeter gave a reading of nearly 60kΩ, so assuming it to be a resistor, I sat down with a cup of stimulus to ponder the puzzle.

A quick calculation suggested it would dissipate about one watt as heat. After that, to quote a cliche, the penny dropped. I disconnected the 'thing' and tried the set again. This time the oscillator failed to function for quite a while.

In review, it would appear that the original fault had been heat sensitive. the vertical section of the chip would only work after reaching some critical temperature (a bit like aged servicemen?).

Also, it very probably developed the fault in a cooler climate than in far

north Queensland. Thus the previous repairer, having become aware of the problem and not in possession of a replacement, had cobbled up this 'practical solution' and thereby salvaged a fast-fading fee.

He would also have anticipated that the TV would not be switched off at the power point, thereby keeping the IC warm continuously and ready to perform whenever called upon. Though how long such an arrangement was likely to remain successful is anybody's guess!

On the owner's return, he received a full run down on my findings, complete with the strong recommendation that the faulty component be replaced. I happened to have the IC in stock and quoted what I felt was a very reasonable price to do the job.

Alas, he declined the offer, pleading that as the temporary fix had proved reliable for a month or two, he saw no reason why it might not see the set out. I wished him luck!

Finally, some words of warning to those other servicemen out there. I'm currently investigating patent rights so if, one day, you are confronted with an NEC with built-in chip preheating, remember that L.K. saw it first!

Well, L.K., that is a real humdinger. It also suggests to me that the legendary Aussie bush ingenuity has not died out altogether with the coming of modern technology. Who else could devise such a simple cure for a faulty IC? I mean, who could devise *any* sort of repair for an IC?

Of course, our mystery serviceman was lucky in one way. Most heat-sensitive faults show up only when the equipment is hot. Hence the popularity of the can of freezer spray. Not often do you find one that goes the other way. What would he have done then. Built a little fridge on the chip? Can't you just imagine it!

Thanks for that story, L.K., and I sincerely hope that it *won't* be your last. Why not make the acquaintance of your nearest friendly serviceman and write up his stories for the column? We all look forward to hearing from you again.

Mysterious drift

Now we go across the Tasman for another Kiwi story. This one comes from Graham Cheer, of Tauranga. We have heard from Graham before, with stories about ancient calculators and antennas that didn't work too well. This time he's working in the meat trade — what a variety of jobs this man has had!

No, Graham's not a butcher in this story. It's much more technical than that. Here's what he has to say...

This story is from about 1976, when I was involved with the installation of data logging equipment for temperature and humidity monitoring in the meat industry.

It was actually part of an R&D problem as we had designed solid state analog multiplexers for the temperature sensors, to replace reed relay switching — which caused inaccuracies due to the resistance of the reed switch contacts increasing with age.

The sensors being used were platinum wire type resistance sensors where the resistance at 0° Celsius was 110Ω with a negative temperature coefficient. To measure the resistance, a constant current is passed through the sensor and the voltage drop across it is measured. The voltage reading is proportional to the resistance and this, of course, is proportional to the temperature.

In the reed relay system a current of 10mA was used, but it was found that if the sensor was left on for more than 10 seconds, the sensor warmed up due to the heating effect of the current through it and we got an incorrect reading. We reduced the current to 1mA, giving an output voltage of 110mV at 0°, and found that the heating effect was then negligible.

The multiplexers we designed used what was then the newly introduced 4000 series CMOS ICs, and we used the 4016 quad analog switches. To overcome the 'on' resistance (up to 300Ω) of the 4016, we used two *switches per sensor, one to connect the constant current source and the other to connect the low pass filter and A to D converter.*

Tests in the workshop showed that the whole system gave very stable readings, but on a real site we found we were getting drift errors of upwards of 2 - 3°. We eventually traced the problem to electrical noise on the sensor cabling being rectified by the protection diodes in the 4016 switches. This placed a DC bias on the line, over and above the constant current source.

The answer to the problem turned out to be quite simple. All we had to do was to separate the digital ground voltage (Vss) from the analog ground. We did this by changing the CMOS power supply from a single ended 0-15V to a split rail of +/-7.5V. This meant that the noise on the line had to exceed 7.5V to cause the protection diodes to conduct. We found the worst case noise never exceeded 2V.

All the installations from then on were fairly straightforward and proved to be very reliable.

Well, there you go! I wonder how many times induced electrical noise has been added to the desired signal information in an analog measurement situation. I can imagine that it has been and probably still is a problem in the automotive world. Just think of all the sensors in a modern car — all of them analog and all susceptible to electrical noise.

It was something I hadn't given much thought to until I read Graham's story, and now you know all about it too! Thanks, Graham. That's the last of your stories to hand, but I don't think it will be long before we hear from you again.

'Too late to help'

Our third contributor this month is Brian Byrne, of Indooroopilly in Queensland. I gather that Brian is a bit peeved that I didn't present a particular story a month earlier. Sorry about that, Brian, but if I had written earlier, you'd most likely have forgotten it by the time your story came about. I think we are all much the same that way. Anyway, here's Brian's story...

This month the Serviceman has really struck a nerve — No! Don't stop me and I'll tell you how.

A few weeks ago I visited a nearby residence whose owner was moving across town. Everything had to go! I spotted a Sanyo CTP3621 (Yes! You guessed it, page 44 in EA for September 94) among the items that 'had to go'. Seeing me viewing it, the owner said "Oh, that's junk! Nothing works in it — it's yours for a couple of bucks". Well, at that rate, a few spare parts from it could be worthwhile so I lugged it home...

A couple of days later I plugged it in and switched on. Nothing — perhaps a tiny whine, but not from the speaker. I soon had the back off, only to find it

was a live chassis switch-mode type. I plugged it into an isolation transformer/voltslider (variac by another name). I've found it causes much less death and disaster that way.

I wound the volts up, but there was only that faint whine — sounded a bit like an inverter being kept low by a short circuited load. I turned it off and tried the most likely short circuit: the horizontal drive transistor. Yep, it was past tense.

On digging around in a bottle of miscellaneous transistors, I found a close replacement and fitted it. Then I turned the set back on and the new transistor worked — for about 4-1/4 seconds. There was a click from the horizontal transformer as the drive transistor joined the official junk collection. A voltmeter monitor on the HT rail had shown excess volts for the electrolytic rating, while it worked.

At this point I would have saved myself a lot of heartache if I had given up, but the set looked clean and neat — so I was hooked. It was off to the dealer for a photocopy of the circuit; but before actually applying the circuit to the brain, it seemed like a good idea to replace the half dozen or so fiddly little electrolytics.

Curiously, on the circuit somebody had ringed C314 (47uF) with a note 'PX flashes, HT unregulated'. Unfortunately, this was one of the fiddly items I had already replaced.

With a new horizontal drive transistor in place, I snuck up on the voltage and the beast worked 100% — at 150V AC input. Obviously the error amplifier/regulator system (so well described by your Serviceman, but too late; I'd already fought this thing two weeks before) was not doing its job.

First, I tried the three transistors — taken out and tested, but all with lovely high betas. They seemed unlikely culprits anyway. I flitted the ohmmeter across the 10 or 12 resistors and pots, and they were all OK.

So what now? There wasn't much left! The diodes all 'dioded' on the ohmmeter. Finally, there was only the zener reference...

Now, I'm a fumble fingers from way back. With one hand holding the voltmeter prod and one on the AC voltage control — yep. My finger slipped and the meter prod shorted the zener to the base of the third transistor. There was a small 'POP!' and the set stopped. The zener now tested dead. So fumble fingers had written off another component...

On reflection, it seemed odd that such a small current source could kill a healthy zener, so it was probably faulty all along. I fitted a new one, and wound up the supply. It worked 100%, just like new. Lovely! And fumble fingers had found a defective zener by the new fumble technique.

So that's how your story touched a nerve — a sore one!

Well, Brian, I'm sorry that you had so much trouble with the old Sanyo. It's not such a bad set to work on, but that zener does seem to be a stumbling block. I've made a note to check that item first time, every time. I may never strike the problem again, but I will be forewarned. I hope you are too!

There was just one problem I had with your story. Are you sure that your 'voltslider' was truly isolated? Most variacs that I've had anything to do with were only simple auto-transformers without any isolating properties. I'd be most upset if your comment led one of our readers to misuse a common variac, with possibly fatal results.

The safest course is to never use

any Variac as an isolating transformer. That way there can be no mistakes...

Thanks for your contribution, Brian. I hope the old Sanyo goes on working well for you, like the one in the following story.

Melted set: the sequel

Back in February 1982 I wrote about a Sanyo television set that had been severely damaged in a fire. The plastic cabinet had melted and run all over the picture tube and onto the chassis. The power switch was buried in a mass of melted plastic and the picture tube was leaning over at a crazy angle, resting on the front edge of the chassis. It was a mess!

The amazing thing about it, though, was that the set still worked. After we had chipped the front panel off the power switch and found the antenna socket among the ruins of the cabinet back, we were able to watch a first class picture.

In the 1982 article, I mused "I wouldn't like to guarantee the set. It might run for a few days or a month. But it is amazing that a TV could suffer such extensive damage without obvious internal faults of one kind or another. I don't think the set will ever be restored, but it is an interesting relic just the same."

I had no idea just how wrong I was going to be!

I gave the set to my colleague who teaches colour TV at the local Technical College. I felt it would be a good example for his students and it well served that purpose for the rest of that year.

When the school year ended, my friend took the wreck home, believing that it wouldn't last over the holidays at school. Somebody would decide it would be OK in their holiday shack and of course, it would never come back to the college...

Time passed, and I had completely forgotten about the old set. Then last week I was visiting my friend and the talk got around to complicated and dramatic TV repairs. My friend told of this set that had been burned and the melted plastic and all. The subject sounded familiar to me but I let him go on with the story.

It seems that he had a friend whose TV had broken down irreparably and he was told about the 'wreck that still worked'. The friend asked what it would cost to replace the damaged cabinet, and so inquiries began.

The upshot was that they bought a whole new cabinet from Sanyo and transferred the works into it. A few quick adjustments and they had a set that looked and worked like a new one.

The only internal part that had to be replaced was the loudspeaker. The speaker cone had taken the full force of a fireman's hose (admittedly from behind the grille) and although it still worked after a fashion, it was replaced to complete the restoration. That was toward the end of 1982.

It is now early in 1996 and the discussion with my colleague revealed that set is still going like a bought one. And what is more, it has not had the back off since it was reassembled nearly 14 years ago!

We tend to class TV sets among the more fragile of housewares — like china, glass, clocks etc. — and to treat them with relative gentleness. This story shows that 'the box' can be a lot more rugged and can tolerate far more abuse than you would ever believe.

The insurance company paid out on the old Sanyo for the original owner. But I have heard, indirectly, that he was not at all pleased with the later model bought as a replacement. I hope he never finds out that his first set is still going strong. I can't bear to see grown men cry!

Well, that's all for this month. I'm in the process of preparing an Index of all Serviceman articles from July 87 to March 96. This will compliment the Index covering January 75 to June 87, which appeared in *Electronics Australia* in January 1988, and will give you a ready reference to every subject that's been discussed in these pages since before colour TV started in Australia. Watch for it in the next few months.

Meanwhile, I'll be back next month with some more stories from the servicing bench. I hope you'll join me. ❖

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Frequency metering for 'Vernus' sweeper

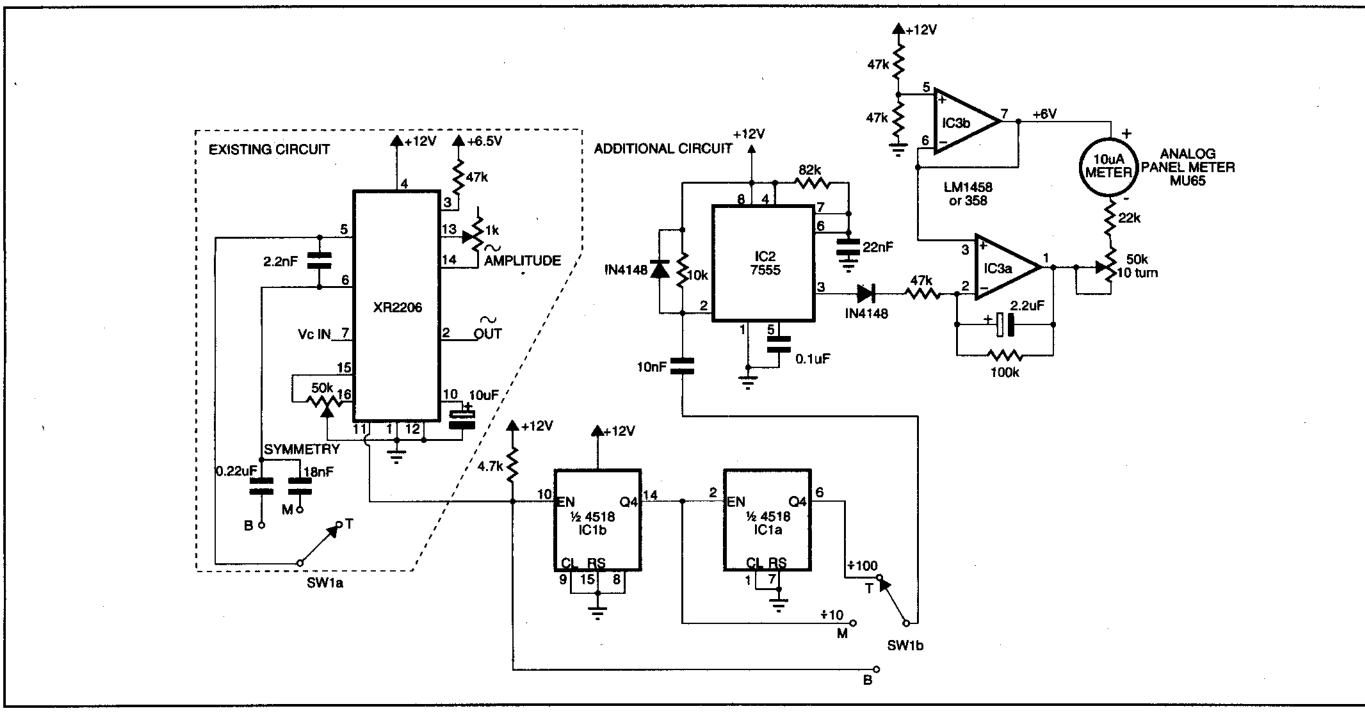
Having built the 'Vernus' audio sweeper (Aug-Sep '92), I was annoyed that my digital frequency meter couldn't read the sweep frequency correctly. So I considered adding analog frequency metering to the sweeper — I had left space on my frond panel for such a contingency!

Using the square wave output from pin 11 of the XR2206 function generator allowed me to do without the usual input conditioning circuitry for the meter. I used a stripped-down version of a design by Andy Flind in *Practical Electronics*, and came up with the following circuit. To modify the Vernus, first cut the track from pin 11 of the XR2206 to ground, and connect it to positive via a 4.7k resistor. This square wave output is then fed to one half of the dual BCD counter IC1b, which in turn clocks IC1a — dividing the frequency by 10 and 100.

When bass-range is selected via SW1b, the square wave is directly applied to a differentiator which produces short negative spikes that trigger IC2, a 7555 wired as a monostable. This produces a string of 2ms pulses which are of equal frequency. To prevent false readings (triggering on multiples of the input cycles), the monostable period is set to less than half of the expected input period (2ms). These pulses are integrated by IC3a, producing a proportional and fairly constant current from pin 1 through the meter.

The meter scale will need to be show three ranges: 200Hz, 2kHz and 20kHz FSD. And as the input frequency is scaled by a factor of 10 and 100 for the Mid and Treble ranges, only one range needs to be calibrated.

M. Schmidt
Edgewater, WA **$40**

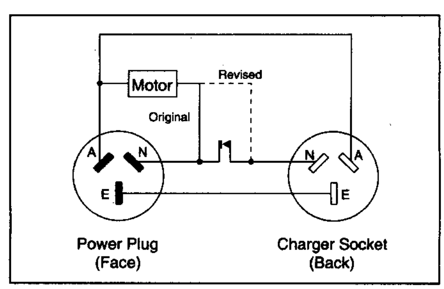


Timer for battery chargers

A programmable 24-hour timer using a small synchronous motor is available from various sources for less then $10, and it provides a convenient way to time a battery charger plugged into its socket. One problem comes about though, as the timer cycles every 24 hours — leaving only a four hour window for the removal of the batteries. If forgotten, the batteries could be seriously damaged.

In such timers the motor usually runs as long as the timer is plugged in. However, a simple change to its internal wiring makes the motor stop when the charging period is over. The circuit shows how the wiring is changed to achieve this. It is usually a matter of extracting the motor wire from one terminal screw and placing it under another. (Although one model required a solder joint.)

BE CAREFUL about the wiring —240 volts is lethal and stressed insulation can break down and start a fire. Only attempt this modification if you are sure you know what you are doing, and get someone qualified to check your work, just in case.



E.G. Wormald
Florey, ACT **$30**

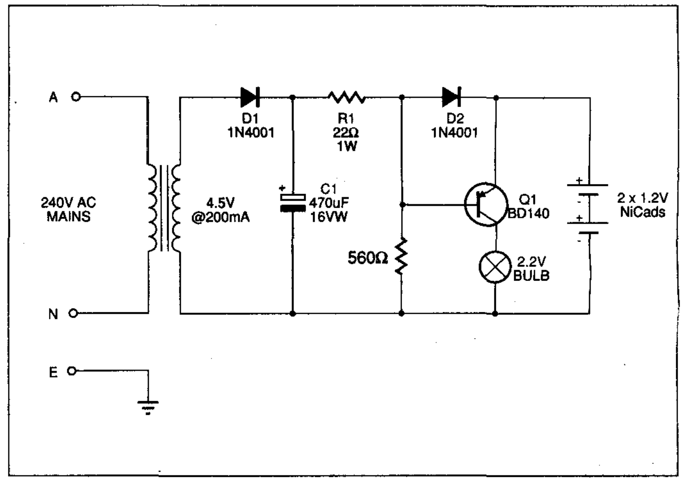
Low cost emergency light

This is a simple and inexpensive way to provide an emergency backup light which will turn on if the 240V mains fails.

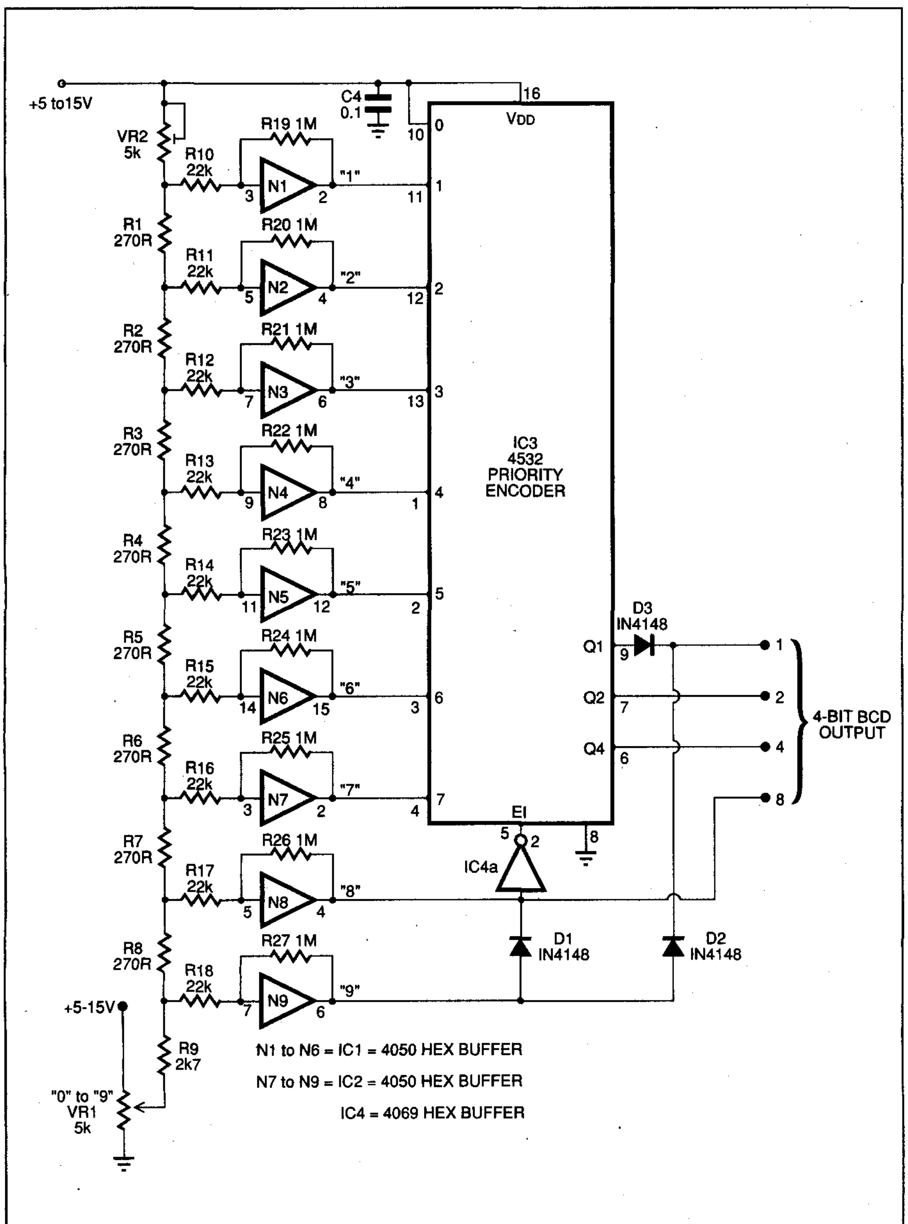
Two 1.2V NiCad penlight batteries are trickle charged and are used to power the bulb when the mains fails. In the presence of the mains AC supply, around 4.5V DC is developed across C1 which turns off the PNP transistor Q1. Current flows through R1 and D2 to charge the batteries at a rate of about 50mA, keeping them topped up.

When the mains supply fails, D2 is reverse biased and Q1's base is pulled low through R2. The transistor is now forced into conduction, which causes the lamp to light. When the mains is reconnected, the transistor turns off and the batteries are then recharged.

Pradeep G.
Alappuzha, Southern India **$25**



4-bit BCD preset uses potentiometer



By controlling the voltage to the input to what is essentially a 4-bit A/D converter, a simple way of producing a BCD value using a rotary control is achieved.

As the potential applied to R9 drops, one by one buffers N1 to N9 are biased on. IC3 then decodes the highest active input as a binary code, up to the maximum of 111 BCD. D1 to D3 are used as logic gating, to allow the addition of one extra bit for representing decimal values 8 and 9. 4050 hex buffers were used as they could be configured, using two resistors, to provide a much narrower hysteresis band (0.11V) than standard Schmitt triggers.To calibrate the unit, set VR1 to 0 ohms, and adjust VR2 until the BCD output reads 1001 (decimal 9). This BCD output could be used to drive a 7-segment display through a suitable decoder/driver chip, such as the 4511. Also best results will be obtained using 1% tolerance resistors for the input network.

S. Carroll,
Timmsvale, NSW **$40** ❖

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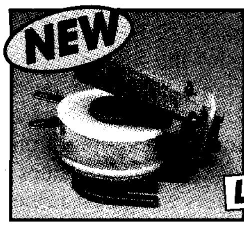

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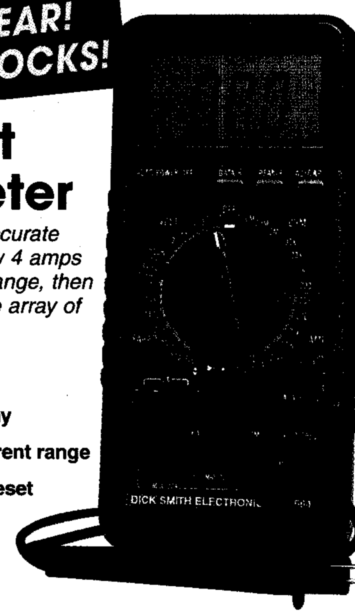

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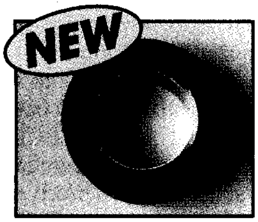

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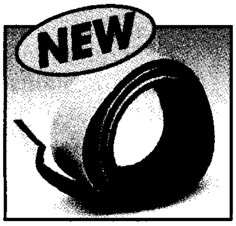

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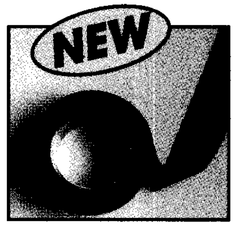

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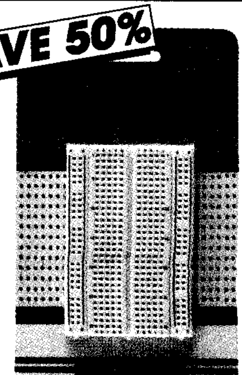

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Supplied as board only.
300 holes in 60 buses plus 2 distribution buses.
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Construction Project:

50W/CH STEREO CONTROL AMPLIFIER - 1

Here's a design for a new low cost, easy to build integrated stereo amplifier with the ability to deliver 50 watts RMS output per channel. It includes a low noise phono preamp, flexible input and tape recording source select switching, the ability to bypass the tone controls for 'direct' operation, a stereo headphone output and many other features.

This new low cost 50W per channel stereo amplifier design is a revision of the popular 30+30W stereo amplifier published in the April 1992 issue, which itself was a revision of the Playmaster 30-30 amplifier of August 1988. The new amplifier has been developed by the R&D department at Dick Smith Electronics, and DSE will be selling a full kit for it (catalog number K-5590) for the very attractive price of only $299.

The amplifier retains such features as simple appearance and straightforward construction, but also includes several new features to make it more useful in the home stereo environment and generally compatible as a basic amplifier for a home theatre sound arrangement.

The power amplifier channels make use of the new LM3886 integrated power amp IC from National Semiconductor. Here they are run from a +/-35V supply, derived from a 25-0-25V 160VA toroidal transformer, which results in a maximum output power of around 50W RMS per channel into 8Ω loads. The LM3886 devices feature excellent internal protection against thermal runaway, shorts to power-supply rails, under-voltage supply rails, over-voltage from inductive loads and output short circuits. We don't suggest they're indestructible, but they seem quite safe from accidental destruction, very robust indeed and ideally suited to this application.

With the new amplifier, we have attempted to simplify the construction and make the project more modular. As such, the kit is broken down into three main circuit boards. IDC ribbon cable is used to route the audio inputs and outputs between front and back, without the need for multiple shielded cables to be separately terminated — which can be very time consuming.

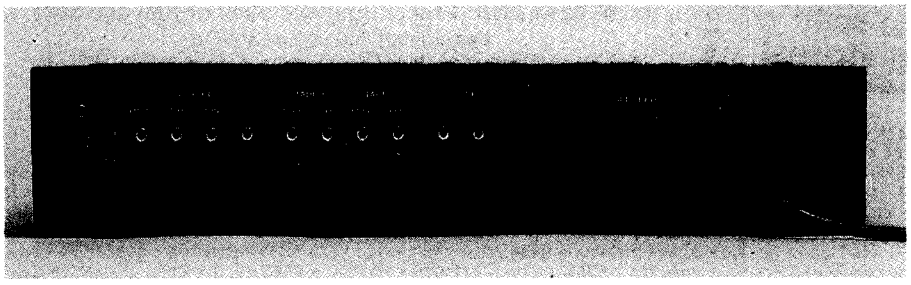
Note that within the ribbon cables, each audio conductor is separated from its adjacent audio conductor by a grounded conductor in between, to reduce any crosstalk. Crosstalk is further checked by the use of guard tracks between the conductors of the left and right channels on the PCBs.

Instead of a single large PCB as used previously, there are three smaller modules: the RCA socket and phono preamp board, the power amplifier board, and the preamplifier board. Should the phono preamp be unnecessary, then the preamp components can be left out and that section bypassed with two links, thus making the phono input suitable as a further standard 'line level' input.

The line level connections to the rear of the amplifier have also been increased in number. The amplifier now fully supports two tape recorders, with switching to enable either tape unit to record directly from the other one. In practice this connection could be used for a cassette tape recorder as Tape 1 and a hifi video recorder for Tape 2, or other arrangements. Each of the two Tape connections can therefore record either from the standard sources or from the other Tape unit.

A set of 'coupler' sockets is now included, with a coupler switch close by. These connections provide direct stereo patch points to the outputs of the preamps and the inputs of the power amplifiers. The coupler connectors may usually be ignored, by having the coupler switch set to the Normal position where each preamp is connected internally to its power amp. In this position the preamp output signals remain available at the Coupler Output sockets, for external use, even though they are still connected to the power amplifiers.This enables other equipment to be connected in parallel, in particular such equipment as a further power amplifier or sub-woofer amplifier. The signal to this other equipment remains under the control of the amplifier's preamp controls.

With the switch in the 'Coupler' position, the internal links between the outputs of the preamps and the inputs of the power amps are broken, and brought out to the coupler sockets. This would therefore allow connection of things like a sound processor to be included in the path. It would also allow the power amplifiers to be driven solely from an external source.



As you can see, the amplifier provides plenty of inputs and outputs. A nice feature is the ability to separate the front end outputs from the power amplifier, to couple in an external sound processor.

Circuit description

Considering the power supply first, all of the supply components except for the transformer are contained on the power amp circuit board. The 25-0-25V 160VA toroidal transformer is well suited to this particular application due to its high power capability versus its com-

pact size. This transformer does include an integral thermal fuse, but even so, 3A slow-blow fuses have been included in its secondary circuit to protect the transformer. These fuses are replaceable, whereas should the transformer's internal thermal fuse blow this would render it inoperable and it would need to be replaced. The primary of the transformer itself is fused with a 2A slow-blow fuse.

The centre-tapped secondary of the transformer is fed via the 3A fuses to the bridge rectifier. This provides +35V and -35V DC supply rails across reservoir capacitors C601 and C602, which are used to power the power amplifier ICs.

The supply rails for the preamplifiers are taken from the 35V rails, via voltage regulators REG1 and REG2. An LM317 adjustable regulator is used for the positive rail and an LM337 for the negative rail, with their associated resistors to set their output voltages. These devices can accommodate an input voltage up to 40V, and can therefore be directly connected to the 35V rails.

Using these devices also permits us to adjust their outputs to above the traditional 15V. Here they are set to close to 17V per rail, to increase the signal 'headroom'

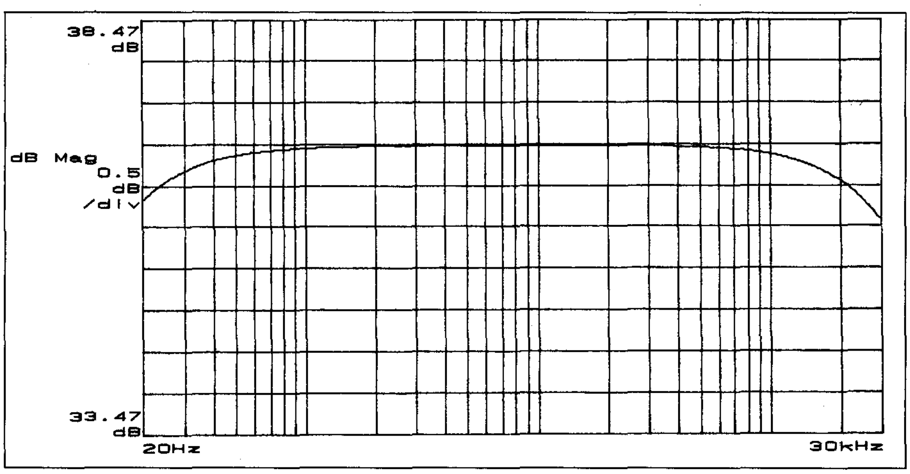


Fig.7: The power response of the prototype amplifier, with the tone controls bypassed and when delivering 49W into a load of 8 ohms. As you can see it is only 0.5dB down at around 23Hz and 31kHz.

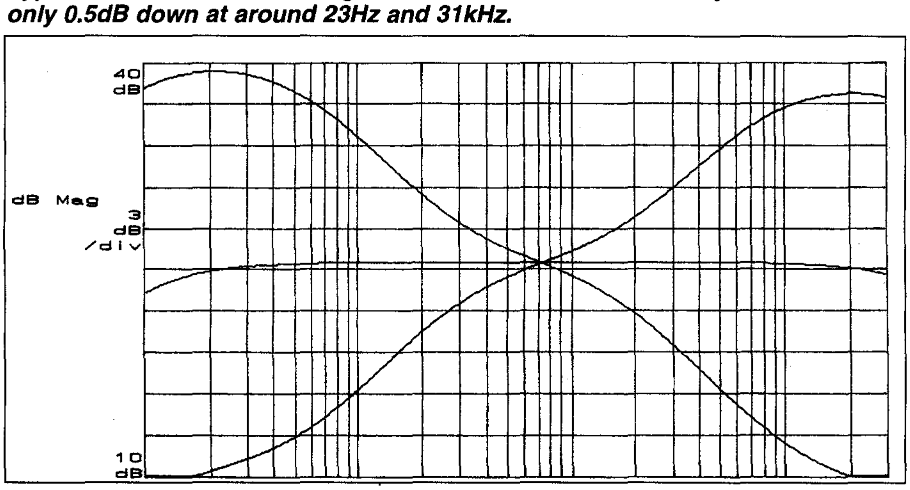


Fig.8: These figures show the response of the amplfier when the tone controls are in circuit, and in the flat, full boost and full cut positions in each case.

SPECIFICATIONS

Performance of prototype:

Output power

Single channel:	54W RMS into 8Ω
Both channels:	46W RMS into 8Ω

(At the start of clipping, but with THD below 1%)

Frequency response

Power amp input	+0/-0.5dB 20Hz to 30kHz
Line input	+0/-1dB 20Hz to 30kHz (Tone controls defeated)

Input sensitivity

Line inputs	281mV RMS
Phono preamp	5mV RMS
Power amp	1V RMS

(Single channel input sensitivity for 50W at 1kHz)

Phono preamp overloads at 200mV.

Harmonic distortion

Less than 0.04%, 20Hz to 20kHz

Signal to noise ratio

CD input	92dB, 98dB A-weighted
Phono input	63dB, 84dB A-weighted

Channel Separation

Preamp	50dB at 1kHz, 35dB at 10kHz
Power amp	75dB at 1kHz, 60dB at 10kHz

Tone controls

Bass	+/-12dB at 55Hz
Treble	+/-12dB at 15kHz

Protection

3A fuses, plus protection as per National LM3886 datasheet, which includes protection against thermal runaway, instantaneous temperature peaks, output short circuits, output shorts to supply.

50W/Ch Stereo Amplifier

through the preamplifiers. For convenience we will continue to refer to these supply rails as +/-15V. The LM833 op-amps used in the preamplifier permit a split supply of up to +/-18V (36V).

In laying out the PCB tracks around the power supply, an effort has been made to keep the high current paths as balanced or as close together as possible. This is to keep the amount of electromagnetic radiation from any high current loops to a minimum, so as to minimise the induction of hum into the audio path. This also applies to the routing of other high-current carrying cables — see the construction section.

Two separate ground connections to the power supply board, that is the headphone socket ground and the power supply to case ground, are each connected by soldering to a ground link rather than connecting them into the PCB. This is to avoid placing them in the direct path of high current AC which may be flowing between the two large capacitors and which may induce hum.

A large U-shaped aluminium extrusion heatsink runs down the centre of the case, and is drilled to accommodate the two amplifier devices and the two regulators. Each of these devices needs an insulating washer between it and the heatsink, and each device is fixed in place with a bolt through an insulating bush. More about this later.

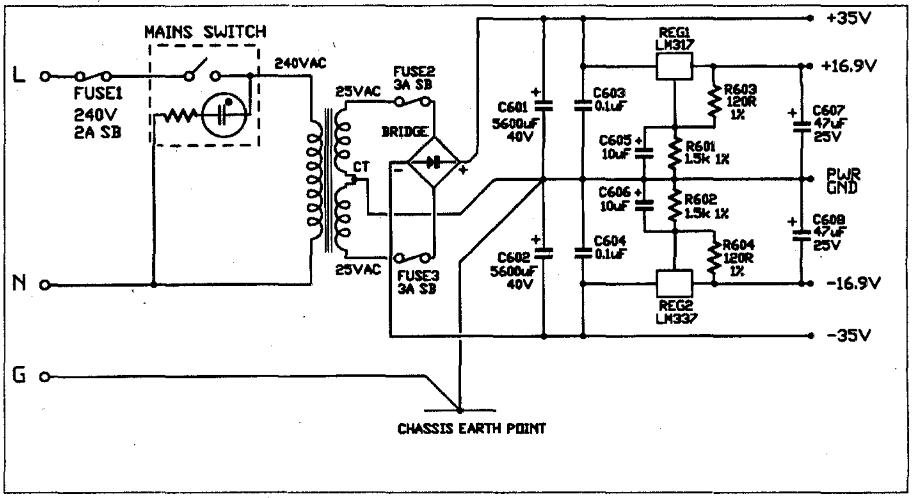


Fig.1: The amplifier power supply circuit. The unregulated 35V rails are used for the power amp stages, with the regulated 17V rails for the earlier stages.

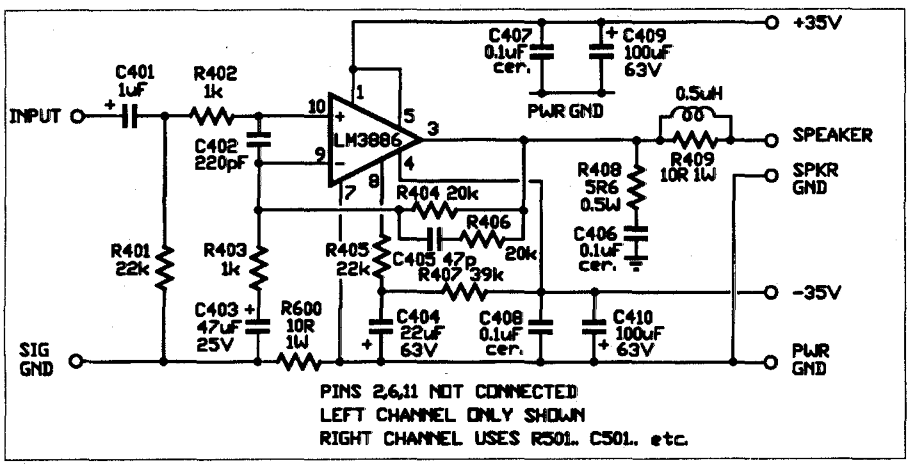


Fig.2: Each power amplifier uses this circuit, based based on the new National Semiconductor LM3886 device. It is capable of delivering around 50W per channel continuously.

Power amplifiers

The National Semiconductor LM3886 audio power amp chips are used here in a manner which closely follows National's recommendations. Resistors R404 (20k) and R403 (1k) form a feedback divider which sets the AC voltage gain to 21, while capacitor C403 ensures that the DC gain is unity for maximum operating point stability. Resistor R408 and capacitor C406 across the output, together with R409 and its accompanying 0.5uH choke (wound on the resistor itself), form a Zobel network to maintain the AC output impedance and ensure stability at high frequencies.

You may note that the LM3886 mute control (pin8) has not been used as an external control; the front panel mute switch is electrically in the preamplifier output path before the power amps, and this arrangement therefore mutes the signal to any equipment connected to the coupler output at the same time.

Pin 8 of the LM3886 connects to an R-C-R network (R405, C404, R407),

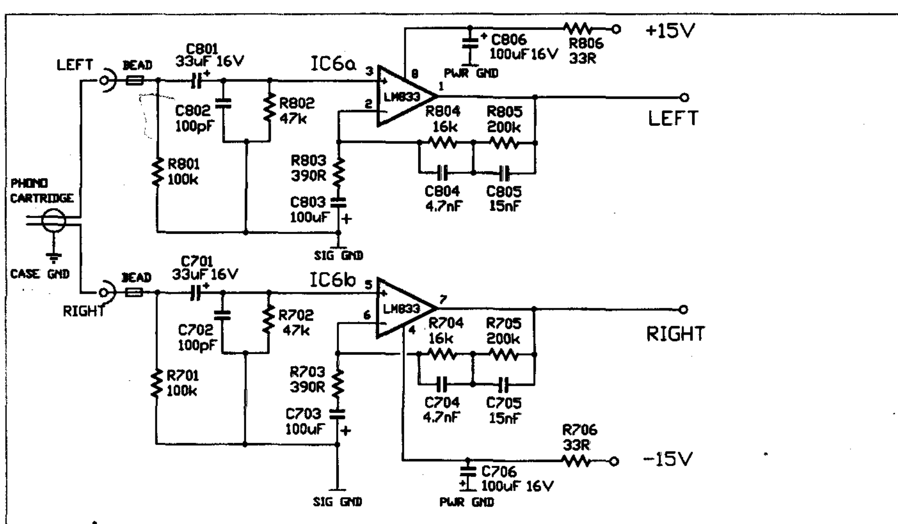


Fig.6: Here is the circuitry for the phono preamps, mounted on the rear PCB. These preamps can be omitted if not required.

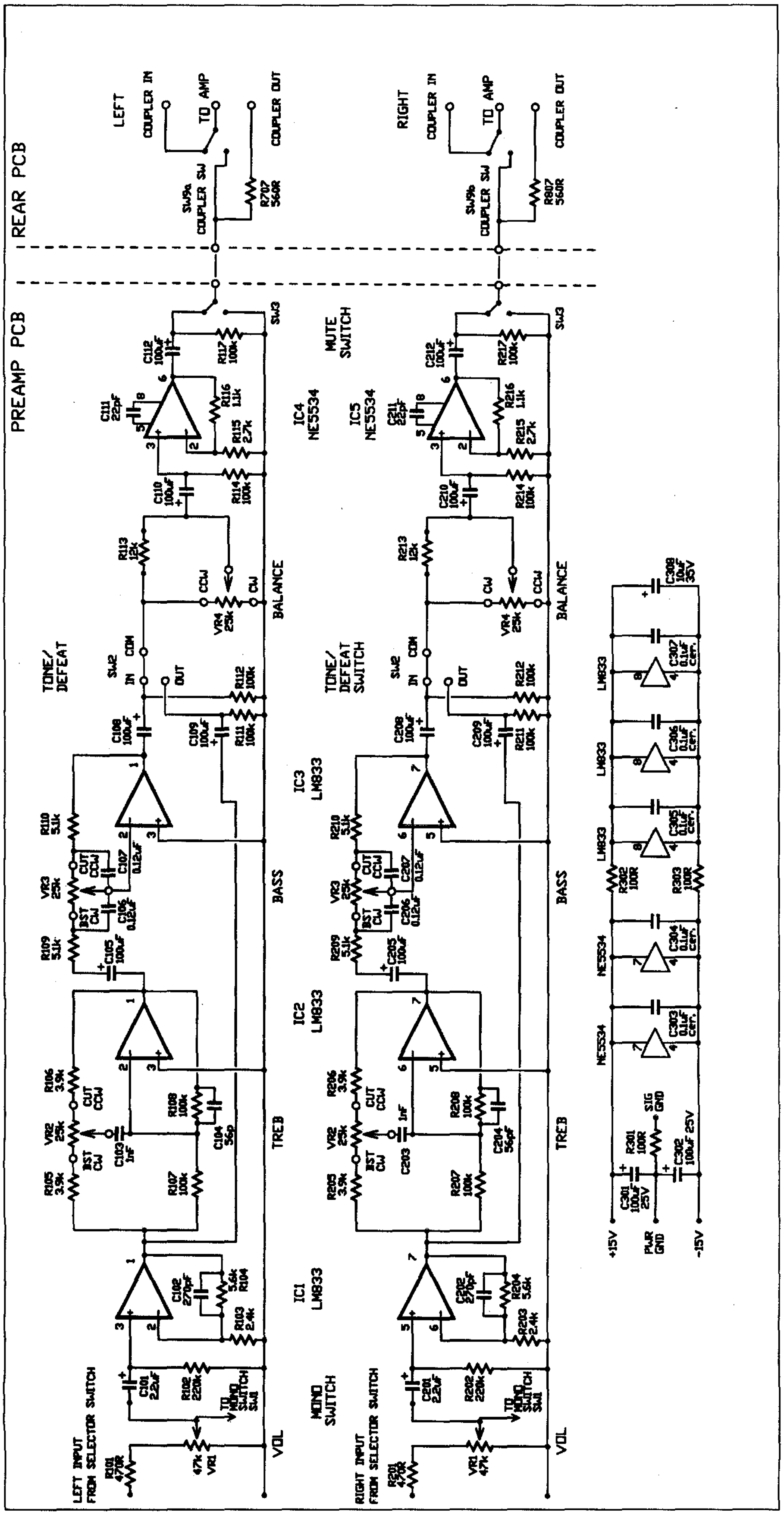


Fig.3: The input buffering and tone control circuitry for both channels. The tone controls provide up to 12dB of boost or cut, but can be bypassed when not required.

which has a time constant of about 0.5 seconds and acts as a de-thump mechanism when the power is first turned on.

Note also resistor R600, a 10Ω 1W type located between the large capacitors of the power supply and the power amp input connection. This is common to both channels of the amplifier and acts to reference the amplifiers' input signal ground to the power supply ground. In each amplifier the signal input ground and speaker output ground are separate.

Preamplifiers

The preamplifier stages use LM833 dual low noise op-amps for its basic circuit elements, and a pair of NE5534 devices for the output buffers. Two 100Ω resistors (R302, R303) decouple the power supply rails between the LM833s of the preamp section and the NE5534 output buffers. Each of the op-amps is decoupled individually with a ceramic capacitor across the supply rails beside the device itself.

Note also that a single 100Ω resistor (R301) is used to provide an earth reference point for the preamp, in case the internal IDC cable connectors at the preamp inputs are removed. The main earth connections of the preamps are via the ribbon cables.

From the input selector switching, the line level input signals first pass through the Volume controls and stereo/mono switch, and are then amplified by the two halves of IC1. These have a gain of about three, as set by the dividers formed by resistors R104/R103 and R204/R203.

If the tone control switch is in the Defeat position, the signals then pass directly to the Balance control (VR4), and then to output buffers IC4 and IC5. These each have a gain of about 1.4, as determined by resistive dividers R116/R115 and R216/R217.

When the tone control switch is not in the Defeat position, the signals pass through the tone control stages around IC2 and IC3, on their way to IC4/5. IC2 is wired as a feedback-type treble control stage, and can be adjusted to give anything between 12dB of boost and 12dB of cut at 15kHz; IC3 is the matching bass control stage, and can give the same amount of boost and cut at 55Hz.

At the 'end' of the preamp circuit is the Mute switch SW3. From there the signals go to the Connect switch and connectors on the rear PCB.

As with the rear PCB, which holds the RCA sockets and optional phono preamp, the preamp PCB layout features many ground guard tracks. These

50W/Ch Stereo Amplifier

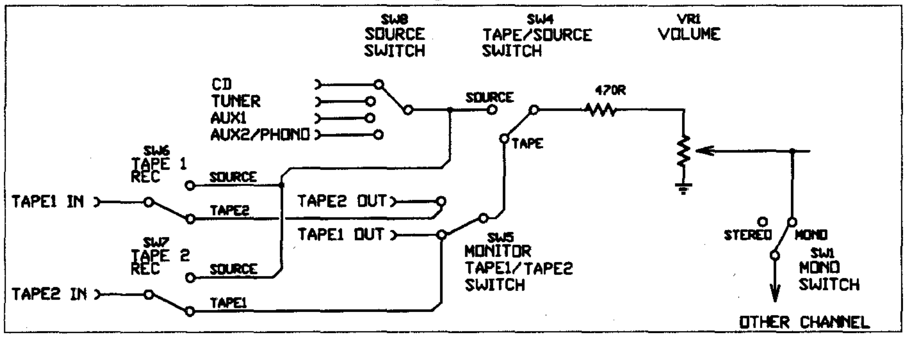


Fig.4: The input source selection and tape recorder mode switching circuitry for one channel, together with the volume control.

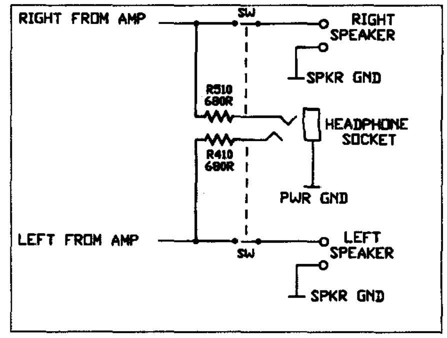


Fig.6: The circuitry around the headphone socket. The switches on the socket are used to mute the speakers when the phones are plugged in.

tracks run between the conductors of the two channels to reduce crosstalk.

Phono preamp

The phono preamp components also reside on the rear PCB, at the other end and close to the RCA phono input sockets. If there is no need for a phono preamp, then all the components of this section can be omitted, and the phono input can be linked through directly as a line level input. The phono preamp bypass links can be seen as the two short vertical links, immediately below where the beads are shown on the overlay. The power supply resistors to the phono preamp can also be omitted, these are R706 and R806.

The phono preamp, when it is included, features a standard implementation of the LM833 as a stereo phono preamp with RIAA correction. Ferrite beads are included over the leads of the first input components for each channel, in this case a pair of 0Ω resistors (link components), so as to avoid the chance of radio frequencies (RF) being picked up and amplified by the sensitive phono preamp.

That concludes the circuit description for the new amplifier. In the second article we'll describe its construction and testing.

(*To be continued.*)❖

PARTS LIST

Case Parts

Metal case with lid and front panel;1 x rear panel label; 1x heatsink (aluminium extrusion, black);1 x red bezel for front panel (see text)1 x M205 fuseholder;1 x M205 fuse 2A slo-blo mains fuse cartridge;1 x toroidal power transformer,25-0-25V; 1 x illuminated mains switch;1 x 3-way mains connector block;1 x stereo headphone socket 6.5mm(insulated);1 x 4-way spring speaker connector;1 x cable clamp grommet; 1 x solder tag; 19 x nylon cable ties,3mm; 60 mm length of 25mm heatshrink sleeving (for fuse holder); 3 x 25mm lengths of 6mm heatshrink sleeving for mains switch contacts; 4 x CSK M4 bolts, black, for front panel; 6 x RH M6 bolts, black, for case cover; 4 x M2 bolts and nuts and star lockwashers; red and black heavy duty hookup wire for speaker wiring; blue heavy duty hookup wiring for local grounds;brown and blue mains-insulated wire for mains switch wiring; 700mm length of 40-way IDC ribbon cable for inter-board wiring.

Power Amp/Power Supply PCB

Resistors

All 1/4W metal film unless specified:

R401/501,R405/505	22k
R402/502,R403/503	1k
R404/504,R406/506	20k
R407/507	39k
R408/508	5.6 ohms, 0.5W
R409/509,R600	10 ohms, 1W
R410/510	680 ohms (mounted on head phone socket)
R601/602	1.5k
R603/604	120 ohms
(Plus 3 x 0W links)	

Capacitors

C401/501	1uF 16V electro
C402/502	220pF ceramic
C403/503,C607/608	47uF 25V electro
C404/504	22uF 63V electro
C405/505	47pF polystyrene
C406/506,C407/507, C408/508,C603/604	0.1uF ceramic
C409/509,C410/510	100uF 63V electro
C601/602	5600uF 40V electro
C605/606	10uF 16V electro

Semiconductors

REG1	LM317 adjustable regulator
REG2	LM337 adjustable neg. regulator
IC7,8	LM3886 power amplifier
Bridge	PO-4 Rectifier bridge

Miscellaneous

32 x TO-220 mounts for regulators; 2 x mica washers for LM3886s; 10 x PCB terminal pins;4 x M3 x 12mm screws, nuts and washers; 1 x 3-way screw terminal block for 25-0-25V AC input;1 x 10mm insulating spacer; 300mm of 0.8mm enamelled copper wire for chokes; tinned copper wire for links; 4 x M205 PCB-mount fuse clips 2 x 3A(or 3.15A) M205 Slo-Blo fuse cartridges.

Preamplifier PCB & switch sub-board

Resistors

All 1/4W metal film, unless noted:

R101,102	470 ohms
R102,202	220k
R103,203	2.4k
R104,204	5.6k
R105/6,205/6	3.9k
R107/8,R111/112, R114,R117, R207/8,R211/212, R214,R217	100k
R109/110, R209/210	5.1k
R113,213	12k
R115,215	2.7k
R116,216	1.1k
R301/302/303	100 ohms
(Plus 18 x 0W links)	

Capacitors

C101/201	2.2uF 16V electro
C102/202	270pF ceramic
C103/203	1nF MKT
C104/204	56pF ceramic
C105/205,108/208, C109/209,110/210, C112/212,301/302	100uF 16V electro
C106/206,107/207	120nF MKT
C111/211	22pF ceramic
C308	10uF 63V electro
C303,C304, C305,C306,C307	0.1uF ceramic

Semiconductors

IC1-3	LM833 dual low noise op-amp
IC4-5	NE5534 low noise op-amp

Miscellaneous

VR1	50k dual log pot
VR2,3,4	25k dual linear pot

Four-way pushbutton switch (SW8); seven single pushbutton switches (SW1-7); 3 x 30mm knob (black); 1 x 40mm knob (black); 1 x preamp PCB (ZA-1252); 1 x switch PCB (ZA-1253); 11 x pushbuttons; 5 x insulating spacers, 15mm; 3 x insulating spacers, 25mm; 1 x 50-pin DIL header pins strip (cut into 2 x 20); 12 x PCB terminal pins.

Connector/Phono preamp PCB

Resistors

All 1/4W metal film unless specified:

R701,R801	100k
R702,R802	47k
R703,R803	390 ohms
R704,R804	16k
R705,R805	200k
R706,R806	33 ohms
R707,R807	560 ohms
(Plus 2 x 0W links)	

Capacitors

C701,C801	33uF 16V electro
C702,C802	100pF ceramic
C703,C803, C706,C806	100uF 16VW electro
C704,C804	4.7nF MKT
C705,C805	15nF MKT

Semiconductors

IC6	LM833 low noise op-amp

Miscellaneous

2 x ferrite beads; 1 x 50-pin section of DIL header pins (use as 2 x 20); 1 x 3-way terminal block (for power in); 6 x PCB terminal pins; 1 x DPDT toggle switch, 90□ PCB mounting; 1 x 4-way RCA sockets, PCB mounting; 2 x 8-way RCA sockets, PCB mounting; 3 x M2.5 x 12mm screws and nuts; tinned copper wire for links; 1 x M3 x 12mm screw with 2 x M3 nuts, 3 x M3 star lockwashers and 2 x solder lugs, for earth terminal; 1 x rubber grommet for coupler switch.

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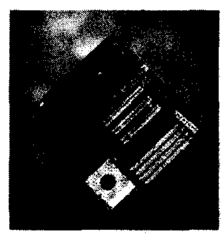

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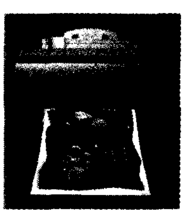

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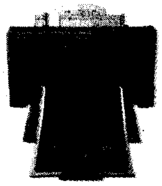

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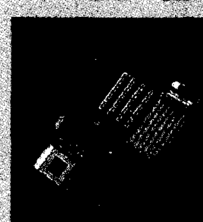

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Construction Project:

LOW COST RF TEST OSCILLATOR - 2

In this second and final article describing our new low cost RF test oscillator design, we describe its construction and setting up. As almost all of the circuitry is mounted on a pair of printed circuit boards connected directly together with PCB terminal pins, there is very little off-board wiring — and the inbuilt frequency counter will obviate the need for external calibration, in many cases.

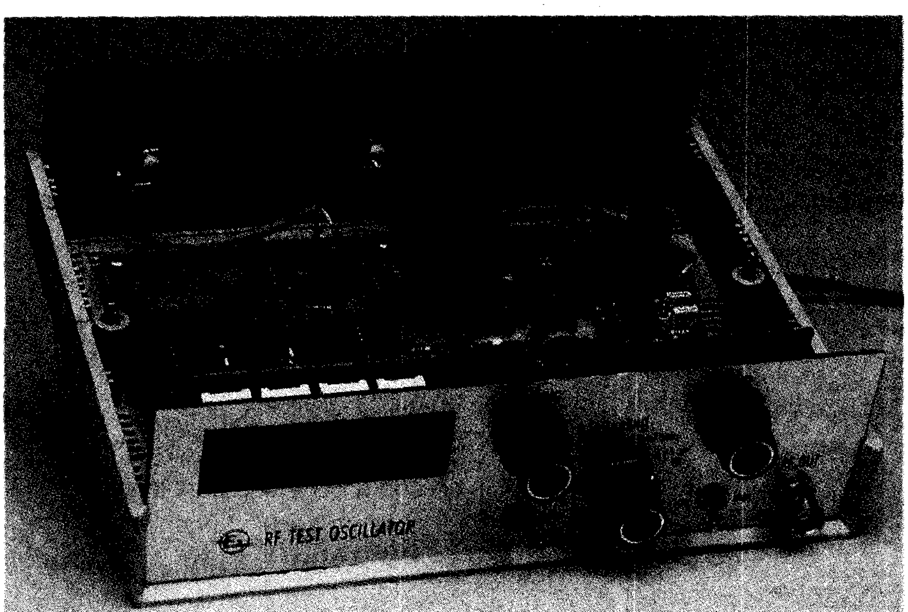
by JIM ROWE

As you can see from the photos, the oscillator is built in a standard and readily available plastic instrument case measuring 204 x 159 x 65mm. This has been done for simplicity and economy. The usual plastic front panel has been replaced by a piece of unetched copper laminate, with the copper layer connected to circuit earth to provide protection against hand capacitance effects and also a measure of shielding.

There is in fact very little radiation of RF from the instrument, partly because of the shielding from the front panel and partly because the 'hot' RF circuitry runs at quite a low power level and has been kept relatively compact. Although there would undoubtedly be even *less* RF leakage if the unit were housed in a fully shielding metal case, the additional cost and complexity is probably not justified for most purposes. It could of course be done if you wish, however...

Virtually all of the circuitry is on two printed circuit boards, one relatively large and mounted horizontally in the bottom of the case and the other somewhat smaller and mounted vertically along the front of the first board, just behind the front panel. The interwiring between the two is made at their junction via some 27 PCB terminal pins, which solder to pads on both and hence bond them together physically as well.

The vertical PCB measures 170 x 52mm, and its etching pattern is coded 96rfo5b. It provides all of the basic circuitry for the frequency counter 'dial' — the 74C926 counter chip, digit multiplexing driver transistors, LED displays and segment current limiting resistors — plus the wiring to the oscillator's own front panel controls. The latter includes range switch SW1, the CW/Modulation switch SW2, Hi/Lo output level switch SW3, tuning pot RV1, output level pot RV2 and the output attenuator resistors.



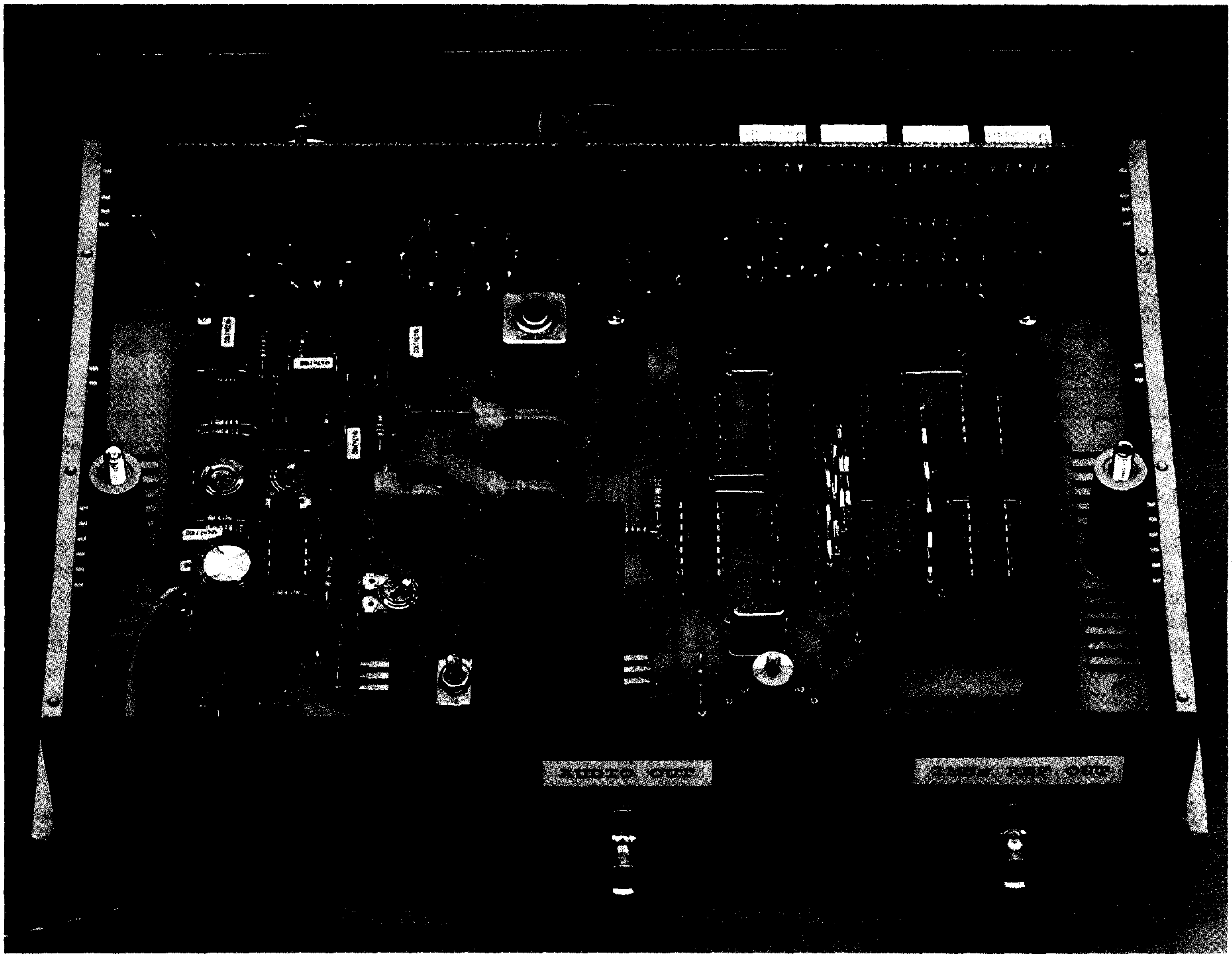
Virtually all of the oscillator's circuitry is on two PC boards, one horizontal and one vertical, which are directly connected to minimise off-board wiring.

Note that tuning pot RV1 should ideally be a 10-turn type, as this gives a much 'expanded' adjustment range and makes it a lot easier to set the oscillator to a desired frequency. However these are more expensive, so if you want to save money and are prepared to cope with much more 'tricky' tuning, a standard single-turn 270° pot could be used. I don't really recommend it, though.

I should note also that as 10-turn pots are somewhat longer than than the standard type, a hole about 22mm in diameter has to be cut in the vertical PCB to provide clearance for the pot body — as can be seen in the photos. The PCB pattern has been designed with a 'blank area' to allow for cutting such a hole, but if you choose to use a standard pot there'll be no need for the hole as the pot will mount in front of the board as with RV2.

Range switch SW1 and the two smaller switches are mounted directly on the vertical PCB, minimising lead length and avoiding the need for off-board wiring. As there are two slightly different versions of the plastic-body three pole four position switch currently available, with the three pole pins rotated radially with respect to one another, the PCB pole pads are elongated to be compatible with either type.

In wiring up the vertical board, I suggest you begin as usual by checking it for possible etching faults — cutting any tiny unplanned links between tracks or pads, and bridging any obvious gaps that shouldn't be there. (Check against the PCB pattern published later in this article, if you're in any doubt.) Then begin the assembly proper by fitting the fixed resistors and wire links, using the over-



Another view inside the case, showing how the two PCBs fit together to form a tidy assembly. Many of the components on the main board are visible here, including three of the four tuning coils.

lay diagram of Fig.4 as a guide. There are only two links to be fitted, located just below the positions for LED displays LD3 and LD4.

Once the resistors and links are fitted, it's a good idea to fit the rotary switch SW1 and the two toggle switches SW2 and SW3. In each case you may need to extend/elongate some of the PCB holes slightly with a jeweller's rat-tail file, to accept the switch lugs and allow the switches to be mounted with their bodies as close as possible to the surface of the PCB. Note that SW1 is mounted with its locating spigot not at '12 o'clock', but at about '4:30' (i.e., rotated clockwise by 135°).

Make sure that each switch is mounted as squarely as possible, with its axis perpendicular to the board, before you solder its lugs to the appropriate pads — otherwise you may have trouble later, mating the switch bushes with their respective holes in the front panel.

With the switches fitted, you can now mount the four seven-segment LED displays, making sure that you fit each one with its decimal point LED towards the bottom of the PCB. Then fit the four digit driver transistors Q1-Q4, taking care to orientate them as shown on the PCB overlay, and also that you don't push their bodies down too near the PCB, as this is likely to strain their leads. There's about 15mm clearance between the front of the PCB and the back of the front panel when everything is later assembled, so the transistors don't have to be mounted very close to the board.

There is no need to mount the tuning or level pots to the vertical PCB at this stage; they can be mounted on the front panel, and connected when the two are assembled together. Similarly the PCB terminal pins used to connect the two PCBs together are best left until this is done. In fact the only thing left to do for the present is to fit counter chip U1, and its bypass capacitor C1. Then the vertical board can be placed aside for a while, while you assemble the horizontal board.

Horizontal PCB

The horizontal board is really the main board, carrying not only the RF oscillator/buffer/modulator circuitry, but also the audio oscillator, power supply and all of the frequency counter circuitry apart from the actual counter and display section. This all mounts on a board measuring 165 x 112mm, and coded 96rfo5a. Like the vertical board it is only single-sided — i.e., with copper on only one side — but with a fairly large amount of earthed shielding copper.

There are a reasonable number of links to be fitted to the horizontal board — 16 in all, so I suggest that after checking the PCB for etching faults, you fit these first. Fourteen of them go in the digital section on the left-hand side of the board, with the remaining two over at the right in the analog section. One of the latter goes between the location for

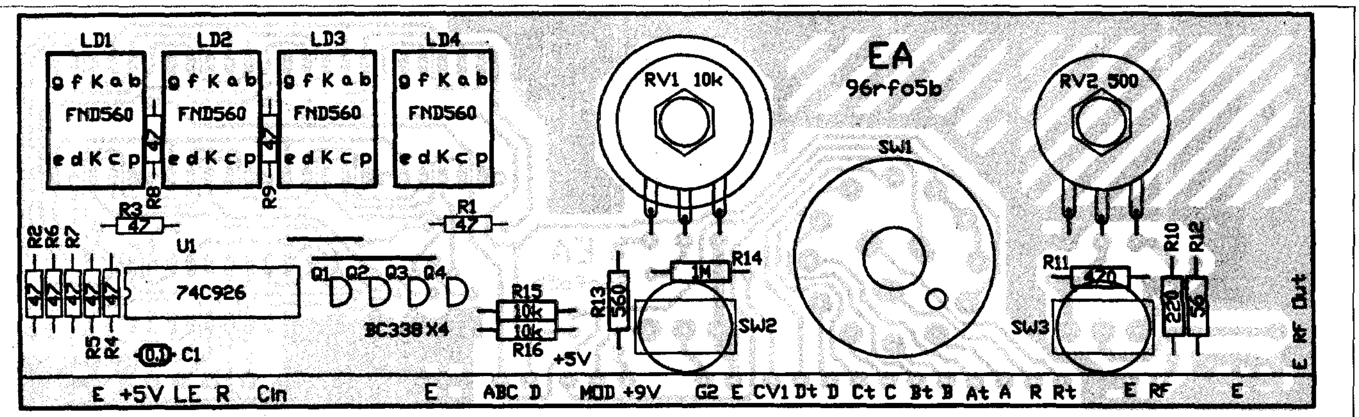


Fig.4: The overlay diagram for the oscillator's vertical PCB. Use it as a guide when you're placing the components.

coil L1 and U12, the audio oscillator chip, while the other goes in the RF oscillator circuitry between R27 and C24, near the front.

I recommend that you use insulated hookup wire for the link in the audio oscillator and the six longest links running 'front to back' in the digital section, together with the longest 'side to side' link running along the very front of the latter section. The rest can be run in tinned copper wire, as there is no risk of short circuits.

With all of the links fitted, I suggest that you then fit all of the fixed resistors, using the schematic, PCB overlay diagram (Fig.5) and internal photos as a guide. All of the resistors are 1/4W metal film types, although some have their leads bent to fit holes spaced apart by 0.5", and others to fit holes 0.4" apart.

Next you can fit the three preset pots RV3, RV4 and RV5. Again you may need to elongate the holes in the PCB slightly to accept the narrower section of the pot lugs and allow the pots to mount securely and level. You may as well also mount the trimmer capacitor CV1 at this stage, in much the same way.

The smaller fixed capacitors can be fitted next. Most of these are monolithic ceramic bypass types, which need to be fitted with their leads as short as possible. However as they are fairly fragile you'll also need to be careful not to strain their leads when you fit them — if necessary shaping them first with a pair of needle-nose pliers. This also applies to the small NPO ceramic capacitors C9, C10 (both in the crystal oscillator) and C19 (in the RF oscillator).

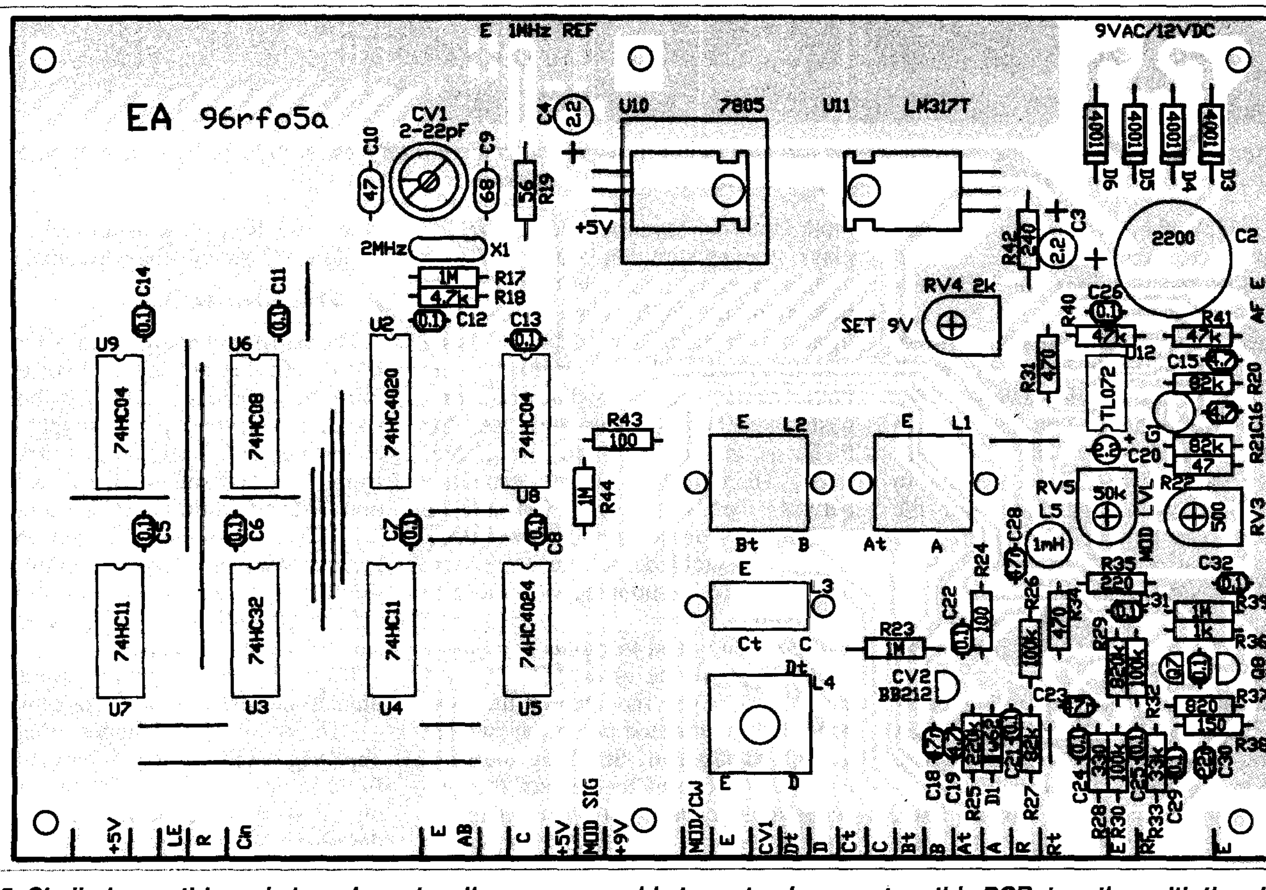


Fig.5: Similarly use this main board overlay diagram as a guide to parts placement on this PCB, together with the photos.

Many of the remaining smaller capacitors are MKT plastic types, which should just drop into place as the PCB holes are all spaced apart by the matching 0.2".

There are also three 2.2uF TAG tantalum capacitors, C3, C4 and C20. These may also need their leads shaped with pliers before fitted them to the board — and take care with their polarity, which is indicated on the overlay diagram.

You may as well add RF choke L5 to the board at this stage, again shaping its leads if necessary to prevent reasonably close mounting without strain.

Before proceeding further, I suggest that you now fit the six PCB terminal pins that are used for the 'off board' connections to the main PCB. Four of these go along the rear edge — two just to the left of centre behind C4, and the other two at the right-hand end behind diodes D4 and D5. The remaining two pins go on the right-hand side, near reservoir capacitor C2 (when it's fitted).

Now you can fit the four main rectifier diodes D3-D6, at the rear right, and also the BAW62 signal diode D1 — at the front between R25 and C21. The four rectifier diodes should have their leads carefully bent in advance to suit holes spaced 0.5" apart, while those for D1 should be bent to suit holes 0.4" apart. All five diodes have their cathode (banded) end towards the front of the board, as shown in the overlay diagram.

Winding the coils

This is probably a good time to wind the main oscillator coils L1-L4, using the information in Fig.6 as a guide. All four are wound using 0.25mm enamelled copper wire, with L1 and L2 wound on F14 two-hole balun cores (13 x 13 x 7mm), L3 on a similar F29 core (13 x 7 x 7mm), and F4 on a small 4mm diameter former of the type with a matching six-pin base and shield can, and fitted with an F29 slug.

Fig.6 shows both the way the various coils are wound, and their connections. Follow these closely, to ensure that your coils are compatible with the PCB. Note that with the three coils wound on balun cores, I have used the convention that 'one turn' is a complete loop through both holes — i.e., 'down one hole and back up the other'. Similarly a 'half turn' means that the wire is passed through only one of the two holes.

When each coil is all wound, it can be prepared for mounting on the PCB. With the coils wound on balun cores, this means cutting the start and finish ends to about 12mm long, and carefully scraping off the enamel from the last 9mm or so, baring the copper ready to be tinned. Similarly the twisted 'tap' is carefully scraped back as well.

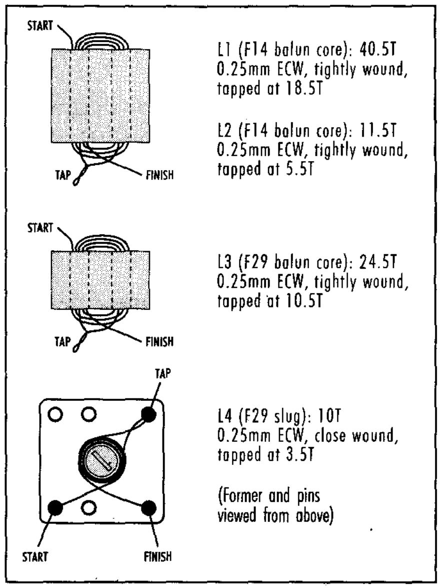


Fig.6: Winding details for the oscillator's four tuning coils.

The three leads are then 'dressed' with a pair of needle-nose pliers, so that they are in the right positions to pass through the matching PCB holes when the core is placed on the top of the board. Then before soldering the leads, a nylon cable tie is passed through the two adjacent 3mm holes, looped around the core and pulled fairly tightly, to secure the coil assembly firmly in position. The leads can then be soldered carefully to the PCB pads, keeping them as short as possible without strain.

L4 is prepared a little differently, being wound on a conventional former. Here I suggest that you cement the former to its base first, and then bare the 'start' end of the winding wire. Then pass this end down the hollow pin shown in Fig.6, and solder it carefully inside — taking care to get as little solder as possible on the *outside* of the pin, as this will make it difficult to fit the finished coil to the PCB.

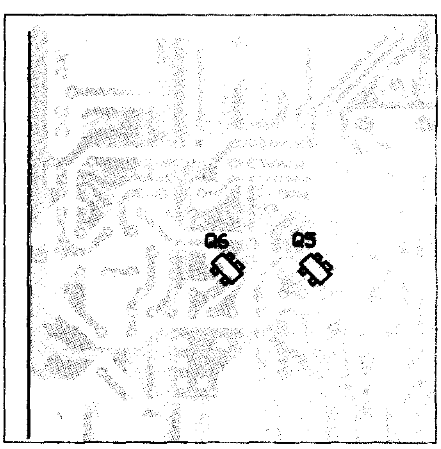


Fig.7: An underside overlay for the main PCB, showing where the two SMD transistors are fitted.

Now wind the first section of the coil, and when you reach the position for the tap form a 'hairpin' loop of doubled-back wire long enough to pass down through the tap pin. Then carefully scrape off the enamel from this loop, and pass it down through the pin until the first section of the coil is tight (i.e., close wound). Then solder it carefully inside the pin as before, and you'll be ready to wind the top part of the coil. At the 'finish' end you can cut, scrape, pass down and solder the wire end as before, completing the coil itself. It should then be an easy matter to pass the pins down through the matching PCB holes (assuming you didn't get any solder on the outside of the pins!), and solder them to the pads.

As this coil is fitted with a threaded slug, this can now be added. However I suggest that you first introduce a length of very thin rubber thread (such as one thread from dressmaker's elastic) to the hole in the former, before screwing in the slug. As the slugs are a rather loose fit, there is plenty of room for the rubber thread, which provides just enough 'resistance' to ensure that the slug remains fixed in position once you have adjusted it.

With the coil pins soldered to the PCB tracks and the slug added, you can finally add the shielding can and solder its leads to the PCB to hold it securely in position.

Now you should be ready to fit the varicap diode CV2, modulator FET Q7, buffer transistor Q8 and the various ICs. As usual take care with the orientation of all of these parts, as they're all polarised. Use the overlay diagram and photos as a guide, and note that Q7 and Q8 are mounted with their flat sides facing. Shape the leads of both these transistors and CV2 so they can be mounted quite close to the PCB, for the shortest lead length that can be achieved without strain.

All of the digital ICs are fitted with their 'notch end' facing towards the rear of the board, while audio oscillator chip U12 has its notch facing the front of the board.

Both of the TO220 three-terminal regulator chips (U10, U11) mount on the board horizontally, with a 3mm machine screw and nuts to hold them down. Only the 7805 (U10) needs a heatsink, and the board allows space for a standard louvred U-shape heatsink measuring 25 x 28 x 35mm. This is held in place between the device and the board by the mounting screw. It's a good idea to give the bottom of the device a thin smear of thermal conducting grease before assembly, to ensure efficient heat transfer.

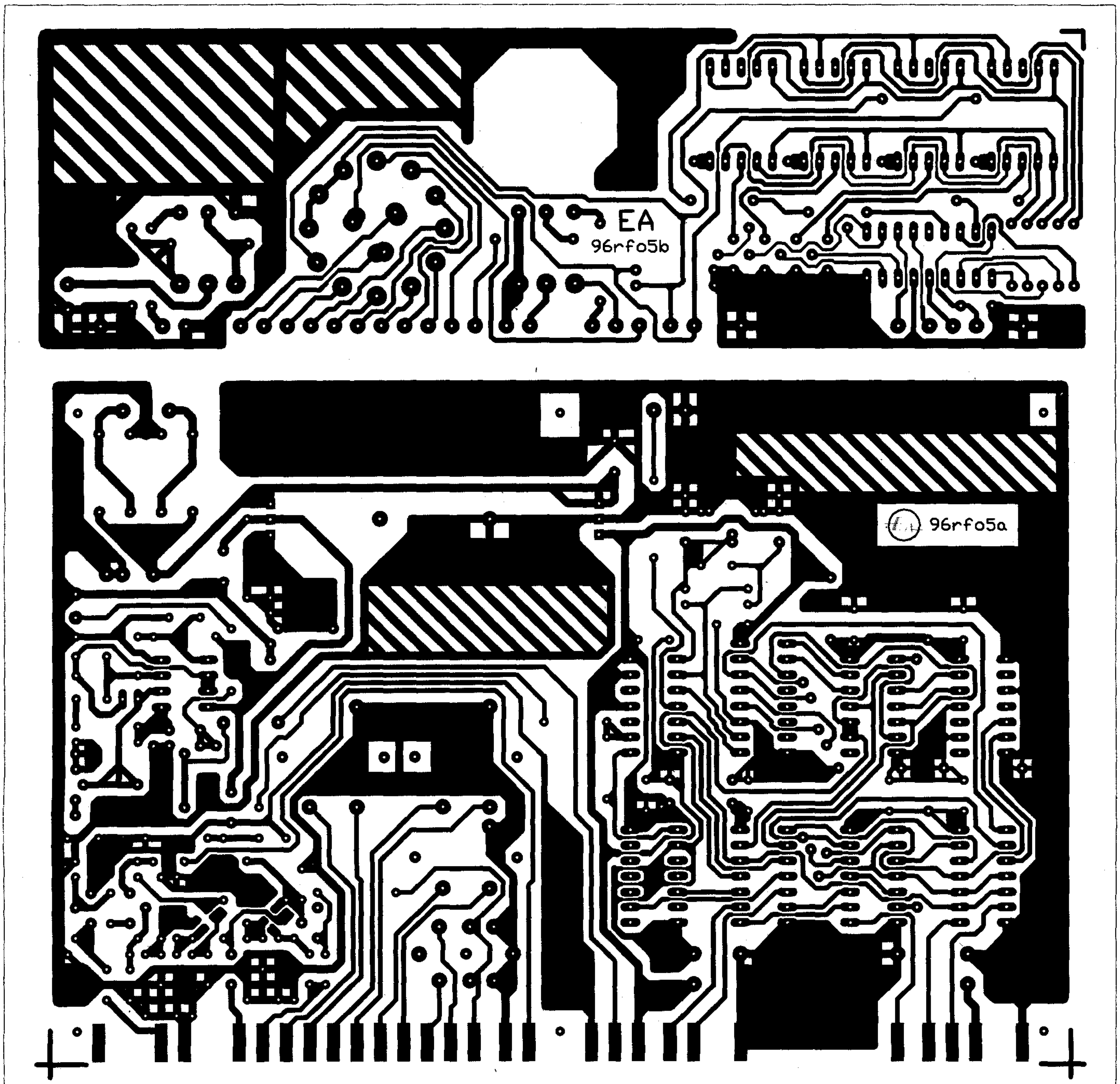
The SMD transistors

The BF998 dual-gate MOSFET transistors (Q5 and Q6) are surface-mount parts in the tiny SOT143 package, and mount underneath the board rather than on top. Use the small overlay diagram of Fig.7 as a guide to their location — but note that the diagram is looking at the *underside* of the board, and with the devices with their top towards you (i.e, with their pre-formed tabs down towards the board copper).

If you closely examine these devices with a magnifying glass, you'll find that one of the four tabs is wider than the others. This is the source tab, and as you can see from Fig.7 the two devices are angled at 45° to the front of the PCB, with these wider tabs in the 'right-hand corners' — i.e., towards coils L3 and L4.

To solder each device to its four matching pads, without damaging it, you'll need a soldering iron with a very fine chisel-pointed bit — well tinned, and very clean. The iron should also be reliably earthed, to ensure there are no leakage currents to damage the devices when you solder the tabs.

I suggest that you *very lightly* tin the four PCB pads for each device first, if they haven't already been solder plated by the board manufacturer. Then place the device very carefully in position,



Here are the patterns for the two PC boards, reproduced here actual size for those who wish to etch their own boards.

and hold it in place using a toothpick while you quickly tack-solder the source tab to its pad. Then you can solder the remaining tabs, and finally re-solder the source connection if you're not entirely happy with it.

The main things to ensure are that (a) you don't overheat either BF998, during the soldering process; and (b) you don't apply too much solder and create 'bridges' to short between the pads or device tabs. The space between the tabs/pads is very small, so you need to be really careful.

Once the two SMDs are in place (phew!) you can fit the 2MHz crystal (X1), which mounts over between R17 and trimmer capacitor CV1. Also the 12V/50mA grain of wheat lamp (G1) in the audio oscillator, next to U12, and the main reservoir electrolytic C2 just to the rear of R40 and R41. All of these mount in the usual way, from the top of the board.

Joining the PCBs

Your main PCB should now be complete, and if everything seems OK it's time to join the two boards together. I suggest that you tackle this operation as follows.

First, fit the 27 PCB terminal pins which are used to link the two, into the holes along the bottom of the vertical board. Push them in from the copper side, with their *shorter* ends passing into the holes, and don't solder them to the pads as yet. They should be a reasonably secure friction fit, if the holes have been drilled to the correct size.

Now invert the main board, and offer up to its front edge the copper side of the vertical board, also inverted but at 90°. The pins attached to the vertical board should line up with and lie on the rectangular pads of the main board, if you've done everything correctly. It's then a matter of holding the two tightly together at an accurate 90°, and soldering the pins to the copper pads on both boards.

This is a little tricky, but not unduly difficult if you use the right approach. I tacked the two end-most pins to their main board pads first, to hold everything together and allow me to make sure that the two boards were positioned at the correct 90° angle to each other. Then without disturbing this alignment, I carefully soldered the remaining pins one by one, first to their vertical board pad and then to the main board pad. Finally I soldered the end pins to their vertical board pads, to complete the job.

When the full 27 pins are soldered, the two boards are very rigidly joined. Just make sure that they are accurately aligned at 90°, before you begin soldering them all — otherwise you'll have trouble later!

Before proceeding, examine the completed PCB assembly very carefully, checking against the overlay diagrams for misplaced or wrongly orientated components. Also look closely for any accidental solder bridges between tracks.

Preparing the panels

If all seems well, you should now be ready to prepare the front and rear panels, cutting out the holes for their controls and connectors, etc.

As noted earlier, the front panel is made from unetched PCB laminate, cut to the same dimensions as the plastic front panel normally supplied with the case. The copper side faces inward, and is connected to the instrument's signal earth via the earth wire for the RF output connector. For the prototype I made a dress front panel from 'Dynamark' photosensitive sheet, and after the various holes were cut in the laminate panel, this was carefully attached to the front to give a professional appearance.

When the front panel itself is finished, the RF output connector is attached to it along with RF output pot RV2 and the 10-turn tuning pot RV1. A small piece of red filter material is also glued (or taped) to the rear of the panel, behind the LED display window.

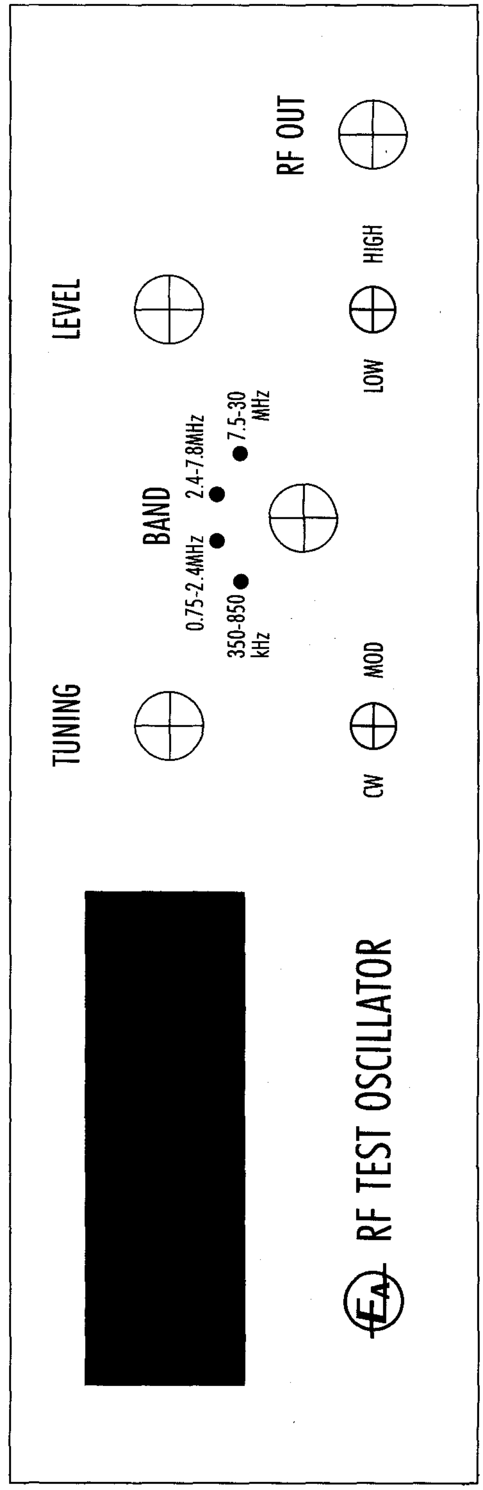
Then, before mating the front panel to the front of the PCB assembly, solder a length of tinned copper wire about 25mm long to each of the lugs of pot RV2, and bend these so that when the panel is offered to the vertical PCB, the wires will mate with the corresponding holes. Fit a similar wire to the 'active' centre spigot of the RF output socket, and a longer one which is soldered not only to the 'earth' lug of the socket, but also to the adjacent front panel copper.

It's also a good idea at this point to solder three short lengths (say 50mm) of *insulated* hookup wire to the lugs of the 10-turn tuning pot, ready to connect to the corresponding PCB pads.

Now it should be possible to mate the front panel assembly with the PCB assembly. The two are held together via the mounting bushes and nuts for rotary switch SW1 and the two small toggle switches, and the panel can be set for accurate parallel alignment with the PCB by adjusting the exact positions of the toggle switch front and rear nuts. You'll find this is easier to do than to explain...

Don't forget to solder the three leads of the tuning pot to the corresponding pads of the vertical PCB. Note that you may need to check the pot connections carefully, as 10-turn pots differ from the standard type — and there are also a couple of connection arrangements used by different manufacturers.

Once the panel is fitted to the boards, the complete assembly can be fitted inside the lower half of the case and fastened using six of the small self-tapping



Here is the front panel artwork for the oscillator, also shown actual size.

RF Test Oscillator — 2

screws provided, through the mounting holes in the main PCB. Note that you may have to cut away some of the unused mounting pillars moulded in the case, to clear some of the solder joints on the underside of the PCB.

The rear panel has only three holes to be prepared — one for the power cable entry (via a suitable rubber grommet), and the other two for the 1MHz reference signal and audio output connectors. Once these holes are cut, the two BNC connectors and grommet can be fitted, and the panel fitted to the case. Then it's possible to connect the two BNC connectors to the PCB, using light duty shielded wire.

If the lead from your power source is then brought inside the case through the grommet, and soldered to the two power pins at the rear of the power diodes, your test oscillator should be functionally complete and ready for testing and adjustment.

Testing and adjustment

To begin the testing, first set preset pots RV3 and RV4 to mid rotation. Then connect the earth probe of your multimeter/DMM to the circuit earth (say the outside of the RF or audio output connectors), and the active probe to the +9V rail on the main PCB — the rear end of resistor R42, for example. Now apply the power gingerly, and check that the DMM gives a reading of somewhere around 9V. It should be possible to adjust the reading to exactly 9V, using preset pot RV4.

If this seems OK, try moving the active DMM probe to the +5V rail (say the link next to capacitor C11). Needless to say, this should measure very close to 5V.

If either of these supply rail voltages are not present, or give readings well away from the expected values, switch off immediately and look for your wiring fault. Otherwise either your power supply, one of the regulators or other components may be damaged.

If both supply rails seem OK, and once you've set the +9V rail to its correct figure, you can proceed.

You should be seeing some sort of frequency reading from the LED displays. All four displays should be glowing, and the decimal point of either LD1 or LD2 should be glowing also depending on which range SW1 is set to. If one or more displays are 'dead', the odds are that you've installed it upside down — so turn off the power immediately, and investigate. If one *is* inverted, you'll have to desolder it carefully and re-install it the correct way around...

By the way, try touching the heatsink for the 5V regulator. It should be quite warm by this stage, but not too hot to touch comfortably. If it's really HOT, you may have a short circuit somewhere on the 5V rail (or perhaps a digital IC fitted the wrong way around), so switch off quickly and investigate.

If all seems well, though, connect the rear-panel audio output to a scope. You should see a nice clean audio sinewave,

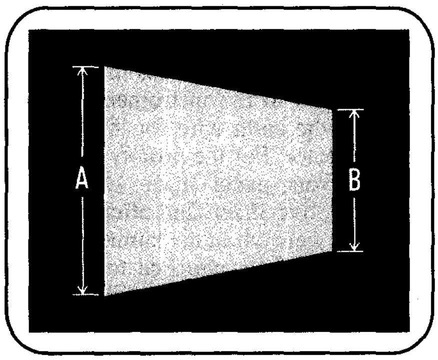


Fig.8: The traditional 'modulation trapezoid'. To set the modulation at 30%, the maximum RF amplitude A should be 1.85 times the minimum B.

of about 2.8V peak to peak and with a frequency of either 1kHz or 400Hz — depending on the values you chose for R20 and R21.

If there's no sinewave signal, or it's distorted by 'flats' at the positive and negative peaks, you'll need to adjust preset pot RV3. If there's no sinewave, turn it anti-clockwise until the oscillator springs to life and operates reliably; alternatively if there's a distorted sinewave, turn RV3 clockwise until the distortion is completely removed and the amplitude is about 2.8V p-p.

Now it's time to check the tuning span of the various ranges, so first set SW1 fully anticlockwise for the lowest range, and try turning the tuning pot RV1 between its two extremes. The frequency displayed should vary from slightly below 350kHz to about 850kHz.

Similarly on the second range, the frequency should vary from about 750-800kHz and a little over 2.4MHz; and on the third range, between about 2.4MHz and just over 7.8MHz.

If any of these three lower ranges won't tune over the correct span, you may have to modify the appropriate coil slightly. If both ends of the range are too low in frequency, the remedy is to remove a turn (or possibly two) from the 'finish' end of the coil. On the other hand if they're both too high, the remedy is to increase the coil by a turn or two — which is not nearly as easy, of course. You'll have to rewind the coil, in most cases.

If the actual span is not quite wide enough, you may have a BB212 varicap diode (CV2) with a relatively low maximum capacitance. In this case you can try adjusting preset pot RV4 to 'tweak' the +9V rail up a little, to give a wider voltage range, and/or try reducing the value of resistor R13 to give a lower minimum tuning voltage.

When these ranges seem OK, you can turn your attention to the highest range. Here the tuning range has to be set, using the tuning slug in coil L4. The procedure is to set SW1 for the top range, turn the tuning pot to its fully anticlockwise limit, and then adjust the slug until the display reads a little below 7.8MHz — say 7.6MHz. You should then find that when the tuning pot is turned to its fully clockwise limit, the oscillator should tune to a little over 30MHz.

The remaining adjustment is to set the modulation level, and for this you'll need a scope — preferably with a bandwidth of 20MHz or better, and with the ability to display two signals in X-Y fashion.

The procedure here is to connect the scope's Y (vertical) input probe to the emitter of output buffer Q8, with its earth clip to the earthy side of the RF output socket. The X input is then driven by the oscillator's rear-panel audio output. Then set SW1 for the second lowest range and the tuning pot for a frequency of around 1MHz. The CW/Mod switch (SW2) should be set to the 'Mod' position, and the scope controls adjusted to give a traditional 'modulation trapezoid' pattern as shown in Fig.8.

Preset pot RV5 is now adjusted until the modulation level is close to 30%, as indicated by the maximum RF ampli-

Omission from Parts List

Please note that the 12V/50mA lamp used for amplitude stabilisation in the audio oscillator of this project was accidentally omitted from the parts list given in the first of the articles. The lamp is one of the tiny 'grain of wheat' types, and is soldered directly into the PCB. I used one of the lamps with a small white plastic base, as used in car burglar alarms, and this gives quite low distortion.

tude A being about 1.85 times the minimum amplitude B.

Final comments

Your RF Test Oscillator should now be completed, and ready to have the case top added.

You'll no doubt have noticed that I haven't suggested adjusting the crystal oscillator trimmer CV1, to perform a calibration of the oscillator's counter and hence make its readings more accurate. That's because for most users, the accuracy of the instrument will probably be quite good enough with the trimmer simply adjusted to the middle of its range.

If you *do* wish to calibrate it for higher accuracy, the simplest approach is to use a high accuracy frequency counter (such as one with a temperature-controlled crystal timebase, or using timebase signals from our TV-Derived Frequency Reference of Oct/Nov 1993). Then it's simply a matter of feeding the oscillator's rear panel 1MHz reference signal to the counter, and adjusting trimmer CV1 until the counter reads as close as possible to 1.0000MHz.

An alternative approach would be to feed the two 1MHz signals to the X and Y inputs of a scope, and use Lissajous figures to set the Oscillator's timebase to the correct frequency.

If you don't have access to a high accuracy counter or a scope, another approach would be to use a communications receiver tuned to a convenient reference signal, like the 5.000MHz signal from Time and Frequency Standard Station VNG, in Llandilo. Connect a short length of wire to the oscillator's rear panel 1MHz output, and then tune trimmer CV1 until the fifth harmonic of the 1MHz output is at zero beat with the VNG signal.

That's about it. I hope you find the RF Test Oscillator a useful and convenient addition to your test bench. ❖

Forum

(Continued from page 45)

cheap nowadays. Even the heavyweights such as the 80C552 family cost NZ$25 each! Specialist parts are difficult to source (especially in New Zealand) and can cost the Earth.

While I clearly understand the problems you face, I think they are not impossible to overcome. I would like to contribute several suggestions as to how you might be able to overcome some of the problems:

1. Source code too long to publish: You can distribute a floppy disk with the magazine. I for one will not mind paying extra for the floppy.

2. Readers lack the facilities and tools to properly use the source code: You can distribute pre-compiled source code (HEX or BIN files). This way, readers who don't have compilers/assemblers can still use the program. I would also like to suggest a project that allows readers to program a simple micro (such as the Motorola 68HCO5K1). I can think of a very simple project that does this. Also, Motorola distributes their assemblers as freeware. You can then base most of your future projects on this micro (or any that you may deem more suitable).

3. Copyright of source code: To protect the copyright of your technical writers, you can include a licence agreement with packaged floppy disk. 'When you purchase the magazine, you also purchase one copy of the licence to use the firmware...' You may only want to distribute the compiled version in this case.

4. Royalties: If your technical writers require a licence fee to use their firmware, you can still protect them. Encrypt the compiled firmware (with something such as PKZIP for example). Readers who want to use the firmware can then send a sum of money to the writer and receive the key to decrypt the firmware.

5. Assembly Language Listing is not much fun to look at: I do not support publishing assembly language source code for the above reason. However, I think the algorithm should be fully explained. I am of the opinion that coding is trivial once a suitable algorithm has been designed. It is also helpful if comparisons to conventional logic can be made against the micro design. C compilers are also available for some micros.

6. Projects involving micros take longer to design: Rome was not built in one day!

I hope you will take these suggestions into consideration. I look forward to more interesting projects and articles in your magazine.

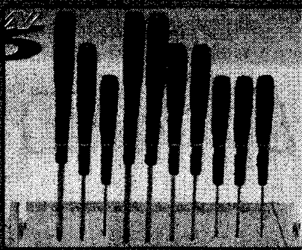
Thanks for your comments too, Mr Chuah, and we'll certainly take them into consideration. Your point 6 does seem a bit glib, though — magazines like *EA* don't have the resources of the Roman Empire to play with!

There are certainly a lot of things to consider with regard to publishing microcontroller-based projects, aren't there? And as many of the people who have contributed to the discussion have demonstrated, at least some of them are mutually conflicting.

Still, it's obvious that micro-based projects are going to have an ever-increasing role in electronics, and that because of this we're going to have to find ways of both giving you more of them, and making them more informative. All without causing undue sorrow to those who still want conventional 'hardware' type projects...

About all I can say for the present is that we'll be doing our best! ❖

JUNE AT JAYCAR



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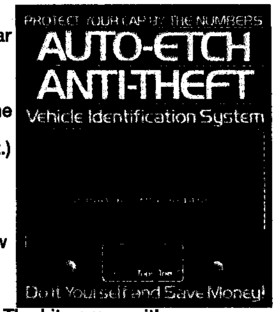

With this kit you will be able to permanently etch the unique VIN on up to six windows on your car. The kit comes with a special glass etching paste which works really well! You also get a set of etch resistant number and letter decals to make up your unique VIN on six windows. After you have done the job (fantastically clear instructions supplied) you wash up and apply two decals on the main driver/passenger windows which highlight the etched number and warns theives that the vehicle has been permanently marked.

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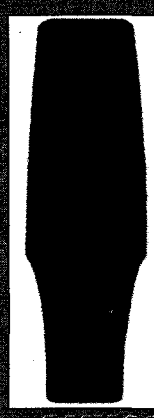

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No. 1 For Kits

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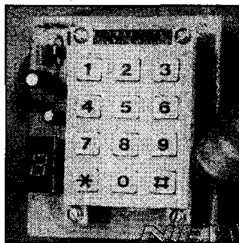

REFER: SILICON CHIP MARCH 1996
You can program into the system: •the RPM at which ignition advance begins •RPM for full advance •max advance angle •REV limit •dwell angle •vacuum advance •number of cylinders •two digit security code. The unit features keypad data entry, tacho drive output, points/sensor input plus 7 segment display. This kit is designed to interface with our High Energy Ignition kit, KC-5030 $55.00. Both kits required. Kit includes PCB, keypad, pre-programmed micro, plus all electronic components and microswitch.

NEW in 96

Cat. KC-5202 **$65.00**

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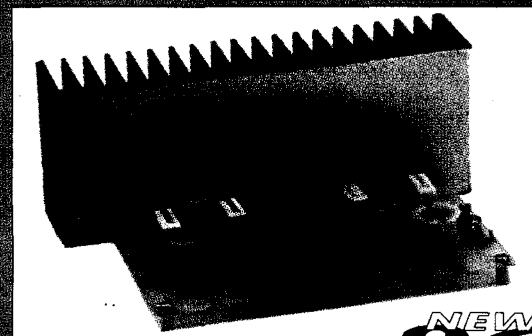
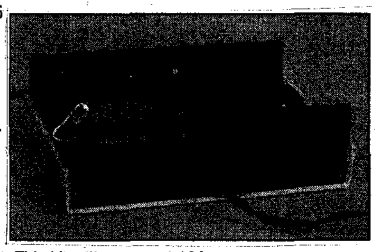


A REAL POWERHOUSE!

NEW 96

Automatic 10 Amp Battery Charger Kit

REFER: Silicon Chip May 1996



Although its possible to buy commercial chargers for under $50, it certainly won't get you out of trouble in a hurry if you have a flat battery. These types of chargers usually output 4A continuous, which means that it can take many hours to bring the battery up to scratch - usually the rest of the day or overnight. This kit will pump out 10A continuous and will automatically charge 6, 12 or 24V batteries. Output short protection, charge status, LED indicators, auto charge from high through medium to trickle. Push aside your old "toy" charger, this beaut design will get you and your car/boat/bike going again quickly on those cold winter mornings. Case, punched and silkscreened front panel, punched rear panel, torroidal, PCB, plus all specified electronic components supplied including high current leads and battery clips.

NEW in 96

Cat. KC-5206 **$179.50**

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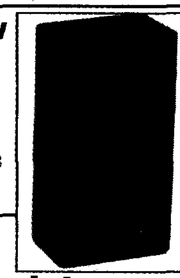

See 1996 cat P13 for details. Cat. KA-1783
$69.50

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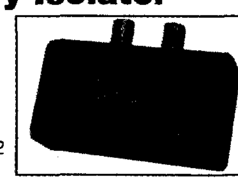
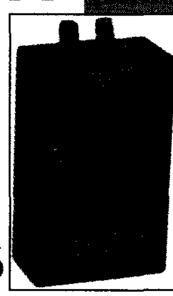


See 1996 cat P16 for details
Cat. KA-1782
$44.95

HIGH VOLTAGE INSULATION TESTER KIT

NEW in 96

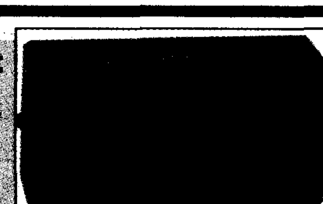


REFER: Silicon Chip May 1996
If you build or repair mains operated equipment, its wise to test the insulation resistance between active and neutral to earth. The essential tester can measure from 1-2200 gigaohms, has five test voltages from 100 to 1000V, is battery operated and displays the readout on a 10 step LED display. Kit includes case, pre punched & silkscreened front panel, PCB plus all specified elec components. 9V battery required use SB2395.

Cat. KC-5205 **$89.50**

Knock Sensor Kit For Cars

NEW in 96



REFER: SILICON CHIP APRIL 1996
This kit warns you when engine knock is occuring, so that you can ease up and avoid costly engine damage. Indication is via a LED bargraph, and piezo buzzer, mounted inside a jiffy box that can mount near the dashboard. PCB, case, silkscreened front panel, electronic components plus parts to make the sensor all included. Cat. KC-5203 **$34.95**

Improved Knightrider LED Scanner Kit

NEW in 96

REFER: Silicon Chip May 1996
This kit simulates the row of scanned lights used on the car in the Knightrider TV series. It has one row of 16 LEDs and is more realistic than our previous kit (KC5042). This new version scanning is in one direction, then the other. The circuit can be modified to drive 12V 35W globes for use in 12V systems (extra components not included). Kit is supplied with PCB, LEDs plus electronic components.

Cat. KC-5204 **$19.95**

PC Driven EGO Analyser

See 1996 cat P20 for details
Cat. KA-1781
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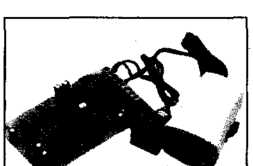

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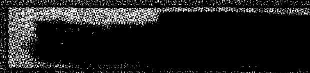

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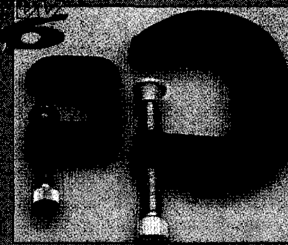

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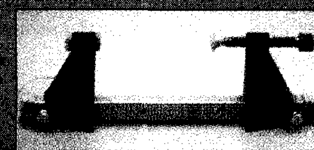

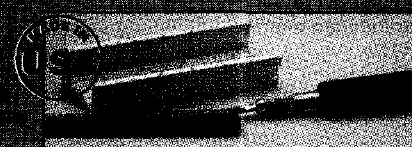

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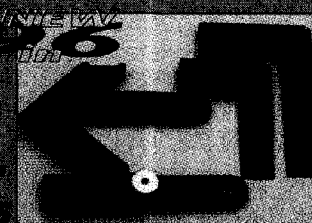

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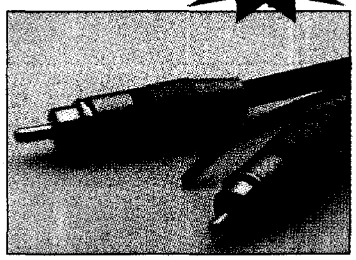

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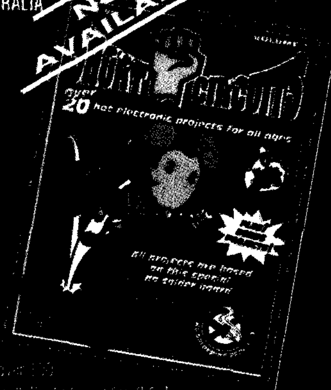

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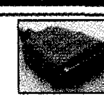

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Construction Project:

'STEAM WHISTLE' FOR MODEL BOATS & TRAINS

Does your latest model seem to be lacking something? A model steam boat cruising around on the water in near silence isn't terribly realistic; neither is a model steam train pulling away from a station with nothing but the whine of an electric motor behind it. This compact circuit can provide your model with a distinctive steam whistle sound, giving your models that extra touch of realism.

by GRAHAM CATTLEY

If you've worked long and hard on your model train layout to make it look great, why not add that final touch and make it *sound* great as well? This project can reproduce the sound of either a steam boat or train whistle quite realistically, due to the fact that it uses two oscillators to produce the note, as well as a white noise generator which, when mixed with the note, gives it that characteristic steam whistle sound. This design improves on existing designs, in that the note produced can be easily altered to suit the size and type of model you are using.

Two notes

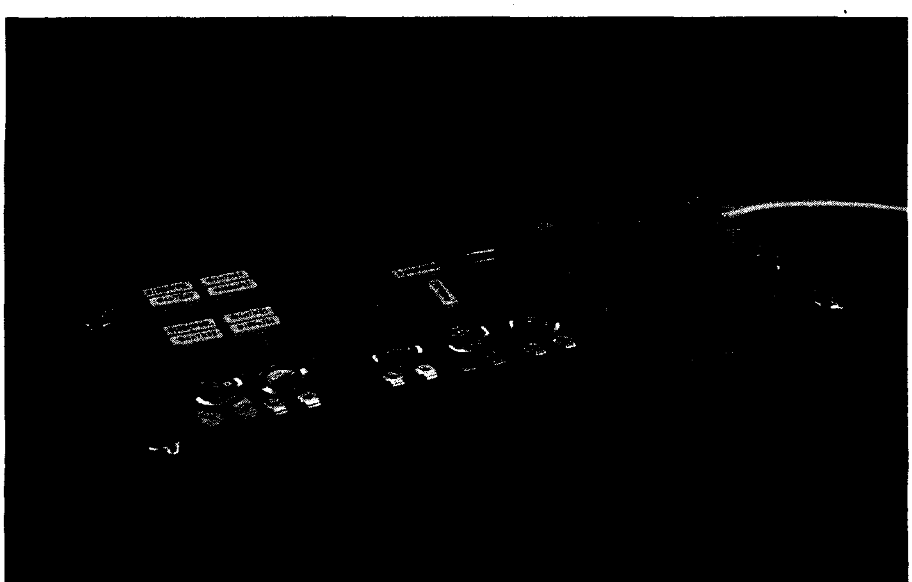
If you listen to a real steam whistle, be it on a vintage boat or locomotive, you probably won't hear just one note, but rather a chord of two slightly different notes mixed together.

This is because the actual whistle itself is usually made up of a pair of pipes of differing diameters or lengths, tuned to give a harmonious chord. This, along with the sound of escaping steam as the whistle blows, is what makes steam whistles sound so distinctive.

For the musically inclined, one note is usually either a major fifth higher than the other (that's a spacing of seven semitones, like the notes C - G, D - A, E - B, etc.), or a major third higher (four semitones, C - E etc.). Of course, other tunings are used, and in this steam whistle project we have included trimpots for each note, so that you can adjust the tuning to suit both your ear and the type of model. (After all, you don't want your model train emitting a blast befitting a departing ocean liner, do you?)

In fact, this design allows you to change almost every aspect of the note, with adjustments for the frequencies of each of the two oscillators; the balance, or percentage of each of the two tones in the output; and both the amplitude and percentage of steam in the note — as well as a way of adjusting the small delay between the higher and lower notes starting up.

As you can see, with such control over the note produced, this whistle should be able to emulate the sound of almost *any* real steam whistle reasonably well.



The circuit

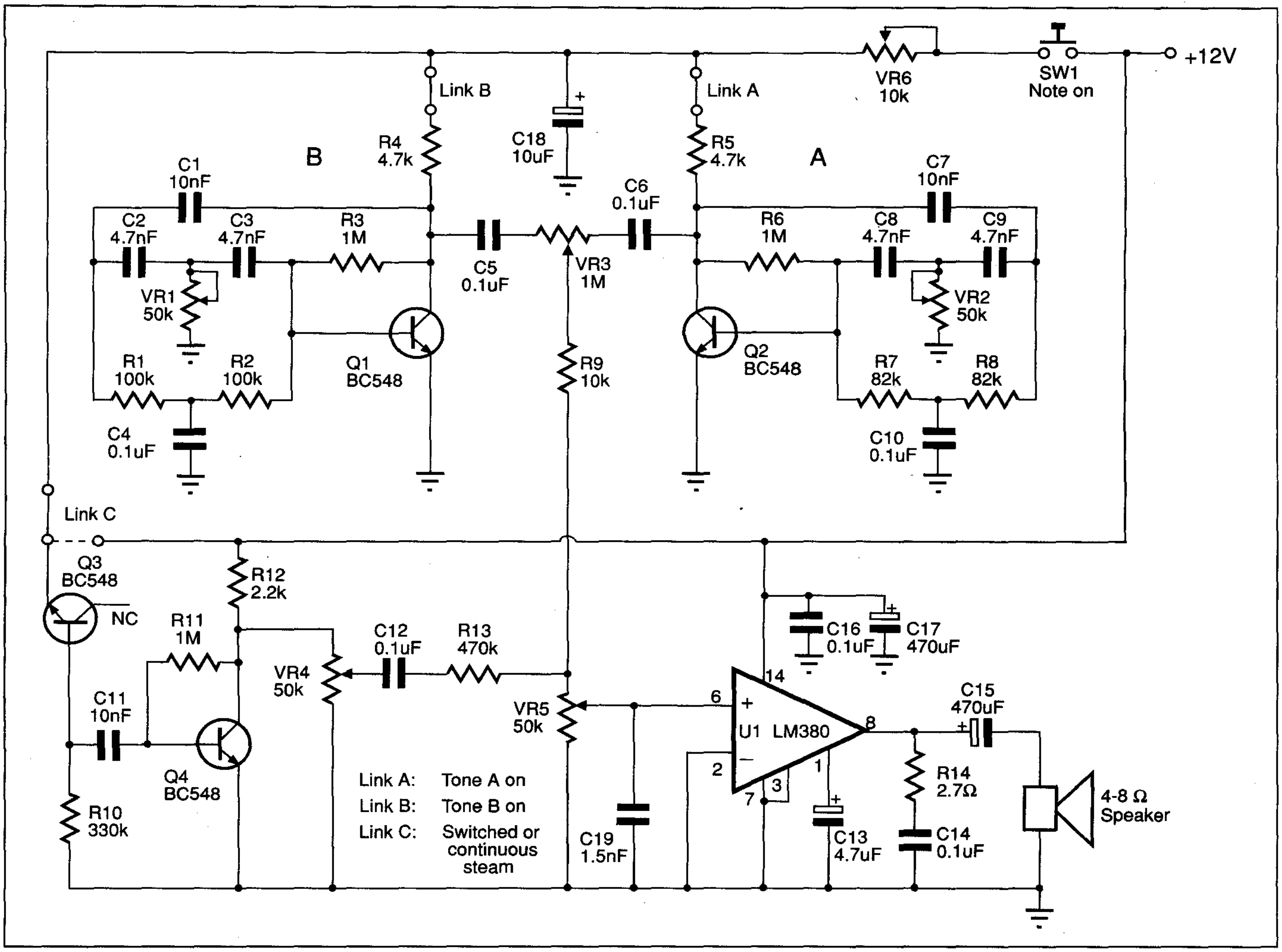
The circuit falls rather neatly into four major blocks: two audio frequency oscillators, based around Q1 and Q2; a white noise generator (Q3 and Q4); and a mixing/amplifying stage consisting of trimpots VR3-5 along with U1, an LM380 amplifier IC capable of delivering around two watts into a 4Ω loudspeaker.

Looking at one of the oscillators, you can see that its frequency is determined by the distinctive 'Twin-T' feedback network. By using this style of oscillator, we can produce a reasonable sine wave output which is easy to adjust in terms of frequency using just one variable resistor.

The two oscillators can be adjusted to run over a wide frequency range, with the one labeled 'A' in the circuit diagram set to run at a slightly higher rate (250-650Hz as opposed to 250-500Hz), due to the lower values for R7 and R8 in the feedback network.

The output of these two oscillators is taken from the wiper of trimpot VR3, which allows you to vary the output level of each note. This control is labeled 'Balance' on the PCB overlay diagram, and with it you control the proportion of the two notes in the output.

The 'steam' sound is produced by the white noise generator based around Q3 and Q4. In this part of the circuit we are taking advantage of a characteristic of the PN junction inside all silicon transistors, namely its reverse bias leakage current.



The two oscillators based around Q1 and Q2 form the heart of the whistle, with a white noise generator (Q3 and Q4) providing the 'steam' sound. The six trimpot adjustments allow you to produce a wide variety of steam whistle sounds.

If the circuit's supply voltage is greater than the reverse breakdown voltage of this junction, transistor Q3's base-emitter junction will break down and current will flow backwards through it. By including a 330k resistor, R10, in series with the base, the current through the transistor is limited to approximately 40uA, preventing the junction from being damaged. The noise produced across this junction due to the reverse current flowing through it is then amplified by Q4, set up in a simple auto biasing configuration.

The three audio signals (the two tones from the oscillators and the white noise) are then mixed at the top of the volume control VR5, with R13 attenuating the steam sound output so as not to swamp the notes from the oscillators. If the transistor that you are using for Q3 seems to be producing a particularly low level of white noise, the value of R13 can be reduced to give a higher output volume for the steam.

An LM380 was the obvious choice for the power amplifier, as it provides a reasonable output power without the need for an external heatsink; by using the copper foil pattern on the PC board, adequate heatsinking can be achieved while keeping the unit compact. The LM380 is used here in a somewhat standard configuration, heavily decoupled by C16 and C17, with R14 and C14 acting as a Zobel network which helps to improve the amp's stability. Also, C19 was included to prevent the amp from breaking into high frequency oscillation, as well as filtering a lot of the harsh higher frequencies out of the white noise, making the note sound a little more 'friendly'.

Note shaping

When designing the prototype, we found that while the circuit produced notes that sounded very realistic, something was lacking somewhere...

Ah yes — *real* steam whistles don't switch sharply or cleanly on and off; they have a reasonable attack and decay, and one note (usually the lower one) often comes in a little later than the the other.

The simplest way to implement this, as it turned out, was to include a 50k pot in series with the positive supply to the oscillators. When the power switch/pushbutton SW1 is closed, the voltage across the 10uF capacitor (C18) slowly rises. This causes the oscillators to slowly spring to life, and increase in output volume as they do.

As the feedback network in the lower frequency oscillator has a longer time constant than that in the other oscillator, it takes slightly longer to 'come up' than the higher one — simulating a real whistle quite accurately.

This method of shaping the tone has another advantage, in that as the switch is released the oscillators keep running on the stored charge in C18. This charge quickly dies away, but it gives a slight 'tail' to the note, again making it that much more realistic.

By adjusting the value of VR6, you can vary the rate of the rise in volume (and also the delay between the two notes coming on), from a short sharp tugboat 'toot' to the fairly long drawn-

Steam whistle for model boats & trains

out sound often heard from steam trains.

You may have noticed that the amplifier is left running the whole time, and not switched on and off with the rest of the circuit. This is to prevent the all too familiar 'Thump' as the amplifier turns on — a sound that steam whistles are not known for. Q4 is similarly connected permanently to the supply rail, as it was found to thump a bit on switch-on as well.

A jumper on the PCB allows you to select between continuous steam, or having it switch on and off with the note. One small thing to point out here is that in order for this circuit to operate correctly, it needs to run off at least 11V due to the voltage requirements of the white noise generator. (The supply voltage needs to be greater then the B-E reverse breakdown voltage of the transistor Q3, which for a BC548 is around 10V). Running the whistle at a lower supply voltage won't hurt anything — you just won't get any steam noise in the note.

The other two links on the board allow you to disable either note A or note B, independently, if you wish. All these two jumpers do is connect the collector resistors of the two oscillators to their positive rail. In contrast, the steam jumper selects either switched or continuous steam sound by connecting the steam generator's positive rail to either the switched or unswitched side of SW1. (Of course removing the steam link 'C' all together will turn off the steam, as will winding VR4 fully anticlockwise.)

Construction

Start construction of the steam whistle by installing the six PC pins in the holes on the right-hand side of the board. These are sometimes a tight fit, and you may find that a small pair of pliers comes in handy. Don't forget to solder them to their pads, when they're in place.

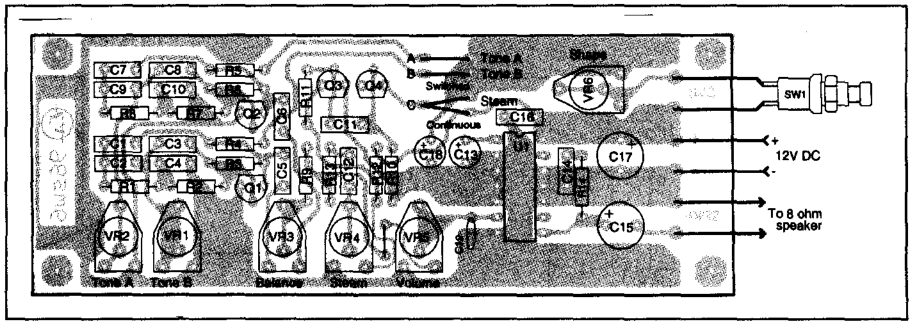
This done, install the four wire links on the board, keeping them as flat and straight as possible. You have a choice with the steam link (C), as it can be fitted in one of two ways on the board. For now, fit it in the upper position (switched steam) — you can always reposition it once you know that the whistle is working correctly.

Mount the resistors next. There's a few of them on the board, and it is quite acceptable to verify each value with a multimeter before soldering it in — especially with the newer five-band 1% tolerance resistors that are somewhat prevalent these days.

The capacitors can now be installed, ensuring correct polarity with the electrolytics, C13, C15, C17 and C18. These are mounted with their positive lead towards the top of the board, except C15, which has its positive lead on the left.

The five trimpots are next, and these can be either the horizontal or vertical types — although you may find that the horizontal style will be easier to adjust once the board is mounted in position.

Finally, install transistors Q1-4 and the amplifier IC, U1. Watch the orientation of these parts, and check them against the component overlay diagram before soldering them in. Make sure that your soldering iron is good and hot when soldering U1, as you'll find that the large copper areas around the IC — used here as a heatsink — tend to perform their function a little *too* well and soak up the heat needed for the joint. It's best to leave the soldering iron to heat up for a few seconds after you solder each pin, otherwise you'll find that the iron will start sticking to the joints. Don't worry too much about overheating the IC, as it is designed to take a little heat in operation and is quite robust.



Use this component overlay as a guide when installing the parts on the board. The steam link 'C' can be installed in either the upper or lower position, and don't forget the small link betwen VR4 and VR5.

This close up clearly shows how the components are mounted on the board. Note that a 50k log potentiometer could be connected as a volume control instead of the trimpot VR5, making volume settings a little easier.

PARTS LIST

Resistors

(All 1/4 watt 5%)

R1,2	100k
R3,6,11	1M
R4,5	4.7k
R7,8	82k
R9	10k
R10	330k
R12	2.2k
R13	470k
R14	2.7 ohms
VR1,2,4,5	50k trimpot, horiz. or vert. mount
VR3	1M trimpot, horiz. or vert. mount
VR6	10k trimpot, horiz. or vert. mount

Capacitors

C1,7,11	10nF MKT polyester
C2,3,8,9	4.7nF MKT polyester
C4,5,6,10,12,14,16	0.1uF MKT polyester
C13	4.7uF 16VW electrolytic
C15,17	470uF 16VW electrolytic
C18	10uF 16VW electrolytic

Semiconductors

Q1,2,3,4	BC548 or equiv. transistor
U1	LM380 5W audio amp IC

Miscellaneous

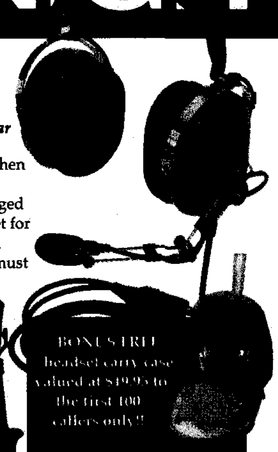
PCB 11.5 x 4.2mm, coded 96sw6; 8Ω speaker; Normally open pushbutton; 50mm tinned copper wire; hookup wire, solder, etc.

OVERNIGHT DELIVERY

Aviation Headset

1000's Sold Across Australia-Includes 2 Year Warranty!
It was not to long ago when spending $450.00 on an Aviation Headset was not uncommon. Altronics changed all that when we released our C 9070 Aviation Headset for $199.00. Add to this enhanced microphone, improved lead shielding and headband comfort these headsets must be the best value for money in Australia!

C 9070 **$199**



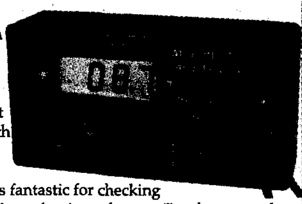
Modular Crimping Tool

Rugged steel and polycarbonate construction. Crimps 4, 6 and 8 way modular connectors. Inbuilt cutter and stripper with stops for correct stripping length. Replacement blades available.

T 1568 **$65**

T 1569 Replacement Blade Set $5.95

Impedance Meter



Measuring a transformer with a standard ohm meter will not give accurate results because it is measuring with a DC signal, not AC. This invaluable unit is fantastic for checking transformers and speaker impedances. For those people dealing in PA equipment, the built in tone generator enables an entire PA system to be checked before the amplifiers are connected. Uses one 9 Volt battery. (Not supplied). Three ranges enable accurate measurement of 2 - 20,000 ohms. Accuracy mid range typically ±5%.

K 2550 Kit Version **$99**

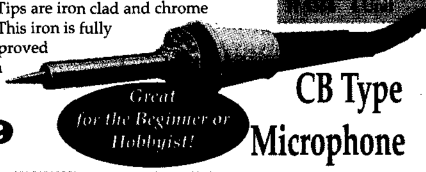
K 2551 Built Version **$159**

Micron 20 Watt Soldering Iron

A fantastic general purpose iron for the hobbyist or beginner and is ideal for kit construction. It features a high efficiency patented heating element, with a 370°C fixed temperature. Tips are iron clad and chrome plated for long life. This iron is fully energy authority approved and is supplied with a 1.5mm conical tip.

Normally $29.95!

T 2420 **$19**



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Save 10% on Professional Rack Cases! Ideal for building Amplifiers, Pre-Amps, Power Supplies etc.

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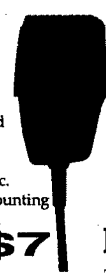
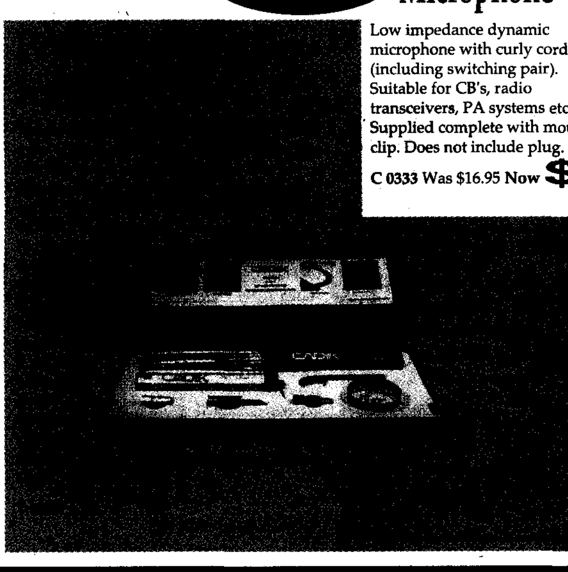
Now available - extra deep shelves for multi-play carousel CD players etc

CB Type Microphone



Low impedance dynamic microphone with curly cord (including switching pair). Suitable for CB's, radio transceivers, PA systems etc. Supplied complete with mounting clip. Does not include plug.

C 0333 Was $16.95 Now **$7**



Professional Series Speaker Grills

Add some class to your speaker cabinets with this professional series of mesh grills. Sturdy steel construction features plastic surround and open grid appearance. Each includes 4 fixing clamps.

C 3706 6.5" (165mm) Was $8.95 Now **$6.70**

C 3708 8" (200mm) Was $10.95 Now **$8.20**

C 3710 10" (250mm) Was $13.95 Now **$10.40**

C 3712 12" (300mm) Was $16.95 Now **$12.70**

C 3715 15" (380mm) Was $19.95 Now **$14.95**

Micron Series III Soldering Station

The *MICRON* Series 3 soldering station employs electronic switch mode circuitry in lieu of a mains transformer. Excellent for all general purpose and production soldering.

Features: • High insulation ceramic heating element • Rapid heat-up and instant recovery • Heater insulation of over 100MΩ • A zero voltage circuit ensures no high voltage spikes or magnetic field are present at the tip to damage sensitive components • Continuous temperature adjustable from 250° to 430°C (480° to 800°F) • Grounded power cord • Selecting the desired operating temperature is as simple as turning a knob.

Now Supplied with Long-Lasting Iron Clad Tip!

T 2443 Normally $129

This Month $99

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ALTRONICS COMPONENTS

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Now over 1000 units in service Australia wide!

De-Solders a 14 Pin IC Socket in Around 30 Secs!

Piezo Alarm

An ear piercing pulsating tone for use in house alarms, car alarms or warning systems. 100mm fly lead length.

SPL Output: 100dB @ 1m
Supply Voltage: 1 - 13V DC
Dimensions: 45Ø x 27H
S 6117 Was $5.25
Now **$4**

Ear piercing piezo for use in alarm panels, reversing buzzers, warning systems etc.

Flush Mount Circuit Breakers

These circuit breakers push fit into a panel and protrude only 5mm from the mounting plane. Push-to-reset action with coloured button and current rating on bezel for easy identification.

Hold Current: 100% indefinitely at 25°C
Trip Current: Within 1 hr at 135% of rated load at 25°C
Within 1 minute at 200% of rated load at 25°C
Maximum Voltage: 250V AC or 32V DC
Dimensions: 52L x 13.5H x 15.5W

S 5553 3 Amp
S 5555 5 Amp
S 5557 7 Amp
S 5560 10 Amp
S 5565 15 Amp

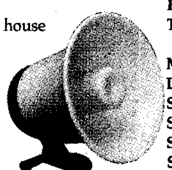
All **$6.95** ea

Ideal for Amplifiers Power Supplies etc. Instantly Resets at the Push of a Button

Weatherproof Horn

8 Ohm. 10 watt. For use in house alarms, CB PA/extension speaker, boats etc. White PVC construction with swivel mounting bracket.

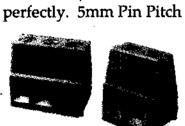
C 2015 Was $15.95
Now **$10**



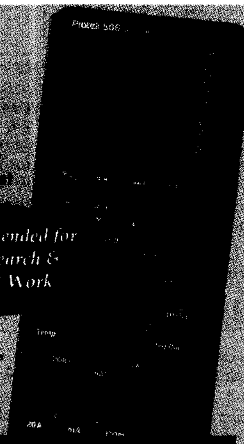
PCB Terminal Blocks

These terminals are slightly imperfect and in some cases they will not readily dovetail together as the grooves are slightly burred. However, if the burr is removed with some side cutters, they join together perfectly. 5mm Pin Pitch with wire protect terminals. Rated at 15A at 300V AC

P 2034 2 way **40¢** 1-9, **30¢** 10-99, **20¢** 100up
P 2035 3 way **60¢** 1-9, **45¢** 10-99, **30¢** 100up
(Note: Not available from resellers)



True RMS Digital Multimeter



Supplied with high quality hard carry case and silicon test leads. This 3.75 digit 4000 count digital multimeter would have to be best meter we have ever evaluated. Features include menu driven functions (no complicated instructions to remember), large backlit display, timer function, 20 amp current mode and many more.

Highly Recommended for Scientific Research & Development Work

Other Features: • RS-232 Mode (Q 1092 only) for interface to PC computer • True RMS mode • Large display includes main and sub displays with bargraph • 10 Location memory • Stop watch/ pre-settable count down timer • Minimum, maximum, average and relative modes • Decibel measurement • Capacitance and inductance measurement • Temperature mode (°C and °F) • Pulse signal generator for logic and audible testing etc • Continuity and diode test • Logic test • Auto power "off" and "keep on" mode • 20A current range • Warning buzzer sounds when leads are incorrectly inserted in the 20A current mode • Back lit display • Data hold and run mode • Low battery indication • Overload protection • Safety design in compliance with UL 1244 and VDE0411

BONUS THIS MONTH
Receive a FREE Q 1093 carry holster and Q 1092 temperature probe adaptor valued at $35.50!

Specifications & Ranges Available:

DC Volt: 400mV, 4V, 40V, 400V, 1000V
AC Volt: 4V, 40V, 400V, 750V
DC Current: 400μA, 400mA, 20A
AC Current: 400μA, 400mA, 20A
Frequency: 10kHz, 100kHz, 1MHz, 10MHz
Resistance: 400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, 40MΩ
Capacitance: 100uF
Inductance: 100H
Temperature: ....-17° - 1093° C (0° - 2000° F)
Display: ....3.75 digit, 4000 count LCD

Q 1091 Standard Model **$239**
Q 1092 RS-232 Interface Model **$289**

Thermalloy TO-3 Heatsink

More than 50% off! Stock up NOW!

Includes threaded studs to secure transistors.

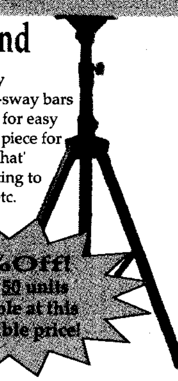
Thermal resistance 7°C/W. Ideal for all those projects with TO-3 transistors such as power supplies, small audio amps, power switching circuits etc.

H 0503 Normally $1.20
This Month .50¢ ea

Heavy Duty Speaker Stand

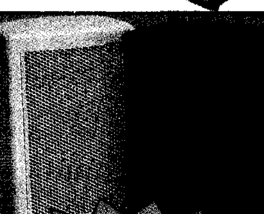
Adjustable height from 1 to 2 metres. Sturdy aluminium tube construction with steel anti-sway bars and heavy duty plastic fittings. Folds down for easy transportation and storage. Comes with tee piece for mounting to speaker boxes, or will fit a 'top-hat' adaptor. Ideal for raising speakers and lighting to audience level. Great for DJ's, bands, clubs etc.

C 0520 Was $140
This Month $99



30% Off! Only 50 units available at this incredible price!

Weather Proof Sound Monitors



Save a MASSIVE $50!

They compare favourably with imported U.S. and European made speakers costing twice as much. John Negus, Audio Equip

PECC Speaker Bargain

This punchy, powerful bass driver features Poly Emulsion Coated Cone (PECC) and large barium ferrite magnet to form a package which has quite remarkable performance and extremely low distortion. Call ALTRONICS for full specifications.

Max Input Power ....60 Watts
Freq Response..................50Hz - 5kHz

C 3022 6.5" PECC Woofer Normally $49.95
This Month Only $38

High Power High Performance Speaker Bargain

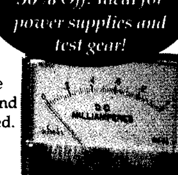
HURRY! Stocks are strictly limited!

Amazing 2 for 1 Offer! Save 50%!

MU65 Panel Meters

Overall dimensions 100W x 82H. Bolt mounting centres 80W x 64H. 63mm hole required, nuts and washers included.

Over 50% Off! Ideal for power supplies and test gear!



Q 0540 1mA
Q 0550 100μA

Both Models $10 ea
Were $24.95 ea

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Up to 50% Off Professional Series Instrument Cases. That's Less than Normal Wholesale Prices!!

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Exclusive to Altronics

Protect your car from theft. Install one of these alarms & save hundreds $$$ on comparable systems!

KSN 1141A Horn Tweeter

The powerline series of Motorola horn speakers incorporates protection circuitry which allows them to be used safely with amplifiers rated as high as 400 watts. Great for use in DJ speaker boxes, PA bins, guitar or keyboard speaker bins etc.

Motorola horns for DJ and PA Audio Systems!

Frequency Response.......1.8KHz - 40KHz
Average Sensitivity.........92dB @ 1m/2.83V
Max Power Capacity.......400W
Max Temperature............80°C
Horn Size..........................177mm x 83mm

C 6150 Was $45 Now $37

These Motorola Horns Are Covered by a One Year Burn Out Guarantee

Stony Broke Speaker Kit by *REDBACK*

Amazing Value and Reflection!

As featured in SC Magazine June '94.

This speaker kit is a bit like the Volkswagon; not too pretty to look at but performs superbly. Well that's the same as the Stony Broke speakers; pretty ugly but sounds sensational. Frankly, the reproduction from these speakers must be heard to be believed. Ideal for bookshelf speakers, extension speakers or speakers for personal walkman type systems. Comes supplied in kit form. The kit for each speaker consists of two large jiffy boxes, one C 0629 30 Watt driver, one C 3010 tweeter, crossover, innerbond wadding, port tube, spring loaded terminals, 6 metres of cable, all fixing screws etc. In fact all you will need is a tube of silicon or similar to seal the 2 boxes together. The main speaker holes have been machined, all you will have to do is drill the mounting holes for the speakers. No special tools are required. Basically all you will need is a screwdriver, soldering iron, drill with 3mm drill bit, cutters etc. Even though these are a low cost kit, there has been a considerable amount of engineering to achieve the resultant sound! The main speaker driver complimented with the tuned enclosure exhibits quite amazing bottom end for a speaker this size.

"These have no right to sound as good as they do!" Leo Simpson, Silicon Chip Magazine.

C 3200 Only $99 per pair

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ALTRONICS

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Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $9.50, 3kg to 5kg is $18.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

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ANU's Siding Spring Observatory is now

CAPTURING THE WARM GLOW OF HEAVENLY BODIES

The Australian National University's 2.3-metre Advanced Technology Telescope at Siding Spring is now able to capture detailed infra-red images of the heavens, thanks to a cryogenically cooled imaging sensor known as CASPIR. Designed and built by Mount Stromlo astronomer Peter McGregor, CASPIR looks set to keep Australian scientists at the forefront of IR astronomy.

by GEOFF McNAMARA

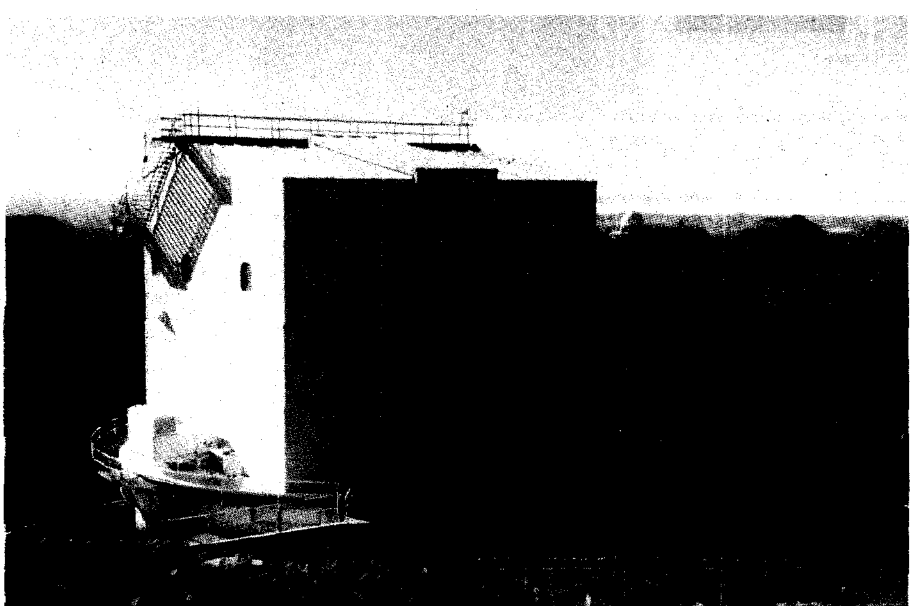
In the film *Silence of the Lambs*, the climax is played out in the dark cellars of the villain's home. Deprived of light, the heroine struggles to find any trace of her opponent; while he, equipped with infrared goggles, navigates easily in the tense gloom.

In a similar way, astronomers often find their cosmic prey invisible in ordinary light. Often the objects they want to study are buried deep within clouds of dust that light just cannot penetrate. Infrared radiation, on the other hand, can penetrate the gloom, allowing astronomers to peer deep into the heart of phenomena ranging from newly born stars to the core of our Galaxy.

But while artificial optical detectors — at first film and later photoelectric devices — have been around for over a hundred years, infrared detectors have only been used for astronomical purposes for little more than a decade. In that time, however, they have been employed in some spectacularly successful instruments.

One such infrared camera is called CASPIR — the Cryogenic Array Spectrometer/Imager. Designed and built by Peter McGregor, an astronomer at Mount Stromlo Observatory near Canberra, CASPIR has been setting the pace for infrared astronomy in Australia since 1993.

CASPIR has been designed for use with the Australian National University's 2.3-metre Advanced Technology Telescope, atop Siding Spring Mountain in northern New South Wales. You may have seen some of CASPIR's images when comet Shoemaker-Levy 9 ploughed into Jupiter in July 1994 — they were the ones where Jupiter seemed to glow from the inside.



The dome of the Australian National University's 2.3m New Technology Telescope, at the Siding Spring Observatory in northern NSW. (Photo by Brenda McNamara)

But CASPIR is used for more than taking sophisticated snapshots of rare events. Not only can CASPIR look deep into Jupiter's atmosphere; it's giving astronomers a detailed view of the very heart of the Milky Way Galaxy and is helping to answer the question of what lies there.

The need for astronomical infrared detectors arises because the Galaxy is a dusty place. Visible light simply scatters off the dust, the way a car's headlights simply illuminate fog, rather than allow you to see through it.

But while infrared light can penetrate interstellar dust, it has a hard time making it through the Earth's atmosphere where carbon dioxide and water vapour make the sky almost opaque to infrared radiation. This forced astronomers to launch infrared cameras into Earth orbit. Examples are the highly successful Infrared Astronomical Satellite (IRAS) which spent 10 months in 1983 surveying the sky in the 10 to 100fm (femtometre) bandwidth, and its successor, the recently launched Infrared Space Observatory (ISO).

But telescopes like these are rare and expensive. As a result, the time available to individual astronomers is correspondingly short, and difficult to secure at best. ISO, for example, was oversubscribed by 50% long before it was even ready for flight.

Despite the infrared opacity of Earth's atmosphere, there are three 'windows' in the near-infrared spectrum, which extends from 0.8 to 8fm. These windows allow ground-based telescopes to peer through the sky into the infrared universe.

Although multipixel infrared detector technology has been used by the military for some time, it has only been used for astronomical purposes since the mid 1980s. Up until then, infrared 'cameras' consisted of a single detector. To build up an picture of an object under study, the astronomer had to point the telescope equipped with the detector at one point after the other, slowly building up an image one pixel at a time.

The advent of charge-coupled devices that use silicon wafers meant that multipixel optical images could be created just as photographic film uses the photochemical effect to record whole scenes. The advantage of CCDs over film is that the images can be stored electronically for later manipulation. When it came to infrared imaging, however, the system doesn't work — for the simple reason that silicon is transparent to radiation beyond a wavelength of about 1fm. Infrared photons just fly right on through, without triggering any electrons.

Doped detectors

To get around this problem, detectors can be 'doped' with impurities such as indium, gallium or copper. An alternative is to create an infrared-opaque layer from either indium antimonide or mercury-cadmium-telluride, to stop the infrared photons.

The first widely used detector like this was produced by the Santa Barbara Research Center in California, and consisted of a 58x62 pixel indium-antimonide array. Later, NASA funded Rockwell Science Center to produce near infrared arrays for the Hubble Space Telescope. The latest detectors have arrays of 256x256 pixels; most major observatories are now installing these devices as part of their suite of instruments. While these detectors are rivalling optical detectors, there are plans to develop 1024x1024 pixel detectors over the next few years.

The detector used in CASPIR was manufactured by the Santa Barbara Research Center and uses an indium-antimonide layer bonded to a silicon wafer. At each pixel storage site 'bumps' of indium metal connect the two layers. This hybrid device, which makes use of the now well-developed silicon solid-state technology, detects infrared photons on the surface but stores the charge in the silicon multiplexer underneath.

The minimum speed at which the detector operates is about 100 milliseconds per exposure, which means the camera produces 10 frames every second. To keep up with such a high production rate, the system uses fast analog-to-digital converters (ADCs) and a transputer based co-adder to combine multiple short exposures into a single image.

A closeup view of CASPIR, a cryogenically cooled infra-red spectrometer/imager, when attached to the 2.3m telescope at Siding Spring. A helium refrigerator cools it down to 32K. (Photo courtesy Peter McGregor, Mt Stromlo and Siding Spring Observatories)

To keep CASPIR working as efficiently as possible, it has to be kept cold — *very* cold. Because infrared is basically heat radiation, anything at room temperature glows brightly to CASPIR's sensitive eyes. If the camera itself weren't cooled, it would have as much success detecting faint infrared sources as you would trying to read this article while your eyes glowed like a car's headlights. A closed cycle helium refrigerator is used to cool CASPIR to -241°C, or just 32° above absolute zero.

One of CASPIR's primary tasks is to provide images of celestial objects in the near infrared. Such objects can include the planets, the centre of our Galaxy, supernovae in external galaxies — even counting faint galaxies with the aim of determining the geometry of the Universe. Already it has provided some spectacular infrared images that not only rival those obtainable at optical wavelengths, but revealing features that optical detectors just can't see.

But CASPIR does more than just produce images of the sky. By using a clever system of lenses and prisms, CASPIR is able to manipulate the incoming infrared light in a number of ways. For a start there's spectroscopy

CASPIR: Capturing the warm glow...

— dispersing the spectrum into its component wavelengths.

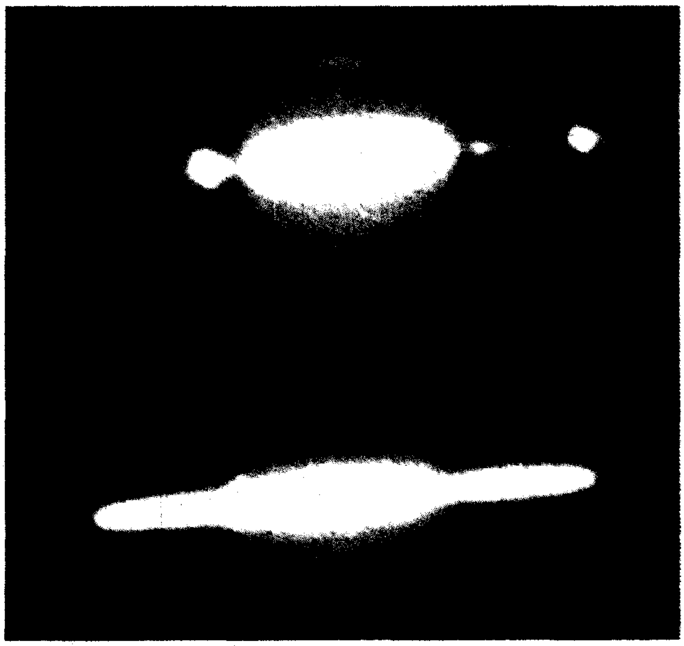
Dispersion in CASPIR is achieved using devices called 'grisms', a cross between a prism and a diffraction grating. The advantage of using a grism is that while the grating disperses the light into a spectrum, the prism characteristic deviates the beam so that it remains more or less parallel to the optical axis of the instrument.

Three grisms are available in CASPIR, in the three infrared windows. For each of these, a second grism at right angles to the first further enhances the spectra produced.

CASPIR also permits imaging polarimetry, essentially measuring the percentage and direction of polarisation of incoming light. This is done using a device known as a 'half-wave plate' that can be rotated in the infrared beam before it enters CASPIR. This polarises the beam in a known way. A prism then produces two images of the object with perpendicular planes of polarisation. By rotating the half-wave plate at intervals of 22.5°, the images produced can be combined in such a way that the degree and direction of polarisation can be determined.

Measuring or imaging faint objects near bright ones calls for a feature called a coronograph. Essentially, a coronograph is a baffle that covers the brighter object, allowing the fainter one to be seen more clearly.

To keep the coronograph properly positioned over the brighter object, CASPIR has to rotate on the back of the telescope. The reason is that as objects move across the sky they slowly rotate with respect to the horizon. But because the 2.3-metre telescope that CASPIR is attached to rides on an alt-azimuth mounting — moving up and down and in azimuth — it stays in the same orientation as the horizon. The 'bottom edge' of the telescope remains parallel with the horizon all night long. If CASPIR didn't rotate, the brighter object would peek out from behind the coronograph baffle and spoil the image.



Infra-red images of Saturn taken by CASPIR in August 1995, when the Earth passed through the plane of its rings. Images like these allowed the exact crossing time to be determined. (Photo courtesy Peter McGregor, Mt Stromlo & Siding Springs Observatories)

The lenses used in CASPIR had to be specially made. Ordinary glasses, while transparent at visible wavelengths, become opaque in the infrared. The lenses used in CASPIR are made from CaF_2 (calcium fluoride), BaF_2 (barium fluoride), MgO (magnesium oxide) and sapphire crystals. They were ground in the optical workshop at Mt Stromlo Observatory, and given an anti-reflection coating of MgF_2 (magnesium fluoride) at the CSIRO's National Measurement Laboratory. This gives CASPIR a peak throughput of about 80%, while the overall efficiency (photons in to electrons out) is about 30%.

One of the neat things about CASPIR is that it's a fully self-contained, yet extremely versatile instrument. The collection of lenses, filters, grisms, and baffles is cleverly arranged on a series of wheels that rotate around a common shaft. Depending on which mode CASPIR is to work in, the wheels rotate to swing the desired optical components into the ray path.

What can it do?

Now that CASPIR is operational, what can it do? The answer is: anything that needs infrared imaging! "What I do is generically infrared astronomy", McGregor said. "I built this camera — put in the investment of time — so I'm involved in everything that it can do!"

One of the most recent applications for CASPIR was when the Earth passed through the plane of Saturn's rings. McGregor used CASPIR to watch the planet leading up to the crossing, with the aim of determining the exact time of the crossing. This information tells astronomers a lot about how Saturn 'precesses', or wobbles in space. This in turn tells them about the physical makeup of Saturn.

"We were viewing the dark side of the rings. In the near infrared the planet is also dark, because methane gas (in Saturn's atmosphere) absorbs the reflected sunlight," McGregor explained.

With the brightness of the planet suppressed, the rings were easier to monitor. As it turned out, the observations were quite successful: McGregor and other astronomers around the world were able to pinpoint the time of the ring plane crossing.The different appearance of planets like Saturn in the near infrared prompted McGregor to contribute to the barrage of images of Jupiter in July 1994, when the ill-fated comet Shoemaker-Levy 9 ploughed into the planet. You may recall seeing some eerie images in which the giant planet seemed to glow from within.

Long before anything was visible in the optical spectrum at the time of the collisions, CASPIR was being saturated by the brightness of the impacts. As the impact sites cooled, the near-infrared brightness decreased rapidly; but CASPIR continued to detect the emerging stratospheric clouds kicked up by the impacts, which reflected sunlight more efficiently than the surrounding methane clouds.

Yet McGregor has his own astrophysical interests, within the range of infrared studies. "Most of what I do concerns the centre of our Galaxy", explained McGregor. One of the most popular ideas for what exists in the centre of the Galaxy is a supermassive black hole, weighing in at perhaps two million times the mass of the Sun.

"The only way you can tell if there's a black hole at the centre of our Galaxy is to look at the motions of the stars there," McGregor continued. The gravity of a massive object in the centre of the Galaxy would cause the stars to move differently than if there were nothing there. "You can't see the centre of the Galaxy in the optical — but you can in the near infrared!"

McGregor is working with theorists at Mt Stromlo Observatory to try and answer the question of a black hole at the Galactic centre. They've concluded that there is no single massive object there, however there is evidence to suggest that there may be a large number of smaller black holes, possibly on the order of ten solar masses each.

A second project McGregor has going is looking into clouds of gas and dust found near the Galaxy's centre. About ten million years ago the centre of the Galaxy underwent a period of starburst — a time of rapid star formation during which several massive stars were born. But massive stars don't live as long as lower mass stars, and McGregor wonders if these glowing clouds of gas and dust are related to the evolution of the massive stars. The objects are glowing at a temperature of about 500K, as if something were warming them from the inside.

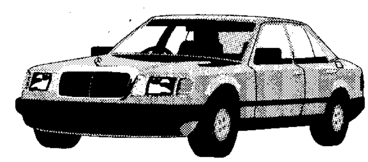
"There's something buried down there powering these things, that we can't see," said McGregor. "When lower mass stars grow old they tend to blow off an envelope of gas and dust — sort of like soot — and that buries the star so you can't see it optically. If that same process is occurring in these very massive stars, then that would account for these dust-obscured objects."

With such a wide range of applications, from imaging Jupiter to helping understand the age and evolution of the Universe, CASPIR has a major role to play in astronomy. It has greatly enhanced the capabilities of the 2.3-metre ANU telescope.

CASPIR is now providing views of the Universe which rival the results achieved in visible light. McGregor is understandably proud of his achievement: "With CASPIR, Australian astronomers are well placed to continue making a significant impact in world astronomy."

(Geoff McNamara is a freelance astronomy writer and Associate Editor for *Sky & Space* magazine.) ❖

AUTOMOTIVE ELECTRONICS



with JON LOUGHRON Assoc. Dip. Electronics

Bosch EST in the VK Commodore and XF Falcon

This month I am going to discuss the Electronic Spark Timing (EST) system found on some VK Commodores and XF Falcons. The system on both vehicles is made by Bosch and is a derivative of similar systems found on earlier European vehicles (EZK).

As indicated by the name of the system, control of the advance and retard of the ignition system is achieved by electronics, not mechanical advance weights and the associated vacuum unit on the distributor. Control of the system is implemented by the use of a microprocessor controlled ECM (electronic control module) and associated peripheral input/output hardware.

Fig.1 shows the system block diagram. The main input, apart from power supply rails, is the input trigger. It is obvious that the ECM must know the crankshaft position and speed to be able to calculate and provide sparks at the correct instants, so it is very important to ensure that the trigger is functioning correctly.

The GMH and Ford systems use different triggers and these will be discussed in detail later. It also should be noted that even though the 25-pin connectors on the ECM's are the same, the actual pinouts are different and as a result they cannot be interchanged.

The ECM must also know what load the engine is under, and manifold vacuum is translated into a voltage by the manifold absolute pressure (MAP) sensor. Engine temperature is also taken into consideration via the coolant temperature sensor (CTS) and engine mode — i.e., idle — when calculating the final timing offset.

The negative side of the coil is switched by a large internal power stage, and this is mounted onto the ECM metal case to provide good heat dissipation. The primary winding of the gnition coil measures less than 1 ohm and it has a 12 volt supply (even higher when the alternator is charging the system), so you can see that a good heat sink is necessary.

While we are discussing the power switching of the electronic system, it provides a good time to discuss briefly why automotive manufacturers decided to pursue electronic ignition over the old points or Kettering method.

Points vs electronics

If you measure the resistance of a points system ignition coil primary winding, you will notice that the resistance is much higher (some coils are up to 4Ω). The reason for this is quite simple: the points in most ignition systems cannot sustain much more than 3-4 amps consistently without burning out. In addition, during normal operation the points become pitted and corroded, due to arcing, and this requires continual maintenance ('cleaning the points') to prevent degrading the system's performance.

On earlier ignition systems this became a problem, because as engine technology advanced and higher revving, multi-cylinder engines developed, the available time to charge the coil at higher RPM became very short.

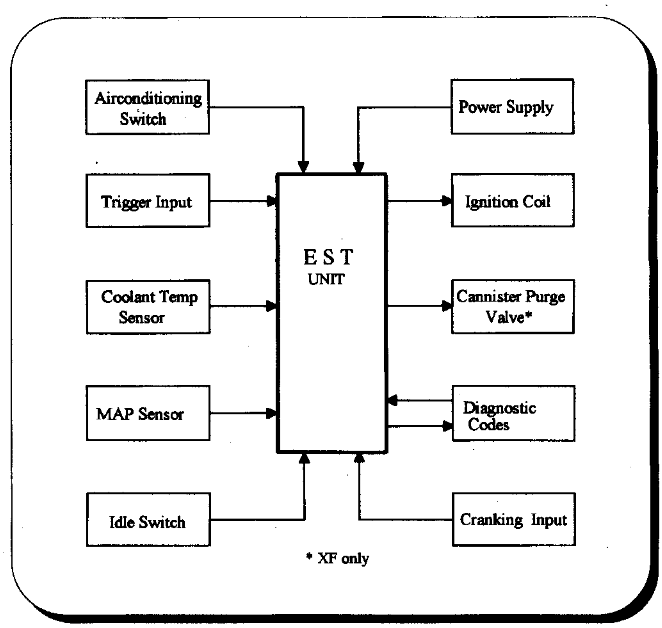


Fig.1: The block diagram for the EST system used in some XF Falcons and VK Commodores, showing the ECM (centre) and its associated sensors and other 'peripherals'.

Increase the primary current, I hear you suggest — well, it can be done, but not without reducing the service life of the points to an unacceptable extent.

To overcome this problem, the number of turns on the coil primary winding was reduced, with the inclusion of ballast resistor to keep the primary system resistance to approximately 3-4 ohms. Because of the ballast resistor the primary current was not increased substantially, but the reduction in primary winding turns reduces the coil's primary inductance, so its opposition to the incoming current is reduced and therefore the current can build up more rapidly.

This overcame some of the problems, at least for a while, but again the search for more powerful engine technology pushed the ballasted points system to its limits.

Around this time transistor technology was beginning to take a firm grip on the power electronics industry, and it

PIN No.	XF DESCRIPTION	VK DESCRIPTION
1	Earth	N/C
2	Hall Sensor +10 Volt supply	Diagnostic Lamp
3	Trigger Input	Coolant Temp Sensor
4	Static Timing Input	Idle Switch
5	Coolant Temp Sensor	Trigger Input (reference)
6	Coolant Temp Sensor	Coolant Temp Sensor Earth
7	Idle Switch	N/C
8	Air Conditioning Swicth	N/C
9	Diagnostic input (STI)	N/C
10	N/C	N/C
11	Cannister Purge Solenoid	N/C
12	Earth	N/C
13	Diagnostic Earth	N/C
14	Ignition Coil (-ve side)	Earth
15	Earth reference (Hall sensor)	Ignition Coil (-ve side)
16	Diagnostic Output	+12 Volts Supply
17	Crank Signal	Air Conditioning Switch
18	Power Supply MAP Sensor	Diagnostic Enable
19	MAP Sensor Signal	Power Supply MAP sensor
20	N/C	Earth
21	Earth Reference MAP Sensor	Earth Reference MAP Sensor
22	N/C	Trigger (AC signal)
23	N/C	Crank Signal
24	N/C	MAP Sensor Signal
25	+12 Volts Supply	N/C

Fig.2: The connections to the EST ECM are quite different for the XF and VK versions, even though both use a 25-pin connector. Interchanging the two is therefore not practical.

was not unnoticed by automotive OEM designers. As a result a myriad of weird and wonderful systems emerged on the market — some destined for fame and others failure. But out of all the confusion and research, stable, reliable systems began to appear on the family wagon.

The early electronic systems still used points to trigger the electronics, and mechanical/vacuum devices to advance and retard the ignition timing — but did use a power transistor to control coil switching and dwell. The main advantage of the semiconductor output stage is the ability to switch on and off very quickly, and also the ability to switch increased current levels reliably.

As technology advanced, pulse generators such as Hall sensors (XF Falcon), inductive pickups (VK Commodore) and optical triggers (VL Commodore) emerged and replaced the points entirely. But this did not overcome the problem of mechanical and vacuum ignition timing variation.

When microprocessor technology became more approachable the automotive engineers rubbed their hands with glee — because now with microprocessors, once the basic control system was built, the ignition timing could be adjusted by a simple ROM change.

So all of that history has stated the obvious: that microprocessor based controllers have enabled designers to provide a more sophisticated, environmentally friendly, flexible and reliable ignition system. This does not mean 'inexpensive', though...

Before we go any further into the Bosch EST system, though, a word of warning regarding safety.

Beware: danger!

As mentioned earlier, the ECM switches the negative side of the coil to ground and then releases control at the correct time so that primary current collapses. Due to the coil's primary inductance this causes a substantial voltage 'kick' — in some HEI systems up to approximately 400V peak. Yes, we're still talking about the primary circuit, and it's a lot higher than just 12V.

As the ignition coil is in reality a step-up transformer, this action induces energy into the much larger number of turns in the secondary winding. Because of the winding ratio the secondary generates approximately 20kV to ionise the spark gap.

The point I'm making is that high-energy ignition (HEI) systems deserve respect on *both* the primary and secondary side, and if you have ever been connected to either circuit when it's active, you certainly understand my point. I am not sure which is more uncomfortable: the actual electrical shock from the system or the crack on the back of the noggin, as you stand up suddenly — forgetting the unfortunate proximity of the bonnet. Ouch!

System connections

The EST system connections for the VK Commodore and XF Falcon are summarised in the table of Fig.2. The inductive trigger unit for the VK system is mounted at the rear of the engine and it should be noted that it passes through the transmission housing to access the flywheel. There are three metal pins mounted on the flywheel 120° apart, so as to inform the ECM of the crankshaft speed and position. The resistance of the sensor is approximately 1000Ω and it generates a peaky AC voltage as the flywheel spins.

To ensure the inductive pickup is operating correctly, an oscilloscope

Applied Vacuum (KPa)	Output Voltage
0	4.4 - 5.3
-25	3.3 - 3.8
-50	2.0 - 2.5
-75	0.7 - 1.1

Fig.3: The output voltage from the MAP sensor used in both VK and XF versions, for different levels of manifold pressure.

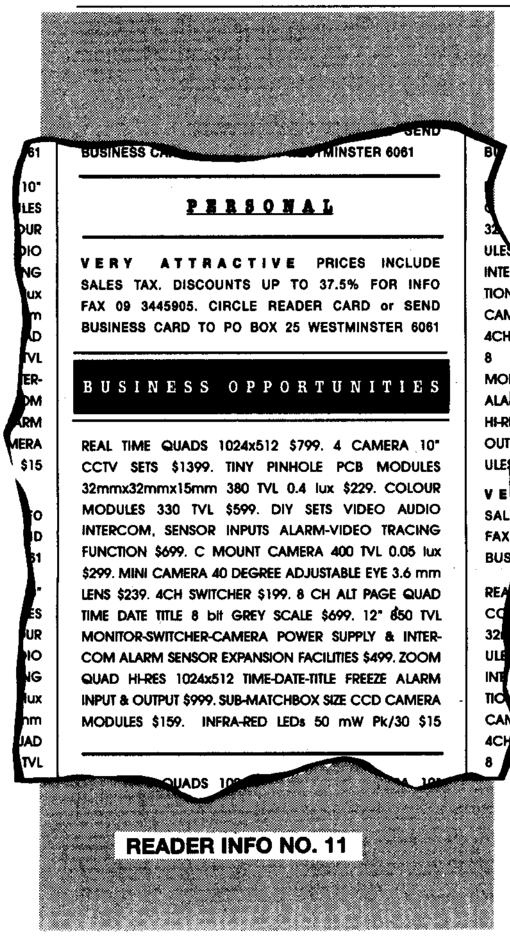
should be used to inspect the output pulses (remember no trigger — no spark). The wiring to the sensor has a coaxial shield to minimise interference and reduce false triggering; so ensure that the shield wire is intact and terminated correctly.

The base timing on the VK cannot be varied, so moving the distributor is futile because the the base timing is fixed and derived from the 'pegs' on the flywheel. (If you remove the distributor cap on a VK with the EST system, you may be surprised to find only a rotor button inside.)

Apart from the wiring to the ECM plug, the trigger, advance map and canister purge control, the XF EST and the VK EST are very similar. The coolant temp sensors and map sensors have the same specifications (see Figs.3 and 4), and both employ an idle switch (for adjustment see the applicable manual), cranking input and air conditioning switch.

Temperature (deg.C)	Resistance (Ohms)
0	5.4 - 6.3 k
20	2.3 - 2.7 k
80	300 - 350
100	170 - 210

Fig.4: The resistance/temperature characteristic for the coolant temperature sensor (CTS) used in both the XF and VK versions.



The trigger on the XF Falcon is a Hall sensor, and it is mounted inside the distributor. So base timing is adjusted by moving the distributor (10° +/-1° BTDC), and can be accomplished by shorting out the two terminal static timing connector near the brake master cylinder. (But remember to remove the link when the adjustments are complete!)

The Hall sensor's power supply is supplied by pin number 2 on the XF Falcon's ECM, and ground on pin 15. The sensor provides an 'open collector to ground' output stage, which generates a 5V square wave with a 50% duty cycle.

One precaution that should be taken when replacing the a faulty Hall sensor is to ensure it is the correct version. The XF's EECIV system (see *EA* May 96) also uses a Hall trigger, which has the same mounting holes and also fits into the EST distributor. The problem is that the actual sensor is mounted on the base plate in a different position; therefore the ignition timing will be incorrect and the resulting problem difficult to diagnose. ("Everything seems to be working correctly!?") So my advice is to check the new Hall sensor carefully against the old one, before it is installed.

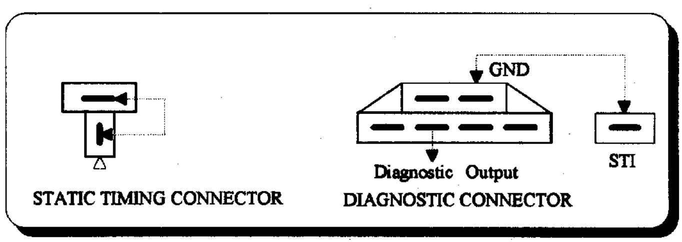


Fig.6: The static timing connector (left) and the diagnostic connectors (right), are both located in the engine bay, near the brake master cylinder.

When fault finding on either system, ensure that the power supplies are correct and that peripheral device parameters are within specification. The connections and specifications for the MAP sensor and CTS sensor are listed in Figs.3 and 4. Remember that when you are disconnecting or reconnecting any ignition components, always ensure the ignition key is in the OFF position.

Fault codes

As the EST systems are microprocessor based, this means that they produce diagnostic codes to aid the technician with fault diagnosis.

The VK system has a warning lamp on the dash and when a fault occurs, the EST warning lamp illuminates. The codes are displayed by this lamp when the diagnostic connector is grounded. This connector is taped to the wiring harness, and located near the rear of the engine rocker cover. Fig.5 lists a summary of the VK codes. Unfortunately when the ignition key is turned off the codes are not stored, so intermittant faults may be hard to find.

Code No.	ECM light	Description
-	Erratic	ECM problem
1	*	Coolant Temp Sensor
2	**	MAP Sensor / TPS
3	***	MAP Sensor / TPS

Fig.5: In the VK version, the ECM light flashes these diagnostic codes every eight seconds, if there is a fault and when the diagnostic connector is earthed (see text).

The XF system needs to have an external device to check the codes, such as an LED test lamp. The connections and code summary are provided in Figs.6 and 7.

Code No.	Description
11	System Pass
21	Coolant Temp Sensor
22	MAP Sensor
58	TPS (Idle Switch)
68	TPS (Idle Switch)

Fig.7: The fault diagnostic codes for the XF version. Note the two codes available for the idle switch.

As you can see, the EST systems used in the XF Falcon and VK Commodore are quite similar, but do have variations that must be understood before testing or servicing either system.

That's all for now, though. Until next time, bye! ❖

PORTABLE AMATEUR RADIO REVISITED - 3

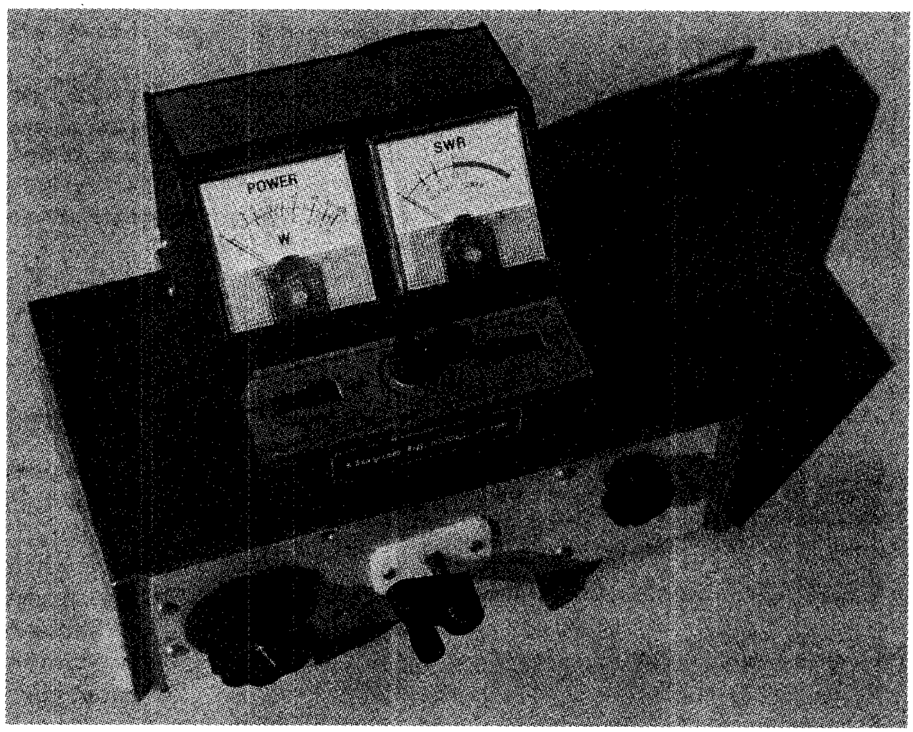
To conclude his discussion of the practicalities of portable amateur radio operation on the HF bands, the author here gives details of a heavier-duty, but still compact antenna maching unit. Like the rest of the equipment described in these articles, the unit concerned was built for use on a recent trip to the UK, when he was researching for his book *In Marconi's Footsteps: Early Radio.*

by PETER R. JENSEN, VK2AQJ

Despite the advantages of the bridge antenna matching device as described in one of the earlier articles, it was decided to rely on a heavier duty and more flexible form of Trans-match for the UK visit. This was because of the 100 watts of power available from the Icom IC 725, which had been decided upon as the most appropriate transceiver for the operation. One of the limitations of the antenna tuner and bridge previously described is that its power handling capacity is limited to about 30W PEP for SSB or 10 watts for CW.

To avoid the weight penalty of a fully built up device, it was decided that the new antenna matcher should be constructed in England upon arrival and only the bare minimum of essential parts should taken on the aeroplane. These consisted of a commercial SWR and power meter and a roller inductor, which can be seen in the illustrations.

As it turned out, finding the appropriate capacitors proved quite difficult — annoying, as the home junk box contained exactly what was required and the components were not all that heavy either. Perhaps my XYL (wife) could have been persuaded to put them in her capacious handbag? On second thoughts, perhaps not.



The author's higher-power SPC Transmatch unit, pictured with an SWR/Power Meter on top of the case.

A number of different designs were investigated, but the most recent form of tuner given in the *ARRL Handbook* of 1984, involving a 'T' network, seemed to be the most likely to give good results. Apart from anything else, it is possible to use tuning capacitors from old valve radios in this design and avoid the 'differential' form of capacitor that is essential to the Universal Transmatch of earlier years.

Quite apart from its fundamental purpose of providing the transceiver with a load matched to its output impedance of 50Ω, the Transmatch has a secondary benefit which can be of some significance if interference to

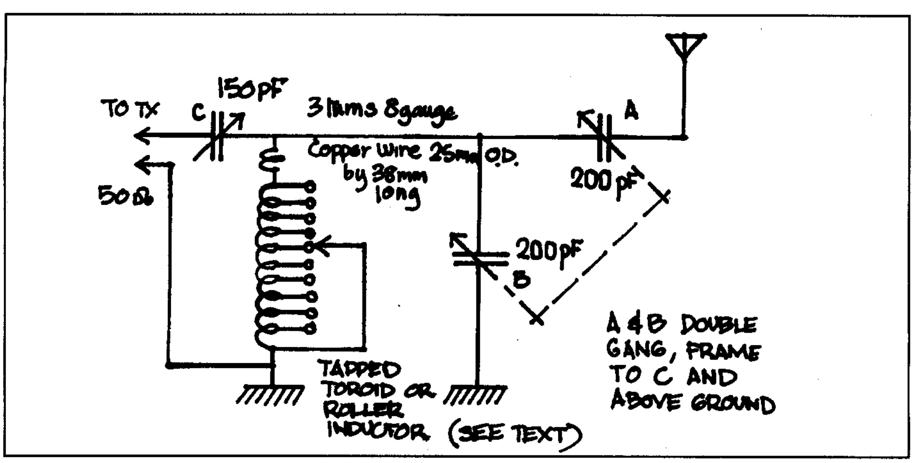


Fig.1: Here is the schematic for the SPC Transmatch, repeated from the first article to refresh your memory. This is the arrangement used in the higher-power matching unit.

nearby television sets may be a problem. This of course is frequently the case in the average motel room.

The last thing the travelling radio amateur wants to do is create an ugly incident because of producing a breakthrough of SSB voice onto the neighbour's late night viewing. Next door, they may well want to watch the antics on *Chances*, and 'herringbone' interference accompanied by garbled voices certainly will not add to the residual charm of the soap opera.

As the *ARRL Handbook* explains, the particular advantage of the 'T' network in a transmatch is its 'bandpass filter' characteristic, which has a major impact on reducing spurious harmonics as compared with the earlier and very well known, Ultimate Transmatch. It says in the text:

The amount of attenuation is dependent upon the loaded Q (Q_L) of the network after the impedance has been matched. The higher the Q_L, the greater the attenuation... The 'SPC Transmatch' described here was developed to correct for the sometimes poor harmonic attenuation of the network in the Ultimate Transmatch. The SPC (Series-Parallel Capacitance) circuit maintains a bandpass response under load conditions of less than 25 ohms to more than 1000 ohms (from a 50 ohm transmitter). This is because a substantial amount of capacitance is always in parallel with the rotary inductor (C2B and L1). In comparison with the 'Ultimate' circuit, it can be seen that at a high load impedance, the Ultimate Transmatch will have a minimal effective output capacitance in shunt with the inductor, giving rise to a high-pass response.

The handbook goes on to point out another advantage of the SPC Transmatch, in its significantly greater frequency range as compared with the older Ultimate Transmatch. With the arrangement given in the accompanying schematic and with the component values as listed, one can expect to be able to cover the range from 1.8MHz to 30MHz for most situations and arrangements of wire, end-fed antennae. The addition of a matching balun will allow balanced feeder antennae to be matched as well.

The counterpoint to this, which may be considered a small disadvantage, is that the tuning is significantly sharper than on the Ultimate Transmatch. In practice this has not been found to be a problem, given a considerable apprenticeship tuning up valve type transmitters. Those with only the experience of dealing with solid state transmitters may have marginally more difficulty.

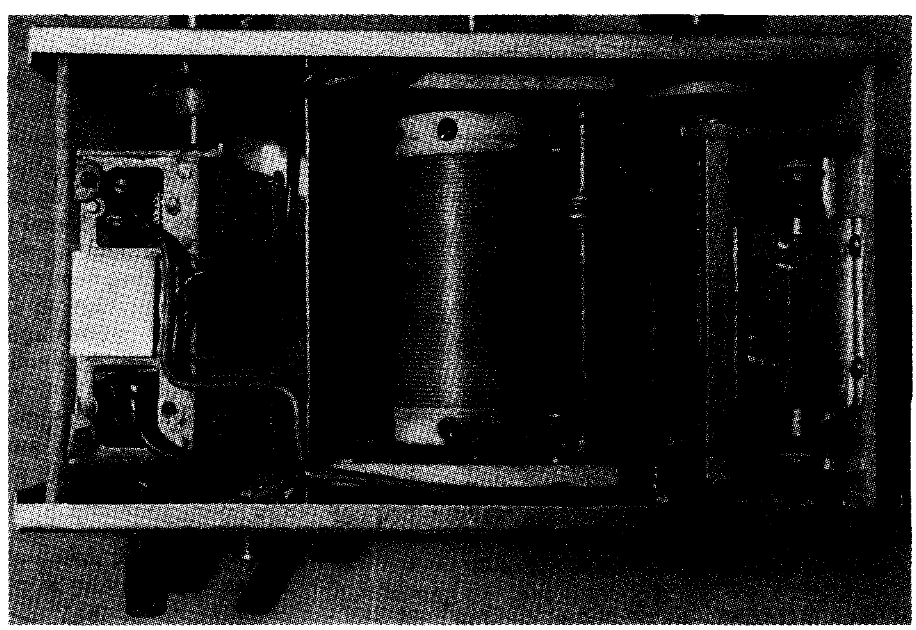
Another view inside the matching unit, showing the general layout.

Simple circuit

As can be seen from the schematic, and despite the apparently complex explanation of the mode of operation of the SPC Transmatch, this is a very simple tuner. The only small practical problem which must be overcome is that the capacitors must be supported above earth on insulated bases.

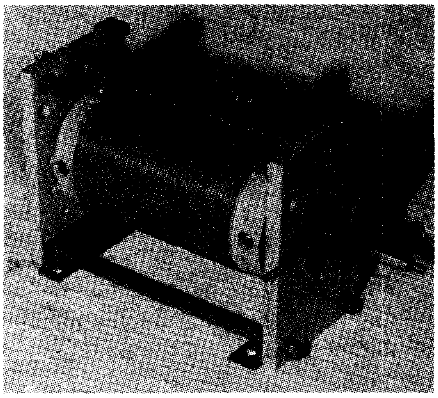
As is evident from the diagram, this tuner also makes use of a roller inductor. While clearly this is a less than common component these days, in the author's case, a well stocked 'junk box' and visits to the Glebe Market have resulted in the availability of a couple of rotary inductors.

Given the extent to which rotary inductors were used in earlier military radio, finding one may not prove to be an insuperable problem. While a tapped and switched form of inductor can be used, there is no doubt that the rotary inductor is the most satisfactory device. In addition, if you are feeling well heeled and there is no other source, then new rotary inductors are available from



A top view inside the high-power matching unit, showing the roller inductor in the centre and the tuning caps on either side.

Portable Amateur Radio Revisited



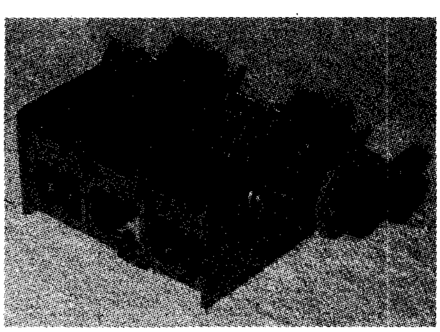
The roller inductor unit before fitting into the case.

Emtronics in Sydney — together with capacitors with wide spaced plates, suitable for high voltages.

The Transmatch is put together using a commercial case and, as it turned out, represents a very compact arrangement. There is really very little space around the components and if you are not worried about the cubic volume of the finished unit, then it would be a much easier construction job if a larger case was used.

To some considerable extent what you can get away with for the case will be a function of the components that you can gather together. In the author's version of the Matcher, a reasonably compact form of roller inductor was available. After some hunting around and access to radio amateurs in England, so too was a wide spaced capacitor, courtesy of a World War 2 'Command' aircraft transmitter. This latter component is a very common item at radio amateur field days and auctions, and should be easy enough to obtain.

The double section capacitor was actually made up from a conventional



The modified three-gang tuning capacitor, with the centre section removed. The case must be insulated above ground.

three-section commercial receiver tuning capacitor from the 1950's, with the centre section completely removed. However there are double gang capacitors around with equal capacity sections and they would be even more suitable than the device used. Again, and as compared with the older Universal Transmatch and its differential capacitor, there are no problems with using a simple domestic radio tuning capacitor and as found at many a tip these days.

Other matters

Given the availability of a motor car in the UK, prudently hired before departure from Australia, it was possible to rely on the automotive battery as the power supply for field operation in that country, although the engine was kept running, given the heavy drain of 20 amps demanded by the Icom transceiver.

Another essential item of equipment was a vertical antenna for 20 metres, and this was put together using aluminium sections and a secondhand fibreglass fishing rod. With a finished length of just on five metres and driven against ground, it proved very easy to load up through a short length of hook up wire and the Trans-match that had been built.

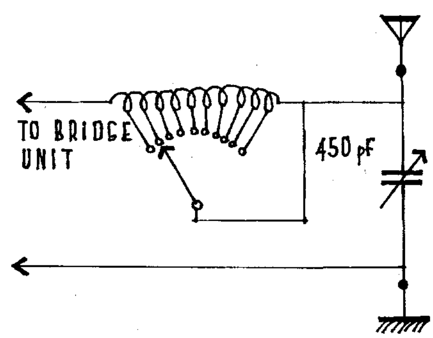
To give a good connection to the anticipated damp earth, a ground spike was made up using 12mm copper piping. The end of this spike was flattened off and soldered so as to provide a rough point, and then filed to a more suitable shape. At the top end was attached a 'T' shaped Yorkshire fitting, which comes with an internal ring of solder, to provide a handle; then a terminal was bolted on to allow a wire connection to the Trans-match.

To attach the Yorkshire fitting, all one has to do is clean up the copper tubing and then place the fitting in position and heat it on a gas flame. The solder soon flows, making a first class electrical connection.

As anticipated, during my expedition to Poldhu the damp earth made an excellent ground plane for the quarter wave antenna and Bavaria came in at a signal strength of 5 & 9. More to the point, this was also the signal report from the other end, so clearly everything was working as it should.

As became clear from the 'home-brewing' efforts in the United Kingdom, the Australian radio amateur is very much better served than the English counterpart. There are very few commercial outlets such as Jaycar, Davred or Dick Smith, although the ubiquitous Tandy (Radio Shack) is quite well represented.

Making up items of apparatus in England is not terribly easy and the name of the game is 'improvise'.



The author's lower-power matching unit, described in the first article, actually used this simpler arrangement. Our apologies for the confusion.

However when one is desperate, it is amazing what can be pressed into service, courtesy of the local DIY (do-it-yourself) store. Tent pegs can also be pressed into service as earth spikes, for example, and bricklayer's twine is almost indispensable for erecting wire antennae.

It is pleasing to be able to report that the long distance portable operation, for which the equipment described in these articles was prepared, proved to be a complete success. No doubt this was due in large measure to careful planning before the event.

The next time that portable operations are undertaken in the United Kingdom, perhaps some form of compact directional beam antenna would be something to consider constructing. The 'Double Cross-bow' is already to the prototype stage, and will be reported upon in due course. ❖

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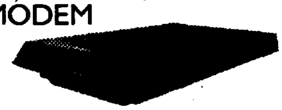

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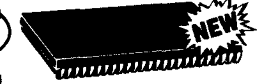

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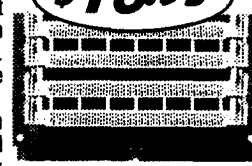

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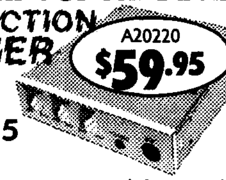

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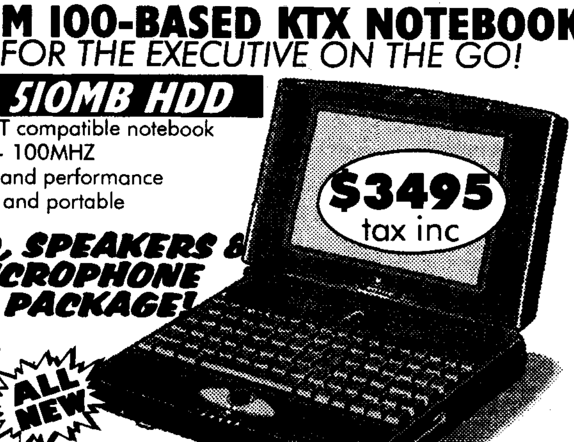

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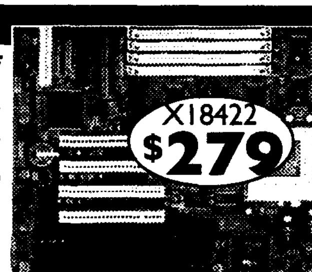

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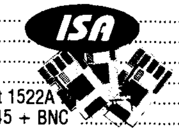

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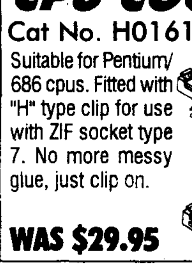

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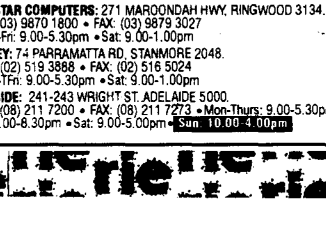

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INFORMATION CENTRE

by PETER PHILLIPS

Fidonet, audio, timers and all

If your Internet costs are starting to mount up, you might be interested in our first topic this month: Fidonet. There's also more about telling the difference between 50-ohm and 75-ohm BNC connectors, and a reader gives us the lowdown on hydrogen generation in a zinc-carbon cell. And of course there are the usual letters about projects and matters various...

These days most people know about the Internet and the World Wide Web. But unless you cruise computer bulletin boards, you may not have heard about a similar, and much older system called Fidonet. Because it's a facility many readers are likely to be interested in, I'm opening this month's column with a description of Fidonet contained in a file I recently downloaded from a BBS linked to Fidonet.

What *is* Fidonet?

Fidonet is an international electronic messaging network of bulletin board systems that allows users of any bulletin board in the network to communicate with other users on other networked boards. Fidonet has spread across Australia, Papua New Guinea, South East Asia, Western Europe, North and South America. Originally, only systems which used Tom Jenning's 'Fido' Bulletin Board program could be part of Fidonet, but now many other systems are participating in the network.

Fidonet can be used in two different ways. A user can address Fidonet mail to another user on another system in the Fidonet network. The mail will be sent through the network, and delivered to the recipient on his or her local Fidonet bulletin board. It typically takes a couple of days for a message to be delivered to another Australian bulletin board, depending on the distance the message has to travel and the reliability of the telephone system.

The second way is by participating in Echomail conferences. An Echomail conference is a discussion on a particular topic which takes place on a number of bulletin boards almost simultaneously. A message placed in an Echomail Conference on one bulletin board is 'broadcast' to all other boards in the network which are participating in that conference. There are a number of conferences available, including international ones, which cover a wide variety of subjects. Not all conferences are available on all Fidonet bulletin boards.

All Network mail and Echomail messages are sent via local, STD and IDD (for international Echomail and Netmail) telephone calls, so unless sponsored, the sysops involved (particularly the sysops of host systems) bear the cost of this. Users are therefore not charged for mail and messages.

Obviously, if messages are going to travel around the network, then the system needs time to send and receive them. A network 'Mail Time' has been set up, during which all Fidonet bulletin boards disallow calls from users, and spend their time delivering messages to their designated 'host' bulletin boards for forwarding to the rest of the network, and receiving messages which have been delivered to their host bulletin board.

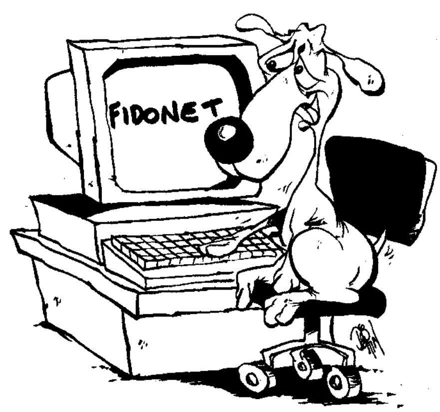
This time is from around 3:00am to 6:00am Australian Eastern Standard Time. A Fidonet bulletin board system is unavailable during this time, but because it's in the early morning, very few users should be affected. If the Fidonet bulletin board also sends and receives mail from zone 1 (North America), there is an additional mail time from approximately 7:00pm to 8:00pm (AEST).

Each bulletin board connected to Fidonet has a unique 'address', allowing the bulletin board to be identified. The address consists of a zone number, network number and node number, and is written in the form zone:net/node. Zone 1 is North America, zone 2 is Europe, zone 3 is Australasia and zone 4 is South America. Zone numbers should only be specified when sending a message to a system outside your own.

So as you can see, the main advantage of Fidonet is cost: it's free. Some boards charge a fee of $30 (or so) per year to be a member, mainly to offset phone call costs to the host board. Others give free Fidonet access, such as the Mt Druitt TAFE College bulletin board run by Peter Harle. The phone number of this board is (02) 839 1310 and its Fidonet address is (3:713\709).

The system was developed by and is run entirely by enthusiasts, and works like this. Let's say you want to ask the world at large a question about electronics. You first dial up a BBS that supports Fidonet and gain entry to the message area relevant to electronics.

There are some 500 possible Fidonet subject areas, which might not all be available on the board you are operating through. As well, it's up to the sysop as to what areas are covered by the board,



and what these areas are called. Typical subject areas include electronics, ham radio, neurology, Windows 3.1, Windows '95 (international or local forums), MIDI music, photography, motor cycles, modems, chess, consumer reports, cooking, dieting, dogs and so on. If the area you want is not listed, ask the sysop to include it.

You then type your message, marking it as a message to ALL. Once the message is complete, do whatever else you want on the board, then sign off. After a few days, replies (hopefully) will come in, ready for you to download.

Rather than read and write messages while you're on line however, it's better to use a mail reader program (like Blue Wave, which is shareware found on most boards). Using the mail reader, you prepare your message first, then upload it. And instead of reading all the messages while connected to the BBS (and preventing others accessing the board), you download them and read them in the mail reader at your leisure. Most mail readers let you insert a reply into a message, so the message and your reply are sent back to the BBS. Once you get the hang of it, it's easy enough.

I suppose you're wondering if we intend hooking the *EA* BBS to Fidonet. Unfortunately a Fidonet board needs about two hours a day of the sysop's time, and if we spent this time each day, we wouldn't be able to get a magazine out each month. But at least you now know about this system, and I can assure you, it's an excellent way of getting information without the cost of being an Internet user.

But our BBS is still a good way to contact other readers, and to leave messages for me. I've used reader messages from our BBS before, so considering the foregoing, it's appropriate to use some more.

PC scope

I was wondering if could help me. Over the last 12 months I've been looking for a program and hardware to build a single trace oscilloscope for my garage as a tune up scope. It appears your magazine has done such a project, but kit suppliers are having a hard time getting parts. As well, no one could tell me if it would be fast enough.

I need one that will plug into a PC and show me coil and spark patterns. The one I have now is getting very old and is not very reliable. Most of the cars are only idling at around 1000rpm. (Martin Heppenstall, via EA BBS)

I'm surprised you cannot get a kit of parts for the DSO Adaptor Mk2 (May/June 1994), Martin. This has been a popular project, and the last time we checked kits were available from a number of suppliers. This adaptor samples at up to 1MS/s, so it should be fast enough for your needs.

If you want a ready made unit, there are quite a few PC-based oscilloscopes around nowadays. These are external hardware boxes that interface the signal to the computer, which does the rest. That is, it does all the work of displaying

the waveform on the computer screen, calculating measurements and so on. The PicoScope range of PC-based instruments is one I'm familiar with, available through Emona Instruments (phone (02) 519 3933).

The speed of a 'virtual' scope is generally fairly slow (bandwidth of 50kHz or so) and usually depends somewhat on the computer. An advantage of a virtual instrument like the PicoScope is all the other instruments you get into the bargain: spectrum analyser, AC and DC voltmeters and so on. My review of the PicoScope is in the July '95 edition of *EA*.

Bondwell remote control

I recently acquired a pre-programmable remote control unit made by Bondwell, with a slide switch to select one of three possible devices to be controlled: VCR, TV and audio. I've tried unsuccessfully to track down the distributors, so I can get the device number listing to allow me to use the control. Can anyone help? (Phil Lee, EA BBS)

This is pretty specialised, so if anyone can help, either write to me, or leave the information on our BBS (phone (02) 353 0627).

Leclanche cell

In response to a recent reader enquiry about the operation of a Leclanche cell, I boldly pronounced that yes! there is hydrogen generated around the anode of a carbon-zinc dry cell. Double whammy — wrong wrong! As you probably read in last month's column, I got the anode bit wrong. Instead it's the cathode when the cell is discharging, and the anode when it's being charged. But now it seems I also got the hydrogen bit wrong — or have I?

I'm sorry, but I have to say that you are wrong — there is no hydrogen in a normally operating Leclanche cell. Here's a quick rundown according to modern theory. It has been found that for a wide range of conducting electrodes immersed in a variety of electrolytes, a voltage which is characteristic of each electrode system is established between the electrode under test and an internationally agreed reference electrode.

This is known as the electrode potential and is listed in textbooks for certain specified conditions. In practice, variations occur due to departure from these conditions, but the variations are small enough to be ignored if only a general understanding is required. Very roughly, the electrode potentials are: zinc electrode -0.7V, carbon electrode +0.8V, giving a total of 1.5V.

If a cell is constructed using any two electrodes in an electrolyte, the cell voltage can be calculated by taking the difference of the two electrode potentials. The magnitude of the electrode potential depends on the chemical reaction occurring at the electrode face, and for the Leclanche cell the zinc atoms lose electrons which flow through the external circuit.

The zinc atoms then become positively charged zinc ions which pass into the electrolyte. Manganese atoms are involved in a complex reaction with electrons returning from the external circuit, leading to the formation of a lower oxide of manganese, water and ammonia; but no hydrogen.

We can now examine the situation where the depolariser (manganese dioxide) becomes exhausted. In this case a second set of reactions take place, but the continuing passage of current causes a third and different reaction to set in. The electrode potential for this third reaction is close to zero so the cell voltage becomes 0 - (-0.7) = 0.7V, and the cell is described as being polarised and — believe it or not — the third reaction produces hydrogen. (Peter Steel, Mandurah, WA.)

Now Peter, aren't we being the teeniest bit pedantic here? As I see it, the manganese dioxide prevents the formation of hydrogen. Without it hydrogen is formed, which is why the manganese dioxide is put there in the first place, that is to get rid of... Well, you can see my drift. It's like denying it's hot outside, from inside an air-conditioned room. You wait when the air-conditioning breaks down! I guess it's a matter of how you want to look at it. Thanks for your letter Peter, I'm sure readers will be interested in this rather in depth look at a Leclanche (zinc-carbon) cell.

OC926 transistor

I've noticed over the years that quite a lot of reader letters get direct replies from other readers, providing I include a contact address. This was the case for a recently published letter seeking information about an OC926 transistor, in which a reader has kindly forwarded copies of the required information to us and to our reader making the enquiry. For everyone's information, here's brief details of this now very superseded transistor.

This silicon device was one of a series released by Philips in the 1970s for general industrial applications. Regarding an alternative, I do not know the type of circuit that you are repairing, but there is nothing special about the OC926 and therefore a number of currently available devices should suit.

One that springs to mind which has the same lead connections and similar general characteristics is the 2N4032, but note that this device has a T0-39 case and therefore requires more space. (W. Woods, Glen Iris, Vic.)

Mr Woods included a copy of the OC926 data which shows a Vceo of 60V, a maximum collector current of 600mA, a current gain of greater than 30 (yes, rather vague), and a transition frequency of 360MHz. The important point of course is that it's a silicon device, so there's quite a lot of substitutes, if package style doesn't matter. Thank you, Mr Woods.

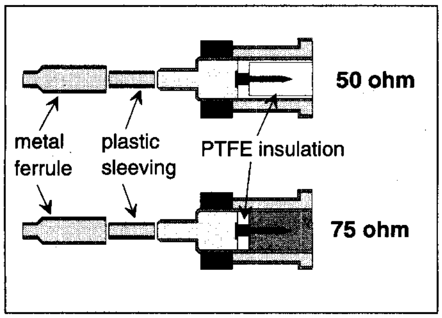
50Ω and 75Ω BNC connectors

And still there's more, on a topic I thought we had finished last month. You might remember a reader asked us recently how to tell the difference between a 50Ω and a 75Ω BNC connector. I included letters last month offering ways of distinguishing between the two, and this month I've got another. But this time the contributor actually sent me examples of both types, which at first sight look identical. But they're not, as the letter explains:

In the February 1996 issue, a reader asked about an easy way (besides actually measuring impedances at specified operating frequencies) to distinguish between 50-ohm and 75-ohm BNC connectors. I am writing from a company called Multi Contact Australia that supplies BNC connectors to many industries, including the broadcasting industry. Hopefully I can shed some light on the differences.

My information comes from speaking to a number of engineers in various TV stations around Australia, as well as actually studying these connectors myself. Once you compare the connectors side by side, the one basic and fairly obvious difference is the amount of plastic insulation lining the inner part of the BNC connector itself. Our connectors are Sofim brand and this material is PTFE.

In a 50-ohm connector, this insulation starts from the front (fat end) of the connector right the way up the cylinder which shields the contact pin. In a 75-ohm connector the insulation begins halfway up the shielding cylinder. The extra 'air' insulation provides the difference in impedance. Please note that this is based on a salesman's explanation (albeit relying on various engineers), and is not from an electrical engineer.



In the 50-ohm BNC connector, a thin sleeve of PTFE dielectric material extends out to the end of the plug, inside the metal 'outer' tube, whereas in the 75-ohm connector there is only the PTFE 'bulkhead'...

I have included a 50-ohm and a 75-ohm connector for your perusal. Interestingly these are for the same size cable. You quite rightly pointed out that normally the barrel sizes are different, but here they are exactly the same.

With the advent of serial digital cable technology becoming more prevalent in the broadcast industry, it's now important electrically (not just physically) to use a 75-ohm connector for a 75-ohm cable, to avoid impedance mismatches. Hope this helps. (Peter Williams, Multi Contact Australia, Sydney, NSW.)

There's nothing like having an example to look at and examine. Thank you Peter, for writing and particularly for the samples. I thought of taking a photograph of the two connectors, but I doubt if you would see the difference. Instead, I've drawn them (cross sectional view) to show what Peter means (Fig.1).

Notice that the PTFE insulation in the 50-ohm connector covers the entire surface of the shield around the contact pin, whereas in the 75-ohm type, it's simply a base for this pin. The only other difference I could find was the colour of the plastic sleeving, green in the 50-ohm type and blue in the 75-ohm version.

The pin in both connectors has the same diameter, the diameter for the cable entry in the metal ferrule is the same, everything else is identical. So it would seem it depends on the brand of the connector, as other readers have described differences that don't apply to this brand. Confusing? I'll say!

Flexitimer

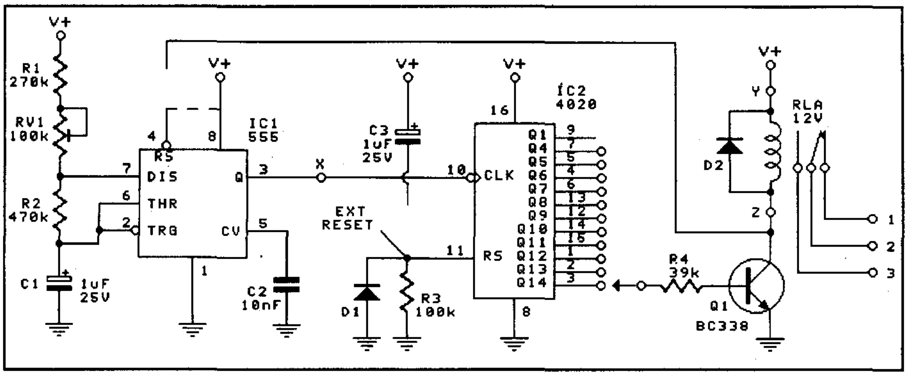
Here's a question that I think refers to our March '91 Flexitimer.

I have built the Flexitimer Mk1, and I find that it latches up after about 50 seconds, which I think is OK. But I am finding that it will not reset itself at all, although the circuit checks out properly. I can get it to reset by applying a positive voltage on pin 4 of IC1 (555 timer) or pin 11 of the 4020 counter, but it will not reset itself no matter how long I leave it run. (Eric Larson, Forest Hill, Vic.)

It seems from your letter, Eric, that your Flexitimer Mk1 is operating as it should — pulling the relay in after 50 seconds and then latching up. This leaves the relay energised after the timing period has elapsed, as the circuit is normally reset only when the power to the timer is interrupted. If applying positive voltage to the reset pin of the 4020 causes the relay to release and then pulls in after another 50 seconds, then this would verify that the timer is performing correctly as designed.

I have a feeling that you are expecting the timer to release the relay, and then start timing again — which it won't, at present, because the circuit wasn't designed to this. But if this *is* what you want, I can suggest two options.

One is to cut the track between the collector of the transistor and pin 4 of the 555, then join pin 4 to pin 8; this will prevent the transistor from inhibiting the 555 at the end of the period, and would result in the relay turning on and off every 50 seconds. The other option



To refresh your memory, here's the circuit for the Flexitimer Mk1 — but with two suggested alternative modifications shown, for those who wish to make it cycle continuously. You can either break the link between the collector of Q1 and the reset pin of IC1, or apply an external reset signal to pin 11 of IC2.

is to disconnect C3 and use some external trigger to reset the binary counter when needed, much as you detailed in your letter.

Yet another option is to use the Flexitimer Mk2 (*EA* Aug-Sep 95), which can provide almost any timing configuration imaginable.

Class A amps

The next letter asks quite a few questions, all about audio...

I am considering building myself a tube and/or a class A amplifier. First question, is there a kit available for a class A amplifier? Next, I have noted in a loudspeaker catalog that it has two recommended power ratings. One for transistor and one for valve. What is the idea behind that, and is there a way of working out what power speakers to use? And is a class A amp in the same boat as a tube amplifier?

Another query concerning speakers. Where would I find the formula and schematic for a delay circuit, to delay tweeters and midranges? I have looked through books such as The Loudspeaker Design Cookbook by Vance Dickason, and have found nothing, except a mention of it. Could such a delay circuit be used in your Economy Surround Sound Decoder? Sorry to ask so many questions, but I'm sure your answers will enlighten me in some way. (Leigh Witchard, Prospect, Tas.)

First up Leigh, a class A amplifier can be either tube or solid state. Audio pundits have generally agreed over the years that a class A amplifier (whether tube, MOSFET or transistor) is superior to other classes of amplifier. To my ears, though, the difference between a good quality class A and class AB amplifier is insignificant.

I also don't agree that a 'tube' amplifier is superior to a good solid state amplifier. As I see it, an amplifier should have no 'sound' at all, which I believe is true of most of today's decent quality amplifiers anyway. In practice, an audio amplifier contributes the smallest amount of distortion compared to all the other components in the audio chain. Of course, there are people that can hear the difference (or claim to be able to), but I'm not one of 'em.

I do agree that the characteristics of a valve amplifier (either output or small signal) suit the needs of some guitarists. As well, the overload characteristics of a valve output stage are different, but if you are operating at overload, it seems a higher power amp is needed.

Having made these points, you mightn't be so disappointed when I tell you we have not produced a class A amplifier design in recent times, if at all.

Hot and inefficient

The problem with such an amplifier is its practicality. Although it gives the least distortion of all types of amplifiers, Class A also results in the largest, hottest and most inefficient amps.

So given that you probably can't hear the difference, why not build a more conventional amplifier, such as the Playmaster Pro Series 3 Power Amplifier described in Feb/March '94. If you want a valve amplifier, one was described in Sep/October '92. We've done many others, and more are on their way, but these two are our most recent.

I have not heard of a speaker power rating being defined in terms of the type of amplifier. It could be an instantaneous power rating, which is the peak short-term power the speaker can handle. The instantaneous output power of a transistor amplifier is generally higher than an equivalent valve amplifier, which might explain the two speaker ratings. Most speakers are rated according to the continuous power they can handle, which makes it independent of the type of amplifier.

As for delaying the sound to tweeters and midrange speakers, this can best be done electronically, not with external resistors, inductors and capacitors. Certainly an RLC network (as in a crossover network) can give a phase change, but not a significant delay. The only way to get what amounts to a delay is to place the tweeters and midrange speakers some distance behind the bass drivers.

Delaying a sound electronically is now done digitally, where sound is converted to a digital signal, clocked through various delay circuits, then converted back to analog. ICs that do this are now available, but note Leigh that they are for low level signals only, not the type of power signals needed by a speaker. One of these would suit the Surround Sound decoder you mention.

What??

This month's question comes from Peter Stuart, who has kindly sent me a number of interesting questions which I'll present in forthcoming issues. This question is not really electronic, despite its electronic 'feel', but can be solved with basic maths and a bit of trial and error:

An electronics enthusiast built two timers, each of which emitted a loud short tone to scare birds away from his vegetable garden. He could adjust the timers to produce their tones at regular intervals of a whole number of seconds, with an adjustment range between 60 and 90 seconds. To make the tones seem random, he set the adjustment for timer A differently to timer B.

One day his neighbour noticed that timer A went off four seconds before 9.00am, and timer B sounded at exactly 9.00 o'clock. Later he heard a tone at four seconds past 10.00am and another one four seconds later. Sometime between 10:10am and 10:20am he heard both timers go off simultaneously. From these observations the neighbour was able to calculate the time setting for each timer.

What were the timer settings, and at what time between 10:10 and 10:20 am did they sound together?

Answer to May's What?

By my calculations, the load current is 850.6A, the current from battery A is 303.8A and the current from battery B is 546.8A. These figures are rounded off to one decimal place. This gives a load voltage of around 10.63V.

I used simultaneous equations to solve the problem. ◆

Vintage Radio

by PETER LANKSHEAR

RF gain control and variable-mu valves

This month we take a look at the problems of controlling the gain of an RF amplifier, while not detracting from its ability to handle signals without distortion and other unwanted side effects. This is an ongoing problem with solid state technology, but it was largely solved in the valve era with the development of the variable-mu valve in late 1930.

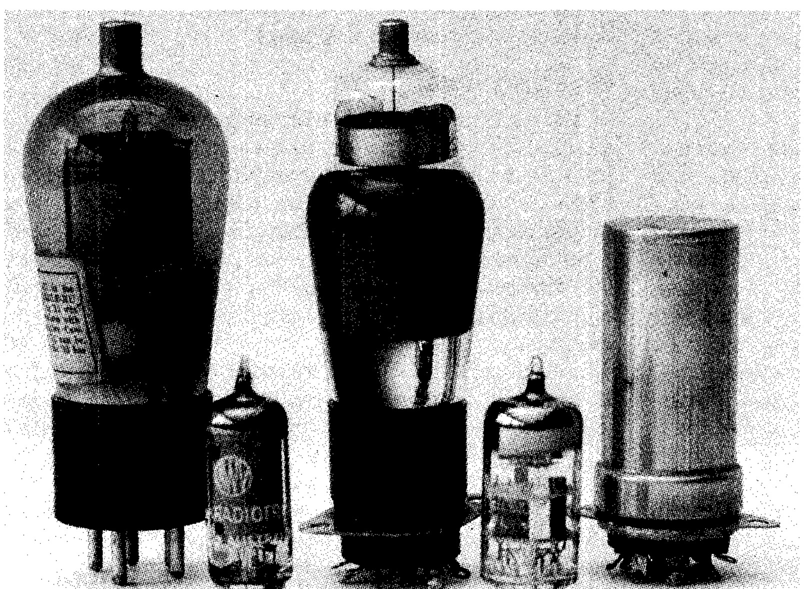
Tom Moffat's story in the January 1996 issue of *EA* about the Hobart receiving station at Quoin Ridge was of special interest to me, as many years ago I worked in a similar station at Quartz Hill near Wellington. To tune across the spectrum with a good receiver connected to a real aerial at such a location is a memorable experience.

Tom mentions the superior performance of an old GEC BTR400 receiver, when compared to a state of the art Icom R-9000. By an odd coincidence, as my term at Quartz Hill was finishing, we were preparing to make room for some new receivers — GEC BTR400's no less — and more recently I have owned one of these monsters.

The BTR400 is a fine receiver, but many of the final generation of valve communication receivers can provide a similar performance. Two such sets, the Hammarlund SP600 and the Eddystone 940, have been previously described in this column, and there were others, including superb models from Racal and Collins. But can Tom Moffat's claim for superior results from equipment designed 40 years ago be substantiated? The short answer is yes.

Back in the late 1950's as semiconductor diodes and transistors became increasingly available, it became evident that in time, these devices would be able to do anything that valves could do, but better. This has of course proved to be so, and today solid state technology is infinitely more efficient and versatile than that of valves. Modern electronics and integrated circuits especially, would just not be possible with 'hollow state' devices, and there is no equivalent to much solid state technology, such as complimentary PNP/NPN operation.

There is one exception, however. To this writer's knowledge, as yet there is no solid state equivalent device to the variable-mu or 'remote cutoff' valve, and this is what provides the superior valve receiver performance quoted by Tom Moffat. In this column I'll try to explain why this is so.



Variable-mu valves came in a wide range of shapes and sizes. At left rear is an original Arcturus 551, on which the '35 was based; centre rear is a 6U7G, long used in Australian receivers; right rear is a Loctal based WB1/EF22, as used in the GEC BTR400 receivers. The small valve at left front is a 6BA6/EF93, developed in 1945 and a standard type until the end of the valve era, while that at right front is a 6ES8/ECC189, a high performance variable-mu twin triode.

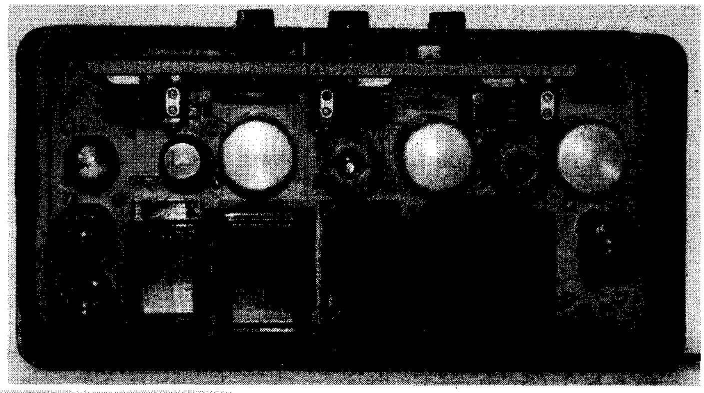
Decades of gain control

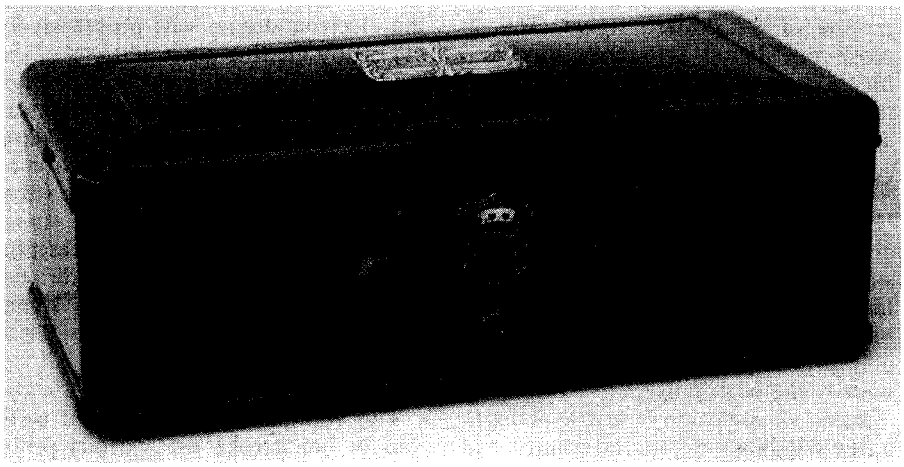
This story really starts about 75 years ago. In the earliest multi-valve receivers, gain was controlled simply by switching amplifier stages in or out as required. With the growth of broadcasting however, something a bit more refined was required and a smoother control was found to be possible by varying valve filament voltage. This was fine, especially with thoriated tungsten filaments, but with the advent in 1927 of the UX226 AC heated valves, as described in this column last November, a new method of gain control was required.

The '26 was essentially the standard '01A type with a low voltage high current oxide-coated filament. But with just over an ampere required for each valve, gain control by means of a filament rheostat was no longer practical. Volume control of the first generation of AC receivers was therefore achieved by nothing more sophisticated than a variable aerial attenuator! This was a simple and effective method, but it did mean that the receiver was running at full gain the whole time — which did nothing beneficial for signal to noise ratios.

By the following year, the indirectly heated type '27 had replaced the '26 and with it came a far better method of gain control — that of

The 1929 Atwater Kent model 55 was one of the first receivers to use the mains powered screen grid type '24 valve. In an effort to overcome its sharp-cutoff characteristic, A-K varied screen voltage to control gain; but the real answer came with the development of the 35/51 variable-mu valve in 1930. Although the model 55 had a single tuning knob, the separate tuning capacitors were ganged using phosphor-bronze drive belts — visible at the top of the interior picture at right.





varying the grid bias of the RF stages, usually by means of a simple variable resistor connected between the cathodes of the RF stages and ground.

As an RF amplifier, typical operation of the '27 was at 180 anode volts with around -15 volts grid bias. Increasing this bias progressively up to -30V or more provided reasonably smooth and satisfactory control of receiver gain, although a local/distance switch, generally some sort of aerial attenuator, was usually provided to cope with very strong signals.

Progress in receiver development around this time was very rapid, with each season bringing features that made previous models obsolete. For broadcast band operation, with suitable stabilisation or neutralisation, the general purpose triode was a reasonably satisfactory RF amplifier, but there were significant shortcomings. Stage gain was limited, and the low anode impedance compromised selectivity; stability was often marginal and triodes were unsatisfactory as shortwave RF amplifiers.

The need for neutralisation and stabilisation was due to unavoidable grid to anode capacitance, which enables tuned triode RF amplifiers to become oscillators. The solution was, in retrospect, simple enough. By inserting an electrostatic shield between the grid and anode, inter-electrode capacitance could be sufficiently reduced to achieve stable amplification. Of considerable benefit too was the considerably higher amplification factor of the tetrode.

There were development problems however, and it was early 1929 before a really satisfactory AC heated screen grid valve, the tetrode '24, was produced in the US — to be closely followed in Europe and England by equivalent valves.

The characteristics of the tetrode proved to be considerably different from those of the triode. Whereas the amplification factor of a general purpose triode might be about 10, that of the '24 was more like 400! Although the full potential of this could not be realised in practice, a stage gain of 50 was readily achieved, a very significant improvement over the 10 or so of a stabilised general purpose triode RF stage. Further advantages were shortwave capability and, in a well designed amplifier, better stability.

SHARP CUTOFF	VARIABLE MU
24A	35/51
57	58
77	78
6C6	6D6
6J7	6K7
6J7g	6U7g
6SJ7	6SK7
6SH7	6SG7
KTZ63	KTW63
EF37	EF39
6AU6/EF94	6BA6/EF93

Table 1: RF pentodes were often designed as sharp- and remote-cutoff pairs. Here are some of the more common types.

However, although the screen grid valve may have permitted stable RF amplification, difficulties were experienced once again with *controlling* receiver gain; and this time there were undesirable side effects.

The problem was the large amplification factor of the tetrode valve. A relatively small change in grid bias voltage meant a significant change in anode current. Increasing the grid bias would certainly reduce the gain of an amplifier stage, but the problem was that, although the anode current might be practically cut off, the amplification factor itself was unaffected, so that even quite small signals overloaded the valve. Consequently, the level of signal that could be handled before the onset of serious distortion was very limited.

Several methods tried

Another method of reducing the gain of a tetrode RF amplifier was to control the screen voltage, but the signal handling ability still remained inadequate.

One well known manufacturer's efforts to solve the gain control problem illustrate the ongoing difficulties. For their 1927/28 receivers using filament-type '26 amplifier valves, Atwater Kent used an aerial attenuator. In 1929, they were one of the first to use the new '24 tetrode and settled for a screen voltage gain control in their TRF receivers. This receiver series went rapidly through several developments, culminating in the impressive type L chassis, used in the 1930 model 70, incorporating a dual volume control controlling both aerial and screen grids. Although an improvement, this method was abandoned for the first A-K superhets. For these, a standard volume control potentiometer was connected between the mixer and the 125kHz IF stage!

It can be said that there was no really satisfactory method of controlling the overall gain of receivers fitted with sharp-cutoff screen grid valves, without creating undesirable side effects.

The problem therefore with the tetrode was that control by grid bias variation certainly reduced stage gain, but in the process crippled its signal handling ability. In one example given at the time, with the transconductance reduced to 10 micromhos, a '24 could deliver only about 0.3 volt of signal without serious distortion.

An ongoing problem

Distortion products from amplification of RF signals have several serious effects, and the problem is not confined to valve receivers. Three of the problems are: modulation rise, cross modulation, and intermodulation — all effects noted in the solid state receivers in Tom Moffat's tale.

Modulation rise is, as its name indicates, an apparent increase in modulation percentage. With signals that have already high levels of modulation, the result is serious audio distortion of the detected signal.

In a crowded band, several signals may be present within the passband of the input circuits of a receiver, but if the amplifying stages are completely distortionless the unwanted signals will be filtered out without any ill effects. However, where there is non-linear amplification, a strong adjacent signal may have damaging effects before being eliminated, and no amount of subsequent selectivity will rectify matters.

By interacting with the wanted signal, the modulation of the unwanted transmission appears in the background of the desired signal. This is cross modulation. Intermodulation is a bit more subtle, and occurs when two transmissions beat together to create spurious signals, and whistles.

Wanted: variable gain

So the situation was that low-mu general purpose triodes could handle strong signals fairly well, but had limitations as RF amplifiers. On the other hand high-mu tetrodes were good RF amplifiers, but could not cope with a wide range of signals.

Basic valve design is simple enough: a fine winding pitch for the control grid provides a high amplification factor or mu, and a coarse pitch a low mu. What was needed therefore was a valve with an adjustable amplification factor — high for weak signals and low for strong transmissions. But how can the effective grid winding pitch be altered in an operational valve?

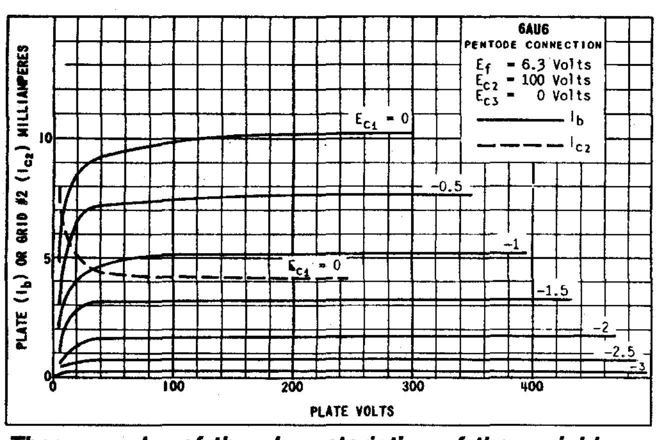
Like so many good ideas, the solution — although not immediately obvious — was in retrospect quite simple. In November 1930, Stuart Ballantine and H.A. Snow of the Boonton Research Corporation presented a paper to the Institute of Radio Engineers in which they described a *variable-mu* tetrode. What they had done was to take a standard '24 valve and fit it with a control grid having a winding which varied in pitch over its length.

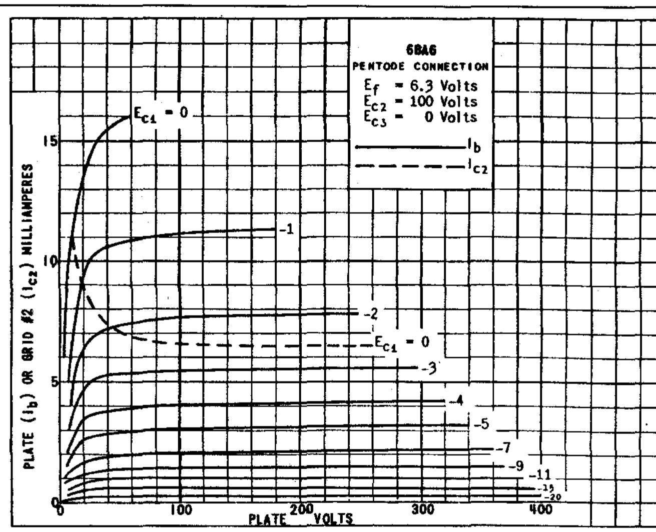
At small values of bias, the entire grid was in control and the valve behaved like a standard screen grid valve. As the grid bias was increased, the electron stream was progressively cut off by the fine pitch portions of the grid; but it required a bias of the order of -30V before the anode current was reduced to something less than 1mA. At this stage only the coarse section of the grid was in operation, and the valve now had the characteristics and signal handling ability of a low amplification factor type. Under high bias conditions, the new valve could handle a signal some 30 times stronger than the '24.

Worked well

The variable-mu grid worked well, and in one stroke the various problems of RF amplifiers using sharp cutoff valves were solved. Indeed, it was so successful that the variable-mu valve rapidly became standard for conventional valve-equipped AM receivers thereafter.

Several major manufacturers produced the variable-mu valve immediately, and exhibited examples early in 1931 at the Chicago Radio Trade Show. For some unexplained reason, two type numbers were selected. One, the '51, was made by Arcturus as type 551 and by DeForest as the 451.





These graphs of the characteristics of the variable-mu 6BA6 (right) and the equivalent sharp-cutoff 6AU6 (above) show clearly how the grid bias needed to cut off a variable-mu type is much greater. Here it is around -20V compared with -3V.

The other type was the '35. RCA made the 235, but with the Cunningham label it became the 335. National Carbon (Eveready/Raytheon) and Sylvania both called their versions type 235. To have several names for the one device was confusing, and within a short time the variable-mu tetrode was listed by most makers as the 35/51.

Receiver manufacturers were quick to make good use of the new valve, and were able to take advantage of its features by incorporating in receivers such refinements as effective automatic gain systems.

Technical progress was rapid during this period, and the RF tetrode's days were numbered. Britain's Cossor had produced an RF pentode, the MS/PenA in 1930, and in the US at the beginning of 1932 the type '39 pentode was released. This was the first American RF pentode and was significantly a variable-mu type. (A very similar valve, the '44, was an alternative offered by some makers and the two types were later combined as the 39/44.)

Popular pentodes

Later in 1932, there appeared a pair of RF pentodes which will be familiar to many collectors as a mainstay of the infant Australian radio industry. These were the sharp-cutoff 57 and its variable-mu partner, the 58. Eventually, given an octal base and 6.3V filament, the 58 became the 6U7G — for many years virtually the standard Australian RF pentode.

It became regular practice to develop sharp-cutoff and variable-mu pentodes as complimentary pairs, and some of the more common examples are listed in Table 1.

Although a feature normally restricted to multi-grid valves, there were triodes intended for VHF RF amplifier service with variable-mu characteristics. One, used by Philips in TV tuners and known in Europe as the ECC189 and in the US as the 6ES8, was a twin triode intended as an AGC controlled cathode coupled 'cascode' low noise amplifier.

With an impressive transconductance of 12.5mA/volt, the ECC189/-6ES8 needed a bias control range of about 10 volts. According to the RCA tube manual, it could be biased back to only 125 micromhos conductance, and still cope with a 0.5V signal with negligible distortion.

Although not primarily intended for HF and MF service, this valve proved to be a very successful 'front end' for the Eddystone 940 receiver described in this column for November 1993. Tested alongside an expensive 'state of the art' solid state receiver, the 940 exhibits a similar interference immunity to that of the GEC receiver observed by Tom Moffat. Significantly, unlike modern solid state communication receivers, the Eddystone and its kind have no need for an aerial attenuator — made obsolete by the variable-mu valve 65 years ago!

About valve life

One frequently expressed concern about older type equipment is that of valve mortality. Although valve life is finite, it can be much greater than is generally realised. For non-commercial service, exact figures are hard are hard to come by, but recently I was able to get an indication.

In 1992, I set up a 'MATE' mini transmitter to relay my favourite FM transmission 24 hours a day. With the exception of a couple of holiday breaks, operation has been continuous, and after 3-1/2 years total service, the 12AU7 and 6AV6 valves were tested. In both cases, mutual conductance had dropped to about 2/3 of the new figure and performance was still quite adequate.

This service works out at 30,000 hours, or more than 10 years at eight hours a day. Admittedly, the MATE valves are conservatively run and there can be failures from causes other than wearing out; but the conclusion is that there needs to be no concern about using valve equipment for protracted periods. ❖

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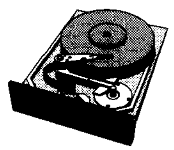
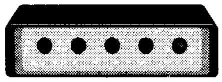

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SKIN & CANCER FOUNDATION AUSTRALIA

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

June 1946

Machine that thinks: United Kingdom scientists are hoping to produce what will be the most wonderful calculator in the world, a machine that can 'think'. Experiments are now being carried out by the newly formed Mathematics Division of the United Kingdom Department of Scientific and Industrial Research. If the experiments are successful — and Mr Wormsley, the Superintendent, is confident that they will be — the machine will not only be able to add, subtract, multiply and divide, but from instructions previously put into it, will be able to decide what it should do in different circumstances without any external help.

British Aid for the Deaf: At a cost of less than a penny an hour for running off batteries, deaf people can now have a new aural aid produced by the British Government as a result of radio research during the war.

The aid is as compact as a cigarette case. It measures three inches by two inches by one inch, and contains three tiny amplifying valves. The cost is £10.

June 1971

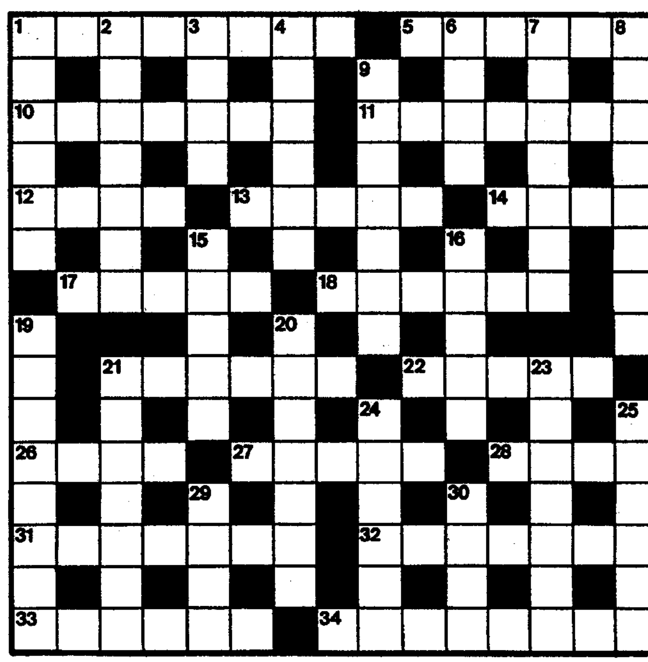
Time signal service: Since September 1964, the Australian Post Office has provided a standard frequency and time service using the short-wave station VNG situated at Lyndhurst in Victoria. The equipment now in use was built by PMG engineers and technicians over a period of two years at a cost of nearly $47,000. Similar commercially built equipment would have cost about $300,000. The service continually provides readings of the time, accurate to within 0.1ms. Tone bursts of varying lengths signify the second, the minute,, and the quarter hours. The equipment consists of two systems that function independently, each maintaining a check on the other.

Semiconductor progress: Two US semiconductor companies have announced new manufacturing processes for low cost high speed IC transistors. Fairchild has developed a new bipolar process which it says could be price competitive with MOS devices and still retain the speed of bipolar ICs. RCA has overcome the speed disadvantages of the cheaper MOS devices by using a silicon on sapphire technique.

The new Fairchild structure, called Isoplanar, is essentially a dielectric isolation technique which reduces transistor size by 40%, to give densities comparable with MOS devices.

RCA has developed silicon-gate CMOS devices which switch in less than 1ns and dissipate only a small fraction of the power consumed by bipolar devices. The circuits give nanosecond switching delays when operated at bipolar voltages, eliminating the need for buffers between the two. ❖

EA CROSSWORD



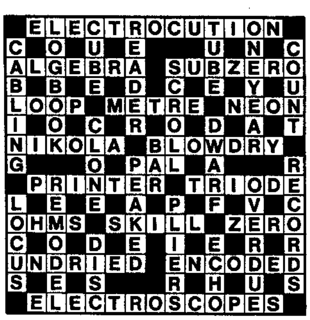
ACROSS

1 Control voltage, etc, to set limits. (8)
5 Relative position or condition. (6)
10 Adjusting device. (7)
11 Having even distribution. (7)
12 Word of phonetic alphabet. (4)
13 Power supply. (5)
14 Sheet. (4)
17 Device for switching AC. (5)
18 Low frequency noise. (6)
21 Information passing through a system. (6)
22 Picture formed on a screen. (5)
26 Part of R.M.S. (4)
27 A memory. (5)
28 Indistinct picture. (4)
31 Group of allied transmitters. (7)
32 Reproduction of radio, etc. (7)
33 Small computer. (6)
34 Listening devices. (8)

DOWN

1 Source of titanium. (6)
2 Small amount of light. (7)
3 Emitter of visible radiation. (4)
4 Location of special microphone. (6)
6 Said of 14 across. (4)
7 Colour and sound of police car? (3-4)
8 Make a substitute system. (8)
9 Discrete amount of energy. (7)
15 Measure of wire. (5)
16 Exothermic device based on fusion. (1-4)
19 Contact point in circuit. (8)
20 Sing-along system. (7)
21 Beginning phase of an operation. (5-2)
23 Military action locatable by radar. (7)
24 Physical quantity with unit named after a Frenchman. (6)
25 Performs a soldering process. (6)
29 Non-stereophonic (abbr). (4)
30 Moved at high velocity. (4)

SOLUTION TO APRIL 1996:



Electronics Australia's

Professional Electronics

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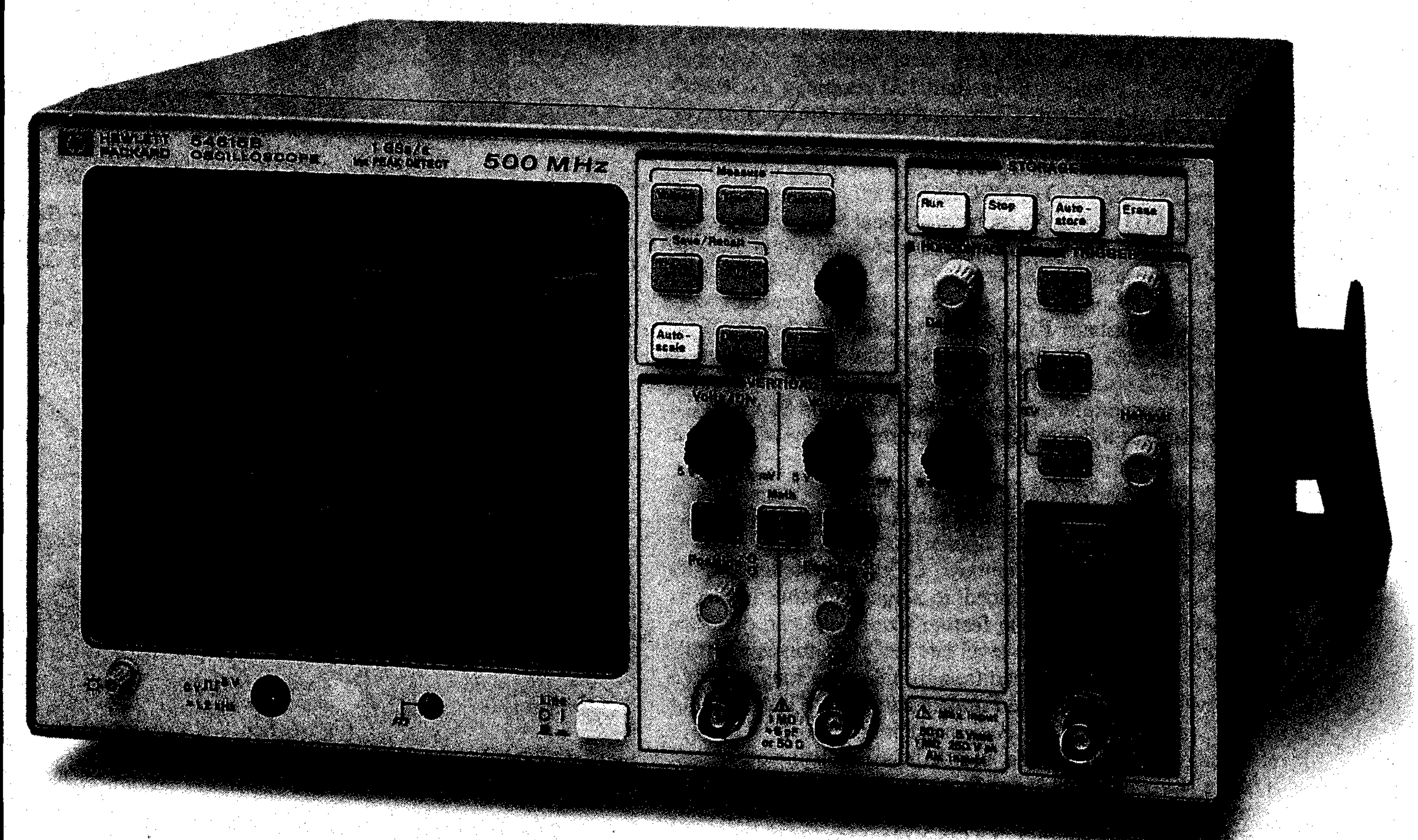
QUALITY SEMICONDUCTOR'S UPGRADED & 'REINVIGORATED' HOMEBUSH CHIP FOUNDRY IS OFFICIALLY REOPENED

REVIEW OF DRAGONDICTATE FOR WINDOWS VERSION 2.0: TALK TO YOUR PC IN ALMOST NORMAL CONTINUOUS SPEECH!

FEATURE ON THE LATEST TEST AND MEASUREMENT PRODUCTS



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NEWS HIGHLIGHTS

FORMAL OPENING FOR UPGRADED CHIP FOUNDRY

Australia's most advanced silicon chip manufacturing facility, the former AWA Microelectronics plant in Homebush NSW, has been formally re-opened following its recent upgrading by new owner Quality Semiconductor Australia. QSA is a wholly owned subsidiary of Quality Semiconductor Inc. (QSI), of Santa Clara in California.

The AWAM facility was purchased by QSA from AWA in February, for around US$13 million. QSI is a small but very innovative Silicon Valley semiconductor maker, which previously had no wafer fab facilities of its own. Founded in January 1989 by Mr Chun P. Chui, a co-founder of Integrated Device Technology (IDT) and pioneer of CMOS technology, and Dr Manohar L. Malwah, formerly head of technology development at IDT, the company went public in November 1994. It currently employs more than 150 people at its 50,000 square foot facility in Santa Clara, and has an annual turnover of around US$50 million.

Present at the recent opening were QSA's Chairman Mr Paul Gupta (President and CEO of QSI) and directors Chun Chui and John Dougall (MD of AWA), along with local MP Paul Zammit. Mr Gupta and Mr Zammit jointly cut the ceremonial ribbon. Also present as guests were former AWA Chief Scientist and director Professor Lou Davies, previous AWAM general managers Professor Graham Rigby and Dr Bob McCluskey, QSI Director of Business Development Jake Foraker, QSA General Manager Phil Cavanagh and most of the Homebush plant staff, including Process Engineering Manager Vladimir Svoboda — who supervised the initial design and commissioning of the plant when it was built in 1988.

Since its purchase by QSA, the Homebush facility has been provided with upgraded fabrication plant, design and manufacturing control systems worth approximately $11 million — including a Lam Research 'Rainbow' Oxide Polyetcher. This is part of a plan, now well advanced, to achieve CMOS fab technology down to the 0.6 micron feature size by the end of 1996. As the plant was at the 1.2um level late last year, this is a formidable task — one that has traditionally taken as long as three years. However as QSI's Jake Foraker said at the QSA opening ceremony, his company has been most impressed by the high level of engineering expertise and dedication displayed by the staff of the Homebush plant, and from the results achieved so far it has every confidence that the 0.6um goal will be reached.

As well as being upgraded, the QSA plant is also likely to be expanded with the addition of a complete second fab line. Around 50% of the plant's output will be dedicated to supplying QSI's requirements, with the remainder available to its existing customers and export business. The plant is currently operating 24 hours per day and seven days a week.

In his speech at the opening, QSA Chairman Paul Gupta said that the Homebush plant was an integral part of QSI's plan to establish itself as a leader in the market areas of high performance logic and specialty memory semiconductors. He added that although it was the company's first foundry, QSI saw it as much more than a low cost in-house fab; the aim was to make use of its human and equipment resources fully, as a foothold in the important and growing Australian and South Pacific markets.

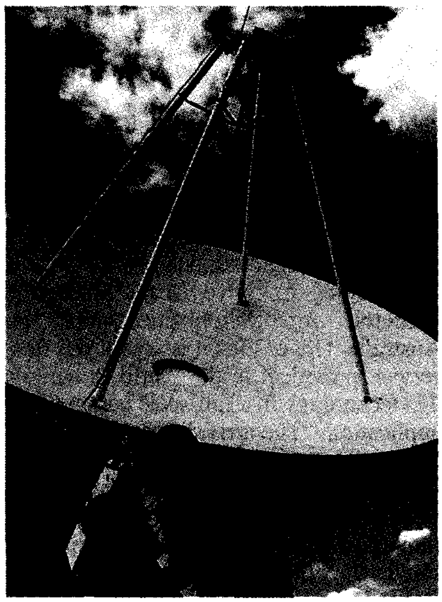
Above (L to R): MP Paul Zammit, QSA Chairman Paul Gupta and QSI Chairman Chun Chou cutting the ribbon to officially open the upgraded Homebush facility. Below shows Mr Gupta speaking at the opening ceremony.

Mr Gupta added that the potential rewards of the strategic alliance between QSI and QSA were great, but that because of the increasing competition and accelerating pace of product life in the global semiconductor industry, it would involve a lot of hard work for all concerned. However he noted that the synergy between Santa Clara and Homebush was already well established, with the local facility now fully involved in the design and development of new products as well as wafer fabrication.

MARCONI MOON BOUNCE AT UNI OF CANBERRA

The University of Canberra's Advanced Telecommunications Research Centre has celebrated the Centenary of the invention of radio and the anniversary of the first trans-Atlantic radio transmission by Guglielmo Marconi (in 1901) with the opening of the Joint DCA/University of Canberra/Satellite Communications Facility, and commemorative EME (Earth-Moon-Earth) radio contacts using the facility's Scientific Atlanta fast tracking 10m diameter F/0.4 dish, with wideband prime focus feeds.

At the facility opening Centre Director Professor Edwards pointed out that it was just 100 years since Marconi had first demonstrated the concept and importance of an antenna in radiocommunication over distances of a few kilometres, and that antennas like the 10m dish were now used routinely in aperture synthesis arrays such as the Australia Telescope, to identify radio sources at distances of tens of billions of light years. It was therefore particularly appropriate to have in the audience Professor 'Chris' Christiansen, the pioneer of the earth rotation aperture synthesis technique used in radio astronomy.



Dr Wayne Pallit and Dr William Cheung at the Centre's 10m F/0.4 fast tracking dish, used for the EME contacts.

The opening of the facility by UC Vice Chancellor Don Aitkin marked the beginning of 'Marconi Week', officially launched at the opening ceremony by His Excellency the Ambassador of Italy Dr Spatafora. Marconi Week culminated in a successful EME communications experiment on IREE 'Marconi Day', December 12, on which worldwide radio contacts were made from the 10m dish of the Joint DCA/UC facility using the moon as a passive reflector.

The Marconi Centennial Station operated at a frequency of 432MHz with linear polarisation, an antenna gain of 27dB, a system temperature of 160K, and a maximum effective isotropic power of 400,000 watts. Strong signals were received in Europe, Asia, North America and Australia, and 11 two-way Morse code contacts were made on the day. A highlight was an unexpected high quality voice contact with a station in Germany. Another was the reception (with the 2.6 second delay expected for the 780,000km round trip) of the historic letter 'S', transmitted with low power (100W) from the 10m dish by Faculty and senior engineering students at the University of Canberra, while setting up the system.

Annual Marconi Moon Bounce and related communications events are being planned to coincide with 1996 IREE Marconi Day, leading up to the Centenary of the trans-Atlantic transmission in 2001.

'ELECTRONICS AT WORK' EXPO IS EXPANDED

The 1996 'Electronics At Work' Expo, which will debut this month (June 5 and 6) at the Sydney Olympics site in Homebush, is being promoted as a 'four in one' event, due to support from industry bodies such as the Spectrum Management Agency (SMA), the Australian Electronics Development Centre (AEDC) and the Australian Electrical and Electronic Manufacturers Association (AEEMA). The Expo is planned to be the Pacific Rim's most comprehensive event for the electronics industry, according to David Kyle, managing director of promoter Practical Marketing.

The event encompasses an exhibition and seminar program dedicated to electronics products and services, and is being staged in conjunction with an international workshop and conference program on electromagnetic compatibility organised by the AEDC and SMA, responsible for implementing the EMC framework. The EMC conference is being held at the Gazebo Hotel in Parramatta, and will include a presentation by Don White, a world authority on EMC and author of 13 books on the subject. Dr Ken Joyner, the head of the EMC section at Telstra Research Laboratories, will be co-presenting with Mike Flood of the Therapeutic Goods Administration on mobile phone interference with medical devices.

Further information is available from Practical Marketing on (02) 9958 1811 or fax (02) 9958 2579.

WORLD'S LONGEST RADIO RELAY LINK

Russia's President Boris Yeltsin recently put the world's longest radio relay link into service, in Moscow. Constructed by consortium partners Siemens and NEC in a record time of only 18 months, the 7600km link runs from Moscow to Chabarovsk.

Siemens constructed the western half, from Moscow to Novosibirsk, while NEC contructed the remainder.

The radio link forms the most important terrestrial East-West long distance telecommunications channel in Russia.

It links western Europe via Russia to Japan and Korea, and operates at transmission speeds reaching 155Mb/s, to permit simultaneous use of up to 12,600 connections. The Siemens portion of the link contract was valued at A$146 million.

Following the commissioning of the link, Siemens was awarded a further order worth A$27.7 million by Russian long-haul carrier Rostelekom, for link extensions.

Siemens has been involved in building Russian telecommunications links since 1852, five years after the company was founded.

WORLD RADIOSPORT TEAM CHAMPIONSHIPS

Contests to see who can log the largest number of radio contacts in a given time are a popular feature of amateur radio around the world. Since 1990 the World Radiosport Team Championships has served as a kind of 'Olympic Games' to bring together the top operators from around the world, to compete on a 'level playing field'. WRTC-90 was held in Seattle, but Australia did not qualify.

WTRC-96 is planned as a much larger event, with 52 two-person teams from approximately 30 countries competing. The USA has 10 teams, Japan four, Germany three, Spain two, Poland two, Canada two and one team each from the remaining countries — including, this time, Australia. The local team consists of Martin Luther VK5GN, selected for his SSB success, and David Pilley VK2AYD for his CW results.

WRTC-96 has been organised and administered by an international committee and is being hosted by the PVRC and the Northern California DX Club in San Francisco, on July 10-15. The teams will operate matched stations in the 1996 IARU HF World Championship contest, to determine 'the best of the best'.

Sponsors of WRTC-96 include Icom, Yaesu, the Shell Oil Company, *CQ Magazine*, Ham Radio Outlet and the Northern California DX Foundation.

OPTUS USING S-A 'MM CABLE TAPS'

Optus Vision is using new Multimedia Taps from Scientific-Atlanta to provide telephony and other interactive services over its broadband cable networks. To date, orders for almost 300,000 multimedia taps and power distribution units (PDUs) have been placed.

Taps are devices which split a signal from street cables and provide services into individual homes. PDUs allow power for telephony and interactive services to be supplied along with signals on a coax cable.

Optus Vision is the first local service provider to install Scientific-Atlanta's new Multimedia Taps. Full-scale production of these units recently began at a custom-built assembly line in Taiwan. Optus Vision has also ordered twisted-pair PDUs, which pass signals and power along composite drop cable. This cable consists of two parts: a coax cable for video, data and telephony signals, plus a twisted-pair wire for carrying power. Scientific-Atlanta's PDU is also available in a version that supports power down the coax drop.

According to Steve Dean, Managing Director for Scientific-Atlanta in Australia, Optus Vision is one of the first service providers in the world to deploy this technology in a full-scale commercial application. "The arrival of cable pay-TV has revolutionised the local telecommunications industry", said Mr Dean. "We believe that within two years, multimedia functionality is likely to be the minimum standard worldwide for service providers. Optus Vision's committment to multimedia technology surpasses traditional network design and helps to put Australia at the cutting edge of telecommunications."

SYDNEY PLANT FOR US SUPPLY FIRM

US based cable television and telecommunications power supply manufacturer Alpha Technologies has opened a new facility in Sydney. The 15,000 square foot facility houses manufacturing and final assembly operations as well as sales offices and a complete customer service centre, and began operating in January.

"Obviously there's a lot of activity in Australia, and the move made strategic sense for both the company and its customers", said Alpha spokesperson Eric Wentz. "This new facility will allow Alpha to fully support the important customer base in the region as well as better serve a growing international industry."

The announcement came soon after Alpha signed a US$20 million three-year contract to supply Optus Vision with power supply products.

Alpha Technologies is headquartered in Bellingham, Washington. In addition to the new plant in Australia, the company operates facilities in Canada, the United Kingdom, Germany and Cyprus. The new Australian facility is located at 8 Anella Ave, Unit 6, Castle Hill, NSW 2154; phone (02) 894 7866, or fax (02) 894 0234.

FIRST INMARSAT-3 LAUNCH SUCCESSFUL

The first Inmarsat-3 satellite, the world's most advanced commercial mobile communications spacecraft, has been launched successfully from Cape Canaveral, Florida aboard a Lockheed Martin Atlas IIA. This was the third launch attempt. The first two attempts had to be delayed due to adverse weather conditions.

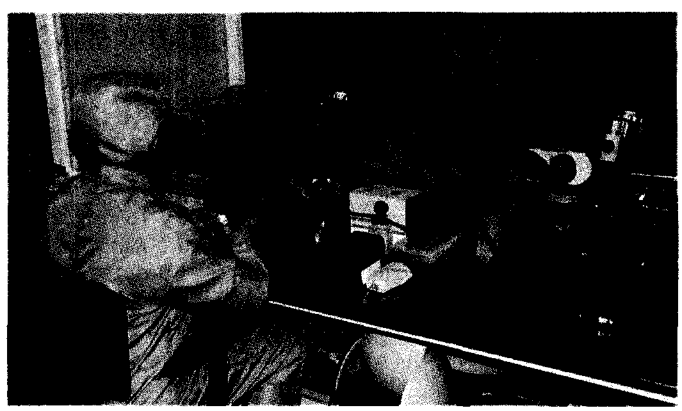
Inmarsat's third generation, which will eventually comprise five satellites, will expand the availability and usefulness of global mobile satellite communications by making possible lower cost communications services operating with even smaller, more economical mobile and transportable terminals.

PHILIPS OPENS NEW CLEAN ROOM FOR SATELLITE SWITCH ASSEMBLY

A 'Super Clean Room' for the manufacture of highly sophisticated telecommunications satellite switching systems has been commissioned at Philips Electronics' plant at Moorebank, NSW. The room will boost the Satellite Components Facility's manufacturing capability and help ensure it continues to be a critical international supplier of microwave switches for Hughes, the American space and communications company which has built more than 40% of the world's commercial communications satellites.

Chairman and CEO of Philips, Justus Veeneklaas says that the Satellite Components Facility is part of Philips' committment to the Australian Government's Partnership for Development programme, in which the company has undertaken to develop activities designed to enhance Australia's competitive advantage in advanced information and telecommunication technologies to the extent of $713 million over seven years.

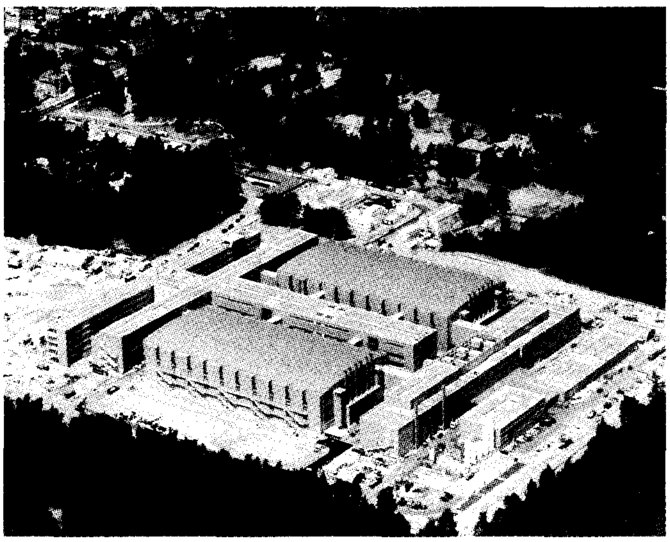
Eight years ago, Philips sent a team of top engineers and technicians to the United States, where they were trained by Hughes in building high precision components for the new generation telecommunications satellites. The team returned to Australia and under sub-contract to Hughes, established the manufacturing centre at Moorebank.



Assembling satellite switches in the Super Clean Room.

Since 1989, Philips has built over 2000 devices for Hughes. Not one has failed.

BIG CHIP PLANT FOR EASTERN GERMANY



Germany's Siemens electrical and electronics company has built one of the world's most modern microchip factories in the record time of 16 months at Dresden, capital of the east German federal state of Saxony. 16Mb memory chips are now being manufactured in a dust-free environment covering 25,000 square metres.

Until now better known as a European cultural mecca with its castles and art treasures, Dresden is now earning a reputation as a centre of high technology. The new Siemens plant initially provided jobs for 1000 people, and will eventually employ 1500 as the company invests a total of almost DM3000 million.

Siemens could have placed its new production unit almost anywhere in Europe, but the new federal state's government came up with an enticing offer — more than 250,000 square metres of land on what used to be a Soviet armed forces training area.

Saxony's state Premier Kurt Biedenkopf, an industrial manager for many years in West Germany, is dedicated to giving East Germany a secure future by developing it as a centre of high technology. "With the Siemens microchip factory in Dresden," said Biedenkopf, "we have established an important milestone in that direction". (iN-Press)

US STUDY SAYS MOBILE PHONES SAFE

The Australian Mobile Telecommunications Association has welcomed the release of a recent significant United States report which refutes claims of adverse health effects from the use of mobile phones. The Study, by the Wireless Technology Research Institute (WTRI), indicates that presumed differences in RF radiation exposure do not appear to have an influence on mortality.The study, based on the analysis of the records of 250,000 portable and mobile cellular telephone customers in the US over a three year period (using telephone company billing data), indicated little difference in mortality rates between users of portable cellular telephones and users of mobile, mostly car mounted, phones.

Epidemiology Resources Inc (ERI) conducted the study for the WTRI. ERI investigators used the Social Security Administration's computerised file of US deaths to compare mortality rates of the two groups.

The AMTA claims that the ERA research is yet another major international study indicating that there is no apparent correlation between the use of mobile phones and adverse health effects such as brain cancer. It says that Wireless Technology Research is an independent research group based in Washington DC and organised to address issues of potential public health risks from wireless communications technologies and develop a scientific database upon which public health decisions can be made.

OPTUS CHOOSES RADIO FOR TAS DIGITAL LINK

In what it claims is an Australian first, Optus Communications has installed a $6 million synchronous data hierachy (SDH) microwave link in its Tasmanian telecommunications network. The new digital link allows vast amounts of traffic to be passed between Hobart and Launceston.

The decision to use SDH radio for this major trunk route, rather than fibre-optic cable, was made after assessing the difficulties of ploughing cable across Tasmania's rocky terrain. The technology, said to be the first of its kind in the world, has resulted in a high level of interest from overseas and is proving a showcase for prime contractor Fujitsu Australia.

NEW VEHICLE DETECTION SYSTEM

Philips have acquired the Australian distribution rights for a leading 'non-intrusive' vehicle detection system, the Smartsonic, and are soon to begin local trials and demonstrations.

Most traffic authorities currently use inductive loops in area traffic control systems. But with loop installation and maintenance the surface of the road has to be cut and lanes of traffic closed. The Smartsonic Vehicle Detection System, developed by International Roads Dynamics Inc (IRD) of Canada, is a non-intrusive acoustic vehicle detector which literally 'listens' for the presence of vehicles via an overhead or side mounted sensor. This sensor 'talks' to a controller card, which is compatible with existing traffic controller cabinets. Installation and maintenance are simplified as the road surface never needs to be cut and lanes of traffic do not need to be closed.

IRD has had great success with Smartsonic throughout North America, where it is operating in diverse climatic conditions from Alaska to Florida without a single failure reported. ❖

NEWS BRIEFS

- A two day seminar on ***The Internet and Business*** will be held at the Golden Gate Hotel, Sydney, June 24-25 1996. Enquiries on (02) 9929 5366.
- ***Motorola*** has announced that Phillip Haas, Director of Operations and General Manager of Motorola Cellular, has been appointed to a senior position at Motorola's headquarters in Chicago. He will be replaced by Mr Glenn McCluskey, who is currently based in Chicago.
- ***SMPTE '97*** will be held at the Sydney Convention and Exhibition Centre, Darling Harbour July 1-4 1997. Enquiries on (02) 9977 0888.
- ***TDK*** has announced several changes to its management. Mr Ted Shibazaki has been appointed Managing Director, Mr Dennis O'Sullivan becomes General Manager Sales and Marketing, and Mr Richard Nelson has been promoted to General Manager Finance and Administration.

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

AMD claims micro outperforms Pentium 75

Advanced Micro Devices has begun sampling the Am5x86 microprocessor, claimed to outperform a Pentium 75 device. It is also claimed to deliver fifth-generation performance while taking advantage of existing 486 system designs and infrastructure, including motherboards and chipsets.

The device is based on AMD's enhanced Am486 microprocessor and runs at 133MHz. It has a 16KB write-back cache and an integrated floating point unit (FPU). Benchmark tests show the Am5x86 microprocessor provides up to 9% better performance than a Pentium 75-based system.

The processor includes power management and stop clock for reduced power consumption. Chipset and BIOS support for the device is available through AMD's third-part Fusion Partner program.

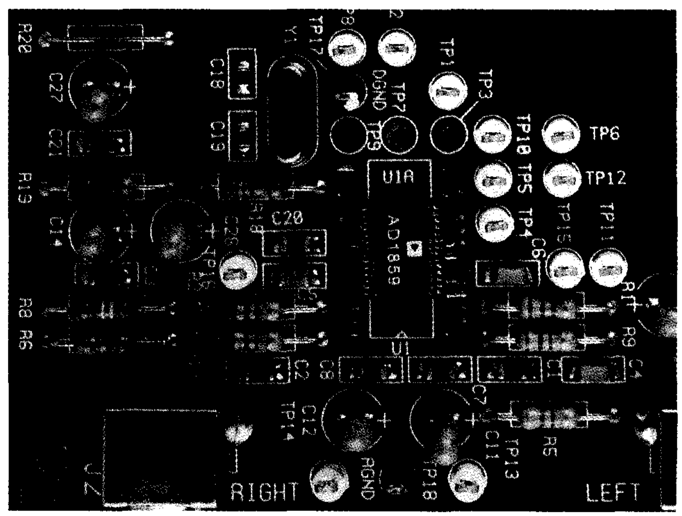
For further information circle 275 on the reader service coupon or contact Avnet VSI Electronics, Unit C, 6-8 Lyon Park Road, North Ryde, 2113; phone (02) 878 1299.

Digital audio subsystem in an IC

Analog Devices has introduced what it claims as the industry's most functionally complete 16/18-bit stereo digital audio playback subsystem on a single chip. It comprises a variable rate digital interpolation filter, a multibit sigma-delta modulator with dither, a jitter tolerant digital to analog converter, switched-capacitor and continuous-time analog filters, and analog output drive circuitry, all in a 28-lead surface mount package.

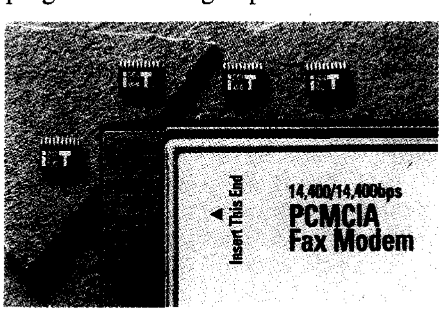
Other on-chip features include a stereo attenuator and mute, programmed entirely through an SPI compatible serial control port. Interface to the device is via a serial data input port that accepts 16 or 18-bit audio data in MSB-first, two's complement format. It operates from a single 5V power supply and is packaged in a 28-pin SOIC and SSOP.

For further information circle 277 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.



PLDs come in very tiny package

ICT is now producing a range of its programmable logic products in thin super small outline packages (TSSOP). This package style has a footprint about one third the area of an equivalent pin count small outline integrated circuit (SOIC). It also has a low profile, allowing programmable logic to be fitted on small boards such as DRAM SIMM modules.



The TSSOP package has about the same height as most surface mount resistors and capacitors, and can be mounted on the track side of most PCBs. Its low profile meets most PCMCIA height requirements. The company is currently shipping its programmable electrically erasable logic (PEEL) 18CV8 and the 22CV10A in the TSSOP package.

For further information circle 272 on the reader service coupon or contact Reptechnic, 3/36 Bydown Street, Neutral Bay,2089;phone(02)9953 9844

2GHz power transistor

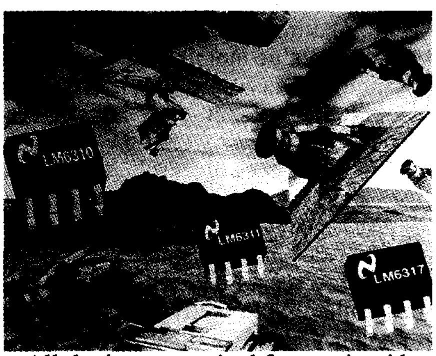
Motorola has announced a new RF power NPN silicon transistor characterised with series equivalent large-signal parameters suitable for PCN base station applications. The MRF6404 device operates at 26V and is designed for microwave large signal, common emitter, class AB linear amplifiers operating in the range of 1.8 - 2GHz.

The transistor has a minimum gain of 7.5dB, and a minimum efficiency of 38% at an output power of 30W. Specific applications include use in DCS1800 and PCS1900 cellular radio.

For further information circle 273 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

Op-amp has 1500V/us slew rate

National Semiconductor has introduced three new 5V op-amps with specifications typically found only with 15V devices. The LM6310 has a bandwidth of 90MHz and a slew rate of 350V/us, the LM6311 a BW of 130MHz and a 400V/us slew rate, and the LM6317 features a slew rate of 1500V/us with a BW of 120MHz.



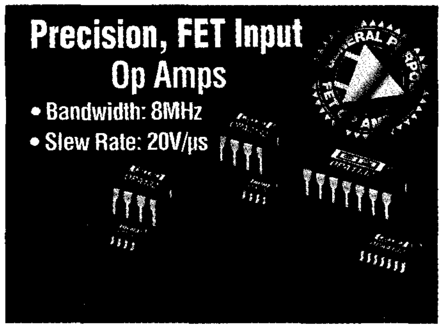
All devices are suited for use in video and imaging equipment, or for driving flash ADC or buffering DACs. The LM6311 and the LM6317 feature low noise and low offset, and the LM6311 is specified for a single 5V supply. The devices are currently available in 8-pin plastic DIP or SOIC packages.

For further information circle 271 on the reader service coupon or contact National Semiconductor (Aust), Business Park Drive, Monash Business Park, Notting Hill, 3168; phone (03) 558 9999.

8MHz BW FET input op-amps

Burr-Brown has released a range of FET input op-amps that feature a bandwidth of 8MHz. Called the OPA132 series, it includes a single package (OPA132), a dual (OPA2132) and a quad package (OPA4132). The series is claimed to be easy to use, and free from phase inversion and the overload problems often found in FET input op-amps.

Key specifications include 500uV offset voltage, 130dB open loop gain, 50pA input bias current, supply voltage of +/-2.5V to +/-18V, 8MHz BW, a slew rate of 20V/us and noise of 8nV/√Hz at



1kHz. The devices come in 8-pin (14-pin for the quad pack) DIP and SO-8 (SO-14) surface mount packages.

For further information circle 274 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130;phone(03)9878 2700.

High voltage switching regulator

Motorola has released the MC33363DW high voltage switching regulator. It contains a 700V, 1A FET power switch as well as a 450V off-line startup FET, a duty cycle controlled oscillator, current limiting comparator with programmable threshold and latching pulse width modulator for double pulse suppression.

Other features include a bandgap reference, cycle-by-cycle current limiting, input under-voltage lockout, over-voltage protection and thermal shutdown. The device is packaged in a 16-pin surface mount pack.

For further information circle 278 on the reader service coupon or contact Veltek Australia, 9 Bastow Place, Mulgrave 3170; phone (03) 9574 9300.

Charger IC for alkaline batteries

Benchmarq has announced the bq2902 rechargeable alkaline charge ICwhich charges two rechargeable alkaline batteries such as Renewal batteries from Rayovac.

The 8-pin IC manages two AAA, AA, C or D size cells, and is designed for use in subnotebook computers, personal digital assistants, cordless telephones, personal audio, flashlights, games and standby power.

The chip manages charge and discharge cycles by monitoring each cell individually to ensure full-charge detection without overcharge, and to extend cycle life by not allowing deep discharges. It uses a current-limited supply to generate the proper charge pulses; a LED status output indicates charge in progress, charge complete and a fault condition.

For further information circle 276 on

the reader service coupon or contact Reptechnic, 3/36 Bydown Street, Neutral Bay, 2089; phone (02) 9953 9844.

Microwave mixers

US-based Miteq has released a range of high isolation microwave double balanced mixers. The devices feature 40dB midband LO-RF and IF-RF isolation, double tuned RF baluns with 5dB typical conversion loss, and IF coverage of DC to 80GHz.

The RF/LO frequencies are between 0.5 and 20GHz with LO power 10-13dBm, and a conversion loss of 5.5 to 6dB. LO/RF isolation is between 35/30 and 40/30dB and IF-RF isolation is between 40/25 and 40/30dB (typical minimums).

For further information circle 279 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999. ◆

NEW PRODUCTS

Video tape rejuvenator

The RTI TapeChek Pro Line 4100 is a cleaning, evaluating and erasing tape conditioning and rejuvenating system for Betcam SP and Digital Betacam format video cassettes. Claimed to offer significant savings for broadcasters and other professional Betacam users, the system effectively recycles expensive Betacam cassettes.

GTV9 recently installed the system in its Melbourne television facility, to condition and recycle Betacam SP tapes for its news and current affairs requirements. Each tape is processed with the system prior to use, and tapes returned from the field are erased, conditioned and evaluated before being returned to service. This allows conta-

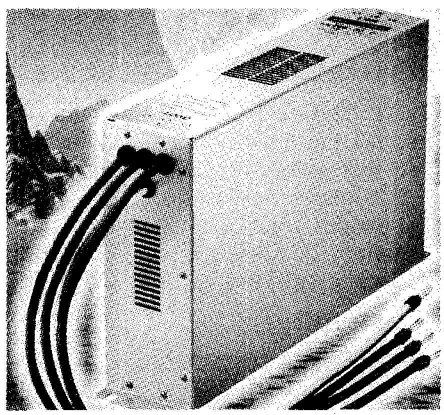
minated tapes to be discarded, and good tapes to be reused. Operating at 30 times PAL speed, the system cleans, evaluates and rewinds a one-hour cassette in two minutes.

For further information circle 241 on the reader service coupon or contact Amber Technology, Unit B, 5 Skyline Place, Frenchs Forest 2086; phone (02) 9975 1211.

3-phase EMC filter

Schaffner has launched the FN258 series of filters that feature a voltage rating of 480V, meeting the requirements of variable-speed motor drive manufacturers and users around the world.

The family has nine models that cover a current range of 7A to 180A, allowing variable frequency drives to meet EMC regulations. The filter has two-stage circuitry which allows the filter to be located up to 75m from the load, giving increased flexibility. The housing size is 50 x 126 x 255mm for



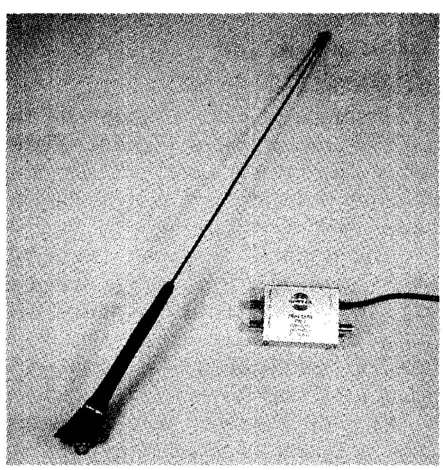
the 7A version, and 110 x 240 x 490mm for the 180A version.

For further information circle 243 on the reader service coupon or contact Westinghouse Industrial Products, Locked Bag 66, South Melbourne 3205; phone (03) 9676 8888.

3-in-1 car antenna

Sirtel has produced a multifunctional antenna that can be used with a mobile phone, CB or a car radio. Called the Unika antenna, it comes with a specially designed triplexer that connects all these devices to the one antenna.

The antenna can be mounted on the



roof (front or back) or on the boot. It is made from a soft, shockproof material and has a removable whip with a total height of 40cm.

For further information circle 244 on the reader service coupon or contact Telaware, 7/245 Springvale Road, Glen Waverley 3150; phone (03) 9802 0599.

High capacitance, tiny size caps

A range of micro-miniature axial leaded MLC capacitors has been annouced by AVX. Designated the MCO2 series, it is expected to supplement higher capacitance value tantalum capacitors in many applications requiring miniaturisation.

The series has a 16V X7R dielectric with capacitance values ranging from 1nF to 0.1uF, with 10% or 20% tolerance. The case measures 2.5 x 1.3 x 1mm, making it a drop-in replacement for lower value tantalum devices in the W moulded case size. Leads are solder coated pure nickel wire suitable for either soldering or welding.

The capacitors are especially suited for general filtering, decoupling, bypassing and RC timing applications. Their size makes them particularly suited for use in hearing aids. Pricing is comparable to equivalent size tantalum capacitors.

For further information circle 245 on the reader service coupon or contact Veltek Australia, 9 Bastow Place, Mulgrave 3170; phone (03) 9574 9300.

Miniature power relays

DGE Systems now has available the Omron range of LY and MY miniature power relays, with a withstand voltage of 2000V AC.

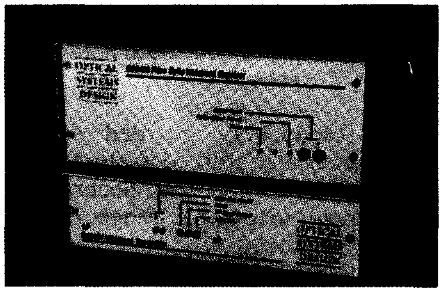
The MY series has many types for sequence control and power applications. Variations include one, two, three or four poles, operation indicators, high capacity capability, built-in diodes and an arc barrier on the three and four pole devices.

The LY series has the same features as the MY range, with AgCdO contacts for a longer service life. It is also available with single or birfurcated contacts, push-to-test button and a built-in RC circuit. Both the MY and LY series are available with plug-in/solder or PCB terminals. Mounting sockets are also available.

For further information circle 246 on the reader service coupon or contact

DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 61 3311.

Optical link for CATV system



Optical Systems Design has announced the release of its Australian designed and manufactured OSD481/OSD483 CATV fibre optic transmitter/receiver pair. It is intended for applications where a number of television signals must be transported over distances up to 20km.The units can be configured either as point to point links, or as a star network with one transmitter feeding several remote receivers via an optical splitter. The system allows a laser of three grades, giving 20, 40 or 60 channels.

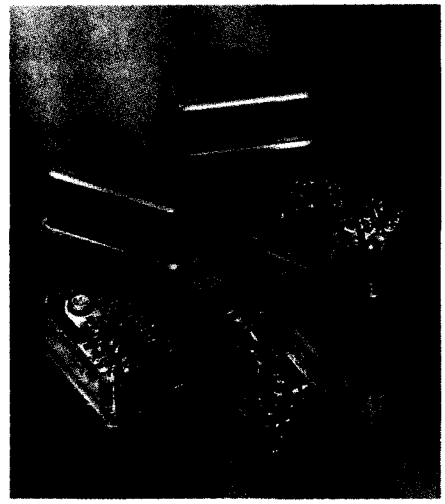
The transmitter accepts a combined AM-VSB spectrum signal at about 90 to 100dBuV/channel, with a carrier frequency in the range of 40 to 860MHz. This spectrum can be created by standard CATV/MATV type VSB modulators or channel translators.

The receiver has a wideband PIN photodiode, and outputs the combined FDM spectrum at a level of about 100dBuV/channel.

The devices are packaged as standalone, and operate from 120V/240V AC. Applications include multichannel CCTV systems, campus audio/visual reticulation networks, CATV/MATV networks in resorts and other large sites.

For further information circle 247 on the reader service coupon or contact Optical Systems Design, PO Box 891, Mona Vale 2103; phone (02) 9913 8540.

TCXO is tiny



AVX has announced its KT11 range of temperature compensated crystal oscillators (TCXO). Claimed as the smallest in the industry, the devices measure 11 x 9 x 4mm. A key feature is compatibility with reflow solder equipment.

The series offers a frequency range of between 12.8MHz and 19.2MHz, with a tolerance down to 2.0ppm. The supply voltage can be either 3V or 5V. An optional automatic frequency control (AFC) function can be specified which allows the centre frequency to be 'tweaked' with an external voltage.

The devices are suited to digital and analog mobile communications systems, in particular GSM, high specification cordless phones and global positioning systems (GPS).

For further information circle 248 on the reader service coupon or contact Veltek Australia, 9 Bastow Place, Mulgrave 3170; phone (03) 9574 9300.

Security clips

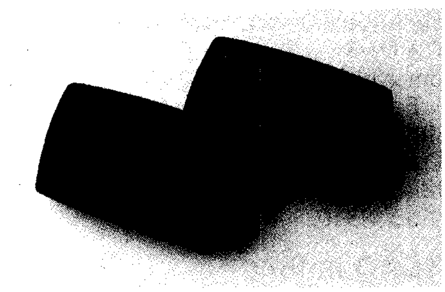
South Australian based Monaad Corporation has released an innovative electronic security product known as Smart Clips. These are proximity sensitive devices designed to safeguard against the loss of almost any item.

Sold in pairs, one Smart Clip is worn by the user while the other is attached to the item or valuable to be protected. When the two Clips are separated by around 7-10 metres, an audible alarm will sound to alert the user. The Clips also have a 'paging' facility, allowing them to 'find' one another even when one is concealed from sight.

Manufactured in South Australia by Gerard Industries to ISO-9002 quality standards, Smart Clips are expected to become an important export item.

The technology used in the devices has taken over three years to develop, and is a closely guarded secret. Monaad has also worked in close association with Zenon Car Security to develop an innovative range of car security products.

Retailing for $157, Smart Clips can only be purchased directly from Monaad Corporation by phoning toll free on 1800 069 669. Each pair carries a 14-day money back satisfaction guarantee and a 12-month warranty, and comes in a quality 'snap close' case with easy to use instructions and a variety of attachments.



For further information circle 242 on the reader service card or contact Monaad Corporation on (08) 377 2000.

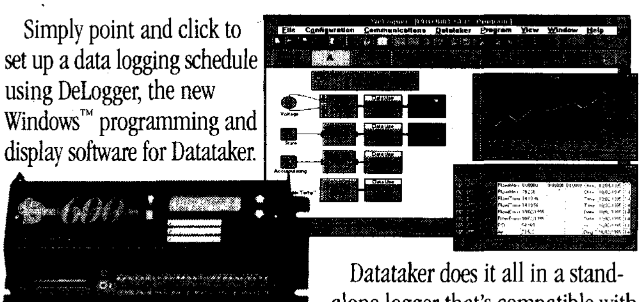
DIL crystal oscillators

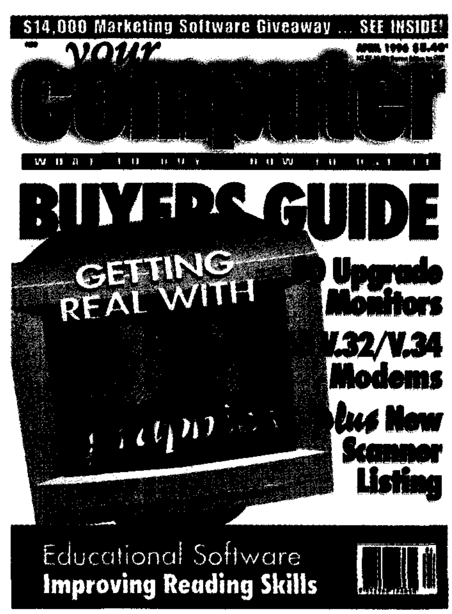
C-MAC Quartz Crystals has introduced the CMT3000 series of DIL-packaged temperature compensated crystal oscillators. The series is designed for use in applications which demand high frequency stability over a wide temperature range with low power, small volume and low cost.

The oscillators are particularly suitable for use in remote telecomms links, hand-held portables or GPS applications where size and portability is important. The series is packaged in a 14-pin DIL package. The enclosure is hermetically sealed by a welding process.

The series covers the frequency range of 2MHz to 50MHz, and requires a 5V 20mA supply, producing either sinewave or HCMOS output.

For further information contact C-MAC Quartz Crystals, Edinburgh Way, Harlow, Essex CM20 2DE England; phone +44 (0) 1279 626 626. ❖





SPOTLIGHT ON SOFTWARE

DragonDictate for Windows V2.0

Dragon Systems, arguably the world leader in speech recognition technology, has recently released version 2.0 of its package DragonDictate for Windows. Available in three editions, which differ mainly in terms of their 'active vocabulary' held in RAM, the new version has improved straight-out-of-the-box recognition performance and also adapts to the user more rapidly.

by JIM ROWE

Ever since computers moved out of their original glass-enclosed ivory towers and onto the desks of we ordinary mortals, there's been a constant request for systems capable of recognising human speech. Mainly, I suppose, because so many people find it either difficult or inconvenient to use a conventional keyboard. (Frankly, I've never found it much of a problem — my thought processes are sufficiently slow that they're easily recorded using a single finger on each hand!)

Despite this potential interest, though, the development of these systems has been relatively slow and tortuous — basically because for a computer, recognising human speech patterns is an exceptionally difficult task. Even reliably recognising the speech of one particular person is hard enough, with all the variations due to emotional state, inflections, etc. — let alone trying to recognise the variations *between* people. When you consider the additional complications due to different ages, genders, accents and dialects, the task becomes truly horrendous.

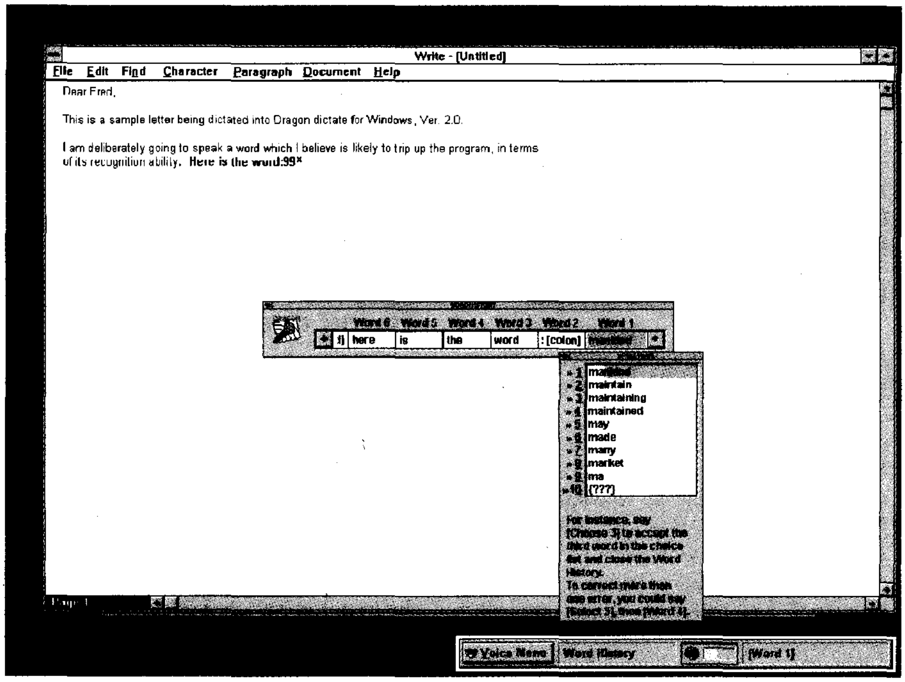
All of which makes the recent development of PC-based speech recognition systems all the more impressive, I believe. Some people criticised the first generation of these products as slow, and were irritated by their inability to cope with 'normal speech' with its high proportion of joined-together words and phrases. But when you consider the huge amount of crunching needed even to recognise words with small pauses between them, these programs were surely analogous to the classic dog walking upright — they may not have done the job perfectly, but it was a minor miracle that they did it at all!

Although DragonDictate for Windows V2.0 is basically a software package, it comes complete with a high quality Shure noise-cancelling microphone.

Probably the most impressive speech recognition products are those produced by Dragon Systems, a company based in Newton, Massachusetts (USA). Founded in 1982 by Drs James and Janet Baker, two pioneering speech recognition researchers at Carnegie-Mellon University, Dragon has been at the forefront of the technology even since its inception. Both James and Janet Baker also worked at IBM's Thomas J. Watson Research Centre on the Continuous Speech Research project, and James Baker developed the use of stochastic processing and Hidden Markov Models, both regarded as key components of modern speech recognition. Janet Baker contributed an important method of time-domain acoustic processing based on neural phase-locking.

Both Drs Baker are still very active in Dragon Systems, James as its Chairman/CEO and head of research, and Janet as its President.

In 1990, the company released DragonDictate-30K, the first commercial large-vocabulary (30,000 words) speech recognition system enabling general purpose free-text translation. Then in mid 1994 came a version for Windows. Even in their initial forms



A screen dump showing a correction taking place during a dictation session with DD for Windows and Write. The horizontal window shows the recent word history, while the vertical list provides DD's suggested alternatives for the word that was misrecognised. They appear when you say "Oops!" after noticing the error. Note the 'Voice bar' at lower right, present when DD is in operation.

practical, but they tended to require a fairly long time to adapt to a particular user and their working vocabulary. They also tended to need a significant pause between words, which steepened the 'user learning curve' and limited the dictation speed.

These restrictions have been largely (although not totally) overcome in the latest versions of the programs, which are DragonDictate for DOS V3.0 and DragonDictate for Windows V2.0, which we're reviewing here.

Released in the US late last year, DragonDictate for Windows V2.0 is basically a high-powered software package which runs on a PC running either Windows 3.X or Windows 95, and fitted with a standard Windows compatible 16-bit sound card. However as undistorted and low-noise audio is very important for reliable speech recognition, the package also comes complete with a high quality Shure noise-cancelling headset microphone.

Version 2.0 incorporates a completely new recognition 'engine', which is claimed to greatly boost accuracy and enable natural continuous speech recognition of numbers and commands. Part of the new engine is a feature called QuickTalk, which is described as providing 'semi-connected speech recognition', to allow significantly shorter pauses between words in normal dictation.

In addition, the new engine is said to be the first in a general purpose PC dictation product to allow recognition of truly continuous phrases, such as naturally spoken numbers like "four-hundred-and-fifty-three", or commands like "move-down-three-paragraphs" or "Bring-Up-Write". You can even customise the program by adding further such phrases to its dictionary as you go along.

The new version also uses new speaker-independent models, which are claimed to give a relatively high accuracy 'out of the box' with most users, without a lengthy training session. There is an optional Quick Training feature which can get you off to an even better start, however.

Like the earlier version, it automatically adapts to user speech patterns as you use it, so that the more you do so the faster and more accurate it tends to get. However this relies on you consistently correcting its errors, and saving your 'User File' after each session.

Included in DD for Windows V2.0 is the ability to direct the computer's cursor around the screen and control the mouse buttons entirely by spoken commands like "Mouse-Up" or "Right-Click". However there's now also a feature called MouseGrid, which allows faster mouse navigation by dividing the screen on command into an array of nine sectors, into which the cursor can be directed quickly and simply by specifying the sector's ID number.

Compatible applications

As well as being compatible with both Windows 3.X and Windows 95, DD for Windows V2.0 is also compatible with many existing Windows applications programs — even those that are fairly specialised, according to Dragon Systems. In addition the Company has tested and certified its compatibility with many of the more commonly used applications, including:

- Microsoft Office 4.2 and 4.3: Word 6.0, Excel 5.0, Powerpoint 4.0 and Access 2.0.
- Lotus Smartsuite 3.1: AmiPro 3.1, Lotus 1-2-3 5.0, Approach 3.0, Organiser 2.0 and Freelance 2.1.
- Novell PerfectOffice 3.0: WordPerfect 6.1, QuattroPro 6.0 and Presentations 3.0.
- Microsoft Office 95: Word 7.0, Excel 7.0 and Powerpoint 7.0.
- Windows Applets: Write 3.1, Wordpad 1.0, Calculator, Solitaire, Minesweeper, Calendar and Cardfile.
- Other applications, including Adobe Acrobat Reader 2.0.

In fact DD for Windows 2.0 is said to contain over 4500 predefined speech macros for the three leading office suites, and for numerous Windows Applets. It also has limited compatibility with a wide range of DOS applications, if they're run in a DOS window.

Hardware requirements

As mentioned earlier, DD for Windows 2.0 comes in three editions which differ mainly in terms of the size of the 'active vocabulary' they maintain in RAM while running. In the Personal Edition this vocabulary is of 10,000 words, which expands to 30,000 words for the Classic Edition and 60,000 words for the Power Edition. All three editions maintain a further 'backup wordlist' of 120,000 words on your hard disk.

Needless to say, the differing RAM vocabulary sizes mean that the three editions have different requirements in terms of computer memory. The Personal Edition needs at least 12MB (16MB recommended); while the other two editions need at least 16MB (20MB recommended for the Power Edition). The hard disk space requirements also vary, depending on both the edition and the number of users — from 28MB for the Personal Edition with one user, up to 36MB for the Power Edition (plus 14MB per additional user).

Dragon Systems' Australian distributor Auscript (a division of the Commonwealth Attorney-General's department) recommends the use of a 90MHz Pentium system, with 24MB of RAM when running under Windows 3.11 and 32MB of RAM with Windows 95.

As a suitable microphone is supplied in the DD for Windows 2.0 package, the only other hardware compatibility consideration is the sound card. In general the package seems to be compatibile with most Windows-compatible multimedia sound cards, with Dragon listing the Sound Blaster 16, Value Edition SB16 and Microsoft Windows Sound System (WSS) cards as being 'certified'. The company also certifies the M-ACPA card, which they say gives faster operation because its onboard DSP processor offloads some of the speech recognition work from the CPU.

Trying one out

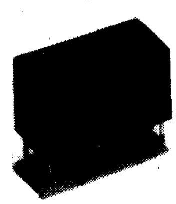
Thanks to Dragon Systems and Auscript, I was able to try out the Classic Edition of DD for Windows 2.0 for myself. I installed it on a 90MHz Pentium machine with 16MB of RAM, running Windows 3.11.

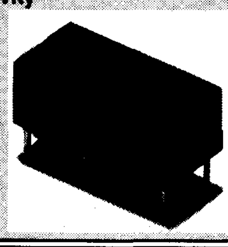
Although the sample package had only floppy disks to install from (a CD-ROM version is apparently available), the installation went smoothly and without any hassles.

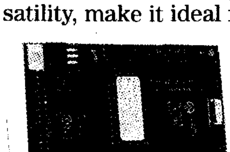
After installation an initial setup box appeared, asking which mike was being used. As it wasn't entirely clear which model of Shure mike we'd been provided with, I clicked on 'Don't Know' — which brought up a Microphone Test Box, and I was led through a sequence to set up the correct settings for the sound card volume settings, etc. This also went quite smoothly.

I noticed that a tutorial program had been installed along with the main program, so I gave this a try. It turned out to provide an easy to follow demo sequence introducing the package and how it's used, with a friendly graphic character called 'Alex the Dragon' guiding us with a combination of images and audio (via the sound card output). At various points you're prompted to try various functions yourself, step by step, to get you going.

Next I tried using DD with Windows Write, to dictate a letter. However at this stage DD seemed to have quite a lot of difficulty recognising much of what I







said (including Windows commands), and it was all very frustrating. Perhaps it was my Australian accent and intonation; after all, it's an American program!

Anyway, I decided to defer using it 'in anger' for a while, and instead fired up the optional program Quick Training — a kind of 'fast track' way to get DD more familiar with your speech patterns. Quick Training presents you with four groups of words (Correction Words, Common Commands, Dictation Words and Additional Words), and you have to speak them into the mike as they're displayed on screen. There are potentially over 700 words in all, but as Quick Training constantly adapts to your speech as you proceed, you normally don't need to run through the lot. In fact my training session seemed to involve only about 150 words or so, and took less than 15 minutes.

After saving my User File, so that DD would 'remember' what it had learned so far about my speech patterns, I tried firing up Windows Write again. This time things were a lot smoother. Telling Windows to "BringUpWrite" immediately brought Write into action, and "BeginDocument" changed the message in DD's little VoiceBar icon to indicate that we were now in Dictate mode. I could then begin dictating the letter, including punctuation and formatting commands like "Period", "Dash", "Comma" and "NewParagraph".

DragonDictate still tended to make a few recognition errors, but these were much less frequent than before. As recommended in the manual I also made a point of mastering the correction procedure, so that it would be able to keep adapting and improving.

Whenever you notice that it has made an error, you merely say "Oops!", and it brings up a dialog box showing the last few words it has registered. If the error involves the second last word, you then say "WordTwo", and it offers a list of other possible words for that sound pattern. If the correct interpretation is listed, say third in the list, you only need to say "ChooseThree" and the correct word is substituted in the text.

What if the list doesn't include the correct word? In this case, you simply begin typing it yourself. As each letter is keyed in, DD changes the words listed; often by the time you've type in a couple of letters, the correct word appears in the list and you can choose it.

This all sounds rather involved, and the first few times it certainly slows you down. But after a while things go surprisingly smoothly — partly because DD is getting more and more used to your speech patterns and making fewer errors, and partly because the correction procedure becomes more intuitive and 'automatic'. After dictating a couple of sample letters, I found that the program and I were getting along much more happily and efficiently...

It certainly takes a while to get used to the 'almost, but not quite continuous speech' dictation technique that the program needs, and I can't say I have mastered this fully as yet. However my impression is that achieving this level is entirely feasible, and should result in a very respectable dictation speed.

In short, then, my impression of DragonDictate for Windows V2.0 is that the Classic Edition in particular is a very powerful and practical PC-based speech recognition package, and one that should be suitable for day to day use by a wide range of people.

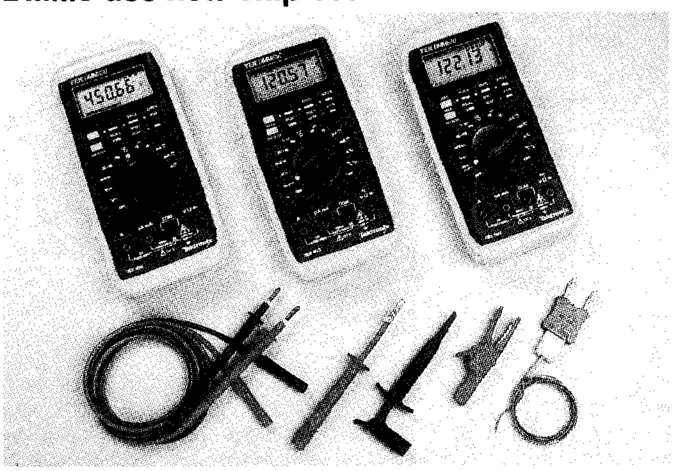
The quoted RRPs for the package are $699 for the Personal Edition, $1299 for the Classic Edition and $2999 for the Power Edition.

Dragon products are now available in Australia through a network of resellers. For further information, including details of dealers in your area, contact distributor Auscript on (02) 238 6565, or fax (02) 638 6566. ❖

Special Feature:

The latest test and measuring instruments

DMMs use new chip set



The DMM800 multimeter series recently announced by Tektronix is the company's new flagship family of handheld true-RMS digital multimeters (DMMs). The series is claimed to provide up to twice the accuracy and up to 10 times the resolution of competing handheld DMMs. Measurement functions include voltage, current, resistance, capacitance, frequency and temperature. The range comprises the entry-level DMM830, the mid-range DMM850, and the high-end DMM870.

Features include a dual numeric display (DMM850 and DMM870), which lets you read two measurements at once. For example, amplitude and frequency of a current or a voltage, without switching between signal displays.

The DMM850 and DMM870 measure temperature, in Fahrenheit and Celsius, and have a time stamp facility to label minimum and maximum values as they occur. The DMM870 includes high/low limit testing, in which a beep indicator sounds when measurements exceed user-set limits.

The meters are based on the TelCom 8129/8131 chip set, for which Tektronix has exclusive rights. These ICs are claimed as the industry's first full-featured, autoranging, autocalibrated DMM analog-to-digital converter. They have a resolution of 4-3/4 digits (40,000 counts) and 0.06% basic DC volts accuracy.

All three models feature adjustable auto power-off, memory store/recall and a durable, water and dust resistant casing and are backed by a Tektronix three-year warranty. Available through authorised Tektronix distributors, the DMM870 costs $499, the DMM850 is $449, and the DMM830 is priced at $399.

For further information circle 206 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde; phone (02) 888 7066.

Multimeter has 1GΩ input resistance

The Thurlby Thandar model 1906 is a true RMS 5-1/2 digit computing multimeter with standard RS-232 and optional GPIB interface, auto and manual ranging. It has an effective scale length of +/-210,000 counts, and provides true RMS measurements regardless of waveshape. It has maximum sensitivities of 1uV, 1mΩ, 1nA and can measure to 750V AC and 10A AC. At high sensitivity ranges, the input impedance is 1GΩ, making the instrument suitable for measurements on high impedance circuitry.

The meter is suitable for AC and DC measurements, contact resistance and resistance measurement (two and four terminal method), capacitor leakage and high impedance measurements. Calibration constants are stored in EEPROM, allowing 'closed case' case calibration and up to six front panel set-ups can be stored, including active computing or logging functions. Computing functions include Ax + B, limits comparison, percentage deviation, min/max storage, logarithmic (dB) measurements and automatic data logging.

For further information circle 207 on the reader service coupon or contact Nilsen Technologies, PO Box 930, Collingwood 3066; phone (03) 9419 9999.

DMM computer interface card

The DMM-100 digital multimeter interface card for PC/AT and compatibles can measure DC and AC voltage and current, resistance, and perform diode/continuity tests. It has a 3-3/4 digit resolution and a sampling rate variable from 10 samples per second to one sample per hour.The card has an on-board microcontroller that performs a range of tasks, including auto calibration and auto ranging. All connections to the card are through four standard banana jacks.The card comes with menu-driven software for Windows and DOS. Also included are software drivers to simplify development of custom applications in C, Turbo Pascal, Quick or compiled BASIC, Visual BASIC and dynamic link library (DLL) for Windows application development.

For further information circle 203 on the reader service coupon or contact Interworld Electronics and Computer Industries, 1000 Glenhuntley Road, Caulfield South 3162; phone (03) 9563 5011.

Measures RF radiation

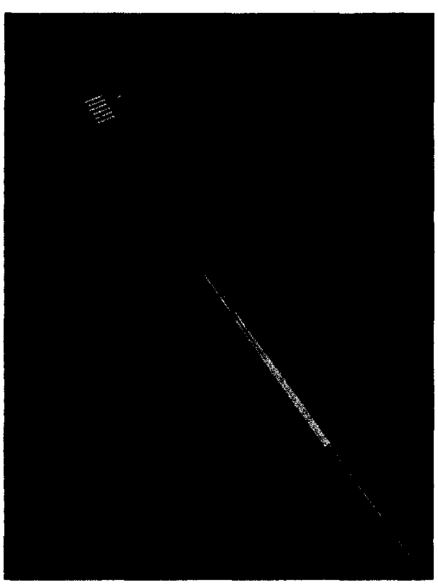
The EMR-30 field analyser from Wandel & Goltermann measures electrical fields from 100kHz to 3GHz simultaneously and isotropically (non-directional). The device has internal memory and a built-in real time clock for long term unmanned measurements. The memory contents can be downloaded to a computer for subsequent evaluation.

Device functions include averaging over time as well as spatial averaging (e.g., quadratic averaging of multiple measurements at different points in a given space). The instrument is calibrated and includes an auto-zeroing function that works under exposure to electromagnetic fields.

For further information circle 204 on the reader service coupon or contact Wandell & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

Measures moisture in building materials

The MicroLance from UK company Hydramotion is a portable, battery-powered probe that measures moisture content and temperature of building materials and minerals such as sand, aggregates, mixes and other minerals.

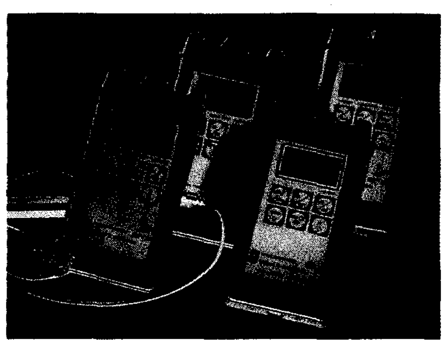


It consists of a tough sensor at the end of a variable length shaft (0.9 to 1.8m), with a computer control and readout unit mounted at the other end. Measurements are taken by inserting the probe into the material, and the meter gives an instant readout of moisture content and temperature. The meter can also average any number of moisture readings, so overall moisture for complete stockpiles or truck loads of material can be determined quickly and easily.

The instrument comes with standard calibrations, and recalibration for any material is easily done. It is powered by four 1.5V batteries that give up to 50 hours of use. Battery failure, or any other fault, is identified by an alarm display. The instrument is claimed to be largely immune to the salts and chlorides typically found in building materials.

For further information circle 208 on the reader service coupon or contact Production Supplies, PO Box 101, Noble Park 3174; phone (03) 9795 6011.

Optical power meters



Wandel & Goltermann has released its latest generation of optical power meters, the OLP-15A, OLP-16A and OLP-18A. Their main applications are in installing, maintaining and repairing fibre optical networks (LANs, complex optical distribution networks, etc).

The devices measure power and attenuation (ABS and REL) in the wavelength range from 800 to 1700nm and offer an extended measurement range and more functions compared to their predecessors.

They cover all test requirements in the fields of data communications and telecommunications.

The OLP-15A has a display range from -70 to +20dBm and suits all telecommunications applications. This meter is also available with 150 internal memory locations and data access/remote control via an RS-232 interface.

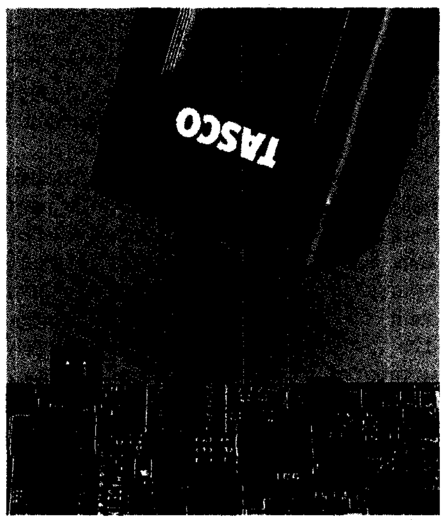
The OLP-16A is for measuring very low input power levels. It has a display range from -80 to +15dBm, and its InGaAs photodiode makes it most sensitive in the second and third optical windows at 1300 and 1550nm.

The OPL-18A has a display range from -60 to +26dBm, for measuring high power levels such as those found on eridium-doped fibre amplifiers (EDFA) and in CATV systems.

All instruments feature audible signalling to help identify a given fibre in a fibre bundle, and include a 'twintest' function, which allows automatic measurement of two wavelengths simultaneously.

For further information circle 205 on the reader service coupon or contact Wandell & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

Non-contact thermometer



TASCO (Japan) has recently released the THI-400N/THI-400S series of non-contact thermometers. The devices cover the range -30 to +400°C, with a choice of twin laser sighting for accurate targeting (THI-400N) or a single LED spot marker for small targets — 2.5mm at 30mm distance (THI-400S).

Both models have adjustable emissivity, an audible alarm with upper and lower limit adjustment, and a reading hold feature. Applications include preventative maintenance in areas such as electrical hot spots, bearing failures, conveyors and any application where a quick response without contact is needed.

For further information circle 202 on the reader service coupon or contact W & B Instruments, PO Box 189, Carlton 3053; phone (03) 9347 0866.

Ultrasonic condition monitor

The Type 1000 portable, single-channel ultrasonic receiver from British company Karousel is an industrial quality handheld instrument that provides condition monitoring and fault diagnosis of plant and equipment. Because of its internal memory, the instrument can be linked to a PC to download information. It does not require an external power supply. Unlike traditional listening techniques, in which the condition of machinery and plant is identified from audible sounds, the Type 1000 uses controlled ultrasonic frequencies, claimed to ensure more accurate and effective fault diagnosis and condition monitoring. The instrument has a high sensitivity and can be used to locate and monitor many types of faults. It is particularly effective as a leak detector. Test results are presented instantly by meter, audio, oscilloscope or chart recorder. The touch-control panel is user friendly, and the instrument can be operated with minimal training. A wide range of probes, including airborne, contact and spring-loaded is available. Accessories include transducers for a wide variety of applications. The instrument is supplied with airborne probe, contact probe, headset and mains charging unit.

Karousel is seeking an Australian agent for the instrument. For more information contact Steve Ahern or Susan Redden, British Consulate-General, Sydney; phone (02) 247 7521. ❖

Silicon Valley NEWSLETTER

Possible bust for chip market

Unless the current problems in the semiconductor industry turn out to be a minor speed bump on the way to reaching a trillion dollar business, the chip industry may be about to renew its reputation as a boom-bust business. A second major chip company in Silicon Valley has announced a layoff, while another has implemented a hiring freeze.

National Semiconductor in Santa Clara said it will issue pink slips for some 400 of its 21,000 workers, while Advanced Micro Devices in Sunnyvale announced it has put the brakes on hiring new employees. The latter announcement followed a warning AMD sent to financial analysts, that earnings in the current quarter are not likely to meet Wall Street expectations.

The latest moves came two weeks after Cirrus Logic in Fremont laid off several hundred people due to slowing demand for some of its chip product lines.

Only three months previously, the semiconductor industry was considered to be in a boom mode characterised by a manufacturing equipment boom, hiring frenzies, product shortages, and stable chip prices at almost unprecedented high levels.

However a glut of memory chips has caused DRAM prices to fall by 75% or more, forcing the cancellation or delay of a number of chip fab projects. This appears to be causing the first of what could result in a new wave of layoffs in the chip industry.

Some industry analysts and executives believe the downturn is a short-term phenomenon, caused by an unexpected oversupply of 4Mb DRAMs which developed during December.

Apple engineer gave Amelio a big ear

Apple Computer's new chief Gilbert Amelio got more than he bargained for when he gathered a dozen or so randomly-chosen employees for an informal meeting in his office. During the talk he spoke candidly about Apple's problems and his thoughts on the steps he may take to remedy the company's woes.

One of the chosen employees, an engineer, wrote a detailed account of the meeting, and forwarded it to Guy Kawasaki, a key member of the original Macintosh development team and now Apple's 'evangelist' in charge of drumming up support for the beleaguered company and its computer line.

Kawasaki, figuring the report would help boost morale among both Apple employees, suppliers, and users, decided — apparently without clearance from the top — to broadcast the report over an electronic mailing list that included more than 10,000 addresses both inside and outside of Apple, including news organisations. The next day, Apple scrambled for damage control as major newspapers began reporting on and interpreting the report.

The unidentified engineer's memo should not be confused with a policy announcement, one spokesman said. "It's important to note that the forum in which these remarks were made by Gil Amelio was a very informal session", said spokeswoman Nancy Paxton. "This was an example of Gil expressing his thoughts. It was not any sort of statement of strategy."

Israel moves on Intel chip plant

Despite a critical internal government report and concerns that the country cannot afford it, Israel's government has given the go-ahead to Intel's plan to build a US$1.6 billion chip plant — the largest foreign investment to date in Israel, and one that will cost the country US$600 million in grants over a 10-year period.

The Treasure Ministry's Investment Centre approved the deal after Intel promised it would purchase more local goods and services. The previous month, the project's prospect had turned sour after a government audit had suggested that Israel would not see sufficient returns on its $600 million investment. Israel's Finance Minister Abraham Shohat approved the deal after reviewing the revised proposal.

Another obstacle for Intel to overcome, however, is Israel's Parliament — where the Finance Committee would have to approve changes in the budget to free up funds for the fab, which will be built in the southern Israeli town of Kiryat Gat.

Motorola Semiconductors and Microsemi Corporation have announced that Motorola is providing a second source for Microsemi's patented 'Powermite' SMD diode package, under an exclusive licensing agreement. Powermite is a microminiature package, slightly larger than the SOT-23 package, designed to house Schottky and ultrafast rectifiers as well as TVS, zener and RF PIN diodes.

The plant is scheduled to come on line in 1998, and will employ some 2500 workers at full production. Intel expects to realise more than a billion dollars in annual revenues from the facility, with virtually all of the output being exported.

Intel phases out its i860 micro line

Intel is phasing out its line of Paragon massively parallel processing supercomputers, replacing the i860 RISC processors with machines built around its new PentiumPro chips.

The company has informed its installed base of some 100 Paragon users that it won't take new orders for the Paragon system after September.

"We will try to ship all of those orders by the end of this year, and continue to support the product through the year 2001", said Intel spokesman Howard High.

The new line of PentiumPro-based supercomputers will be smaller versions of the massive US$45 million teraflop-capable supercomputer Intel is building for the US Department of Energy's Sandia National Laboratory. That machine links more than 9000 Intel PentiumPro processors and will process data at the rate of 1.8 trillion operations per second. It will be used in simulating nuclear weapons tests, eliminating the need for underground testing.

Sun buying Britain's IMP

Sun Microsystems has entered into an agreement to acquire United Kingdom-based Integrated Micro Products, for US$96.1 million. IMP makes fault-tolerant computers for telecommunications companies. Sun will operate IMP as a new business unit.

Mark L'Anson, IMP's chief executive officer, will become vice president and general manager of the new business unit, according to Sun president Edward Zander. "With the acquisition of IMP, Sun can further expand our role in the telco market."

Added L'Anson, "After years of working side by side as technology partners, IMP and Sun now have the opportunity to create a single product family with features that offer unparalleled value to the telecom industry."

Java bug reported

Sun Microsystems has discovered a significant flaw in its Java internet programming language — one that could allow a hacker to take control of Web pages, booby-trap, read, or delete files, and subsequently invade other Web sites connected to the initial site.

Sun said a team of high-level engineers was currently working almost around the clock to fix the bug. The company hopes to deliver the software patch to NetScape Communications which uses Java, as well as post the fix on Sun's own websites for concerned internet users to download it to their own systems.

The Java bug was originally discovered by a computer science professor at Princeton University, and two of his graduate students.

Sun Microsystems Chief Executive Scott McNealy said the company takes any security issues seriously. "We'll make mistakes and application vendors will make mistakes. We'll have to correct them."

The Princeton research team said the flaw in question was the latest of three separate security faults in Java that they have discovered.

Foreign marketshare soars in Japan's chip market...

Surging Japanese demand for semiconductor products made by non-Japanese chip makers sent the foreign market share soaring to nearly 30% during the fourth quarter of 1995, more than three times the 8.4% level at the time the first US-Japan Chip Trade Agreement went into effect 10 years ago.

During the fourth quarter, foreign chipmakers' share of the Japanese semiconductor market increased by more than 3% for the second consecutive quarter, reaching 29.6% in the quarter, and boosting the 1995 average foreign share of the Japanese chip market to a record 25.4%, up from 22.4% in 1994.

"These numbers reflect that the trade agreement is working to ensure greater access for foreign suppliers to Japanese customers", said SIA President Thomas Armstrong. "Without the agreement, in fact, we wouldn't even have these numbers to look at. This new milestone of progress also serves as an ideal stage to launch cooperative negotiations on a new trade pact between the US and Japan. The agreement not only benefits foreign manufacturers and Japanese consumers, but also US-Japan relations."

The current trade agreement with Japan is set to expire on July 31. Japanese industry and government officials have indicated they are not interested in renewing the agreement, arguing that the agreements have met their objectives and that it is time to let market forces determine progress.

AMD finally ships its Pentium clone

'Better late than never' was the operative phrase from Sunnyvale when Advanced Micro Devices announced it had begun delivering volume orders for its AMD5K86 Pentium-compatible processor, a chip the company has invested US$100 million to develop.

The K5 chip was originally scheduled to ship last August, at the height of the chip boom market. Now AMD will sell its 75MHz version of the K5 for $75, about $30 less than Intel's charge for a 75MHz Pentium.

AMD projects it will deliver a K5 processor with the performance of a 150MHz Pentium by the end of the year.

The chip was developed at AMD's facilities in Austin and is in production at Fab 25, a US$1.4 billion state-of-the-art wafer fab that began operating last fall. The plant, which currently produces 486 chips, was built to make the 5K86 and its more advanced successors.

"At least they have a product now", said analyst Dean McCarron of Mercury Research in Scottsdale, Arizona. "This is a very important first step. Late-to-market is better than never-to-market."

AMD acknowledges that it set a too-aggressive schedule for a 'ground-up' chip design of this complexity. The chip has 4.3 million transistors. AMD projects it will make five million of the new chips over the next 12 months, generating several hundred million dollars in revenues.

Analysts believe that while critical, AMD is merely warming up the Fab 25 facility for the PentiumPro-compatible NexGen-based processor that AMD acquired last year. K6 is expected to be in production at Fab 25 early next year.

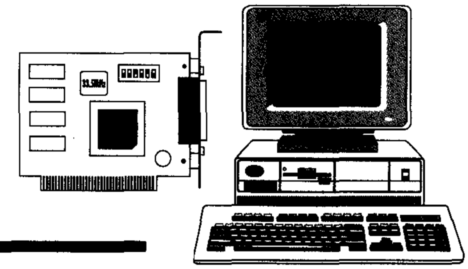
C-Cube feels pinch from IBM

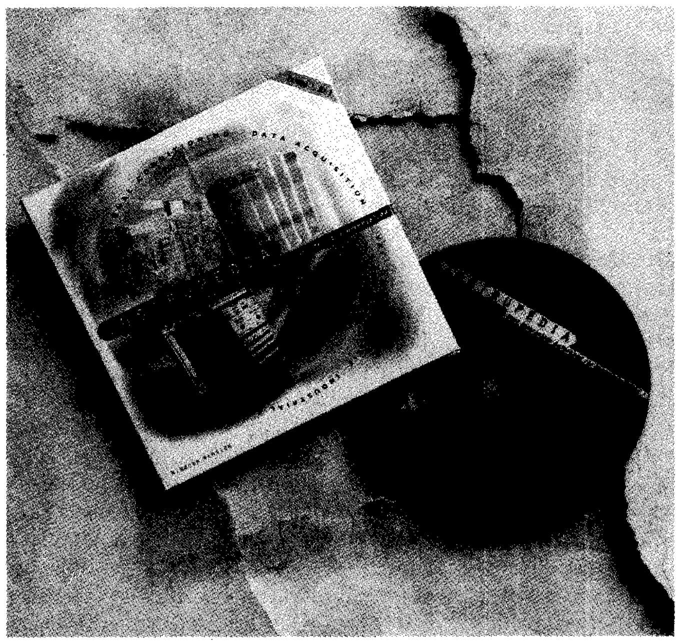
C-Cube Microsystems, the leading supplier of video compression ICs for products ranging from PCs to digital satellite TV systems, saw its shares plunge $12 to US$42.75 recently, as IBM announced its semiconductor business unit has set its sights on the fast-growing video compression niche market.

IBM has launched a set of six chips that would allow digital video signals to be more easily transmitted over computer networks.

At C-Cube, marketing head David Taylor called Wall Street's reaction to the IBM announcement "laughable", saying that IBM's planned move into video compression had been known about for 18 months, and only covered a small group of products. ❖

Computer News and New Products





Free CD-ROM on instrumentation

National Instruments has announced a free new CD-ROM containing instrumentation information for engineers and scientists building test and measurement, and process monitoring and control applications. The Windows-compatible Instrupedia features more than 60 tutorial and 'how-to' application notes to help users learn how to combine hardware and software to build computer-based systems for instrument control and data acquisition, analysis and presentation.

It includes more than 20 user solutions that describe how scientists and engineers used instrumentation hardware and software to build custom, computer-based systems for real-world applications in electronics testing, fibre manufacturing, aerospace, automotive, electric power, transportation, environmental control and education. It also describes more than 500 hardware and software products that can be used to build instrumentation systems on more than 20 industry-standard computer platforms and more than 25 operating systems.

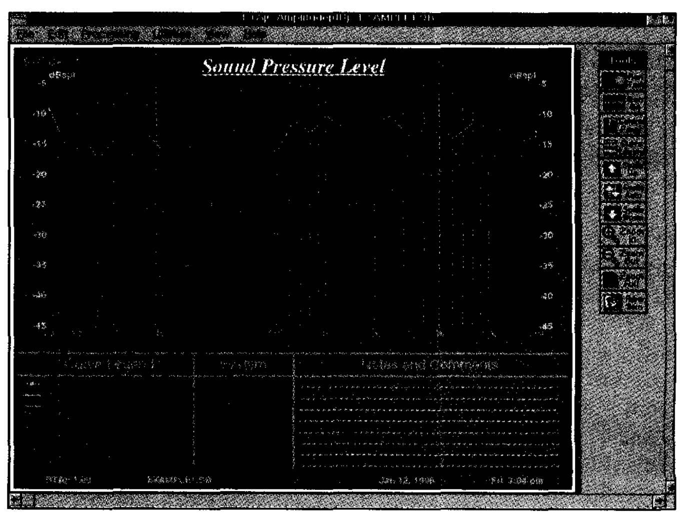
For further information circle 161 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 9422.

PC-based audio analyser

LinearX Systems is now shipping the new RTAjr PC-based Real Time Analyzer, a 1/3 octave real time analyser for PC computers. The complete system consists of an ISA half-length PC slot card, a 3.5mm to XLR mic adapter cable, and Windows based operating software. There are four different, calibrated LinearX microphones (M31, M51, M52, or M53) with maximum SPL capabilities ranging from 125dB to 170dB.

Included are built-in scoring systems popular with car stereo enthusiasts for both IASCA and USAC, as well as a host of different post processing and display capabilities, only possible in a PC-based analyser. In addition to measuring maximum SPL and 1/3-octave RTA response, the RTAjr also includes built-in ANSI A, B and C weighting filters, and an impedance measurement capability for checking speakers and crossovers for defective components or connections. The curve data can be viewed in various ways including bar graph mode, line graph mode and text chart mode. The analyser is priced at $1095.

For further information circle 163 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2200. ME can also be contacted by email at **me@midcoast.com.au**; or on the internet at URL **http://www.midcoast.com.au/bus/me**.



Amateur radio log program

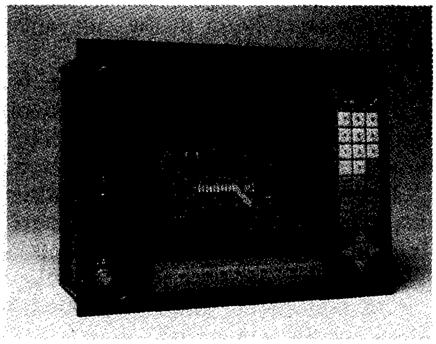
Ham Log is a logging program specifically designed for ham radio operators. Version 3.1 has just been released, which according to its developer contains all the features that 'heavy' log users said they wanted.

The program keeps statistics on log contacts such as the number of countries worked, versus the mode and frequency. The same statistics are kept for confirming contact.The program requires about 1.35MB hard disk space, comes with a manual and has the usual F1 help screens. The program is priced at $59.

For further information circle 162 on the reader service coupon or contact Dr HiFi, 74 Carrington Road, Waverley 2024; phone (02) 369 2008.

Industrial panel mount 486DX computer

The Lucas Deeco range of 486DX series panel mount industrial computers incorporate a flat panel display. Designed for use in harsh environments, these industrial computers are powered by a 486DX/2 at 66MHz or a 486DX at 33MHz, and include a patented Lucas Deeco SealTouch infrared touch system, with an integrated touch mouse and/or membrane keypad.



There is a choice of an active matrix colour LCD or mono electroluminescent display. The sealed front panel meets NEMA 4 and 12 (IP-65) Standards with the floppy drive access and reset switch covered by a sealed door. Input/output is available through a serial port, a parallel port and a sealable keyboard port. Four full sized expansion slots are provided.

For further information circle 164 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; phone (02) 805 0844.

DC powered computer systems

Intecolor Corporation has developed a range of 24V and 48V DC power options that lets critical work stations and monitors run from batteries, independently of commercial mains. This option is available on several Intecolor product lines including Intecolor's stand alone rackmount PCs, fully integrated PC workstations with 14" or 20" display, and 14", 20" and 21" computer monitors. This compares to standard monitors powered by inverters. The option doesn't require any extra rack or panel space.

For further information circle 165 on the reader service coupon or contact Intelligent Systems Australia, PO Box 118, Berwick 3806; phone: (03) 9796 2290.

Transformer design software

Magnetics Designer is a new program for Windows that helps you design all types of transformers and inductors. Typical design applications include high frequency switching regulator transformers and output chokes for off-line full wave and forward converters, 60Hz single phase line transformers, AC inductors, planar magnetics, and 400Hz aircraft transformers. Virtually any single phase, layer wound, inductor or transformer from 10Hz to over 1MHz can be synthesized with the program.

The software produces a complete transformer or inductor design based on electrical specifications. An extendable database with thousands of cores and a wide variety of materials is included. Core and material information can be added using a supplied Excel spreadsheet template. A variety of core families are represented from vendors like TDK Magnetics, Philips, Thomson, Micrometals and Ferrite International, each with its respective magnetic and geometric properties. The program predicts magnetising and leakage inductance, interwinding capacitance, peak flux density, DC winding resistance, high frequency AC resistance, copper loss (both

AC and DC), core loss, weight, temperature rise, layer fill, and window fill percentage. As an introductory offer Magnetics Designer is priced at $1570, valid until June 28, 1996. Thereafter the price is $2355.

For further information circle 163 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429 phone (065) 50 2200. (email **me@midcoast.com.au**; internet **http://www.midcoast.com.au/bus/me**).

High speed cable modem

Scientific-Atlanta has announced a stand-alone cable modem for hybrid fibre/coax (HFC) networks. Operating at data rates of up to 27 megabits per second (Mb/s), the modem will significantly outperform current modems that provide access to the Internet and online services.

Scientific-Atlanta has already demonstrated a high-speed data communications system running over a hybrid/coax fibre network. The demonstration system delivered rates up to 27Mb/s using a modified version of Scientific-Atlanta's current digital home communications terminal and digital headend equipment.

For further information circle 167 on the reader service coupon or contact Scientific-Atlanta 2/2 Aquatic Drive, Frenchs Forest 2086; phone (02)452 3388.

New class of colour lasers

Hewlett-Packard has announced its next-generation color laser printers, the HP Color LaserJet 5 and 5M printers. Both printers feature image resolution enhancement technology (Image REt) 1200, an HP-developed technology that gives 1200dpi equivalent image quality — resulting in colorful graphics, sharp text and millions of solid colors. Through more efficient toner placement, HP claim a colour page from the Color LaserJet 5 printer costs less than a page from some monochrome laser printers.

The printers are part of a new class of colour laser printers that produce smooth, 'continuous tone' image quality through advanced colour-control techniques. With this new type of colour laser printer, dots per inch alone is no longer an accurate indicator of print quality.

Many printers in this new category can produce continuous tone output by controlling precisely how colour toner is placed on the page. These printers, known for their detailed, smooth image quality, are a step above traditional colour laser printers, which use simple dot patterning or 'dithering' techniques to reproduce non-primary colors such as orange or purple.

The HP Color LaserJet 5 printer, designed for Windows 3.1, Windows 95, Windows NT, DOS and IBM 0S/2 computing environments, comes with enhanced HP PCL 5 with Color, 20MB RAM and an HP Bi-Tronics bidirectional parallel port.

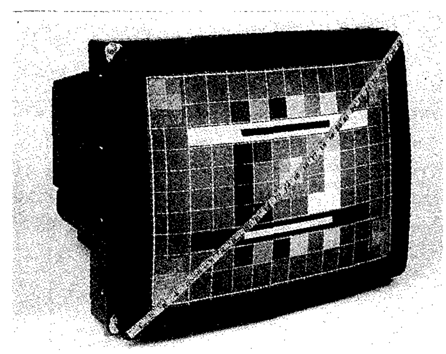
The RRP (including sales tax) for the HP Color LaserJet 5 is $14,040, and $17,309 for the HP Color LaserJet 5M. For further information contact HP Customer Service on 13 1347.

29" monitor for industry

Intecolor's 29" computer monitor is the newest addition to the company's line of industrial displays.

The new monitor is suitable for training facilities, large control rooms and in specialised areas such as shipboard control and telecommunication.

The monitor supports resolutions from VGA up to 1600x1280. Features include high bandwidth differential video inputs, dynamic focus, a unique 'VGA boot mode' and a high contrast invar shadow mask CRT.



With a high temperature limit of 55°C tested for 1000 hours at 70°C and a MTBF of over 45,000 hours at 25°C, the Intecolor unit is one of the most robust of any display on the market.

For further information circle 168 on the reader service coupon or contact Intelligent Systems, PO Box 118, Berwick 3806; phone (03) 9796 2290. ❖

1/8W Carbon Film Resistor Bargain

We have managed to obtain in excess of 1 million miniature carbon film resistors. Most are 5% tolerance or better and most values are available. They are ideal for surface mount applications measuring only 0.15" x 0.06" diameter. Available in boxed quantities of 1000 items of the same value only! An absolute bargain at **$8.00** per box (Yes that's less than 1 cent each!).
Call us with your requirements and take note of the item about the DS-750 kit alongside!

Actual Size

LOOK Resistors Under 1c each!!!

Get 'em while they last! TCM3105NL Modem Chips

This popular single chip 1200 baud FSK modem is no longer being made. We have only a handful left so you'd better be quick! Provides full/half duplex operation. Runs from 5V supply. On-chip group delay equalisation. Carrier detect etc.

CMOS **$16.10**

Philips Micro-Controller Kit DS-750

Thank you for the huge response to our promotion of this great development kit and following the review in April's Electronics Australia. We have been able to obtain further limited supplies of this kit after all our original stock was exhausted. So if you missed out, get your order in now! Still at the same price **$159.90!**

Hakko 926 Soldering Station

The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.
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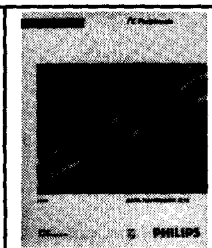

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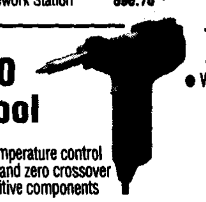

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